

PowerPro with *PowerFlow Firmware* 8 Channel Power Quality Datalogger

User's Guide



CANDURA
instruments

PowerPro User's Guide

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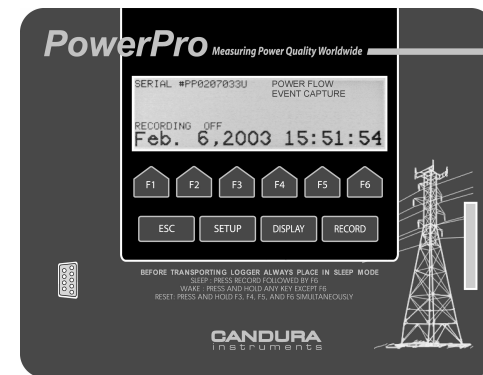
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Introduction

The **PowerPro** represents leading edge technology in the measurement of Power Quality. From the logger front panel or, for more detail, using Candura Instrument's **PowerView** software you can view:

- Trends in Voltage, Current, Power and Frequency
- Waveforms and harmonic activity for both voltage and current
- Voltage sags and swells
- Frequency deviations
- Flicker (IEC 868 / IEC 61000-4-15) - *Optional*



The **PowerPro** is an 8 channel power quality data logger. It monitors 3 phases of voltage and current as well as a neutral 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 logged data can be transferred to a computer using the removable memory card. The memory card interface also provides the means to program the logger and to upgrade the **PowerPro** firmware. The logger is powered from the V1 voltage measurement input, or if V1 is a weak source an auxiliary power supply may be used. The **PowerPro** has an internal battery that can power the logger for up to 5 hours in the event of a power outage. Voltage inputs are transformer isolated and protected with metal oxide varistors and fuses for safety. The entire unit is enclosed in a rugged water tight case for use in harsh environments.

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 by suitably qualified and authorized personnel.

Please read and UNDERSTAND the following information before operating this instrument

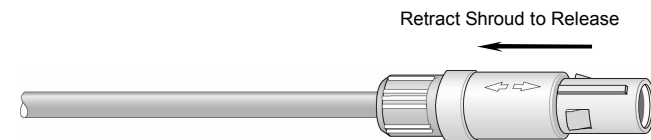
- The **PowerPro** uses a membrane keypad that could be damaged if a sharp object is brought into contact with it. This may expose the operator to potentially hazardous voltages.
- Frequently inspect the test leads and the instrument for damage. If the instrument shows any signs of physical damage or functions improperly, it should not be used.
- Never work alone with high voltage circuits. Ensure that a qualified observer is mindful of your activities.
- When performing any measurements involving high voltage circuits, all connections should be made to the circuits while the power is off. To ensure personal 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 750V RMS. Failure to observe the maximum rating could result in damage to the equipment or personal injury.
- Refer servicing of this instrument to qualified personnel only. 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.

Quick Start

Connecting the **PowerPro** 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 phase CT clamps or the three phase Flex CT.

Note that only one or the other may be used - if the three phase Flex CT is used then the phase CT clamps must be disconnected. The neutral CT clamp may be used at the same time as the three phase Flex CT.



3. Ensure a memory card is installed.
4. Turn the logger on (if it is turned off) by pressing and holding any key except F6. If installed memory card has data, select 'NO' when asked to load Setup and Data from card.
5. Use the 'SETUP' key and function keys to check and modify any of the setup parameters.
6. Press the 'Record' key and then F2 to start recording. If there are any error messages, please refer to the 'Hookup Diagnostic Warnings' section.
7. The measured values can be viewed from the logger using 'DISPLAY' key and function keys.

Continued....

Quick Start continued

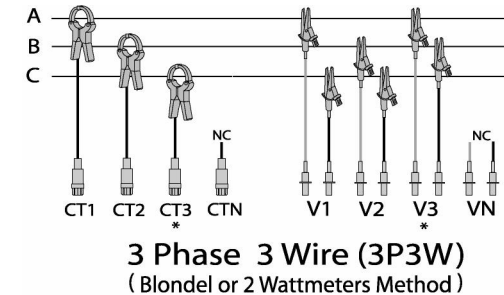
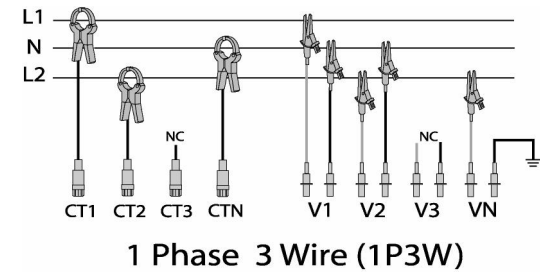
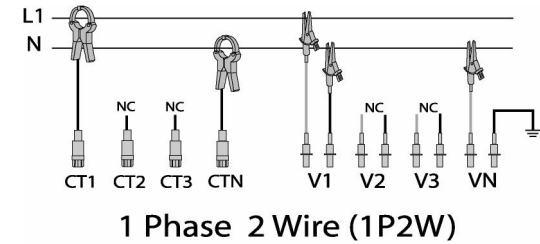
- To stop logging press the 'RECORD' key and then F4 followed by F1 to confirm the stop command.

