

## Ranger Power Master 7500 (PM7500)

Three Phase Rackmount Power Quality Analyser with Enhanced Harmonics to the 127th and Fast Frequency Measurement



### All Your P.Q. Needs In A Single Unit

A comprehensive, high performance tool with all the P.Q. measurements required to run your network.

### Multiple Modes of Direct & Remote Comms

Great choice of communication methods to suit any situation. Choose from **Bluetooth**, **USB** and **Ethernet**, **Native Modbus**, **ModbusTCP** and **IEC60870-5-104** to enable real time remote comms communication<sup>1</sup>.

### Automatic event capture

No need to set thresholds! Our intelligent data handling technique, the patented **Adaptive Store**, and our **Auto-Ranking Waveform Capture** optimally retain detail when the 'worst' disturbances occur during your recording.

- Up to 770 channels reporting to the Standards
- 32 troubleshooting channels with single cycle, live values available over Ethernet
- 8 channels for Waveform Capture, at 19.2kHz (384 samples per cycle at 50Hz per channel).
- All channels sampled and recorded simultaneously

### RMS accuracy 0.1% excluding sensors\*

- Individual voltage and current **Harmonics** as well as both voltage and current Interharmonics to the **127th** to IEC61000-4-7, THD Voltage and TH Current to the 100th .
- Instantaneous **Flicker** sensation, short term and long term Flicker to IEC61000-4-15
- **Power parameters, unbalance, phase angle, frequency, inrush current** and much more.

### Expect safety as standard

The PM7500 is a Cat IV 600V Power Quality Analyser, powered , 100-264Vac, 110Vdc or 12Vdc.

**Accurate Time Synchronisation:** External Time synchronisation allows <10ms accuracy.

### Correct Data 1st Time

Without the need to set any thresholds, our patented **Single Cycle Adaptive Store™** recording process provides single cycle resolution when it matters whilst remaining economic with data use.

### Disturbances Ranked

Our **Auto-Ranking Waveform Capture** technique retains and ranks the waveforms of the 'worst' disturbances throughout the recording.

We take you straight to the core of your P.Q. problem.

### Unit Configuration password protected

**Virtually unlimited memory.** The PM7500 can automatically download data after each recording session to USB stick or hard drive or upload to server (externally polled).

**Comprehensive Software:** The PM7500 comes with Outram's flexible yet straight forward analysis software, Pronto for Windows, at no extra cost. No dongle required.

### Automatic Data Export to PQDif

<sup>1</sup>ModbusTCP and IEC60870-5-104 available using external protocol converter. Bluetooth can be disabled.

Technical help: support@outtramresearch.co.uk - +44 (0)1243 573050  
Sales enquiries: sales@outtramresearch.co.uk - +44 (0)1243 573050

**Ranger** PRODUCTS

designed and manufactured  
in the UK by



12/12/2024

## PM7500

## Rack Mount for Permanent Substation Power Quality and Energy Monitoring.

Record events, trends, transients, min/max logging, >800 channels recorded simultaneously, expandable memory, automatic sag/swell monitoring down to single cycle, harmonics measurement up to 127th order (voltage and current harmonics to the 50th on 8 inputs or optional **voltage and current harmonics to the 100th on 6 inputs simultaneously**), flicker measurement, waveform capture at 384 samples/cycle at 50Hz, Ethernet, USB and Bluetooth communication. External time synchronisation. Compatible with iHost.

Records 32 channels simultaneously with single cycle resolution on disturbances due to our exclusive, patented Single Cycle Adaptive Store™. Can record indefinitely using this method with automatic local download to USB Flash drive and data extraction to remote storage.

Records > 770 channels of general parameters in 10 minute (or user specified: 1 sec to 2 hr) increments.

Records automatically at 50 or 60Hz.

**Routine measurements, troubleshooting & high speed waveform capture all recorded simultaneously.**

Records both Voltage and Current Harmonics to the 100th simultaneously (3 phases V and 3 phases I) and to the 50th on remaining 2 phases (optional).

Harmonic Direction shows if Harmonics are upstream or downstream of the point of measurement. Also measures individual Voltage and Current Individual Harmonics, Interharmonics, Interharmonic Sub-Groups harmonics to the 127th are optional.

THD Voltage and TH Current measured to the 100th (optional)

Auto-ranking Waveform Capture means time taken to analyse data is greatly reduced.

Sampling rate: 384 samples / cycle @ 50 Hz.

Waveform triggers include transients, sags, surges, notches, rings, THD and TH current.

Extended Waveform Capture can record disturbance waveforms for up to 60 secs.

G5/4 and IEEE519 Harmonics surveys automatically generated in companion Software, Pronto.

Real Time access to detailed recording channels available using Native Modbus, ModbusTCP and IEC60870-5-104 protocols.

Provides authoritative Flicker measurements (Pst, Plt and Pinstantaneous) to IEC61000-4-15.

Dual frequency measurement (optional) enables independent, higher resolution (0.001Hz) frequency measurement on V4 suitable for Firm Frequency Response (FFR) commissioning.

Over 200 MB of on-board data storage plus USB Flash.

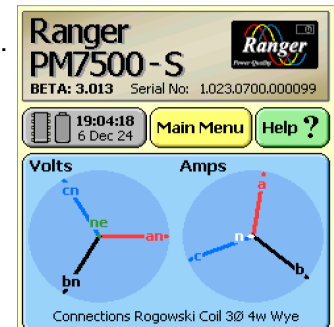
Comes with 12 pre-stored configurations. Just choose one using your portable device or PC, or program your own with the included software, PMScreen.

Stores up to 200 configurations on board. Eliminates the need to program on site. Just choose a configuration, press Load and Start.

Remote Reconfiguration available. Password protected.

Phasor Diagram Display ensures correct hook up and shows the phase relationship of individual harmonics, NOT just the fundamental.

On-screen HELP guides users through configuration and hook up.



PMScreen and PMGateway Android Apps available in Software package. PMScreen shows:

- Analyser status,
- Live screens for waveforms,
- Harmonics,
- Interharmonics,
- Trends,
- Disturbance Incidents
  - 3D Bar Graph,
  - ITIC (CBEMA),
  - Severity Duration v Time,
- Phasor diagrams & many more.

