

# PQPro™ User Manual



Copyright © 2012 ELCOMPONENT Ltd.

All Rights Reserved.

The information in this document is subject to change without notice.

Elcomponent has made every effort to ensure the accuracy of this manual. However, Elcomponent makes no warranties with respect to this documentation and disclaims any implied warranties of merchantability and fitness for a particular purpose. Elcomponent assumes no responsibility for any errors that may appear in this document.

## Trademarks

PQPro and PV II are registered trademarks of Candura Instruments.

All other product names are copyright and may be trademarks and/or registered trademarks of their respective companies.

## Manufactured by:

Elcomponent Ltd  
Unit 5 Southmill Trading Centre  
Southmill Road  
Bishop's Stortford  
Herts CM23 3DY

Document number: CID1008.01  
Date: 2 November, 2012

Printed in the UK

# PQPro™ User Manual

## Table of Contents

Introduction.....	1
Safety .....	2
Quick Start.....	3
Hookup Configurations.....	4
Hookup Diagnostic Warnings.....	5
PQPro™ Firmware Features.....	7
RMS and Waveform Data Storage.....	7
Harmonics .....	7
Interharmonics.....	8
Power Calculations.....	8
Frequency.....	8
Event Capture .....	8
Under/Over Voltage Events.....	9
High Speed Voltage Transients .....	9
Current Inrush .....	9
Voltage and Current Unbalance.....	9
PQPro™ Back Panel.....	10
PQPro™ Front Panel .....	11
PQPro™ Operation .....	12
Turning On and Off.....	12
Memory Card.....	12
PQPro™ Setup .....	13
Phase CT Range.....	13
CH 4 CT Range.....	13
Connection .....	13
1P2W - 1 Phase 2 Wire .....	13
1P3W - 1 Phase 3 Wire (Edison circuit).....	13
3P3W - 3 Phase 3 Wire (Delta circuit) .....	13
3P4W - 3 Phase 4 Wire (Wye circuit).....	13
2.5E - 2½ Element .....	13
PQPro™ Data Storage.....	14
Storage Rate .....	14
Recording Mode .....	14
Interharmonics.....	15
Voltage Spike Waveforms .....	15
Under/Over Voltage Waveforms .....	15
Current Inrush Waveforms .....	15
RMS Capture.....	15
PQPro™ Trigger Levels .....	16
Event Enable .....	16
Phase Current Inrush .....	16
Channel 4 Current Inrush .....	16
Phase Voltage Nominal.....	16
Channel 4 Voltage Nominal.....	16
Voltage Spike .....	16
Phase Voltage Over .....	16
Phase Voltage Under .....	17
Channel 4 Voltage Over .....	17
Channel 4 Voltage Under .....	17

# PQPro™ User Manual

PQPro™ Operation – Setup (continued) .....	17
Ext PT/CT .....	17
System Freq .....	17
Clock.....	17
Bluetooth .....	17
Calibrate .....	18
Language.....	18
Display.....	18
Record.....	19
Specifications .....	20

# PQPro™ User Manual

## Introduction

The **PQPro™** is the third generation of power quality analyzers developed by Elcomponent for the measurement of power quality and for power system diagnostics. From the instrument's front panel or, for more detail use Elcomponent's **PV II™** software, you can view:

- AC and DC Voltage, Current, Power and Frequency
- Waveforms, harmonics and vector diagrams for both voltage and current
- Three phase voltage and current unbalance
- Voltage sags and swells
- High speed voltage transients
- Current inrush
- Flicker (IEC 61000-4-15)
- Power Quality (IEC 61000-4-30 Class A)



The **PQPro™** is an 8 channel power quality analyzer / data recorder. It monitors three phases of voltage and current as well as a fourth channel of voltage and current. Measured parameters are updated every  $\frac{1}{2}$  cycle to ensure that nothing is missed. Most measurements can be viewed on the front panel LCD in the field and recorded data can be transferred to a computer using the removable memory card. The instrument is powered from the V1 voltage measurement input, or if V1 is a weak source, an auxiliary power supply may be used. The **PQPro™** has an internal rechargeable battery that can power the instrument for up to 4 hours in the event of a power outage. The entire unit is enclosed in a rugged weather proof case for use in harsh environments.

# PQPro™ User Manual

## Safety

Although this instrument is designed to be as safe as possible, safety is ultimately the responsibility of the operator. This instrument should only be operated as specified by the manufacturer and by authorized personnel.