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

- Data is transferred to a computer using the memory card. When logging has been stopped the memory card can be removed from the logger. The memory card can be inserted directly into a card reader or, with a PCMCIA adapter, it can be inserted into a PCMCIA slot in a laptop computer. Run **PowerView** 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, a directory and file name (you can keep the same file name) must be selected for the processed file.

Hookup Configurations

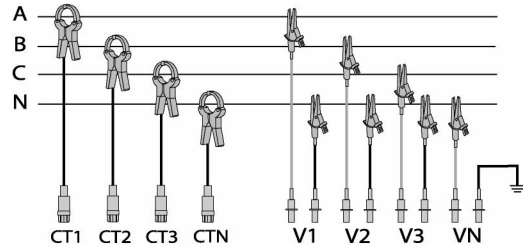
The **PowerPro** can be used to monitor any three phase power configuration. Following are descriptions of the five most common field setups:



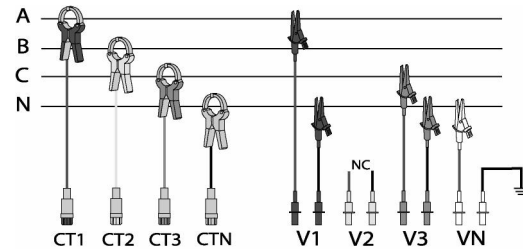
* Optional: CT3 and V3 are not used in Total Power Calculation

Continued....

Hookup Configuration continued



3 Phase 4 Wire (3P4W)



2 1/2 Element (2.5E)



Note: If a 3 phase Flex CT is connected then CT1, CT2, and CT3 must be disconnected.

Hookup Diagnostic Warnings

Before the logger starts recording it does a number of checks on the connected signals, if it detects a potential problem a message is displayed and the operator must select either 'Retry' or 'Ignore' – if the operator presses 'ESC', 'SETUP', 'DISPLAY' or 'RECORD' the start process is aborted.

Possible messages and descriptions:

- 'Voltage 1 Too Low'
- 'Voltage 2 Too Low'
- 'Voltage 3 Too Low'

-Voltage being measured is less than 35V on 240V range or less than 90V on 600V range.

- 'Voltage 1 Too High'
- 'Voltage 2 Too High'
- 'Voltage 3 Too High'

-Voltage being measured is greater than 300V on 240V range or greater than 750V on 600V range.

- 'Current 1 Too High'
- 'Current 2 Too High'
- 'Current 3 Too High'

-Current being measured is greater than 125% of the CT rating.

'Voltage Hookup Error'

-This indicates that the operator has selected a single phase configuration but has connected to a three phase system or vice versa.

'V2 Inverted'

-Voltage leads on channel two are reversed.

Continued....

Hookup Diagnostic Warnings continued**'V3 Inverted'**

-Voltage leads on channel three are reversed.

'-ve Power Check CT#1'**'-ve Power Check CT#2'****'-ve Power Check CT#3'**

-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 'Retry'. In some cases this is not an error (i.e. when measuring a generator output) and pressing 'Ignore' is the correct response.

'Phase Sequence Error'

-This occurs for three phase installations and indicates that the measured phase sequence is not ABC. To fix the problem swap the B and C voltage leads and then press 'Retry'.

'Data Sync Error'

-This problem is internal to the logger. To fix the problem put the logger to sleep (press 'RECORD' and then 'F6') and then wake it up (press and hold any key except 'F6'). If this does not fix the problem please contact your nearest Product Support Centre.

'Freq Event Triggered'

-This indicates that an under/over frequency condition is active. This may indicate that the trigger levels are not set up properly (to view them press 'SETUP' and 'F2').

Hookup Diagnostic Warnings**'Volt Event Triggered'**

-This indicates that an under/over voltage condition is active. This may indicate that the trigger levels are not set up properly (to view them press 'SETUP' and 'F2').