## Single Cycle Adaptive Store™

**“Starting from scratch we would have spent weeks zeroing in on something like this on a conventional recorder, but the PM7000 caught it on the first try, with no special setup”**

*Pat Coleman, Southern Company, USA.*

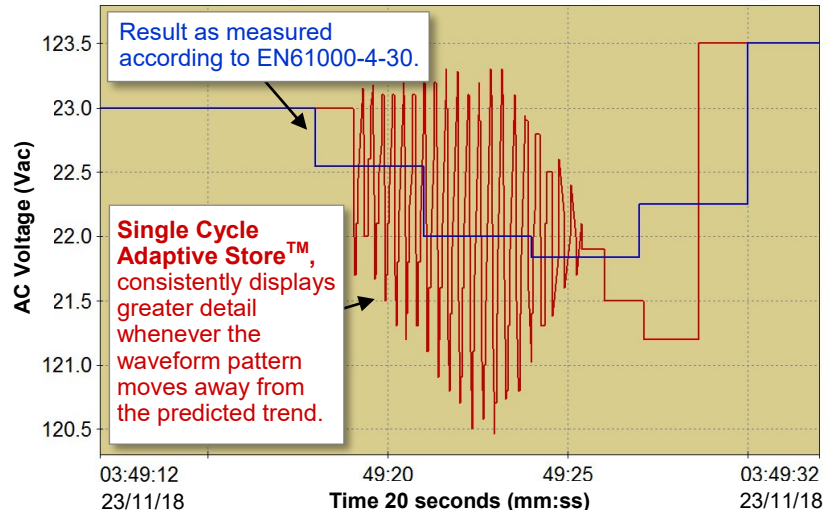
Adaptive Store is our patented compression technology available in all PM Series Analysers. It automatically records the chosen parameters in great detail and at high sampling rates when anomalies and deviations from the predicted trend occur.

**Adaptive Store is designed to make the best use of available memory**, whilst meeting two conflicting requirements:

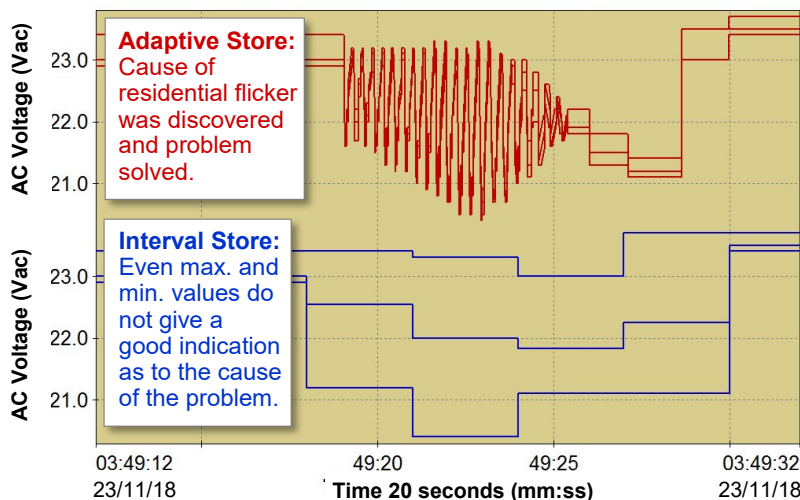
- to provide long-term trend data, observing the worst extremes of max and min values, and;
- to provide detail where new activity occurs, i.e., detecting and capturing sudden changes.

Adaptive Store assesses signal conditions in real time without having to set thresholds. The only required user parameter is the total time of the recording.

**Outram's Adaptive Store vs. Interval Store (3 sec averages) of Van**



**Max, Min and Average of Van: Adaptive Store vs. Interval Store**



**Adaptive Store recognises the unpredictability of future signal activity**

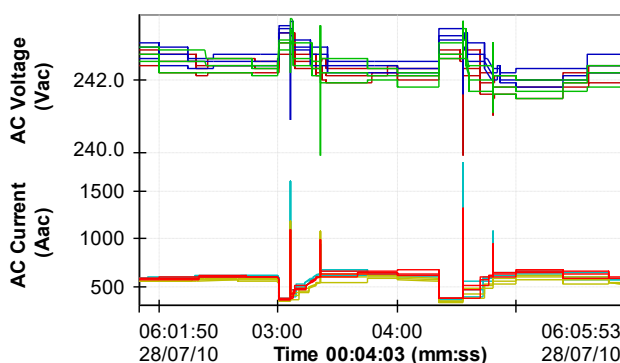
This unique method of *anticipating* the possible signal path has many advantages. For example:

- it allows for immediate reaction to transients capturing the entire duration of the disturbance, and;
- it works with extremely long recording periods.

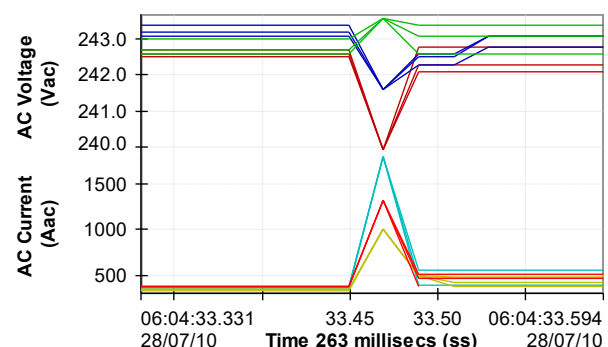
By automatically adjusting the thresholds distinguishing the anomalies from the trend as signal dynamics change or the available memory becomes full, Adaptive Store ensures that less significant phenomena can be summarised and greater detail recorded for abnormal behaviour.

The Single Cycle Adaptive Store™ recording mode is the most powerful automatic data compression system available in any data logger on the market.

