

- 3-PHASE POWER QUALITY ANALYZER

# 8435 PowerPad®













**IMPORTANT WARRANTY NOTE:**

By registering online within 30 days from the date of purchase, your warranty will be extended to 3 years

Thank you for purchasing a **PowerPad® III Model 8435**

For best results from your instrument and for your safety, read the enclosed operating instructions carefully and comply with the precautions for use. These products must be only used by qualified and trained users.

	WARNING, risk of DANGER! The operator must refer to these instructions whenever this danger symbol appears.
	CAUTION! Risk of electric shock. The voltage at the parts marked with this symbol may be dangerous.
	Equipment is protected by double insulation.
	USB socket.
	SD Card.
	Ground/Earth.
	Important instructions to read and to fully understand.
	Useful information or hint to read.
	The CE marking guarantees conformity with European directives and with regulations covering EMC.
	The trash can with a line through it means that in the European Union, the product must undergo selective disposal for the recycling of electric and electronic material, in compliance with Directive WEEE 2002/96/EC.

### Definition of Measurement Categories (CAT)

- **CAT IV** Measurement category IV corresponds to measurements taken at the source of low-voltage installations. Example: power feeders, counters and protection devices.
- **CAT III** Measurement category III corresponds to measurements on building installations. Example: distribution panel, circuit-breakers, machines or fixed industrial devices.
- **CAT II** Measurement category II corresponds to measurements taken on circuits directly connected to low-voltage installations. Example: power supply to domestic electrical appliances and portable tools.

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## PRECAUTIONS FOR USE

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This instrument and its accessories comply with safety standards IEC 61010-1, IEC 61010-031, and IEC 61010-2-032 for voltages of 600V in category IV or 1000V in category III.

Failure to observe the safety instructions may result in electric shock, fire, explosion, and destruction of the instrument and of the installations.

- The operator and/or the responsible authority must carefully read and clearly understand the various precautions to be taken in use. Sound knowledge and a keen awareness of electrical hazards are essential when using this instrument.
- If you use this instrument other than as specified, the protection it provides may be compromised, thereby endangering you.
- Do not use the instrument on networks of which the voltage or category exceeds those mentioned.
- Do not use the instrument if it seems to be damaged, incomplete, or poorly closed.
- Before each use, check the condition of the insulation on the leads, housing, and accessories. Any item of which the insulation is deteriorated (even partially) must be set aside for repair or scrapping.
- Use only the leads and accessories supplied. Using leads (or accessories) of a lower voltage or category reduces the voltage or category of the combined instrument + leads (or accessories) to that of the leads (or accessories).
- Use personal protection equipment systematically.
- Keep your hands away from the terminals of the device.
- When handling the leads, test probes, and crocodile clips, keep your fingers behind the physical guard.
- Use only the mains power adaptor and battery pack supplied by the manufacturer. They include specific safety features.
- Some current sensors must not be placed on or removed from bare conductors at hazardous voltages: refer to the sensor manual and comply with the handling instructions.



## READ CAREFULLY BEFORE USING FOR THE FIRST TIME

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Your instrument is equipped with a NiMH battery. This technology offers several advantages:

- Long battery charge life for a limited volume and weight.
- Possibility of quickly recharging your battery.
- Significantly reduced memory effect: you can recharge your battery even if it is not fully discharged.
- Respect for the environment: no pollutant materials such as lead or cadmium, in compliance with the applicable regulations.

After prolonged storage, the battery may be completely discharged. If so, it must be completely recharged.

Your instrument may not function during part of this recharging operation.

Full recharging of a completely discharged battery may take several hours.

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 **NOTE:** In this case, at least 5 charge/discharge cycles will be necessary for your battery to recover 95% of its capacity.

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To make the best possible use of your battery and extend its effective service life:

- Only use the charger supplied with your instrument. Use of another charger may be dangerous.
- Only charge your instrument at temperatures between 0° and 40°C.
- Comply with the conditions of use defined in the operating manual.
- Comply with the storage conditions specified in the operating manual.

NiMH technology allows a limited number of charge/discharge cycles depending significantly on:

- The conditions of use.
- The charging conditions.

Do not dispose of the battery pack with other solid waste. Used batteries must be entrusted to a qualified recycling company or to a company specialized in processing hazardous materials.

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# 1. INTRODUCTION

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## 1.1 RECEIVING YOUR SHIPMENT

 **NOTE:** After receiving your PowerPad® III Model 8435, charge and discharge the instrument one or two cycles to ensure the proper level display of the battery indicator.

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Make sure the contents shipped are consistent with the packing list. Notify your distributor of any missing items. If the equipment appears damaged, file a claim immediately with the carrier and notify your distributor at once. Save the damaged packing container to substantiate your claim. Do not use equipment which is damaged or appears to be damaged.

## 1.2 ORDERING INFORMATION

**PowerPad® III Model 8435** (No Sensors - Waterproof IP67)..... **Cat. #2136.41**  
**PowerPad® III Model 8435** (AmpFlex®- Waterproof IP67 )..... **Cat. #2136.42**

Includes extra large tool bag, accessory pouch, 5 ft USB cable, five 10 ft black voltage leads with alligator clips, 110V US power cord, four water-tight AmpFlex® A196-24-BK (included with Cat. #2136.42 only), NiMH battery, SD-Card (2GB), twelve color-coded input ID markers, quick start guide, and a USB stick containing DataView® software and user manual.

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 Only the SR, AmpFlex® and MiniFlex® sensors are rated 600V CAT IV. The MN, MR and SL probes are 300V CAT IV, 600V CAT III. Only AmpFlex® 196-24-BK sensors are rated IP67.

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### 1.2.1 ACCESSORIES

10 ft USB cable..... Cat. #2136.80  
AC/DC Current Probe Model SL261\* (10A-100mV/A, 100A-10mV/A, BNC) ..... Cat. #1201.51  
\* Adapter - BNC Adapter (mandatory if using an SL261 w/ the 8435)..... Cat. #2140.40  
AC Current Probe Model MR193-BK..... Cat. #2140.28  
AC Current Probe Model MN93-BK..... Cat. #2140.32  
AC Current Probe Model SR193-BK ..... Cat. #2140.33  
AC Current Probe Model MN193-BK ..... Cat. #2140.36  
MiniFlex® Sensor 10" Model MA193-10-BK ..... Cat. #2140.48  
AmpFlex® Sensor 24" Model A196-24-BK..... Cat. #2140.75

### 1.2.2 REPLACEMENT PARTS

Extra Large Classic Tool Bag ..... Cat. #2133.73  
Battery 9.6V NiMH..... Cat. #2140.19  
Set of 12, Color-coded Input ID Markers ..... Cat. #2140.45  
5 ft USB cable..... Cat. #2140.46  
Accessory Pouch (accessories not included)..... Cat. #2140.72  
AmpFlex® Sensor 24" Model A196-24-BK..... Cat. #2140.75  
Lead – One 10 ft (3M) Black Lead (Waterproof cap) {Rated 1000V CAT IV} &  
One Black Alligator Clip {Rated 1000V CAT IV, 15A} ..... Cat. #2140.73  
Power Cord 110V ..... Cat. #5000.63

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## 2. PRODUCT FEATURES


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### 2.1 DESCRIPTION


The easy-to-use, compact and shock-resistant PowerPad® III Model 8435 is a three-phase power quality analyzer equipped with four current inputs and five voltage inputs. It is intended for technicians and engineers to measure and carry out diagnostic work and power quality work on one, two or three phase low voltage networks.


The PowerPad® III Model 8435 has 2GB of SD Card memory for storing trend data, and internal Flash memory for storing transient, alarms, and snapshot data. You can store up to 50 screen snapshots, up to 210 captured transients that contain four cycles for each active input, and 10,000 alarm events from up to 40 different parameters. You can also record trend data for days, weeks, or even months. The Model 8435 is IP67 rated.


Six access buttons quickly display the following functions. Note that these functions can be accessed during a recording.


**Waveforms** () displays volts, amps, THD, and Crest Factor by phase or for all phases. You can display all the voltage inputs on one screen, phase-to-phase or phase-to-neutral. Real-time phasor diagrams can be displayed for volts and amps, also by phase or for all phases including phase unbalance.