**Please read and UNDERSTAND the following information before operating this instrument**

- The **PQPro™** uses a membrane keypad that could be damaged if a sharp object is brought into contact with it.
- Frequently inspect the test leads and the instrument for damage. If the instrument shows any signs of physical damage or functions improperly, it should not be used. Clean with a damp cloth only.
- Never work alone. Ensure that a qualified observer is mindful of your activities.
- When performing any measurements, all connections should be made to the circuits while the power is off. To ensure personnel safety, the test leads and related connectors should not be handled while the circuit is energized.
- Do not attempt to measure any voltage higher than the maximum rating of 600V RMS. Failure to observe the maximum rating could result in damage to the equipment or personnel injury.
- Refer servicing of this instrument to qualified personnel only. Disconnect supply power before servicing. Potentially lethal voltages may be present inside the case. If any of the protective circuitry is improperly repaired, the safety of this product could be compromised.
- Do not expose the **PQPro™** directly to outdoor elements.
- The following international symbol is used on the equipment and in this manual:



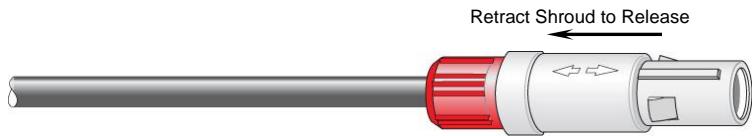
See explanation in manual to find out the nature of the potential HAZARD and any actions to be taken.

# PQPro™ User Manual

## Quick Start

Connecting the **PQPro™** to the circuit to be measured is a straightforward process.

1. Connect the voltage leads for each phase to be measured. For proper operation V1 must always be used. Three phase circuits can be connected in either a 'wye' or 'delta' configuration. Refer to the 'Hookup Configurations' section for the various methods of connecting the voltage leads.
2. Connect the clamp CTs or flex CTs. Channels 1, 2 and 3 must use the same type and rating of CT, channel 4 may use a different type and/or rating CT (Ensure that the correct CTs have been selected in the SETUP menu).



3. Turn the instrument on by pressing the On/Off button.
4. Ensure a memory card is installed.
5. Use the 'SETUP' key and function keys to check and modify any of the setup parameters.
6. Press the 'Record' key and then F1 to start recording synchronized to the real time clock or F2 (if recording interval is continuous) to start recording immediately. If there are any error messages, please refer to the 'Hookup Diagnostic Warnings' section.
7. The measured values can be viewed from the instrument using the 'DISPLAY' key and function keys.
8. To stop recording press the 'RECORD' key and then F2 followed by F1 to confirm the stop command.

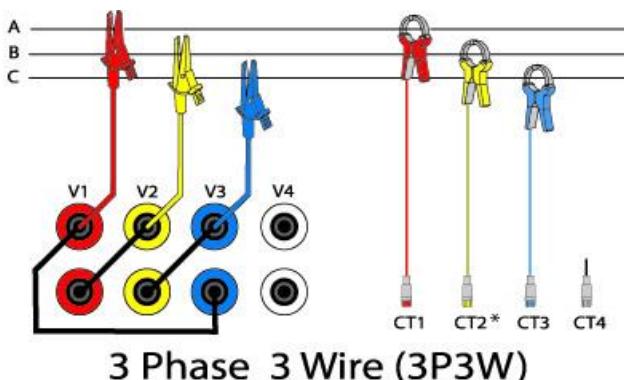
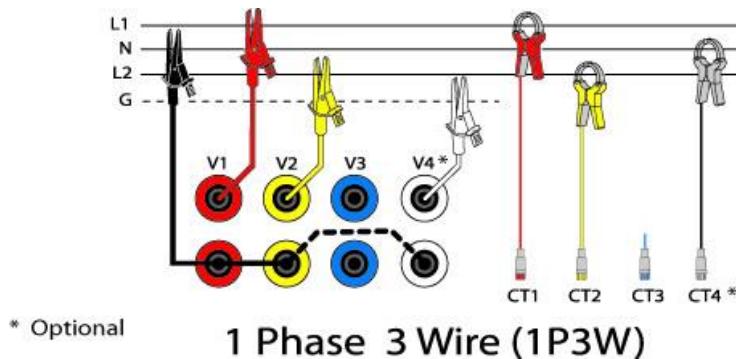
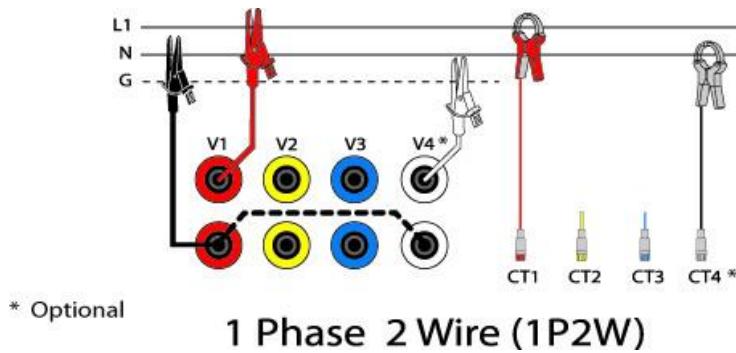
**Note:** Static discharges may occur when connecting leads or the memory card, depending on environmental conditions. This is not hazardous and will not damage the instrument. However it may affect the integrity of the data if the instrument is recording. Connection and disconnection of leads etc. should be done while the instrument is not recording. Before handling an instrument that is recording the operator should discharge any potential static by touching a grounded object.