**Determine relationship between volts and current**



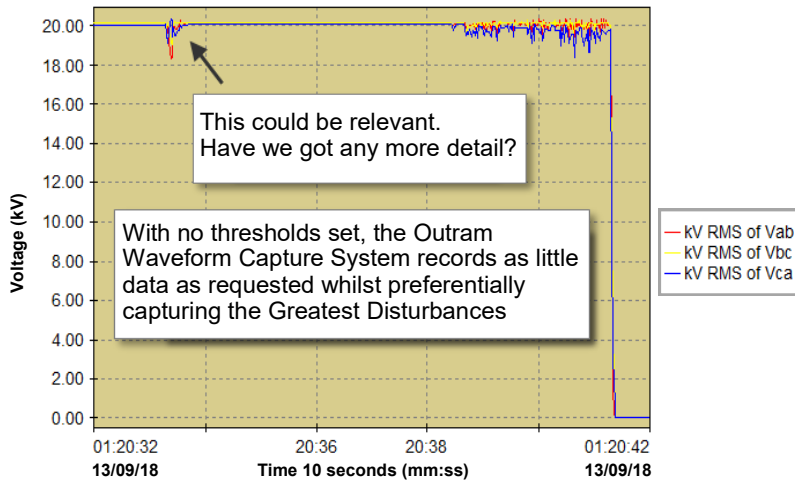
**Single cycle detail can reveal where an event originates**





## Auto-Ranking Waveform Capture

Voltage transient occurs 8 secs before voltage collapse



Outram's Autoranking Waveform Capture is designed to manage the high speed waveform data measured by the PM7500.

**It tracks and ranks multiple categories of sub-cycle transient and other problem event types, such as sags, surges, notches and rings.** It then discards smaller events when larger ones occur.

This automatic real time data management process has these advantages:

- It fills the allocated memory at the start of a recording with anything the analyser sees, then discards the least interesting disturbances, as more 'exciting' ones come along.
- It captures the best, most revealing events without any prior knowledge of what might happen. **Setting thresholds is not necessary.**

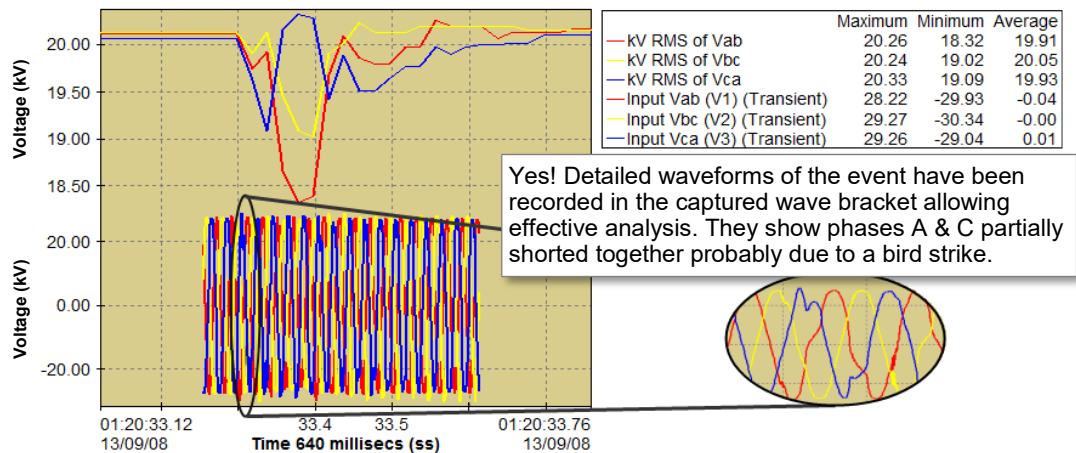
• It increases the quality of data at the same time as reducing volume, consequently speeding up download time as well as making data review easier.

• It works equally well over short and long recording periods.

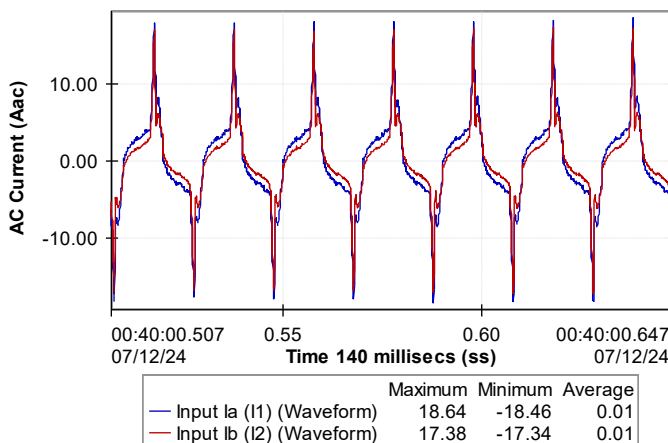
• It is continuously re-triggerable and does not require re-arming.

The waveforms captured are normally up to 2 cycles before the event and up to 5 cycles after. However, captures may be extended up to 60 seconds after the event with different extensions for individual triggers.

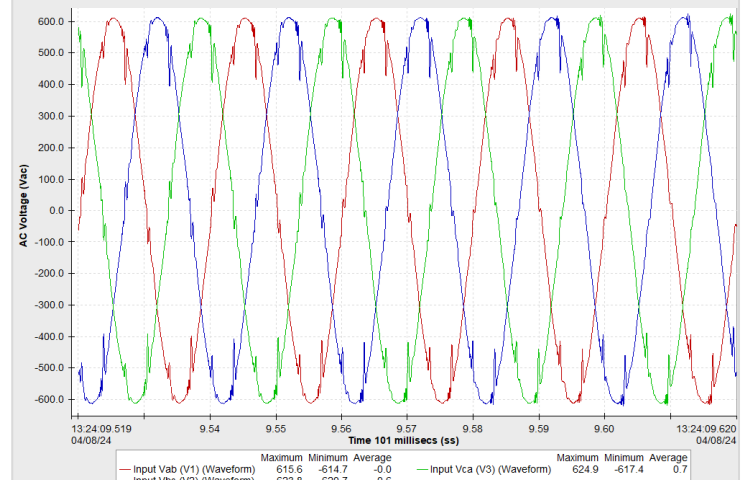
Voltage transient occurs 8 secs before voltage collapse



Domestic Heat Pump Start Up (Current Aac)



Voltage Waveform Notching



## Ranger PM7500 Specification

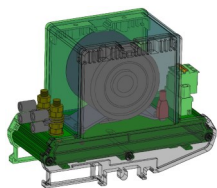


PM7500 Front View

### 8 Analogue Inputs:

4 Voltage input channels. Nominal 110V (< 600Vac RMS) for secondary VT output. 0-600Vdc.

4 Current input channels. Typical 0-1V RMS. Current to Voltage CTs supplied, nominal input 1A (5A or 10A on special request). Please note that Current clamp primary connection is by Ring Crimps to 5mm Brass Studs. 14 AWG Imperial size 10 (M5 2.5mm<sup>2</sup>), cable insulation diameter 2.9mm to 4.4mm (primary winding 2.5mm<sup>2</sup>).  
DC Current range: +/- 4Vdc peak inc. AC ripple (optional)



Example of a  
closed, toroid  
current clamp  
used (GF1).