**Harmonics** () displays harmonics out to the 50th for volts, amps, and VA. Individual harmonics are displayed as a percentage and value for volts, amps and VA. Harmonic direction and sequencing can also be displayed.


**Transients or Inrush Current** () sets, captures, and displays transients. You select the threshold and the number of transients to capture. The Model 8435 then captures four waveforms for each transient; the triggering waveform as well as one pre-triggered and two post-triggered waveforms. As many as 210 transients, each consisting of 4 waveforms per channel for up to 8 channels, can be captured. Inrush current is measured when the power is first turned on. Depending on the type of load, the Inrush current may be very high for some time when compared with steady state current later on.

**Trend** () records and displays trend data at user selectable sample rates from 1/sec to 1/15 minutes and user programmable recording periods into 2GB of memory.

**Alarm Events** () provides a list of the alarms recorded according to the thresholds programmed during configuration.

**Power/Energy** () records and displays power levels and associated parameters (power factor, displacement, and tangent).

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 Recordings can only be downloaded through the USB port. Extremely long recordings will take a long time to download (> 2H per 100MB).

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### 2.2 KEY FEATURES

- Voltage ratios: 1V to 500kV individual or grouped configuration of channels
- Mixed sensors: 10mA to 60kA depending on sensor. Combine as needed. The measurements are performed simultaneously using several different current sensors
- Transient adjustment level: Adjustment of 1V or 1A increments. Individual or grouped channels
- Measurement of TRMS voltages up to 1000Vrms AC/DC for two, three, four, or five-wire systems
- Measurement of TRMS currents from 1mA to 6500Arms (sensor dependent)
- Measurement of DC current up to 1200ADc (with MR193 probe)
- Automatic probe detection and scaling
- Frequency measurement (40 to 69Hz systems)

- Direct measurement of neutral current for WYE configurations
- Record and display trend data as fast as once per second for one month for up to 25 variables. It is recommended to limit recordings to under 100MB to reduce downtime
- Energy assessments
- Transient detection on all V and I inputs
- Inrush current detection and measurement
- Calculation of Crest Factors for current and voltage
- Calculation of the K Factor for transformers
- Calculation of short-term flicker for voltage
- Calculation of the phase unbalance for voltage and current (3 phase only)
- Measurement of harmonic angles and rates (referenced to the fundamental or RMS value) for voltage, current or power, up to the 50th harmonic
- Display of harmonic sequencing and direction
- Calculation of overall harmonic distortion factors
- Real time display of phasor diagrams including values and phase angles
- Monitoring of the average value of any parameter, calculated over a period running from 1 sec to 2 hrs
- Measurement of active, reactive and apparent power per phase and their respective sum total
- Calculation of power factor, displacement power factor and tangent factor
- Total power from a point in time, chosen by the operator
- Recording, time stamping and characterization of disturbance (swells, sags and interruptions, exceedence of power and harmonic thresholds)
- Detection of transients and recording of associated waveforms
- Color-coded input ID markers identify voltage and current inputs
- 2GB internal SD-Card
- DataView® analysis software. This includes the PowerPad® III Control Panel for configuring the instrument and viewing measurement data in real time, as well as DataView® report generation capabilities.

## 2.3 CONTROL FUNCTIONS

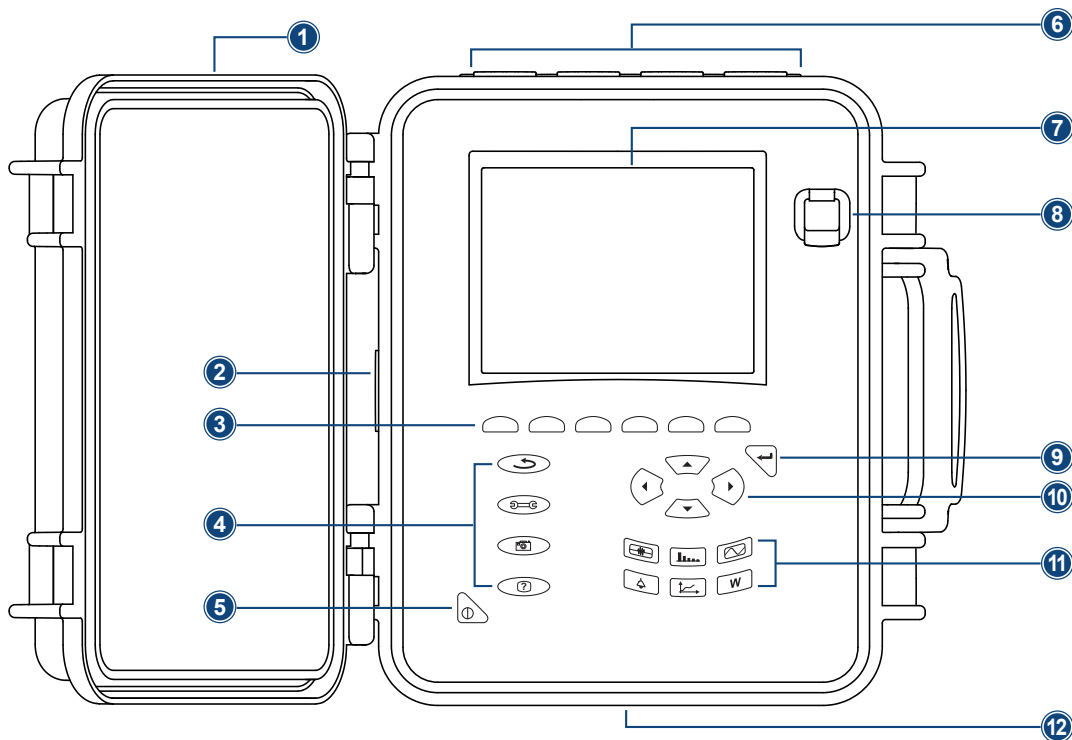


Figure 2-1

- |  |  |
|--|--|
| 1. Protective cover                            | 7. LCD Display                                 |
| 2. Battery charging connector                  | 8. USB port                                    |
| 3. Six variable function buttons (yellow)      | 9. Confirm/Enter button (gray)                 |
| 4. Four function buttons (gray)                | 10. Navigation buttons (gray)                  |
| 5. ON/OFF button (gray)                        | 11. Six mode buttons (see § 2.6) (purple)      |
| 6. Four current inputs and five voltage inputs | 12. Battery compartment and SD-Card slot cover |

## 2.4 CONNECTION TERMINALS

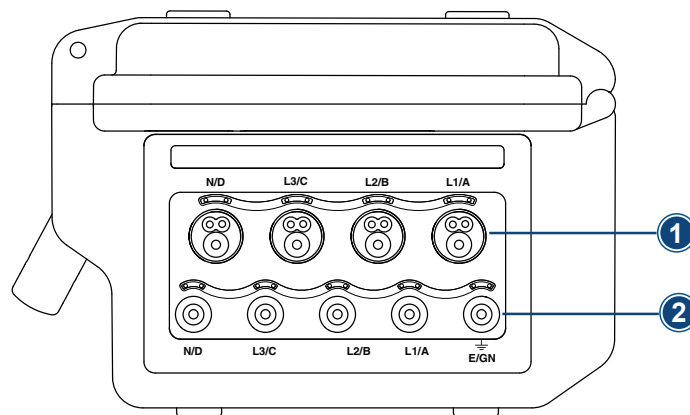


Figure 2-2

1. Four current inputs on the top of the instrument to enable the use of current sensors (MN, SR, AmpFlex®, MiniFlex®, and MR probes).
2. Five (5) voltage inputs.

The instrument ships with protective plugs that are designed to be inserted into the connection terminals. The plugs must be removed to connect the leads, then stored in the pouch inside the front cover. Insert the plugs into unused terminals to keep the instrument water/air-tight and the terminals clean.

## 2.5 DISPLAY

The Model 8435 includes a 320 x 240 pixel LCD display.