Power Flow Firmware Features

RMS Data Storage

The **PowerPro** stores RMS data at set intervals which can be adjusted from 1 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.

Harmonics and Waveform Storage

The logger displays up to the 21st harmonic on its display while the software displays up to the 64th harmonic. Storing harmonics uses a significant amount of memory. To maximize memory usage harmonics and waveforms can be stored at a lower rate than the RMS data. For example, if the logger is configured for 3P4W, Neutral On, it can record up to 14,285 records when recording harmonics and waveforms every storage interval on a 32 M memory card. When harmonics and waveforms are stored every 5th storage interval up to 56,490 records can be stored.

Power Calculations

The power calculations are updated every $\frac{1}{2}$ cycle. Only the averaged 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 voltage and current) and is calculated as the ratio of the real power (KW) divided by the apparent power (KVA).

Total Harmonic Distortion (THD)

THD is calculated as the ratio between the square root of the squared sum of the harmonic magnitudes (for harmonics 2...64) divided by the fundamental value.

Frequency

The system frequency is measured from the signal on V1 input. Frequency will not be measured if the voltage is below 35V in the 240V range or 90V in the 600V range.

Power Flow Firmware Features

Event Capture

Under/over voltage events and under/over frequency events are stored when they occur. The trigger levels are set from the Setup menu under 'TRIGGER LEVELS'. The duration of the events are recorded with a $\frac{1}{2}$ cycle resolution. Voltage events are tagged as sags/swells if they are under 2 seconds in duration and under/over if they are longer. The **Power View** software reports their duration in number of cycles for events less than 10 seconds and in seconds for longer events.

The logger 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 logger will start recording an event when the voltage goes under 228.0 volts and will stop recording the event when the voltage goes over 228.3 volts.

Flicker (Optional)

Flicker is an optional extra to the Power Flow firmware. If the logger has been enabled for recording flicker the words 'FLICKER METER' will be printed on the display on the right hand side of the main screen (pressing 'ESC' a number of times will access the main screen).

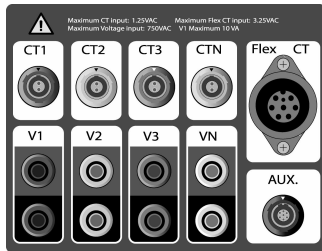
Flicker is calculated according to IEC 868 / IEC 61000-4-15 specifications. Both PST (short term flicker) and PLT (long term flicker) are calculated for each of the 3 voltage channels.

Side Panel

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

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

There is a dedicated connector for a three phase Flex CT. This connector supplies the power to the Flex CT and receives the 3 isolated current signals. 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).

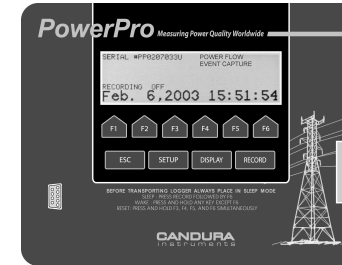


When measuring less than 3 voltages V1 must always be used. V1 zero crossing is used to synchronize the data sampling and measure frequency. In the event of an outage on V1 the logger has an internal digital phase lock loop that simulates the zero crossing until V1 is restored.

Either phase CT's or a three phase Flex CT may be used to monitor phase current. Only one type of CT may be connected to the logger at a time - if the three phase Flex CT is used then the phase CT's MUST be disconnected from the logger. Leaving the phase CT's connected will cause errors in the Flex CT readings.

Front Panel

The front panel of the **PowerPro** has a graphics display, a 10 button keypad, an RS-232 communications port and a memory card interface.



The graphics display is 240x64 pixels with an LED backlight. Text on the display is organized in 8 lines by 40 characters (small characters) or in 4 lines by 20 characters (large characters), some screens incorporate both types of characters. Graphics (waveforms and harmonic bar chart) are also displayed with text.

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 in inverse video and is used to describe the functions associated with the six function keys.

The RS-232 communications port is a 3 wire (Rx, Tx, Gnd) serial interface. Data is sent and received using the software package **PowerView**. The Xmodem communications protocol is used to transfer data.

The memory card interface is used to store recorded data on a memory card. The **PowerPro** 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.

Logger Operation

Turning On and Off

The **PowerPro** should be put into low power (or sleep) mode when not in use. In low power mode only the real time clock and keypad interface are active. Current consumption from the battery is reduced to less than 100 microamps. The logger is put in low power mode by pressing the 'RECORD' button followed by the F6 (SLEEP) button. The logger will put itself into low power mode when it detects a low internal battery voltage. If the logger was recording at the time it will close the data files as if the operator had stopped recording before going into low power mode. After going into low power mode due to a low battery voltage the battery will have enough capacity to keep the real time clock functioning for over 2 months.