### Five distinct simultaneous recording systems available:

**Waveform capture:** High Speed sampling: 384 samples/cycle at 50Hz on all inputs.

**Troubleshooting:** Utilising the patented Single Cycle Adaptive Store™ to capture comprehensive detail over long recording periods on up to 32 selected parameters (see Table). Shows anomalies down to single cycle detail.

**General Parameter Analysis / Trends:** > 470 parameters recorded automatically and simultaneously enabling reporting to recognised Standards. >770 parameters available with optional Enhanced Harmonics Measurement.

**RMS Event Database:** Automatic recording of nominal power quality events: sags, surges and interruptions.

**Fault Level (optional):** ½ cycle Peak Fault Level, RMS Break Fault Level at 50-100ms and ½ cycle Downstream Motor Contribution. Fault Level available in kA or MVA in Pronto for Windows software.

**Resolution:** Programmable to 0.1 Vac and 0.1 Aac, 0.01V high resolution mode. Frequency to 0.001Hz (optional).

Fault Level current resolution 0.01kA in real time display and in analysis software.

**Real Time Clock Uncertainty:** Internal clock can be synchronised to a few milliseconds using packets sent via an external synchronisation source. Precision dependent on network latency and jitter, but can be ≤10ms.

**Configurations:** Space for over 200 files. These may be used to store configurations or recording sessions.

### Troubleshooting (Adaptive Store) Measurement Parameters:

	AC Single Phase Installation	AC 2 (split) Phase Installation	AC 3 Phase Installation (Delta, Wye & variants)
RMS, V and I	Y	Y	Y
Stray Voltage RMS Hi Res < 35V	Y (L-N, L-L where appropriate).	Y	Y
Real power W	Y	Y	Y
Reactive Power VARS	Y	Y	Y
Apparent Power VA	Y	Y	Y
Power Factor PF	Y	Y	Y
Displacement Power Factor	Y	Y	Y
Phase Angle	Y	Y	Y
Frequency	Y	Y	Y
Instantaneous Flicker Sensation	Y	Y	Y
Flicker Short Term (Pst) (selectable, default 10mins)	Y	Y	Y
Flicker Long Term (Plt) (selectable, default 2hrs)	Y	Y	Y
Flicker Flag	Y	Y	Y
Distortion Power	Y	Y	Y
Voltage Unbalance, (Conventional & Symmetrical Components)			Y
Current Unbalance			Y
Positive Sequence Fundamental Real & Reactive Power (IEEE1459)			Y
Harmonics:			
Total Harmonic Distortion % and value, V and I	Y	Y	Y
Individual Harmonics value and % to the 50th, V and I	Y	Y	Y
Individual Harmonics value and % to the 127th, V and I (optional).	Y	Y	Y
Interharmonics and Sub groups to the 127th, V and I (optional).	Y	Y	Y
Odds, V and I	Y	Y	Y
Evens, V and I	Y	Y	Y
Triplens, V and I	Y	Y	Y
Harmonic Direction	Y	Y	Y
K Factor	Y	Y	Y
Channel X * Constant	Y	Y	Y
Channel X / Channel Y	Y	Y	Y
Filtered Channel X	Y	Y	Y
Internal Temperature	Y	Y	Y
On Charge	Y	Y	Y
Battery Volts	Y	Y	Y

### Symmetrical (Sequential) Components:

Positive, negative, zero sequence:

NPS, NPS/PPS (Voltage and Current), ZPS, ZPS/PPS (Voltage).

## Ranger PM7500 Specification cont.

**Accuracy\*:** 0.2%. 0.1% in reference range 20-30°C (excluding sensors). +/-2LSB.

IEC 61000-4-30 Class A: Designed to meet the accuracy requirements of IEC 61000-4-30 Class A. To avoid generating a discontinuity in 10-12 cycle data at the 10 minute clock tick as prescribed by IEC 61000-4-30 (Clause 4.4 *Measurement aggregation over time intervals*) the PM7500 employs a frequency based 10-12 cycle aggregation process synchronised to real time. This method ensures correct reporting of a single power system disturbance occurring at the 10 minute clock tick.

Fault Level measurement accuracy is dependent on quality and quantity of disturbances seen and measurement point chosen; typically better than 3% when given numerous, abrupt voltage disturbances of >0.5% on a stable, radial network.

**General Parameter (Trend) measurement:** Records up to 470 parameters automatically or 770 (optional) using RMS samples updated every ½ cycle. These are fixed functions recorded at 1 of 14 selectable intervals between 1 sec up to 2 hours:

- Voltage & Current RMS (Max, Min, Avg)
- THD V / Total Harmonic Current (% and Value) to IEC 61000-4-7 and IEC 61000-4-30 Class A (8 inputs)
- Flicker to IEC 61000-4-15 and IEC 61000-4-30 Class A (3 Voltage inputs)
- Power (kW, VAR, AP, PF)
- Harmonics to IEC 61000-4-7 and IEC 61000-4-30 Class A:
  - Individual Harmonics 1-50<sup>th</sup> (8\*50 signals on Volts and Current) or (optional) 1-100<sup>th</sup> (6\*100 and 2\*50) on Volts and Current.
  - Unbalance
  - Frequency

**Waveform Capture:** Sample rate - 19.2kS/s (~384samples / cycle at 50Hz, 320 samples / cycle @ 60Hz) on 8 channels. Auto-Ranking Waveform Capture - Events automatically examined, **ranked** & stored in real time, no thresholds need to be set.

### Selectable Waveform Parameters:

**Wave Retention Basis:** Greatest disturbances (automatic ranking and low rank discard) and first past a threshold.

**Capture wave bracket:** Wave Sets: from 20ms up to 160ms. Can be extended to 60secs. Can be contiguous; no re-arming delay.

**Signals to be captured:** Offending wave / complementary current or voltage, all voltages, all currents.

**Triggers to be used:** Transient, Ring, Notch, Sag, Surge, THD Volts, THD Current.

**Wave Allocation:** Waves allocated across trigger functions. (number and trigger selectable).

### Frequency:

Automatic frequency tracking in 50 or 60Hz regions. Normal range 45-64Hz (can track down to 10Hz).