9. Data is transferred to a computer using the memory card. When recording has been stopped the memory card can be removed from the instrument. The memory card can be inserted directly into an SD card reader. Run **PV II™** and select 'File', 'Open' and then go to the drive that has been configured for the memory card. If there is data on the card you will then see a file that can be opened. After opening the file on the data card the file is processed and stored on the computer's hard drive.

# PQPro™ User Manual

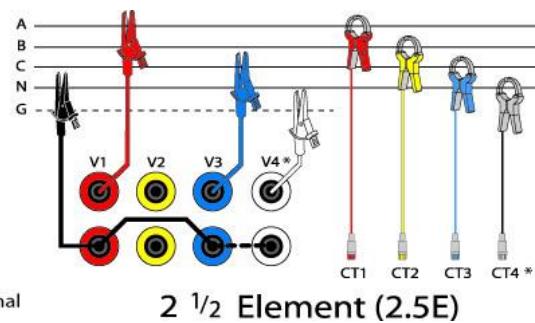
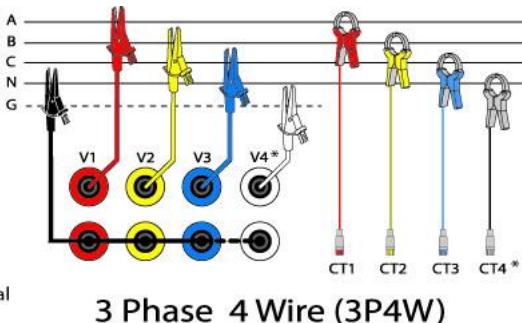
## Hookup Configurations

The **PQPro™** can be used to monitor any single phase or three phase power configuration. Following are descriptions of the five most common field setups:



\* Optional: CT2 current is not required for 3 phase power measurement.

# PQPro™ User Manual



## Hookup Diagnostic Warnings

From the 'RECORD' screen the operator can select 'SYSTEM CHECK'. The instrument does a number of checks on the connected signals, if it detects a potential problem a message will be displayed in the RECORD screen. The operator can elect to ignore these messages and start anyway in which case these messages will not appear while the instrument is recording. If the operator makes changes to the instrument setup or the connections to the power system and the condition clears then the messages will clear when the operator selects 'SYSTEM CHECK' again.

Possible messages and descriptions:

**'CH1 VOLTAGE TOO LOW'**

**'CH2 VOLTAGE TOO LOW'**

**'CH3 VOLTAGE TOO LOW'**

Voltage being measured is less than 10V

**'CH1 VOLTAGE TOO HIGH'**

**'CH2 VOLTAGE TOO HIGH'**

**'CH3 VOLTAGE TOO HIGH'**

**'CH4 VOLTAGE TOO HIGH'**

Voltage being measured is greater than 120% of rated value.

**'CH1 CURRENT TOO HIGH'**

**'CH2 CURRENT TOO HIGH'**

**'CH3 CURRENT TOO HIGH'**

**'CH4 CURRENT TOO HIGH'**

Current being measured is greater than 120% of the CT rating.

## PQPro™ User Manual

- ‘-VE POWER CHECK CT1’
- ‘-VE POWER CHECK CT2’
- ‘-VE POWER CHECK CT3’
- ‘-VE POWER CHECK CT4’

This usually means that the relevant CT has been connected in reverse. To fix the problem remove the CT, rotate it 180 degrees, reconnect it and then press ‘SYSTEM CHECK’ again. In some cases this is not an error (i.e. when measuring a generator output).

---

### ‘VOLTAGE PHASE SEQ ERROR’

Voltage phase sequence is checked when voltage on channels 1, 2 and 3 are greater than 30V and error occurs when phase sequence is not A B C. To fix this problem, swap the voltage connections to channels 2 and 3 and then press ‘SYSTEM CHECK’ again.

---

### ‘CURRENT PHASE SEQ ERROR’

Current phase sequence is checked when currents on channels 1, 2 and 3 are greater than 5% of range and error occurs when phase sequence is not A B C. To fix this problem exchange CT’s for channels 2 and 3 and then press ‘SYSTEM CHECK’ again.

---

### ‘VOLTAGE OUTSIDE TRIG WINDOW’

This indicates that at least one of the four measured voltages is above the over voltage trigger level or at least one of channels 1, 2 or 3 voltage is below the under voltage trigger level.

**Note: Channel 4 under voltage is not included in the system check.**

---

### ‘CURRENT GREATER THAN TRIG LEVEL’

This indicates that one or more currents are greater than the current inrush threshold.