To turn the logger on any key (except F6) must be pressed and held for approximately 1 second. When the logger powers up it does a self diagnostic on internal functions, if an error is detected a diagnostic screen is displayed and the logger waits for an operator to elect to put the logger back into sleep mode or to re-initialize the logger (reboot).

Memory Card

The logger 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 logger checks the card size and looks for valid data on the card. The operator must press any key to continue. The logger can now be used to start a survey and data will be stored on the memory card.

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

'MEM Card Error. Please Re- Insert MEM Card
or Survey will end in xx seconds'.

The number of seconds depends on the time until the next storage time. Even if the card is re-inserted in time it is possible that data on the card may be corrupted.

Logger Operation (Memory Card)

The Memory card should NEVER be removed while data is being recorded, 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 the PCMCIA slot of the computer using a PCMCIA adapter or insert directly into a card reader. Select 'File' from the **PowerView** toolbar and then select 'Open'. Change the directory to the drive that has been configured for the memory card. If there is data on the card you will see a file that can be opened. After opening the file, a directory and the file name (you can keep the same file name) must be selected for the processed file.

Logger Operation

Setup

Pressing the 'SETUP' button calls up the main setup screen. From the main setup screen you can select 'LOGGING SETUP', 'TRIGGER LEVELS', 'FLICKER SETUP', 'SCALE FACTOR' or 'SYSTEM SETUP'.

Logging Setup

Pressing F1 to select 'LOGGING SETUP' allows the operator to select and change the RMS storage interval, the harmonic storage interval and the wiring configuration. The operator must press 'NEXT VALUE' until the desired setup parameter is highlighted and then press 'CHANGE VALUE' to be able to modify the selected setup parameter. To exit press 'ESC' and the display will return to the parameter list screen.

If the logger is recording and 'CHANGE VALUE' is selected the screen will change to the modification screen, 'Recording On' will be printed on the bottom and no changes will be allowed.

If the Lock function is on and 'CHANGE VALUE' is selected the screen will change to the modification screen, 'LOCK On' will be printed on the bottom and no changes will be allowed.

RMS Storage Interval

The RMS storage interval appears on the left side of the screen and can be adjusted to between 1 and 30 seconds or 1 and 30 minutes. The harmonic storage interval appears on the right, see description for 'Harmonic Storage Interval'.

Harmonic Storage Interval

This selects the same screen that the RMS storage Interval selection accesses. The harmonic storage interval is displayed on the right side of the screen. The harmonic storage interval can be set between the RMS storage interval and 60 seconds (if recording interval is in seconds) or 60 minutes (if recording interval is in minutes). The increment value is the RMS storage interval.

Logger Operation (Setup - Logging setup)

Connection Type (1P2W, 1P3W, 3P3W, 3P4W and 2.5E)

This allows the logger to be configured for the five most common configuration types:

1P2W	1 Phase 2 Wire
1P3W	1 Phase 3 Wire (Edison circuit)
3P3W	3 Phase 3 Wire (Delta circuit)
3P4W	3 Phase 4 Wire (Wye circuit)
2.5E	2½ Element

Recording of neutral voltage and current can be enabled or disabled for any of these five configuration types.

Trigger Levels

The trigger levels for under/over voltage and under/over frequency are set here. An event is triggered when either one of the phase voltages or frequency is equal to its trigger level. The event is finished when the value goes back 0.1% (hysteresis) more than its trigger level. The hysteresis value is based on the full scale range. For example if the logger is set on the 240V range (full scale is 300V) and the under voltage level is set to 230.0V then an event will be triggered when the voltage goes down to 230.0V and is over when voltage goes above 230.3V.

Line Voltage

This allows the operator to set the nominal line voltage. The under/over voltage levels are automatically adjusted as a percent of this value. For example, if the nominal system voltage is 240V with an under voltage setting of 216.0V (90%) and the operator adjusts the nominal system voltage to 120V then the under voltage setting will automatically change to 108.0V (90%). For convenience there are four 'speed' buttons that can be used to set the nominal line voltage directly to 120V, 220V, 480V, 600V.

Changing the nominal line voltage also affects the flicker calculations.