### Dual Frequency Measurement (Optional):

Independent frequency variation measurement on V4. Resolution to 0.001Hz (frequency), single cycle



**PM7500 Rear View**

(time), latency ~3 cycles. FFR (V4) measurement range 40-70Hz.

**Memory:** 128MB internal Flash (long term) memory for all files. 16MB RAM for waveform capture data, 64MB working RAM. Expansion with USB Memory Device (size limit of 128GB) which can be removed and reinserted whilst recording is in progress. Automatic download to USB memory device.

**Firmware (program memory)** - Flash upgradeable

**User Preferences** - Stored in non-volatile Flash Memory.

**Portable Device Requirements for PMScreen:** Android or Windows compatible.

**Data Retention:** During recording sequential data is saved to internal Flash memory. Waveform capture data is held in RAM and transferred to Flash memory when recording ends. Configurations and user settings stored in Flash memory.

**User Interface is PC/Android App 'PMScreen':** Full colour remote display on PC via USB, Bluetooth or Ethernet. Display also available on Android device such as tablet or mobile phone via Bluetooth. Includes setup/configuration, data review and recovery. PMScreen can also initiate data download to USB stick.

### Displays On PMScreen:

**Live:** Power & Energy, Phasors, Flicker, Harmonics, Harmonic Phasors, Waveforms, ITIC curve, EN50160 Comparison. Interharmonics (optional).

**Historical:** Trends, Statistics, List of Channels, all General Parameters.

### Communications:

**Bluetooth:** Wireless interface (isolated) reception up to 10m. Can be disabled on request.

**USB:** Serial interface to PC (isolated > 2.5kV), download to PC & control through Pronto for Windows. Download through serial interface to Android device.

**Ethernet:** 10/100 Mbps Ethernet Port. Connectivity through local network. Download to PC. Compatible with iHost.

**USB Memory Stick/Hard Drive:** Automatic download to USB stick or Hard Drive (non-isolated).

**Remote Communication over PMGateway App.:** Enables Android mobile phone to act as a Gateway (over WiFi or Bluetooth). Use PMGateway to send data files to preferred email address or Dropbox and start and stop recordings.

**Protocol:** Native ModbusASCII. ModbusTCP and IEC60870-5-104 available through external protocol converter.



## Ranger PM7500 Specification cont.

### Data Retrieval

Automatic export to PQDif available  
Automatic download to **USB flash drive**, and **Android Mobile Phone** via Bluetooth (PMGateway: Data files sent on to email inbox). Download to **PC** via USB, Bluetooth, or Ethernet to an area network (including internet). Download to **Android Tablet** or **Mobile Phone** via Bluetooth. (Bluetooth can be disabled as required)

**SCADA:** Modbus compatible. 32 Troubleshooting parameters accessible via Native Modbus, ModbusTCP and IEC60870-5-104 protocol in real time. Regular, automatic download of full dataset available via recording session download.

### 1 Volt free contact closure:

Status output. Volt Free 'Status' terminals magnetic isolation. Three terminal relay SPDT (Common, NO, NC) contact specification 125V (Pollution degree 2). Creepage and Clearance  $\geq 1.5\text{mm}$  relay between contacts. 'Failed' status indication both when the charge current is interrupted and when the central processor ceases normal operation (watchdog failure).

**Power:** Requires 100-264Vac 50-60Hz or 110Vdc, rated power consumption 11 W, or 12Vdc at 6 W.

**Battery Capacity:** 850mAh (5 Hi-Temp NiMH batteries).

**Battery Ride Through:** Ten minutes at a time. If power is lost, the unit continues recording for 10 minutes before shutting itself down. The unit immediately wakes up and continues to record if power is returned before the recording end time is reached. If in FIFO mode, the unit wakes up whenever power is restored and continues to record in the same cycle as previously set up.

**A/D Converter:** 24 bit at 19.2kSamples per second. 16 bits used normally for harmonics, power & energy, flicker.

**Digital Signal Processor:** 32/64 Bit

**Measurement & Reporting Standards:** IEC 61000-4-15, IEC 61000-4-7, IEC 61000-4-30, IEEE1453 (Flicker), IEEE1459, IEEE100, Report to EN50160.

**Safety Standards:** IEC 61010 second ed., 600V Cat. IV, pollution level 2, IEC 61326 (EMC).

**Computer Requirements for Pronto Software:** Windows 7, 8, 10, 11; 250MB hard drive space.

**Case Dimensions:** Standard 19 inch x 2U Sub Rack: minimum depth required behind the front panel 257.5mm. 466.2 x 76.3mm front panel fixing centres

**Operating Temp:** -20°C (-4° F) to 60°C (140°F).

**Environmental:** IP41

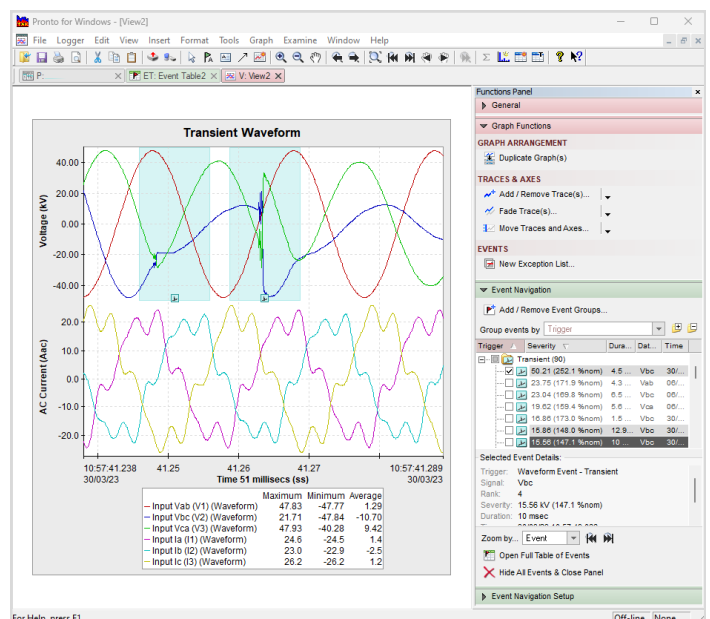
**Applicable Patents:** 6424277, 0230712, 4910692.