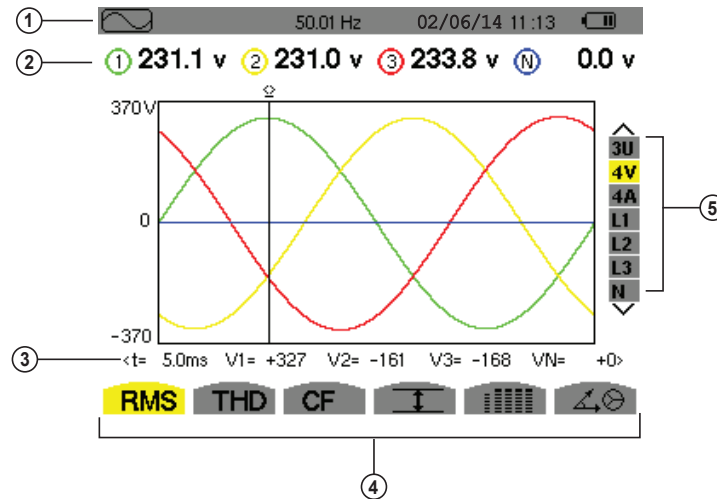


Figure 2-3

- Top bar on the display, including:
  - Symbol of the tested mode (☹️, 📊, **W**, etc.)
  - Frequency of measured signal
  - Memory capacity status bar (only available in certain modes)
  - Current date and time
  - Battery charge status (see § 7.1)
- Measured RMS values associated with waveforms.
- Values of signals at an instant “t” at the intersection of cursor and the waveforms. The cursor can be moved along the time scale by pressing the ◀ and ▶ buttons.
- Measurement selection (refer to chart below)

 Calculation of DPF, Tan, KF,  $\Phi$ , UNB, Min, Max, VAR, Harmonics, PST, and DF parameters and the frequency measurement can only be performed if voltage or current with a frequency of 40 to 70Hz is applied to the Ch1 voltage input or the A1 current input.




- Selection of waveforms to be displayed (use the ▲ and ▼ buttons to select):

U: Signifies phase-to-phase voltage

V: Signifies phase-to-neutral voltage

A: Displays current for each phase







L1, L2, L3: Refer to the phases (A,B,C)

Icon	Description
<b>RMS</b>	True RMS Measurement
<b>THD</b>	Total Harmonic Distortion
<b>CF</b>	Crest Factor
	Display of current values and their min/max extremes
	Display all voltage and current measurements simultaneously (RMS, DC, THD, CF, PST, KF, DF) in tabular format
	Phasor diagram
<b>V</b>	Phase-to-neutral voltage mode
<b>A</b>	Phase-to-neutral current mode
<b>VA</b>	Power mode

Icon	Description
U	Voltage mode (phase-to-phase)
	Zoom in
	Zoom out
< >	Left/right key prompt
^ v	Up/down key prompt
PF...	Display of PF, DPF and Tan.
W...	Active power
	Recording mode
	Recording display and selection mode
OK	Validation prompt
	Stop function in progress prompt
	Display of energy consumed
	Display of energy generated
	Screen 1 of the help function
	Screen 2 of the help function
	Screen 3 of the help function
	Screen 4 of the help function
	Screen 1 of the selected recording parameter
	Screen 2 of the selected recording parameter
	Screen 3 of the selected recording parameter
	Screen 4 of the selected recording parameter
>t=0<	Moves the cursor to transient triggering time
>5=-T<	Moves the cursor to one signal period before the transient triggering date
	Activates/deactivates the selection of the transients list display filters
	Following page screen
	Previous page screen
	Trash to delete or remove elements

## 2.6 BUTTON FUNCTIONS

Icon	Description
	<b>Transients or Inrush Current:</b> <ul style="list-style-type: none"> <li>Sets and views transient and Inrush current waveforms associated with rapid changes in input</li> </ul>
	<b>Harmonics Mode:</b> <ul style="list-style-type: none"> <li>Displays the harmonics in percent and value ratios for voltage, current, and power for each harmonic through the 50th</li> <li>Determines harmonic current produced by non-linear loads</li> <li>Analyzes the problems caused by harmonics according to their order (heating of neutrals, conductors, motors, etc.)</li> </ul>
	<b>Waveforms Mode:</b> <ul style="list-style-type: none"> <li>Displays voltage and current waveforms or vector representation</li> <li>Identifies signal distortion signatures</li> <li>Displays of amplitude and phase unbalance for voltage and current</li> <li>Checks connections for correct phase order</li> </ul>
	<b>Alarm Events:</b> <ul style="list-style-type: none"> <li>Provides a list of the alarms recorded according to the thresholds programmed during configuration</li> <li>Logs interruption with half-cycle resolution</li> <li>Determines energy consumption exceedances</li> <li>Stores value, duration, date, time and set point for up to 4096 events</li> </ul>

	<p><b>Trend Mode:</b></p> <ul style="list-style-type: none"> <li>• Lists all recording trends and views them on the display (Urms, Vrms, Arms, etc.)</li> </ul>
	<p><b>Power / Energy:</b></p> <ul style="list-style-type: none"> <li>• Displays power levels and the associated parameters (power factor, displacement, and tangent)</li> <li>• Energy monitoring</li> <li>• Four quadrant measurement to discern produced/consumed active energy and inductive/capacitive reactive energy</li> </ul>
	<p>Return to the choice of measurement view</p>
	<p>Configure the PowerPad® III Model 8435 (see § 3.2)</p>
	<p>Take a snapshot of the current screen or access snapshots already stored in the memory. Record associated waveform and power measurement data.</p>
	<p>Get help on the current display functions, in the language chosen by the user.</p>

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## 3. OPERATION

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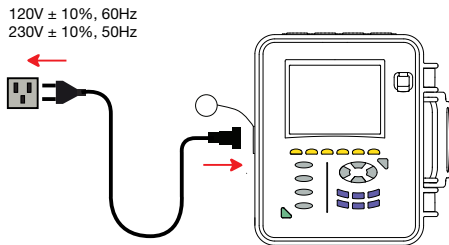
### 3.1 GETTING STARTED

Fully charge the battery before the first use.


---

**i** **NOTE:** A full recharge of a completely discharged battery takes approximately 5 hours.


---



To recharge the battery:

1. Unscrew the cover of the power charging connector.
2. Connect the supplied power cord to the instrument and AC power.
3. The  button lights and will go out when the power cord is disconnected.

#### 3.1.1 CONNECTING

1. Start the instrument by pressing the  button.
2. Configure the unit to obtain the required results and type of network (see § 3.2).
3. Connect the current leads and sensors to the Model 8435.
4. Connect the ground and/or neutral lead to the network ground and/or neutral (when distributed), as well as the corresponding current sensor.
5. Connect the L1 phase lead to the network L1 phase, as well as the corresponding current sensor.

Repeat the procedure for phases L2, L3 and N.

---

**i** **NOTE:** Complying with this procedure limits connection errors to a minimum and conserves time.

---

#### 3.1.2 DISCONNECTING

- Proceed in the reverse order to connecting, always finishing by disconnecting the ground and/or neutral (when distributed).
- Disconnect the unit leads and power it down.
- Recharge the battery and recover the data registered where necessary.
- USB sockets can be used to connect the unit to any type of network.

**The following precautions for use must be complied with:**

- Do not connect any voltages exceeding 1000Vrms in relation to the ground/earth.
- When connecting and disconnecting the batteries, check that measuring leads are disconnected.

The instrument operates on batteries. The batteries are charging when the instrument is connected to a 120/240; 60/50Hz line.

---


**i** The current probes connected are identified every second. The scaling will automatically reset when a new probe is connected. When installing probes, face the arrow on the probe in the direction of the load.  
For the SL261, MN193, and 5A Box, the ratio needs to be programmed from the instrument menu or software.


---



## 3.2 INSTRUMENT CONFIGURATION (SET-UP MODE)

**NOTE:** All configurations can also be modified through DataView® software.

 The instrument must be configured the first time it is used. The configuration is saved in memory when the instrument is turned OFF.

1. Press the  button to configure the unit. The following screen appears:

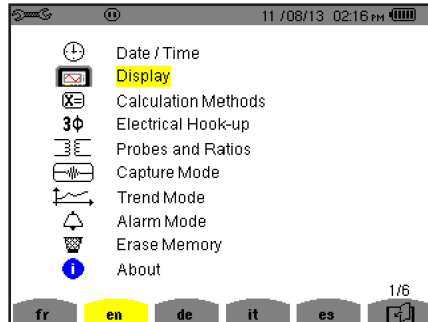





Figure 3-1

2. Set the display language by pressing the yellow button corresponding to the screen language icons.
3. The parameter that is ready to be configured will be highlighted in yellow. To move to a different parameter, use the ▲ and ▼ buttons.
4. Press the Enter  button to select a parameter.
5. Use the ▲, ▼, ◀, and ▶ buttons to change a value or setting; and the  button to save the setting.
6. When finished, return to the Configuration menu by pressing the  button.