---

### ‘CT TYPE ERROR - PHASE’

The type of CT (Flex or Clamp) connected to the phase CT inputs is not the same as selected.

---

### ‘CT TYPE ERROR - CHANNEL 4’

The type of CT (Flex or Clamp) connected to channel 4 inputs is not the same as selected.

# PQPro™ User Manual

## PQPro™ Firmware Features

### RMS and Waveform Data Storage

The **PQPro™** stores RMS data at set intervals which can be adjusted from 0.2 (continuous) to 30 seconds or 1 to 30 minutes. The minimum, maximum and average values are stored at the end of each storage interval. The averaged values are calculated from the sum of the RMS values (updated every  $\frac{1}{2}$  cycle) over the preceding storage interval. The minimum and maximum values are updated every  $\frac{1}{2}$  cycle over the preceding storage interval.

The **PQPro™** has a **continuous** store mode which stores RMS minimum, maximum and average data every 200 milliseconds and waveform data continuously. During continuous store mode event capture functions are disabled, and Bluetooth communication is disabled.

Data is stored in files with a maximum size of 409M. There are two different implementations of the **continuous** store function.

For data cards 64G and larger the Connection Type is set to 3P4W (3P3W systems may be measured but the power measurements will not be correct) and three channels of voltage and three channels of current data are stored. The Storage Mode is automatically set to 'Restart When Full'. When the maximum file size of 409M is reached a new file is automatically started until the card is full. The user may stop recording at any time. There is no gap in waveform data between the end of one file and the start of the next file. At 60 Hz it will take 3.3 days to fill a 64G data card.

For data cards 32G and smaller the Connection Type and Storage Mode are user configurable. If the user selects a Storage Mode of 'Circular' then the **PQPro™** will keep recording until the user stops recording. When the 409M file is full the oldest data will be overwritten. At 60 Hz a full file will have 28 minutes of data. If the user selects a Storage Mode of 'Restart When Full' there will be a small gap in the waveform data between the end of one file and the start of the next file.

### Harmonics

The **PQPro™** displays up to the 41<sup>st</sup> harmonic on its display while the software displays up to the 128<sup>th</sup> harmonic. Total Harmonic Distortion (THD) is calculated as the ratio between the square root of the squared sum of the harmonic magnitudes (for harmonics 2...128) divided by the fundamental value. THD is calculated over a 200 millisecond window.

# PQPro™ User Manual

## Interharmonics

Interharmonics are calculated by the software from the waveform snapshots that are stored every storage interval. The Interharmonic calculation requires multiple cycles of waveforms. If Interharmonics are turned off only one cycle of waveforms is captured and the software can only calculate the harmonics. If Interharmonics are turned on 10 cycles (for 50 Hz systems), 12 cycles (for 60 Hz systems) or 40 cycles (for 400 Hz systems) are stored every storage interval. Interharmonics can be resolved to 5 Hz resolution from 10 cycles or 12 cycles and to 10 Hz resolution from 40 cycles.

In Continuous storage mode the 10 cycles, 12 cycles or 40 cycles of waveforms are stored continuously with no missing cycles. This enables the software to be able to calculate Interharmonics over a longer period. For example the software could use 120 cycles resulting in a resolution of 0.5 Hz (in 60 Hz systems) for the Interharmonics. Note that in Continuous storage mode there is no option to turn Interharmonics On or Off.

## Power Calculations

The power calculations are updated every  $\frac{1}{2}$  cycle. The average values of power are recorded. Power factor displayed is the true power factor (not the displacement power factor which is determined from the phase angle shift between fundamental values of voltage and current) and is calculated as the ratio of the real power (kW) divided by the apparent power (kVA).

## Frequency

The system frequency is measured from the signal on V1 input. Frequency will not be measured if the voltage is below 10V.

## Event Capture

Under/over voltage events, high speed voltage transients and current inrush events are stored when they occur. The trigger levels are set from the Setup menu under 'TRIGGER LEVELS'. When an event is triggered data for all four voltage and current channels is stored, if configured for a 3 phase system, irrespective of which channel triggered the event.

# PQPro™ User Manual

## Under/Over Voltage Events

Under/over voltage events are tagged as sags/swells if they are under 2 seconds in duration and under/over if they are longer. The **PV II™** software reports their duration in number of cycles, with  $\frac{1}{2}$  cycle resolution, for events less than 2 seconds and in seconds for longer events. The **PQPro™** uses a hysteresis value of 0.1% of full scale to determine when the event has finished. For example if the under voltage trigger level is set at 228.0 volts the instrument will start recording an event when the voltage goes under 228.0 volts and will stop recording the event when the voltage goes over 228.8 volts. For under/over voltage events both event waveforms and RMS data, with  $\frac{1}{2}$  cycle resolution, are recorded. Pre-trigger data is  $\frac{1}{4}$  of the event buffer for waveforms and 64 cycles for RMS data. The Event Waveform buffer is user adjustable between 4 and 100 cycles. The Event RMS buffer is user adjustable between 120 and 3600 cycles. Under/Over Voltage and Current Inrush events have the same Waveform and RMS buffer lengths.