**Data Analysis Software, Pronto for Windows Top Features:**

- Create graphs and tables of data with 100s of flexibility options.
- Accommodate multiple different parameters on the

same graph for comparison, zooming in and out of a graph down to single cycle and beyond.

- Add and remove traces from a single graph, separate them out and move the axes around.
- Create exception filters/ lists for values over and/or under any threshold(s),
- Rank waveforms,
- Create graphs and tables through saved templates,
- Fade traces to easily compare many traces on the same graph.
- Create ITIC curve graphs,
- Copy and paste graphs into MS Word,
- Easily export using Excel, CSV and PQDif ,
- View multiple sessions and projects together on the same graphs, including data from other Outram Power Quality equipment
- Create Harmonics graphs and tables for specific events including 95<sup>th</sup> and 5<sup>th</sup> percentiles (other percentiles selectable),
- Harmonic Analysis of captured waveforms
- Portray Fault Level results in both 3D and 2D formats for analysis
- Create a G5/4 or IEEE519 report with a few clicks,
- Create averages (e.g. 10min) of all measured parameters (average value selectable)
- Save configurations from previous recordings and upload into a different analyser (same model)
- Perform single and dual cursor examine functions on graphs
- No software dongle or USB key required



## Exclusive Software, Pronto for Windows



How to make the most of all your recorded data:

Use our **Pronto for Windows Software**, the best graphing software on the market for use with all PM Analysers

### STANDARD REPORTS

Automatic report generation to IEEE519.

### UPSTREAM OR DOWNSTREAM?

Our Adaptive Store recording regime can deliver enough detail to indicate whether a disturbance is coming from upstream or downstream of where the measurement was taken. Work it out by looking at the relationship between the voltage and current data streams.

### COMPARE LIKE WITH LIKE?

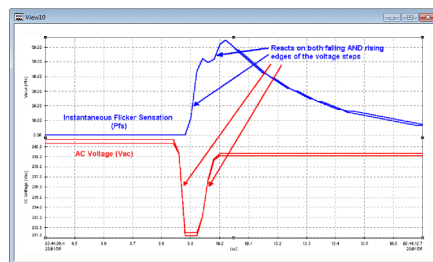
From your own recorded data in Pronto you can load the same configuration back into the analyser to record the same measurements again and again.

### TECHNICAL SUPPORT

Technical support is available from those who either designed the unit or have over 20 yrs experience with the Ranger and PM series.

Who better to instruct you on how to make the most of your analyser?

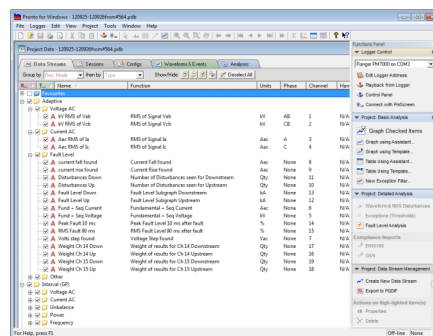
**Pronto for Windows** is a full-featured, Windows based program designed to extract data from the Power Master series and present it either graphically or in tables for straightforward analysis.



Analyse detailed data that Single Cycle Adaptive Store™ has captured automatically

Pronto for Windows is the only program you will need to communicate, analyse, report, and manage your data (as well as configure the analyser itself).

Through the use of easy to follow 'assistants' and pre-loaded templates, create graphs and tables for emails and hard copy reports simply and quickly. Manage and save your favourites to create the same graphs recording after recording.



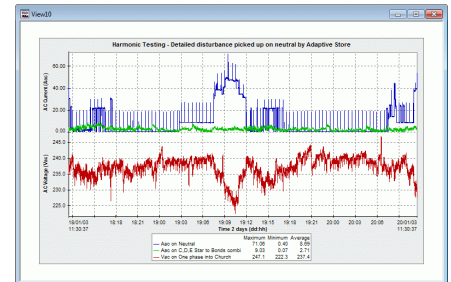
Pronto for Windows Project Browser

The selection of icons on the toolbar makes all commonly used instructions such as zooming, statistical analysis, annotation, downloading, and printing as easy as pointing and clicking the mouse.

Simply 'copy & paste' graphs into any word processing program and export tables straight to Excel or PQDIF for further analysis.

Sales enquiries: [sales@outramresearch.co.uk](mailto:sales@outramresearch.co.uk)  
+44 (0)1243 573050

Technical help: [support@outramresearch.co.uk](mailto:support@outramresearch.co.uk)  
+44 (0)1243 573050



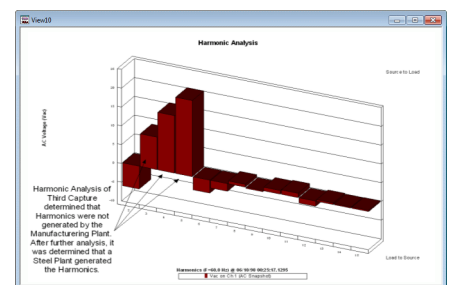
Sample Graphical Data of Voltage & Current

### More Pronto Features:

- Analysers configuration is saved with data for retrieval any time
- Easy file management tools
- Watch our New video tutorials on-line
- Reporting Tools:
  - Automatically generated G5/4 Harmonics Survey reports
  - Exceedence reports
  - Summary statistics
  - Tabular Listings
  - Custom Reports saved as templates