PARAMETER	FUNCTION
<b>Date / Time</b>	Sets the date and time format (see § 3.2.1)
<b>Display</b>	Adjusts the contrast and brightness of the display Defines the color of the voltage and current curves (see § 3.2.2)
<b>Calculation Methods</b>	Determines if harmonics are used or not used in calculations of reactive quantities (power and energy) - (see § 3.2.3) <ul style="list-style-type: none"> <li>• With harmonics: Harmonics are taken into account when calculating reactive parameters</li> <li>• Without harmonics: Only the fundamental part is used for the calculation of reactive parameters</li> </ul>
<b>Electrical Hook-Up</b>	Determines the type of connection to the network (see § 3.2.4) <ul style="list-style-type: none"> <li>• 1-Phase 2-Wire</li> <li>• 1-Phase 3-Wire</li> <li>• 2-Phase 2-Wire</li> <li>• 2-Phase 3-Wire</li> <li>• 2-Phase 4-Wire</li> <li>• 3-Phase 3-Wire</li> <li>• 3-Phase 4-Wire</li> <li>• 3-Phase 5-Wire</li> </ul>

<b>Probes and Ratios</b>	Defines the type of current probe to connect (see § 3.2.5) <ul style="list-style-type: none"> <li>• MN93: 200A</li> <li>• MN193: 100A or 5A (with variable ratio)</li> <li>• SR193: 1000A</li> <li>• SL261: 10A and 100A range</li> <li>• AmpFlex® Sensors: 3000A (measures up to 6500Arms)</li> <li>• MiniFlex® Sensors: 1000A</li> <li>• MR193: 1000AAC/1200ADC</li> <li>• 5A three-phase adapter (3-channel only)</li> </ul>
<b>Capture Mode</b>	Configures the voltage and current thresholds (see § 3.2.66)
<b>Trend Mode</b>	Selects the parameters to record (see § 3.2.77) (Up to four configurations)
<b>Alarm Mode</b>	Defines the parameters of an alarm (see § 3.2.88)
<b>Erase Memory</b>	Deletes configurations, alarm settings, snapshots, and recordings (see § 3.2.9)
<b>About</b>	Displays the serial number, software and hardware version

### 3.2.1 DATE/TIME

The  parameter defines the system date and time. The display is as follows:

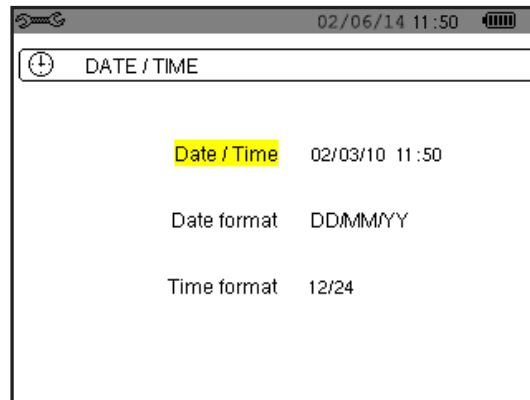







Figure 3-2

The Date/Time field is highlighted in yellow.

- To change the date/time, press the  button.
- To change a value or move from one field to another, press the  or  button.
- Press the  button to confirm configuration.

 **NOTE: 12/24:** Display of time in 24-hour format. **AM/PM:** Display of time in 12-hour format. The time is followed by AM or PM.

To return to the Configuration menu, press the  button.

## 3.2.2 DISPLAY

### 3.2.2.1 CONTRAST/BRIGHTNESS

The ☾ menu is used to define the contrast and brightness of the display unit.

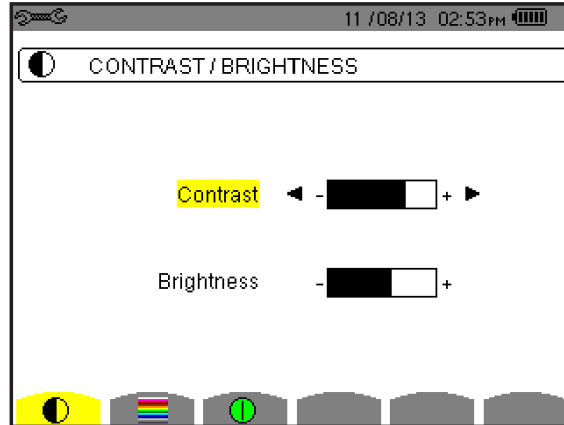


Figure 3-3

The selected field is highlighted in yellow.

- To modify the contrast, press ◀ or ▶
- To move to the next field, press ▲ or ▼
- To change the brightness, press ◀ or ▶
- To return to the Configuration menu, press ↻

### 3.2.2.2 COLORS

The 🌈 menu is used to define the colors of the voltage and current traces on the graph. The colors available are: green, dark green, yellow, orange, pink, red, brown, blue, turquoise blue, dark blue, light grey, grey, dark grey, and black.

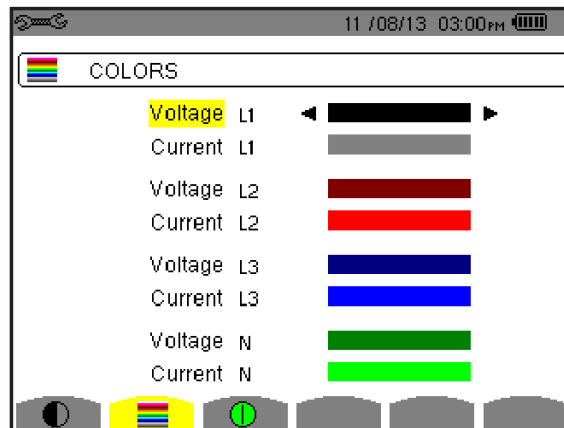


Figure 3-4

The selected field is highlighted in yellow.

- To select the color of the voltage and current curves, press ◀ or ▶
- To move to the next field, press ▲ or ▼
- To return to the Configuration menu, press ↻

### 3.2.2.3 DISPLAY SHUTDOWN (AUTO POWER OFF)

The Display Shutdown button  displays a menu that defines the screen shutdown process.

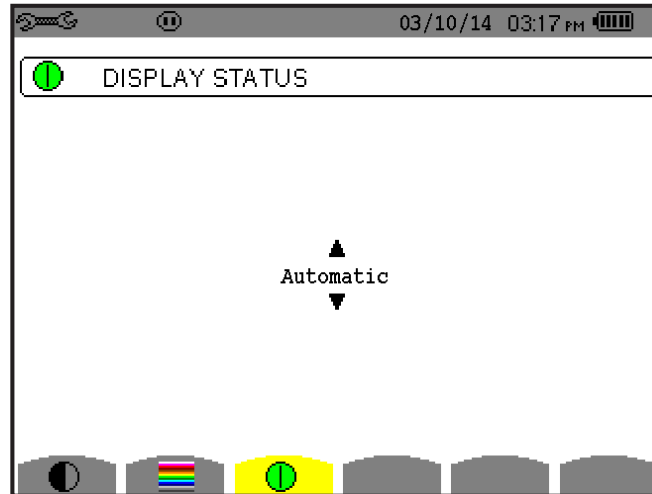





Figure 4-5

Use the up and down arrow buttons to choose Automatic or Never.

- In Automatic mode the display screen switches OFF automatically after five minutes of inactivity when the instrument is powered by the battery and a recording is in progress, and after ten minutes if no recording is in progress.
- The ON/OFF button  blinks to indicate that the instrument is still in operation. Press any button to relight the screen. To return to the Configuration menu, press .

### 3.2.3 CALCULATION METHODS

 determines a number of variables used in calculating the reactive parameters (powers and energy).