## High Speed Voltage Transients

The **PQPro™** captures high speed voltage transients that are 20 microseconds (50Hz) / 16 microseconds (60Hz) / 39 microseconds (400Hz) or longer. When a transient is detected on any of the four voltages, high resolution (1024 samples/cycle) waveform data is stored. Only waveform data for all voltage and current channels is stored with a user adjustable buffer of between 2 and 10 cycles. Pre-trigger recording is fixed to  $\frac{1}{2}$  cycle.

## Current Inrush

Current inrush data for all voltage and current channels is stored when the current on any of the four channels exceeds the threshold setting. The trigger level setting for channel 4 can be set independently from channels 1,2 and 3. Both event waveforms and RMS data, with  $\frac{1}{2}$  cycle resolution, are recorded. Pre-trigger data is  $\frac{1}{4}$  of the event buffer for waveforms and 64 cycles for RMS data. The Event Waveform buffer is user adjustable between 4 and 100 cycles. The Event RMS buffer is user adjustable between 120 and 3600 cycles. Under/Over Voltage and Current Inrush events have the same Waveform and RMS buffer lengths.

## Voltage and Current Unbalance

This is for three phase systems. Unbalance is calculated as the ratio of the negative sequence component divided by the positive sequence component. Unbalance is calculated over a 200 millisecond window.

# PQPro™ User Manual

## PQPro™ Back Panel

The voltage and current connections are colour coded according to phase and polarity (for voltage).

Channel 1 or Phase A	Red
Channel 2 or Phase B	Yellow
Channel 3 or Phase C	Blue
Channel 4 Current	Grey
Channel 4 Voltage	White

There is an auxiliary connector that is used to connect to an external DC power supply (for use when V1 is connected to a weak source).



When measuring less than 4 voltages V1 must always be used. V1 zero crossing is used to synchronize the data sampling and measure frequency. In the event of an outage on V1 the logger has an internal digital phase lock loop that simulates the zero crossing until V1 is restored.

# PQPro™ User Manual

## PQPro™ Front Panel

The front panel of the **PQPro™** has a colour graphics display, a 10 button keypad and a memory card interface.

The colour graphics display is 270x480 pixels.

The keypad has two types of buttons. The bottom row of 4 keys are fixed function buttons and the top row of 6 keys are function keys that change function depending on the active screen on the display. In most screens the bottom line of the display is used to describe the functions associated with the six function keys.



The memory card interface is used to store recorded data on a memory card and also to load new firmware. The **PQPro™** will not begin a survey without a memory card installed. Once a survey has been started the memory card may not be removed until the survey has been stopped.

# PQPro™ User Manual

## PQPro™ Operation

### Turning On and Off

The **PQPro™** has a dedicated On/Off button. If the instrument is running on battery power, is not recording and there has been no key pressed or Bluetooth activity for two minutes the instrument will automatically turn off in order to conserve battery capacity. If the instrument is running on battery power and recording is on the instrument will not turn off until the battery capacity is below 15%. At that time the data file will be closed and the instrument will automatically turn off – no data will be lost.

After turning off due to low battery voltage the battery will have enough capacity to keep the real time clock functioning for over a month.

### Memory Card

The **PQPro™** continually checks the memory card interface to see if a card has been inserted or removed. When it detects a card being inserted (or a card in the socket immediately after power up) the instrument checks the card size and the number of files on the card. The **PQPro™** supports from 2GB to 64GB SD memory cards. Each file is allocated approximately 0.5GB on the card so that a 2GB card can hold up to 4 data files and a 64GB card can hold up to 128 data files.

When the instrument detects a card being removed it changes the screen to the initial screen if the instrument was not recording. If the instrument was recording when the memory card is removed recording is stopped and an error message is displayed:

MEMORY CARD REMOVED WHILE RECORDING  
RECORDING STOPPED  
RE-INSERT CARD TO CLOSE FILE PROPERLY

If the memory card is not re-inserted the data file on the card will have the name Q999XXXX.TSQ and **PV II™** software **may** be able recover the trend data.

**The Memory card should NEVER be removed while recording is on, ALWAYS stop recording before removing the Memory card.**

The Memory card offers a fast and convenient method to transfer recorded data to a computer. To transfer data from the memory card to a computer, remove the card from the logger and insert into an SD card reader. Run **PV II™** and select 'File', 'Open' and then go to the drive that has been configured for the memory card. If there is data on the card you will then see a file that can be opened. After opening the file, the processed file can be saved on the computer's hard drive.