Logger Operation (Setup - Trigger Levels)Line Frequency

This allows the operator to set the nominal line frequency (50 or 60 hertz). The under/over frequency levels are automatically adjusted as a fixed offset from this value. For example, if the nominal line frequency is 60 Hz with an over frequency setting of 60.50 Hz and the operator adjusts the nominal system frequency to 50 Hz then the over frequency setting will automatically change to 50.50 Hz

Over Voltage

When the trigger level screen is selected and the over voltage setting is not highlighted then the trigger level for V1 is displayed. When the over voltage setting is highlighted then all three voltage trigger levels are displayed. Pressing 'CHANGE VALUE' displays the screen that allows modification of these values.

The trigger levels can be changed individually ('SELECT NEXT' allows selecting which phase to change) or they can be changed at the same time ('SELECT ALL' selects all three phases). If they are all selected pressing 'SELECT NEXT' puts the display back into individual change mode.

The trigger levels can be changed in increments of 0.1% and for convenience there are two 'speed' buttons that set the levels directly to 110% and 125%.

Under Voltage

When the trigger level screen is selected and the under voltage setting is not highlighted then the trigger level for V1 is displayed. When the under voltage setting is highlighted then all three voltage trigger levels are displayed. Pressing 'CHANGE VALUE' displays the screen that allows modification of these values.

The trigger levels can be changed individually ('SELECT NEXT' allows selecting which phase to change) or they can be changed at the same time ('SELECT ALL' selects all three phases). If they are all selected pressing 'SELECT NEXT' puts the display back into individual change mode.

Logger Operation (Setup - Trigger Levels)

The trigger levels can be changed in increments of 0.1% and for convenience there are two 'speed' buttons that can be used to set the values directly to 90% and 75%.

Over Frequency

The over frequency setting is set with a resolution of 0.01 Hz. The minimum and maximum settings are ± 4.00 Hz with an override that the over frequency setting must be 0.10 Hz greater than the under frequency setting. For convenience there are four 'speed' buttons that can be used to set the values directly to +0.10 Hz, +0.25Hz, +0.50 Hz and +1.00 Hz.

Under Frequency

The under frequency setting is set with a resolution of 0.01 Hz. The minimum and maximum settings are ± 4.00 Hz with an override that the under frequency setting must be 0.10 Hz less than the over frequency setting. For convenience there are four 'speed' buttons that can be used to set the values directly to -0.10 Hz, -0.25Hz, -0.50 Hz and -1.00 Hz.

Flicker Setup

Flicker firmware is optional. If the **PowerPro** does not have Flicker firmware installed this menu will not appear. Setting up the flicker parameters involves setting the short term flicker calculation interval (PST), the long term flicker calculation interval (PLT) and the nominal line voltage. The nominal line voltage is required as flicker is determined from a calculation involving the percentage change in RMS voltage over time. This nominal line voltage is the same setting as the one in the Trigger setting window.

The flicker calculations are done according to the IEC 868 / IEC 61000-4-15 specifications.

PST Duration

This can be set, as prescribed by the IEC specifications, to 1 minute, 5 minutes, 10 minutes and 15 minutes.

PLT Duration

This can be set from 1 hour to 24 hours

Logger Operation (Setup - Flicker Setup)Line Voltage

This allows the operator to set the nominal line voltage.

For convenience there are four 'speed' buttons that can be used to set the values directly to 120V, 220V, 480V and 600V.

Changing the nominal system voltage also affects the under/over voltage trigger settings.

Scale Factor

Phase voltage and phase and neutral current scaling factors can be adjusted here. Neutral voltage scaling is fixed to a maximum of 100V on the input.

Voltage Range

The voltage range can be set to 240V or 600V. The maximum voltage that can be measured in the 240V range is 300V and the maximum in the 600V range is 750V.

Ext PT

To measure voltages greater than 750V external PT's must be used. The ratio of the external PT is entered here so that the **PowerPro** can display primary side values. The maximum ratio that can be entered is 200:1. If this is not sufficient the **PowerView** software can change this ratio after the data is transferred to the computer.

Clamp (or Flex) CT

When 'Change Value' is selected the operator will be able to select 'Clamp CT' in 'Flex CT'. Once the CT type has been selected the operator can select the CT rating. The Clamp CT ratings are 10A, 100A, 200A, 300A, 1000A, and 3000A and the Flex CT ratings are 10A, 30A, 100A, 300A, 1000A, and 3000A. The **PowerPro** can be calibrated for each of these CT rating and when the operator changes CT ranges the proper calibration factors are automatically set.

Logger Operation (Setup - Scale Factor)Ext CT

In situations where the **PowerPro** is measuring the secondary current of a CT, the ratio of the external CT is entered here so that the **PowerPro** can display primary current values. The maximum ratio that can be entered is 200:1. If this is not sufficient the **PowerView** software can change this ratio after data is transferred to the computer.