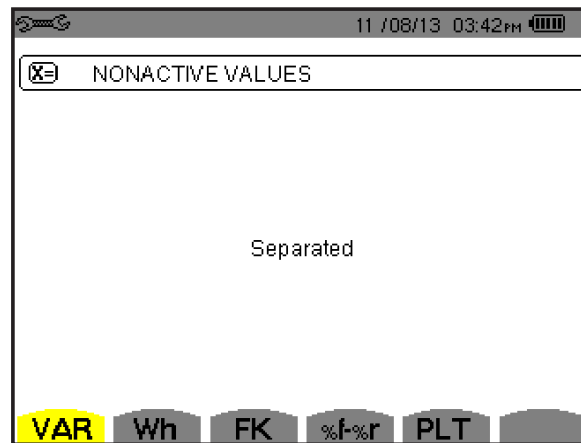



Figure 3-6

To select Separated or Combined, press  or .

- **Separated:** Harmonics are not taken into account when calculating reactive quantities.
- **Combined:** Harmonics are included in the reactive values calculations.

Press the  button to save the setting and return to the Configuration menu.

### 3.2.3.1 ENERGY UNIT

This **Wh** screen determines the units to be used to display calculation results.

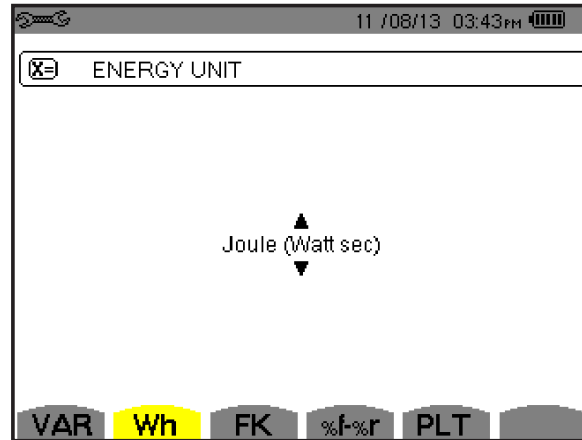



Figure 3-7

To select the units, press ▲ or ▼. Choices are:

- Wh
- Joule (Watt/second)
- Nuclear toe (Tonne Oil Equipment)
- Non-nuclear toe
- BTU

Press  to save the setting and return to the Configuration menu.

### 3.2.3.2 K FACTOR

This screen defines the transformer factor K. This value is used for weighting the harmonic load currents in accordance with their effects on transformer heating. A higher factor K indicates larger harmonic heating effects.

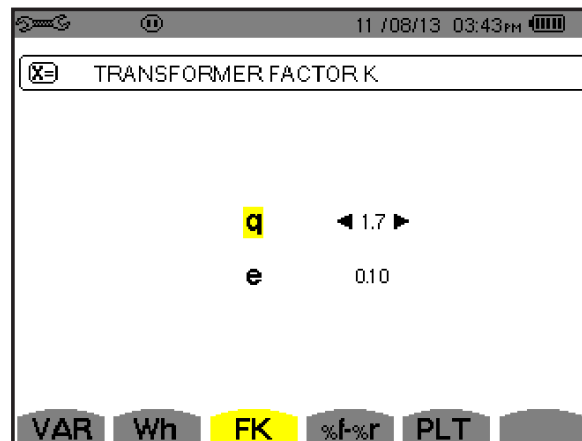



Figure 3-8

This consists of two values, q and e:

- q (allowable values are 1.5, 1.6, and 1.7)
- e (allowable values are 0.05, 0.06, 0.07, 0.08, 0.09, and 0.10)

Press ▲ or ▼ to select q or e; press ◀ or ▶ to select values for these parameters. Press  to save the settings and return to the Configuration menu.

### 3.2.3.3 PHASE HARMONIC RATIOS

You can choose to calculate, display, and report harmonics as a ratio of the fundamental value, or in absolute value.

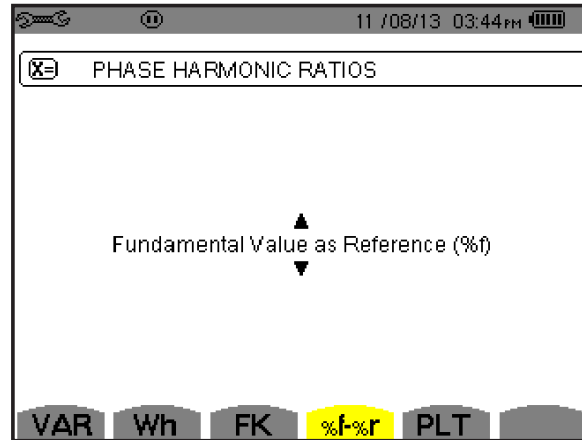


Figure 3-9

Press ▲ or ▼ to toggle between **Fundamental Value as Reference (%f)** and **Total Value as Reference (%r)**. Press  to save the setting and return to the Configuration menu.

### 3.2.3.4 LONG-TERM FLICKER

This screen defines whether a fixed or sliding window is used to calculate long-term flicker (rapid fluctuations in the power supply).

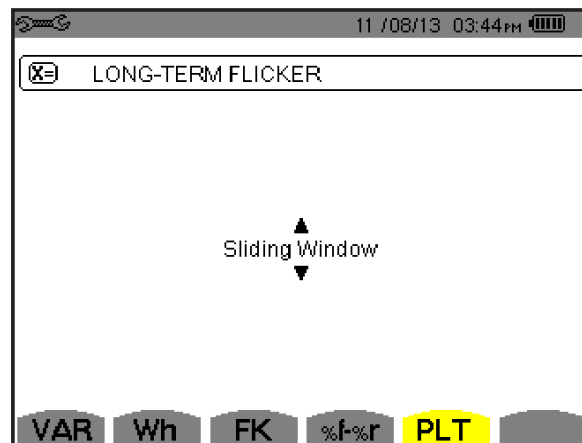


Figure 3-10

Press ▲ or ▼ to toggle between **Sliding Window** and **Fixed Window**. Press  to save the setting and return to the Configuration menu.

### 3.2.4 ELECTRICAL HOOK-UP

The  $3\phi$  menu is used to define how the instrument is connected, according to the type of network.

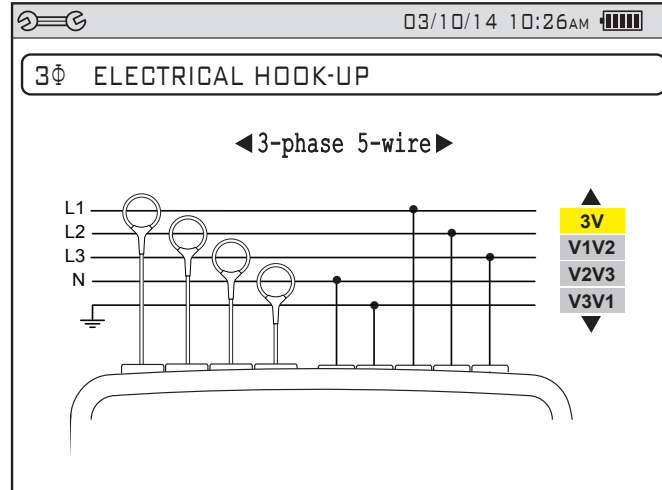



Figure 4-11

Several electrical diagrams can be selected. Use the arrow buttons to choose a connection. One or more types of network correspond to each distribution system.

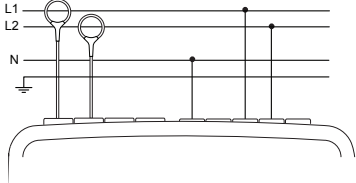
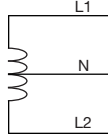
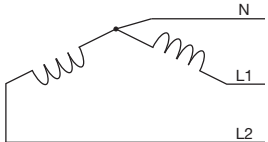
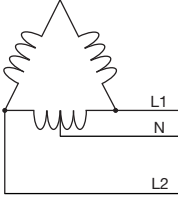
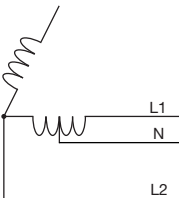
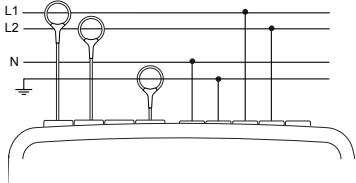
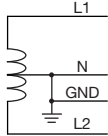
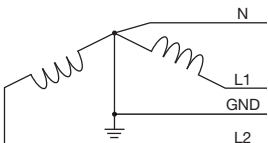
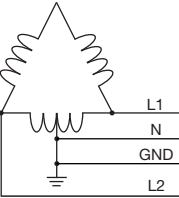
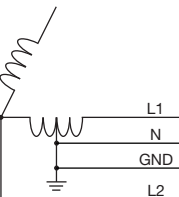
These connection choices allow you to connect the instrument to all existing networks.