# PQPro™ User Manual

## PQPro™ Setup

Pressing the 'SETUP' button calls up the main setup screen. From the main setup screen you can select:

- PHASE CT RANGE
- CH 4 CT RANGE
- CONNECTION
- DATA STORAGE
- TRIGGER LEVELS
- EXT PT/CT
- SYSTEM FREQ
- CLOCK
- BLUETOOTH
- CALIBRATE
- LANGUAGE

### Phase CT Range

User selects the clamp CT or flex CT that is being used on channels 1, 2 and 3. The same type and rating is used for all three channels.

### CH 4 CT Range

User selects the clamp CT or flex CT that is being used on Ch 4. The type and rating can be different from the phase CT.

### Connection

User selects the type of phase connection, in all configurations channel 4 voltage and current is recorded:

#### 1P2W - 1 Phase 2 Wire

User can select 1, 2, 3 or 4 CTs to be associated with V1 in order to monitor multiple single phase loads

#### 1P3W - 1 Phase 3 Wire (Edison circuit)

Channels 1 and 2 for voltage and current are used for monitoring a residential type split phase service.

#### 3P3W - 3 Phase 3 Wire (Delta circuit)

Line to line voltages ( $V_{ab}$ ,  $V_{bc}$  and  $V_{ca}$ ) and line currents ( $I_a$ ,  $I_b$  and  $I_c$ ) are measured directly. Only  $I_a$  and  $I_c$  are required for three phase power calculations.

#### 3P4W - 3 Phase 4 Wire (Wye circuit)

Line to neutral voltages ( $V_{an}$ ,  $V_{bn}$  and  $V_{cn}$ ) and line currents ( $I_a$ ,  $I_b$  and  $I_c$ ) are measured directly

#### 2.5E - 2½ Element

Line to neutral voltages ( $V_{an}$  and  $V_{cn}$ ) and line currents ( $I_a$ ,  $I_b$  and  $I_c$ ) are measured directly. Line to neutral voltage  $V_{bn}$  is calculated from  $V_{an}$  and  $V_{cn}$ .

# PQPro™ User Manual

## PQPro™ Data Storage

User can configure various data store parameters:

- STORAGE RATE
- RECORDING MODE
- INTERHARMONICS
- VOLT SPIKE WVFRM (Voltage Spike Waveforms)
- VOLT U/O WVFRM (Under/Over Voltage Waveforms)
- CURR INRSH WVFRM (Current Inrush Waveforms)
- RMS CAPTURE

### Storage Rate

The storage rate has the following settings:

30, 15, 10, 5, 1 minute

30, 15, 10, 5, 1 second

Continuous

RMS calculations are updated every  $\frac{1}{2}$  cycle using a sliding one cycle window. At each storage interval the minimum, maximum and average RMS values based on the  $\frac{1}{2}$  cycle update are stored. For Continuous storage rate the RMS values are stored every 200 (50 or 60 Hz systems) milliseconds, or every 200 milliseconds (400Hz systems). Event capture and Bluetooth communication are disabled.

Waveforms for each channel are stored every storage interval. For storage rates 1 second or longer one cycle of waveforms are stored if interharmonics are turned off and 10 cycles (50 Hz systems), 12 cycles (60 Hz systems), 40 cycles (400Hz systems) if interharmonics are turned on. For Continuous storage rate 10 cycles (50 Hz systems) or 12 cycles (60 Hz systems) of waveforms are stored every 200 milliseconds. For 400 Hz systems and continuous storage rate 40 cycles of waveforms are stored every 100 milliseconds.

### Recording Mode

There are three different recording modes:

#### **Stop when full**

When the data file is full (approximately 409MB) recording is turned off.

#### **Circular**

When the data file is full newer data overwrites the oldest data. Trend data is stored separately from event data so it is possible that Trend data could be full while event data is not resulting in recorded events that occur prior to the start of the recorded Trend data.

# PQPro™ User Manual

## Restart when full

When the data file is full the file is closed and a new file is automatically started. For storage rates 1 second or longer the new file will start on an even minute boundary so there could be a gap of up to a minute between the end of one data file and the start of the next one. For continuous storage rate with data cards 32G or smaller the new file will start immediately with a 1 to 2 second gap between the end of one data file and the start of the next one. For continuous storage with data cards 64G or higher the new file will start immediately with no gap. When the memory card is full or when the Stop button is pressed, recording will stop.

## Interharmonics

Interharmonics are calculated by the software from the waveform snapshots that are stored every storage interval. If Interharmonics are turned off one cycle of waveforms are stored every storage interval and the software can only calculate the harmonics. If Interharmonics are turned on then multiple cycles of waveforms are stored every storage interval, 10 cycles (for 50 Hz systems), 12 cycles (for 60 Hz systems) or 40 cycles (for 400 Hz systems).