Neutral CT

There is only a clamp CT interface provided for the neutral current measurement. The allowable neutral clamp CT ranges are: 10A, 100A, 200A, 300A, and 1000A.

System Setup

Under 'SYSTEM SETUP' the operator can modify system related parameters such as locking the setup parameters, changing the logger ID, setting the time and date and calibrating the logger.

Setup Lock

The operator must enter the lock code to enable or disable the setup lock. This code is the same for all **PowerPro** loggers and is not user changeable. The code is '4123'. Turning the lock on inhibits any changes to the setup parameters.

The only way the setup parameters can be changed when the lock is on is by loading data from a card. This allows the creation of setup cards for various applications.

Logger ID

The operator can set these four ID characters to any combination of numbers and upper case letters for convenient tracking of multiple **PowerPro**'s. The factory set 10 digit serial number can also be used for the same purpose.

Pressing 'RECORD' will display the logger ID.

Logger Operation (Setup - System Setup)Time and Date Setting

The operator can adjust the time and date setting of the logger. Once changes have been completed the 'SAVE' button must be pressed to save the new settings. The time and date can also be set from the **PowerView** software.

Calibration

Voltage, current, power and frequency readings can be calibrated. Before accessing this menu a 6 digit calibration lock password must be entered. Once this password is entered it will stay in effect until the logger is turned off (ie. Put into sleep mode). The password is not given in this manual, it is provided to the purchaser when the logger is purchased. If the password is lost please email info@candura.com requesting the password and include the logger serial number.

Current Calibration

Each range of Clamp CT's and Flex CT's are independently calibrated. The first step is to select the CT. This is done from the 'SCALE FACTOR' submenu of 'SETUP'. Next select the calibration menu and then select 'CURRENT'. Apply a known and stable current to the CT being calibrated and, using the 'INC' and 'DEC' keys, adjust the reading until it is correct. See also the Power Calibration section.

Voltage Calibration

The 240V range and the 600V range are independently calibrated. The first step is to select either the 240V range or the 600V range. This is done from the 'SCALE FACTOR' submenu of 'SETUP'. Next select the calibration menu and then select 'VOLTAGE'. Apply a known and stable voltage to the voltage channel being calibrated and, using the 'INC' and 'DEC' keys, adjust the reading until it is correct.

Neutral Voltage and Current

The neutral voltage and current are calibrated from the same screen. Apply a known and stable voltage that is free of harmonics (the fundamental of the neutral voltage is used for calibration) and, using the 'INC' and 'DEC' keys, adjust the reading until it is correct. Apply a known and stable current that is free of harmonics to the neutral CT and, using the 'INC' and 'DEC' keys, adjust the reading until it is correct.

Logger Operation (Setup - System Setup - Calibration)Frequency



Set Voltage scaling to 240V scale (600V scale could be used but minimum applied voltage must be greater). Apply a voltage to V1 that has a known and stable frequency and has a magnitude of at least 60V. The frequency should be between 48.000 Hz and 62.000 Hz. Using the 'INC' and 'DEC' keys, adjust the reading until it is correct.

Power Calibration

The power calibration compensates for phase shift errors in the CT. This calibration should be done at the same time as the current calibration. To perform this calibration a stable voltage/current supply capable of supply current with about a 0.7 power factor (either lead or lag) is required. Apply rated voltage (240V if on the 240V range or 600V if on the 600V range) and apply rated current to the CT. Next select the 'POWER FACTOR' calibration option. Adjust the power factor of the current to 0.7 and, using the 'INC' and 'DEC' keys, adjust the reading until it is correct.

Calibrating the power factor will also calibrate the real and reactive powers.

Display

Pressing the 'DISPLAY' button calls up the main display screen. From this screen you can select measured data ('MEAS DATA'), data statistics ('DATA STATS'), waveforms () , harmonic bar chart () , memory statistics ('MEMORY STATS') and logger statistics ('LOGGER STATS').

Measured Data

This selection brings up a submenu that enables selection of voltage, current and frequency ('VOLTS AMPS'), neutral voltage and current ('NEUT V/A'), real power and apparent power ('WATTS KVA'), reactive power and power factor ('KVAR PF'), total power ('TOTAL POWER') and flicker ('PST PLT').

Logger Operation (Display - Measured Data)*Voltage, Current and Frequency*

The three phases of voltage and current as well as the frequency of channel 1 voltage are displayed in large character format. The bottom line that is normally used for function key definitions has been used to display the frequency, however the function keys are active and can be used to select the display options described in 'Measured Data' above.