Press  to confirm the selection and return to the Configuration menu.

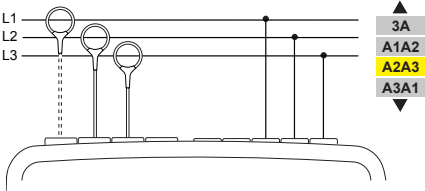
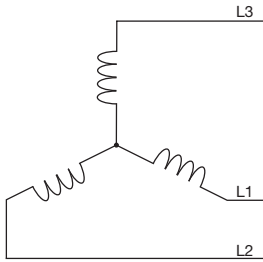
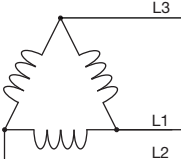
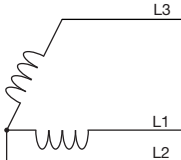
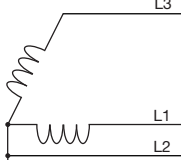
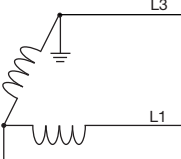
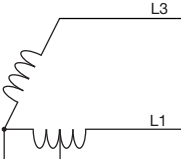
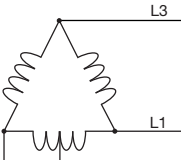


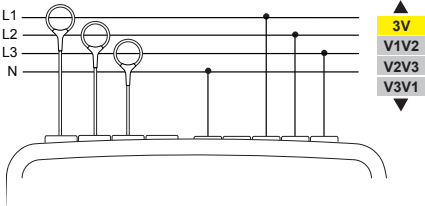
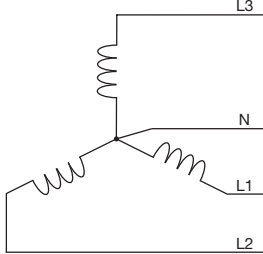
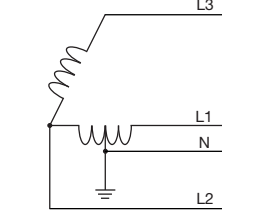
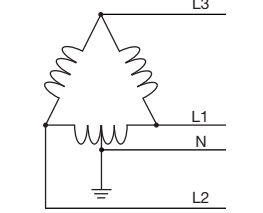
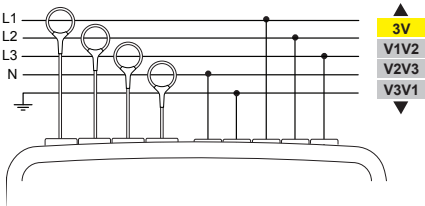
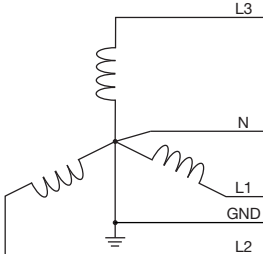
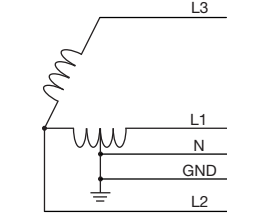
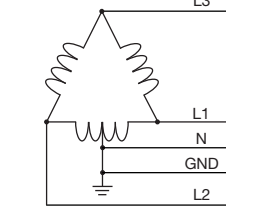
**NOTE:** This setting cannot be modified when the instrument is recording, and/or searching for alarms.

Distribution System	Source	
<p>Single-phase 2-wire (L1 and N)</p>	Single-phase 2-wire non-grounded neutral	
<p>Single-phase 3-wire (L1, N and ground)</p>	Single-phase 3-wire grounded neutral	
<p>Split-phase 2-wire (L1 and L2)</p>	Split-phase 2-wire	
	3-phase open star 2-wire	

Distribution System	Source	
<p data-bbox="164 457 516 485">Split-phase 3-wire (L1, L2 and N)</p> 	Split-phase 3-wire non-grounded neutral	
	3-phase open star 3-wire non-grounded neutral	
	3-phase high leg delta 3-wire non-grounded neutral	
	3-phase open high leg delta 3-wire non-grounded neutral	
<p data-bbox="120 1276 560 1304">Split-phase 4-wire (L1, L2, N and ground)</p> 	Split-phase 4-wire grounded neutral	
	3-phase open star 4-wire grounded neutral	
	3-phase high leg delta 4-wire grounded neutral	
	3-phase open high leg delta 4-wire grounded neutral	




Distribution System	Source	
<p>3-phase 3-wire (L1, L2 and L3)</p>  <p>Indicate which 2 current sensors will be connected: A1 and A2, or A2 and A3, or A3 and A1.</p> <p>Two-wattmeter method or two-element method or Aron method.</p> <p>The third sensor is not necessary if the other two are of the same type, same range, and same ratio. Otherwise, the third sensor must be connected to make current measurements.</p>	3-phase star 3-wire	
	3-phase delta 3-wire	
	3-phase open delta 3-wire	
	3-phase open delta 3-wire grounded junction of phases	
	3-phase open delta 3-wire grounded corner of phase	
	3-phase high leg delta 3-wire	
	3-phase open high leg delta 3-wire	

Distribution System	Source	
<p>3-phase 4-wire (L1, L2, L3 and N)</p>  <p>Indicate which voltages will be connected: all 3 (3V) or only 2 (V1 and V2, or V2 and V3, or V3 and V1).</p> <p>If only two of the three voltages are connected, the three phase voltages must be balanced (2½-element method)</p>	<p>3-phase star 4-wire non-grounded neutral</p>	
<p>3-phase open high leg delta 4-wire non-grounded neutral</p>	<p>3-phase open high leg delta 4-wire non-grounded neutral</p>	
<p>3-phase high leg delta 4-wire non-grounded neutral</p>	<p>3-phase high leg delta 4-wire non-grounded neutral</p>	
<p>3-phase 5-wire (L1, L2, L3, N and ground)</p>  <p>Indicate which voltages will be connected: all 3 (3V) or only 2 (V1 and V2, or V2 and V3, or V3 and V1).</p> <p>If only two of the three voltages are connected, the three phase voltages must be balanced (2½-element method)</p>	<p>3-phase star 5-wire grounded neutral</p>	
<p>3-phase open high leg delta 5-wire grounded neutral</p>	<p>3-phase open high leg delta 5-wire grounded neutral</p>	
<p>3-phase high leg delta 5-wire grounded neutral</p>	<p>3-phase high leg delta 5-wire grounded neutral</p>	

## 3.2.5 PROBES AND RATIOS

### 3.2.5.1 CURRENT PROBES

The  screen defines the current probes and ratios. It automatically displays the current probe models detected by the instrument. It can also be used to define the transformation ratio (sensitivity) of certain current sensors (SL261 clamp). To select current probes and current ratios settings, press the **A** button to display the following screen:

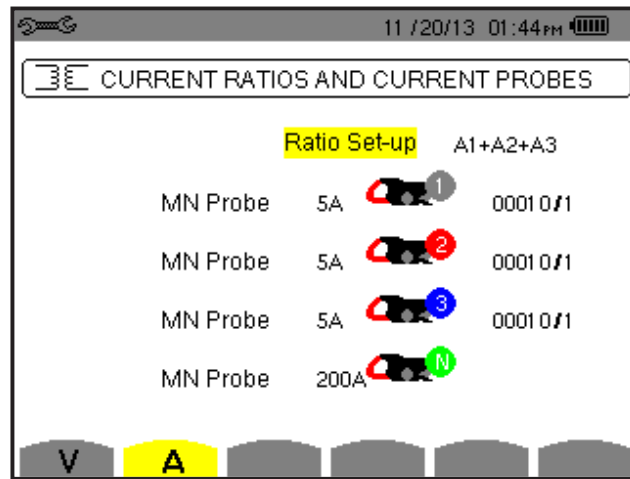











Figure 3-12

The probe choices that are available are:

	MN93 clamp: 200Aac
	MN193 clamp: 100 or 5Aac
	SR193 clamp: 1000Aac
	J93 clamp: 3500Aac/5000Adc
	AmpFlex® A193: 6500Aac
	MiniFlex® MA193: 6500Aac
	MR193 clamp: 1000A/1200Aac/dc
	SL261 clamp: 100A (sensitivity 10mV/Aac/dc)
	SL261 clamp: 10A (sensitivity 100mV/Aac/dc)
	Three phase adapter: 5Aac

If an MN193 clamp, 5A range, or an Adapter is used, the current ratio setting is proposed automatically. The configuration is done as follows:

- To select the channel, press the ▲ or ▼ buttons.
- To configure the primary circuit current (1 to 60,000A) / secondary circuit current (1A, 2A or 5A) transformation ratio, press . To select the fields, use ◀ or ▶.
- To adjust the values, use ▲ or ▼. Proceed in the same way for the primary and secondary circuit currents.
- To validate, press  (the parameters are applied only if confirmed).