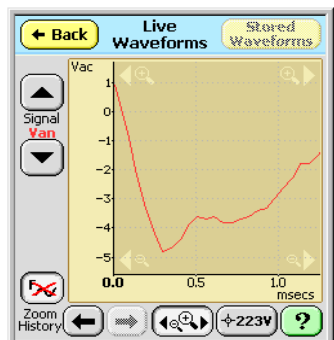
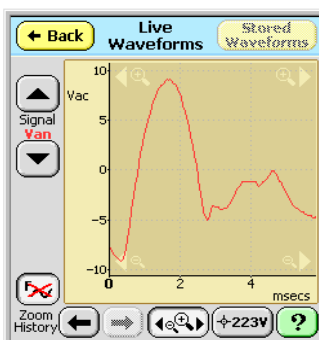
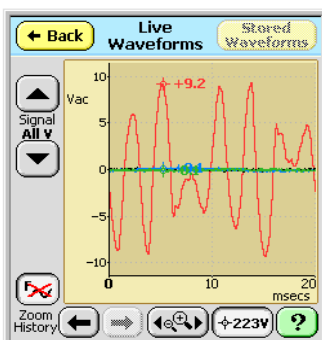
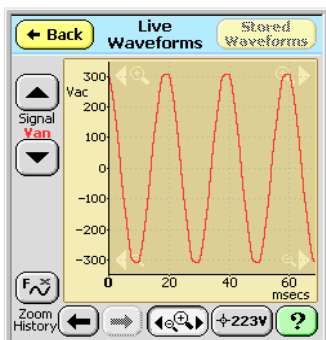
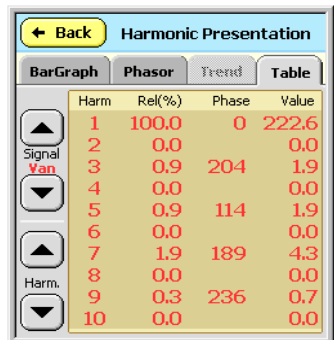
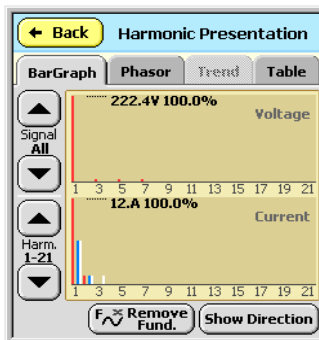
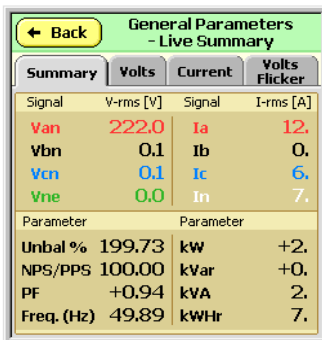
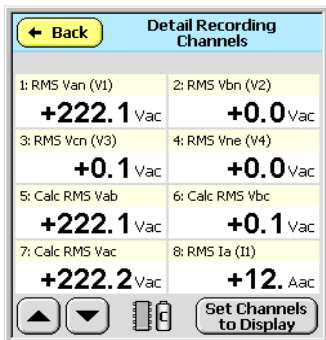
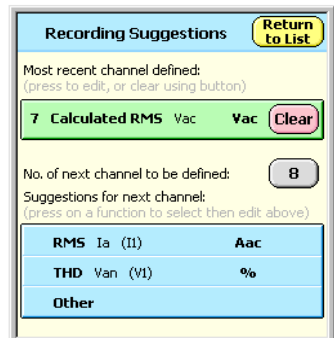
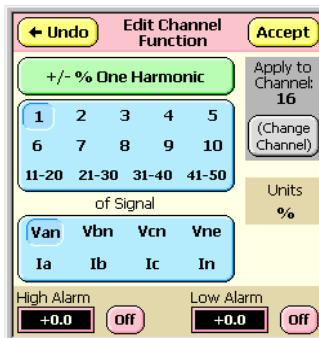
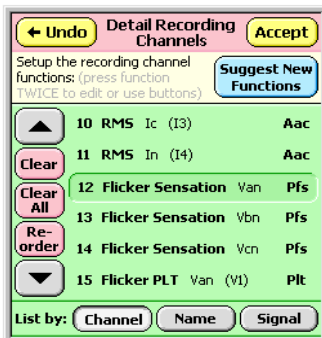
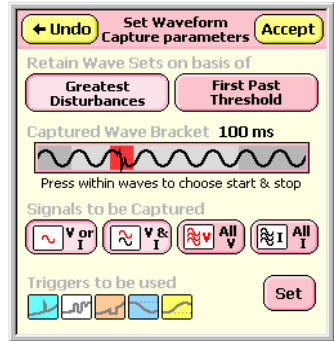
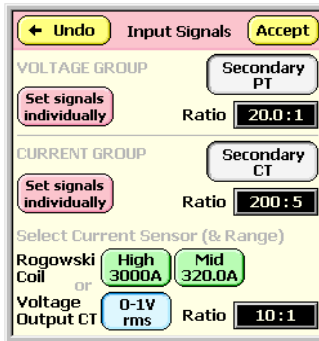
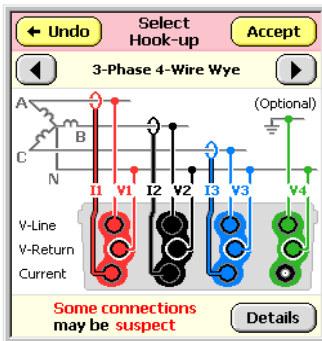
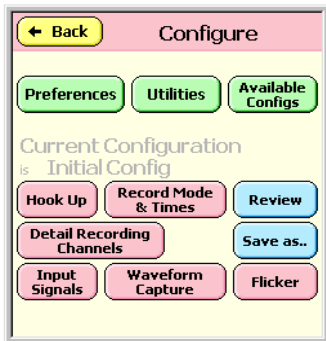
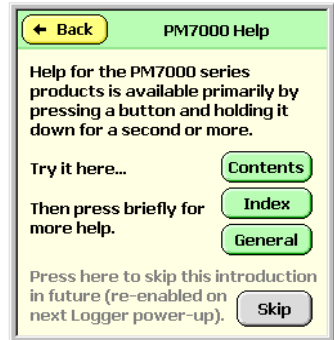
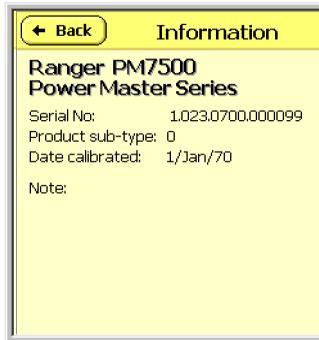
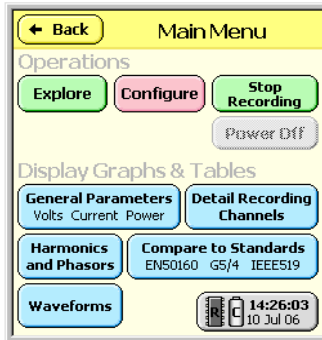
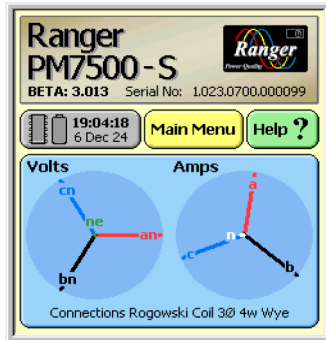
- Unlimited traces on a screen
- Arrange traces on any axis, full freedom of editing on all aspects of a graph
- A comprehensive, context-sensitive help system