Neutral Voltage and Current

The first and third harmonics of neutral voltage and current are displayed.

Real Power and Apparent Power

Three phases of real power (kW) and apparent power (kVA) are displayed. If the logger is configured for 3P3W (Delta) then individual phase powers are not available, only total power can be viewed.

Reactive Power and Power Factor

Three phases of reactive power (kVAR) and power factor, leading (LD) or lagging (LG), are displayed. If the logger is configured for 3P3W (Delta) then individual phase powers are not available, only total power can be viewed.

Total Power

Total real, apparent and reactive power and total power factor are displayed.

Flicker (Optional)

Both the short term flicker (PST) and the long term flicker (PLT) are displayed.

Data Statistics

This selection brings up a submenu that enables selection of voltage statistics ('VOLTS MN/MX'), current statistics ('AMPS MN/MX'), power statistics ('POWER MN/MX'), neutral voltage and current statistics ('NEUTRL MAX'), flicker statistics ('FLICKER MN/MX'), and frequency statistics ('FREQ MN/MX').

Logger Operation (Display - Data Statistics)

These statistics are compiled for the total survey, each value has a time stamp showing when it occurred. The time stamp has a resolution of 1 second and can be at any time and is not restricted to the data storage time.

Voltage Statistics

Pressing 'F1' from the Data Statistics submenu brings up another submenu that enables selection of instantaneous voltage statistics ('INST MN/MX'), average voltage statistics ('AVERAG MN/MX') and voltage THD statistics ('THD MN/MX').

Instantaneous Voltage Statistics

This is automatically displayed when voltage statistics are first selected. The instantaneous minimum and maximum values (updated every ½ cycle) are displayed along with a time stamp. Channel 1 voltage is displayed first, if more than one channel is being measured then the other channels can be viewed by pressing 'F6' ('NEXT CHAN').

Average Voltage Statistics

Pressing 'F2' selects the average voltage statistics. The average minimum and maximum values (updated every storage interval) are displayed along with a time stamp. Channel 1 voltage is displayed first, if more than one channel is being measured then the other channels can be viewed by pressing 'F6' ('NEXT CHAN').

Voltage THD Statistics

Pressing 'F3' selects the voltage THD statistics. These are instantaneous values. The voltage THD minimum and maximum values (updated every ½ cycle) are displayed along with a time stamp. Channel 1 voltage THD is displayed first, if more than one channel is being measured then the other channels can be viewed by pressing 'F6' ('NEXT CHAN').

Current Statistics

Pressing the 'F2' from the Data Statistics submenu brings up another submenu that enables selection of instantaneous current statistics ('INST MN/MX'), average current statistics ('AVERAG MN/MX') and current THD statistics ('THD MN/MX').

Logger Operation (Display - Data Statistics - Current Statistics)*Instantaneous Current Statistics*

This is automatically displayed when current statistics are first selected. The instantaneous minimum and maximum values (updated every ½ cycle) are displayed along with a time stamp. Channel 1 current is displayed first, if more than one channel is being measured then the other channels can be viewed by pressing 'F6' ('NEXT CHAN').

Average Current Statistics

Pressing 'F2' selects the average current statistics. The average minimum and maximum values (updated every storage interval) are displayed along with a time stamp. Channel 1 current is displayed first, if more than one channel is being measured then the other channels can be viewed by pressing 'F6' ('NEXT CHAN').

Current THD Statistics

Pressing 'F3' selects the current THD statistics. These are instantaneous values. The current THD minimum and maximum values (updated every ½ cycle) are displayed along with a time stamp. Channel 1 current THD is displayed first, if more than one channel is being measured then the other channels can be viewed by pressing 'F6' ('NEXT CHAN').

Power statistics

Pressing 'F3' from the Data Statistics submenu brings up another submenu that enables selection of real power statistics ('WATTS MN/MX'), apparent power statistics ('VA MN/MX'), reactive power statistics ('VARS MN/MX') and power factor statistics ('PF MN/MX').

Real Power Statistics

This is automatically displayed when power statistics are first selected. The average real power minimum and maximum values (updated every storage interval) are displayed along with a time stamp. Channel 1 real power is displayed first, if more than one channel is being measured then the other channels can be viewed by pressing 'F6' ('NEXT CHAN').