The primary current cannot be less than the secondary current.

### 3.2.5.2 VOLTAGE RATIOS

The  $\mathbb{E}$  screen also enables you to define the voltage ratios. To do this, press the **V** button to display the following screen.

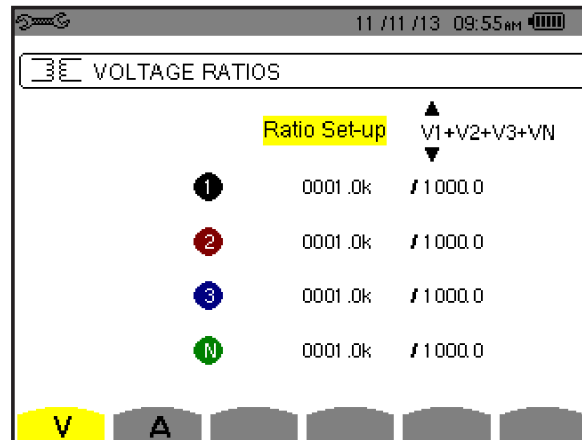



Figure 3-13

The ratios can be programmed to be the same in all channels, or different in one or more of them. The following steps describe a 3-phase 5-wire hook-up; the available channels are determined by connection type and may be different for your connection.

1. Highlight **Ratio Set-up** and press  $\mathbb{E}$ . Then use the  $\blacktriangle$  or  $\blacktriangledown$  buttons to display the available options:
  - V1+V2+V3+VN**: each channel and the neutral has a different ratio. You are prompted to enter a separate ratio for each channel (1, 2, and 3) and the neutral (N) as shown in Figure 3-13.
  - 3V + VN**: all channels have the same ratio and the neutral has a different ratio. You are prompted to enter a ratio for the channels and another ratio for the neutral.
  - 4V**: all channels have the same ratio. You are prompted to enter the ratio that will apply to all.
  - 4V 1/1**: all channels have the same 1/1 ratio.
2. Select the set-up and validate by pressing  $\mathbb{E}$ .
3. To select channels, press the  $\blacktriangle$  and  $\blacktriangledown$  buttons to highlight the channel field and press  $\mathbb{E}$ . Then use the  $\blacktriangleleft$  and  $\blacktriangleright$  buttons to navigate within the field, and the  $\blacktriangle$  and  $\blacktriangledown$  buttons to adjust values. When you are finished with the field, press  $\mathbb{E}$  to validate (the parameter must be validated to be applied).
4. To return to the Configuration menu, press  $\curvearrowright$ .

For the primary voltage (in kV) and the secondary voltage (in V), it is possible to specify the use of the multiplier  $1/\sqrt{3}$ . If the phase-to-neutral voltage ratios of phases 1, 2, and 3 are not identical; then all measurements and curves concerning the phase-to-phase voltages are suppressed.

### 3.2.6 CAPTURE MODE

The  Capture Mode screen defines voltage and current thresholds for transient and Inrush captures.

#### 3.2.6.1 TRANSIENT VOLTAGE THRESHOLDS

By default, the Capture Mode screen opens with the Transient Voltage Thresholds screen displayed.

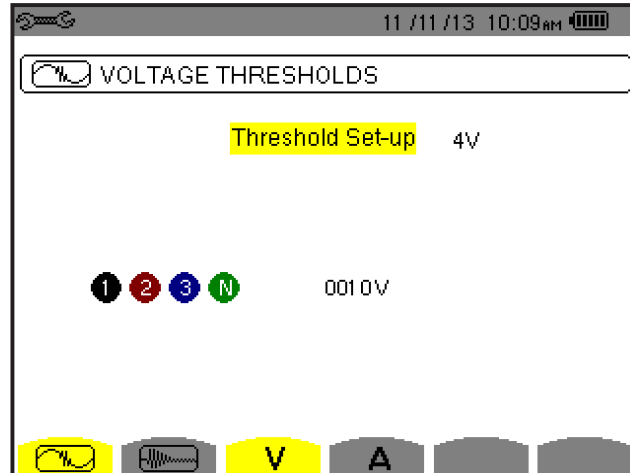







Figure 3-14

1. Select **Threshold Set-up**, highlighted in yellow, by pressing . The ▲ and ▼ buttons appear in the field to enable you to select the threshold configuration.
2. Use the ▲ or ▼ button to go from one type of configuration to another.
3. Press  to validate the choice of configuration.
4. Select the field of the first threshold using the ▲ or ▼ button. The selected field is highlighted in yellow. Press  to display the arrows in the field.
5. Use the ▲ or ▼ button to increment or decrement a value and ◀ or ▶ to go to the next digit in the value.
6. Press  to validate the programming of the threshold.

To return to the Configuration screen, press .

The voltage thresholds can be configured in V or in kV.

### 3.2.6.2 TRANSIENT CURRENT THRESHOLDS

To display the Transient Current Thresholds screen, open the Capture Mode screen and press the **A** button.

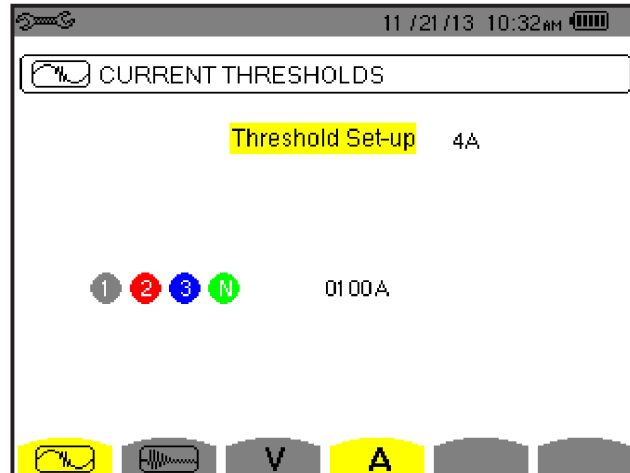


Figure 3-15

1. The process for setting the transient current threshold is similar to setting the transient voltage threshold. Select **Threshold Set-up**, highlighted in yellow, by pressing . The and buttons appear in the field to enable you to select the threshold configuration.
2. Use the or button to go from one type of configuration to another.
3. Press to validate the choice of configuration.
4. Select the field of the first threshold using the or button. The selected field is highlighted in yellow. Press to displays the arrows in the field.
5. Use the or button to increment or decrement a value and or to go to the next digit in the value.
6. Press to validate the programming of the threshold.

To return to the Configuration screen, press .

You can configure the current thresholds in mA, A, or kA.

### 3.2.6.3 INRUSH CURRENT THRESHOLDS

You can also set Inrush current thresholds from the Capture Mode screen. To do this, press the  button.