Interharmonics use a lot of memory and should only be used if required. For example, in a 60 Hz system at 1 minute storage it will take 45 days to fill a data file with Interharmonics off and 4.0 days with Interharmonics on. On power up Interharmonics are off and the user must turn on Interharmonics if desired

## Voltage Spike Waveforms

For high speed voltage transients (>20 microseconds for 50 Hz systems >16 microseconds for 60 Hz systems or >39 microseconds for 400Hz) user can adjust the number of waveform cycles stored from 2 to 10 cycles. There will be  $\frac{1}{2}$  cycles of pre-trigger data.

## Under/Over Voltage Waveforms

For under or over voltage transients that are  $\frac{1}{2}$  cycle or longer the user can adjust the number of waveform cycles stored from 4 to 100 cycles. Pre-trigger data is  $\frac{1}{4}$  of the waveform buffer. Both Under/Over voltage and current Inrush waveform buffers will be set to the same length.

## Current Inrush Waveforms

For current inrush transients that are  $\frac{1}{2}$  cycle or longer the user can adjust the number of waveform cycles stored from 4 to 100 cycles. Pre-trigger data is  $\frac{1}{4}$  of the waveform buffer. Both Under/Over voltage and current Inrush waveform buffers will be set to the same length.

## RMS Capture

This setting affects the RMS transient data stored for both under/over voltage transients and current inrush. The pre-trigger buffer size is fixed at 64 cycles. User can adjust the length of the post-trigger RMS storage from 120 to 3600 cycles.

# PQPro™ User Manual

## PQPro™ Trigger Levels

The event trigger levels are set here. The options are:

- EVENT ENABLE
- PHASE CURRENT INRUSH
- CH4 CURRENT INRUSH
- PHASE VOLT NOMINAL
- CH4 VOLT NOMINAL
- VOLTAGE SPIKE
- PHASE VOLT OVER
- PHASE VOLT UNDER
- CH4 VOLT OVER
- CH4 VOLT UNDER

**Note:** This menu is not accessible if the storage rate is set to continuous.

### Event Enable

The three events types (Voltage Spike, Under/Over Voltage and Current Inrush) can be individually disabled. On power up all events are automatically enabled. All events are disabled if the storage Interval is set to continuous.

### Phase Current Inrush

This trigger level is an RMS value. If any of the three phase currents (channels 1, 2 or 3) exceeds this level then a Current Inrush Event is triggered.

### Channel 4 Current Inrush

This trigger level is an RMS value. If the current on channel 4 exceeds this level then a Current Inrush Event is triggered.

### Phase Voltage Nominal

This is the expected nominal voltage for channels 1, 2 and 3. If measuring Line – Neutral this is the line to neutral nominal voltage, If measuring Line – Line this is the line to line nominal voltage. This is used as a reference for channels 1, 2 and 3 voltage event trigger levels.

### Channel 4 Voltage Nominal

This is the expected nominal voltage for channel 4. This is used as a reference for channel 4 voltage event trigger levels.

### Voltage Spike

Trigger setting for the high speed voltage transient capture function.

### Phase Voltage Over

The RMS over voltage trigger level for channels 1, 2 and 3.

# PQPro™ User Manual

## Phase Voltage Under

The RMS under voltage trigger level for channels 1, 2 and 3.

## Channel 4 Voltage Over

The RMS over voltage trigger level for channel 4.

## Channel 4 Voltage Under

The RMS under voltage trigger level for channel 4.

## PQPro™ Operation – Setup (continued)

### Ext PT/CT

For use when measuring on the secondary sides of external PTs and CTs. Entering these values enables user to view voltage, current and power as they are on the primary side of the external PTs and CTs. With the ratios set 1:1 user would see them as they are on the secondary side. The maximum voltage ratio that can be entered is 999,999:1. The maximum current ratio that can be entered is 99,999:1.

### System Freq

User can select one of three frequencies. These frequencies are factory set. In most cases these frequencies will be 60 Hz, 50 Hz, and 400 Hz but could be different for special cases.

The frequency setting will affect the operation of some of the instrument functions. These functions are:

- i) Flicker calculation. The **PQPro™** calculates flicker according to the IEC 61000-4-15 standard which has different requirements for 50 Hz and 60 Hz systems. For frequencies other than 50 Hz and 60 Hz flicker is not calculated.
- ii) Interharmonic calculation. **PV II™** calculates interharmonics according to the IEC 61000-4-30 standard which has different requirements for 50 Hz and 60 Hz systems. For both frequencies a 200 millisecond window is used which corresponds to 10 cycles at 50 Hz and 12 cycles at 60 Hz resulting in an interharmonic resolution of 5 Hz. For 400 Hz systems a 100 millisecond window is used which corresponds to 40 cycles resulting in an interharmonic resolution of 10 Hz
- iii) Continuous recording, for 50 and 60 Hz systems the **PQPro™** stores RMS data every 200 milliseconds and waveforms, with 256 samples/cycle, continuously. For 400 Hz systems the **PQPro™** stores RMS data every 100 milliseconds and waveforms, with 64 samples/cycle, continuously

### Clock

This enables the user to set the **PQPro™** internal clock from the front panel. The internal clock can also be set from a computer using **PV II™** software and a Bluetooth interface.