Logger Operation (Display - Data Statistics - Power Statistics)*Apparent Power Statistics*

Pressing 'F2' selects the apparent power statistics. The average apparent power minimum and maximum values (updated every storage interval) are displayed along with a time stamp. Channel 1 apparent power is displayed first, if more than one channel is being measured then the other channels can be viewed by pressing 'F6' ('NEXT CHAN').

Power Factor Statistics

Pressing 'F4' selects the power factor statistics. The average power factor minimum and maximum values (updated every storage interval) are displayed along with a time stamp. Channel 1 power factor is displayed first, if more than one channel is being measured then the other channels can be viewed by pressing 'F6' ('NEXT CHAN').

Neutral Voltage Current Statistics

Pressing 'F4' the Data Statistics submenu brings up another submenu that enables selection of neutral voltage ('NEUT VOLTS') and neutral current ('NEUT AMPS').

Neutral Voltage

This is automatically selected when neutral statistics are first selected. The neutral voltage first and third harmonic maximums (updated every ½ cycle) are displayed along with a time stamp.

Neutral Current

Pressing 'F2' selects the neutral current statistics. The neutral current first and third harmonic maximums (updated every ½ cycle) are displayed along with a time stamp.

Flicker Statistics (Optional)

Pressing 'F5' from the Data Statistics submenu brings up another submenu that enables selection of short term flicker ('PST') and long term flicker ('PLT').

Logger Operation (Display - Data Statistics - Flicker statistics)***Short Term Flicker***

This is automatically selected when flicker statistics are first selected. The PST minimum and maximum values (updated every PST interval) are displayed along with a time stamp.

Long Term Flicker

Pressing 'F2' selects the long term flicker display. The PLT minimum and maximum values (updated every PLT interval) are displayed along with a time stamp.

Waveform Display

Pressing 'F3' from the Display menu displays one cycle of voltage and current waveform. On the left of the waveform, voltage and power information is displayed and on the right of the waveform, current and power information is displayed. This display is updated once a second. The 'F1' key is used to freeze ('HOLD') and release ('GO') the display. The 'F6' key is used to select different channels for display.

Harmonic Bar Chart Display

Pressing 'F4' from the Display menu displays the first 21 harmonics (including even harmonics) of phase voltage and current. This display is updated once a second. The 'F1' key is used to freeze ('HOLD') and release ('GO') the display. The 'F6' key is used to select different channels for display.

Memory Statistics

Pressing 'F5' from the Display menu displays memory usage. The number of records available and used for both RMS/power data and event data are displayed.

Logger Statistics

Pressing 'F6' from the Display menu displays the logger serial number, the firmware revision level and the internal battery capacity.

Logger Operation**Record**

Pressing the 'RECORD' button calls up the recording screen. From this screen you can start recording, stop recording and turn the logger off (SLEEP).

Start Recording

Pressing 'F2' will initiate recording start. If there is data in the logger from a previous survey the operator must first reset the memory. The logger then does a diagnostic check on the voltage and current connections - see section 'Hookup Diagnostic Warnings'. Once the diagnostics have been completed and passed (or the operator has ignored the diagnostic warnings) logging will start.

Stop Recording

Pressing 'F4' will initiate recording stop. If the logger is recording data the operator will be required to confirm that recording is to stop. If the logger is not recording data pressing 'F4' will cause no action.

Sleep or Low Power Mode

Pressing 'F6' will put the logger into sleep or low power mode. If the logger is recording data the operator will be instructed to stop recording before putting the logger to sleep. In sleep mode only the internal real time clock and the keypad interface are running. Pressing and holding any key, except 'F6', for about one second will return the logger to active mode.

Downloading

Recorded data is transferred from the **PowerPro** to a computer using the memory card. When logging has been stopped the memory card can be removed from the logger. The memory card can be inserted directly into a card reader or, with a PCMCIA adapter, it can be inserted into a PCMCIA slot in a laptop computer. Run **PowerView** 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 a directory and file name (you can keep the same file name) must be selected for the processed file.

RS-232 Cable Configuration

The **PowerPro** uses a standard DB9 male to DB9 female 'straight-through' cable. Although there are nine conductors only three of them are used.

DB9 Male (logger)	DB9 Female (computer)
Pin 2	Pin 2
Pin 3	Pin 3
Pin 5	Pin 5

Downloading using the RS-232 Serial Port

Data can be downloaded through the serial port while the logger is recording data, however it is recommended that the serial cable be connected when the logger is not recording.

Sometimes there can be a static potential difference between the logger and the computer ground that causes a static discharge when the serial cable is connected. This is not hazardous and will not damage the logger. However it may affect the integrity of the data if the logger is recording.

Notes