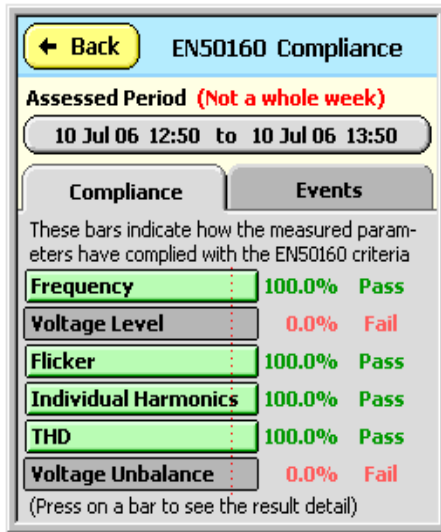
Harmonic Analysis of Waveform Events (PM7000, PM7000FLM and PM7500 series only)



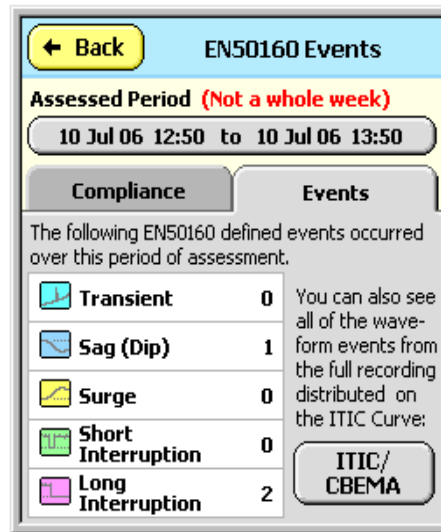
## Example Screens of the Ranger PM7500



## PMScreen example screens cont.



Screen a)



Screen b)

### Compare vs. the standards

Recorded results may be compared against various standards, for example EN50160, the European Public Voltage Supply Characteristic.

The screens here show examples of Screen a) the summaries for compliance of the supply during the assessed period, and Screen b) the number of specific events.

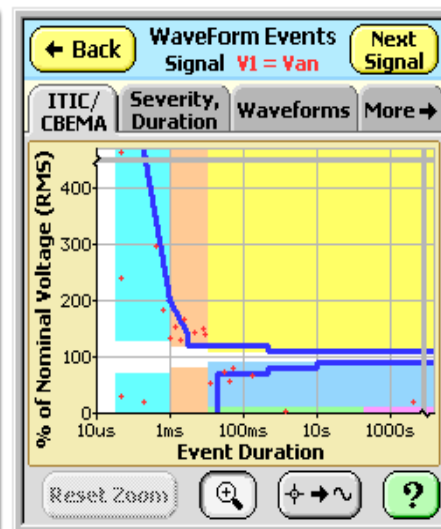
For both of these screens the assessment period can be adjusted.

### View data in multiple forms

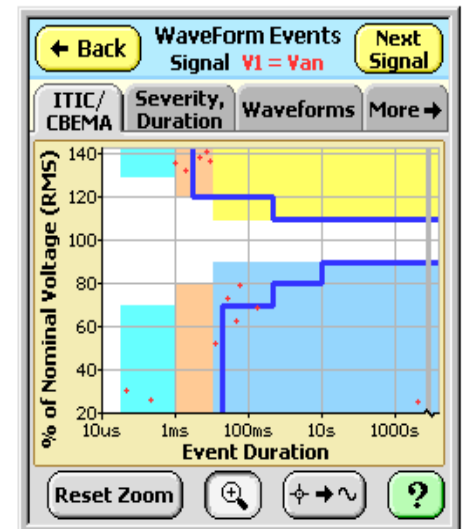
#### ITIC (CBEMA) Curve

The screens to the right and below show different ways of presenting recorded event data, Screen c) is the conventional ITIC (CBEMA) presentation. This graph can be zoomed (d) to distinguish elements of a cluster, then the relevant waveform can be displayed.

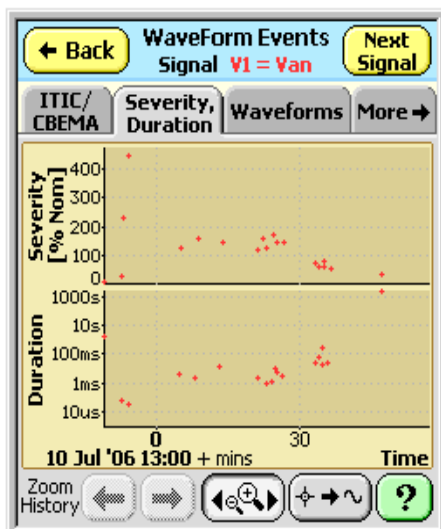
A CBEMA curve can also be created in the companion software to the Ranger products, Pronto for Windows.



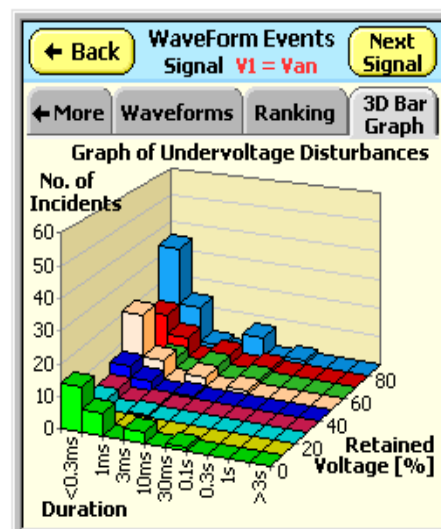
Screen c)



Screen d)



Screen e)



Screen f)

### Severity / Duration Curve

Screen e) shows event severity and duration against time for the recording. This too can be zoomed in.

### 3D Undervoltage Disturbance Graph

Screen f), the 3D Undervoltage Disturbance Graph, shows how serious the supply disruptions have been in terms of an industrial process being disturbed.

Remember that sags/dips may effect processes more seriously than complete outages.