### Bluetooth

User can turn off the internal Bluetooth radio transmitter.

# PQPro™ User Manual

## Calibrate

Calibration factors are stored internally in the **PQPro™**. Any user can view the calibration factors without the ability to modify them. Qualified personnel can modify the calibration factors by first entering a six digit password. Please consult sales@elcomponent.co.uk to receive the password.

## Language

User can change the language used by the **PQPro™** display. Presently only English and Spanish are supported

## Display

Pressing the 'DISPLAY' button calls up the main display screen. The main display shows the real time values of AC voltage, current and power. The main display is formatted depending on the connection configuration.

From the main display screen you can select:



### AC/DC Voltage, Current and Frequency

AC and DC voltage and current for all four channels are displayed independent of the connection configuration. For 1 phase 2 wire connection the power shown is for the channel current referenced to the voltage on channel 1. For 3 phase 3 wire connection only the total power is shown



### Waveforms

Voltage and current waveforms can be viewed in real time.



### Harmonic Bar Chart

Voltage and current harmonic magnitudes up to the 41<sup>st</sup> harmonic can be viewed in real time. When data is recorded and viewed with **PV II™** software harmonic magnitudes up to the 128<sup>th</sup> can be viewed.



### Vector Diagram

Voltage and current vectors can be viewed in real time.



### System Information

User can view the **PQPro™** serial number, the firmware revision, the recording status (on or off), the battery status (charging or discharging and capacity) and memory card usage.

## PQPro™ User Manual

### Record

Pressing the 'RECORD' button calls up the recording screen. From this screen user can:

- i) (F3) Run a system check that checks over range voltage and current, reverse CT connections, reverse phase sequence and voltage and current outside trigger levels.
- ii) (F2) Start recording immediately. This is only available if the storage interval is Continuous.
- iii) (F1) Start recording synchronized to the internal clock. Recording starts on an even minute. User can adjust the start time to be the next even minute or delayed as much as 24 hours. When delayed start is initiated the display will show 'RECORD DELAY'. When the delay is over this will change to 'RECORD ON' and the first record will be written to the data file.

The Record screen also shows the memory usage in terms of number of records available and used. When recording has been started it also shows the filename that is being used for data storage.

When recording is started 'F2' becomes the stop recording button.

If events are active messages in red will be printed above the function keys.

# PQPro™ User Manual

## Specifications

		Specifications	Comment
<b>Measurement</b>	V1, V2, V3 0 - 600 VAC	0.1% of full scale + 0.1% of reading	-
	V4 0 - 80VAC / 110VDC Or 0 - 600VAC / 850VDC	0.1% of full scale + 0.1% of reading	-
	I1, I2, I3 0 - 1VAC/DC (Clamp) 0 - 100mVAC (Flex)	0.1% of full scale + 0.1% of reading + Flex position error	CT's are voltage output
	I4 0 - 1VAC/DC 0 - 100mVAC (Flex)	0.1% of full scale + 0.1% of reading + Flex position error	CT's are voltage output
	Sampling	1024 samples/cycle every cycle	16 - 100Hz
		64 samples/cycle every cycle	16 - 1000Hz
<b>Internal Clock</b>	Initial Accuracy	±0.05 seconds	-
	Drift	±0.5 sec/day	-
<b>Recording</b>	Storage Rate	Continuous 1, 5, 10, 15, 30 sec 1, 5, 10, 15,10 min	-
	Memory	2G- 64G removable memory card	-
<b>Power supply and Battery charger</b>	Internal Power Supply	20VA 90 - 600VAC	Operated from voltage on V1 measuring channel.
	External Power Supply	Input: 120VAC, 60Hz, 16W. Output: 12VDC, 800mA, Class2	Mode Electronics Model DV-1280, p/n 68-12BP-1
	Battery Run Time	4 hours	-
<b>Environmental</b>	Operating Temperature	-20°C to 60°C	-
	Humidity	Max 80% relative non condensing	-
	Altitude	Max 2000m	-
<b>Safety</b>	Approval	CAN/CSA-C22.2 No. 61010-1-04	-
		Pollution Degree 2	Normally only non-conductive pollution occurs. However, temporary conductivity caused by occasional condensation must be expected.
		600V CAT-IV	Measurement category IV is for measurements performed in the building installation.

\*Specifications may change without notice.