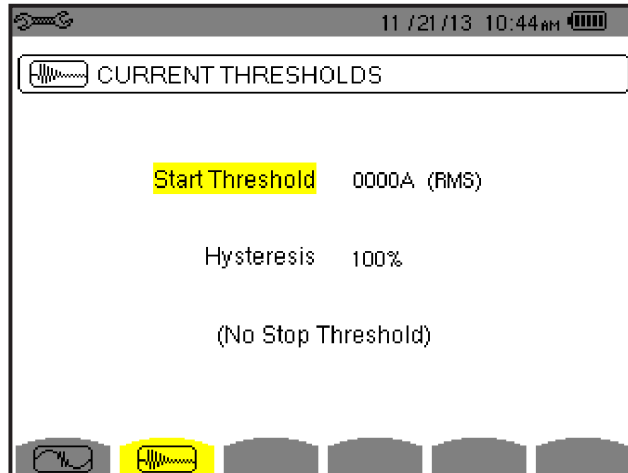






Figure 3-16



This screen defines the Inrush current thresholds for each recognized current probe. The thresholds can be the same for all channels or different for some or all of them. To select the Inrush current threshold, proceed as follows:

1. Select **Start Threshold**, highlighted in yellow, by pressing . The navigation arrows appear in the field to enable you to select the appropriate value.
2. Use the ▲ and ▼ buttons to raise or lower the threshold value, and the ◀ and ▶ buttons to move to a selected digit in the value.
3. Press  to validate the threshold value.
4. Press ▼ to highlight the **Hysteresis** field. The selected field is highlighted in yellow. Press  to display the arrows in the field.
5. Use the ▲ or ▼ button to raise or lower the value.
6. Press  to validate the hysteresis percentage.

To return to the Configuration screen, press .

You can configure the current thresholds in mA, A, or kA.

### 3.2.7 TREND MODE

The Model 8435 has a recording function button  for recording measured and calculated values (Urms, Vrms, Arms, etc.). Four independent configurations can be configured as needed. To do this, select  **Trend Mode** from the Configuration menu to display the following screen:

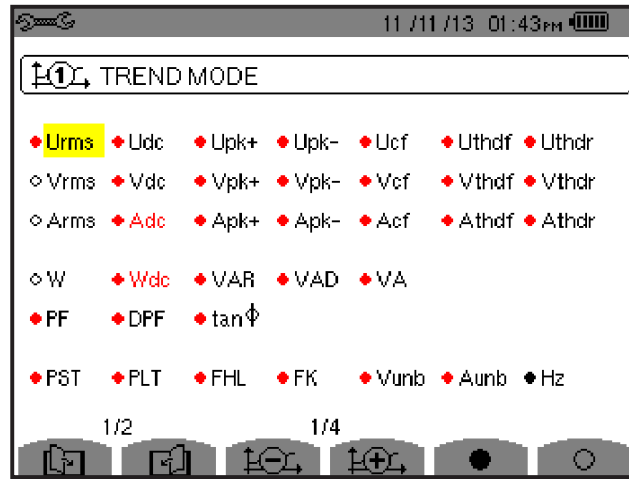


Figure 3-17






















The recordable values are:

Value	Description
Urms	Phase-to-phase voltage (2 $\phi$ , 3 $\phi$ )
Vrms	Phase-to-neutral voltage
Arms	Phase A, B, C, N
W	Active power
PF	Power factor
PST	Short-term flicker
Udc	Direct voltage phase to phase
Vdc	Direct voltage neutral to ground
Adc	Direct currents
Wdc	Direct powers in W
DPF	Fundamental power factors
PLT	Long-term flicker
Upk+	Positive peak phase to phase voltages
Vpk+	Positive peak phase to neutral/ground voltages
Apk+	Positive peak currents
VAR	Reactive power
tan $\phi$	Tangent
FHL	Harmonic loss factors
Upk-	Negative peak phase to phase voltages
Vpk-	Negative peak phase to neutral ground voltages
Apk-	Negative peak currents
VAD	Distortion powers in var
FK	Factor K
Ucf	Crest factor of phase voltage (2 $\phi$ , 3 $\phi$ )
Vcf	Crest factor of phase-to-neutral voltage
Acf	Crest factor of current
VA	Apparent power
Vunb	Line voltage unbalance (2 $\phi$ , 3 $\phi$ )
Uthdf	Harmonic distortion of line voltage (2 $\phi$ , 3 $\phi$ )
Vthdf	Full harmonic distortion of phase-to-neutral voltage




<b>Athdf</b>	Full harmonic distortion of current
<b>Aunb</b>	Current unbalance (2 $\phi$ , 3 $\phi$ )
<b>Uthdr</b>	Phase to phase voltage total harmonic distortions
<b>Vthdr</b>	Phase to neutral voltage total harmonic distortions
<b>Athdr</b>	Current total harmonic distortions
<b>Hz</b>	Network frequency
<b>U-h</b>	Phase-to-phase harmonics
<b>V-h</b>	Phase-to-neutral harmonics
<b>A-h</b>	Phase current harmonics
<b>VA-h</b>	Apparent power harmonics


### To activate these parameters:

1. Choose one of the four configurations by pressing the yellow buttons corresponding to the , (page up) and  (page down) icons. The selected Trend page number (, , , or ) appears in the title bar at the top of the screen.
2. Display the first page of values listed in the preceding table by pressing the  button. The numbers “1/2” appear in the bottom left corner of the display, indicating that you are viewing page 1 of 2.
3. Move through the choices with the arrow buttons. As you move through the parameters, each choice in turn will be highlighted.
4. To activate the selected parameter, press the  button. Selected parameters will appear with  next to their names; those not selected will have an unfilled . Value names that appear in red type are not applicable to the current hook-up selection and configuration.
5. After you have finished selecting the values on the first page, display the second page of values by pressing the  button (“2/2” will appear in the lower left corner of the display). These variables include U-h (phase-to-phase harmonics), V-h (phase-to-neutral harmonics), A-h (phase harmonics), and VA-h (apparent harmonics).
6. Highlight the value you want to modify using the arrow buttons, then press the  button to select it.
7. Use the  button to move to the first modifiable field for this parameter. A value from 00 to 50 may be selected using the  and  buttons. Press the  button to select the value.
8. Press the  button to move to the upper value. Use the same process to select the upper limit.
9. Press the  button again to move to the right to modify the last value needed to complete the definition. Here you will choose whether to include all harmonics or only the odd harmonics. Use the  button to make this selection. The diamond preceding the **Odd Only** choice will appear filled in  for selected and unfilled  for not selected. For example:


Vh 02 → 15  Odd Only

In this user defined condition, all odd voltage harmonics between the 2<sup>nd</sup> and the 15<sup>th</sup> will be recorded.

10. Press the  button when you have finished selecting all the parameters to be recorded to apply the new setup.

 The battery may fully discharge when the instrument is recording for long periods of time while not connected to a power supply. The Model 8435 will continue to record for some time, even if below the minimum battery charge value. However, the display may not come back ON, and the instrument will eventually stop saving data when the battery is too low. All data recorded will be saved. If the instrument is in the Record Mode, and the display does not come ON, do not turn the instrument OFF. Supply power to the Model 8435 with the power cord and the display will come back ON when any button (other than ON/OFF) is pressed.

### 3.2.8 ALARM MODE CONFIGURATION

The  screen defines the alarms used by the Alarm Mode function (see § 4.4). You can configure 40 different alarms.

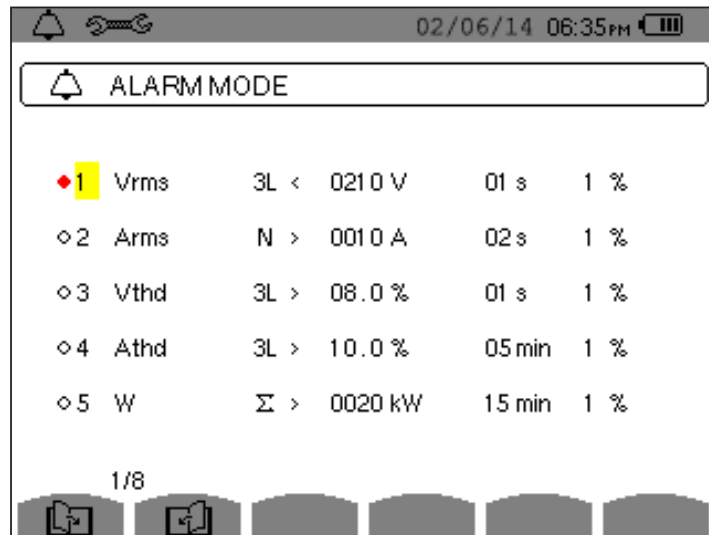












Figure 3-18

1. There are five user-defined parameters on each page. Initially each parameter name appears as a question mark (?). Select the alarm number you want to modify using the ▲ and ▼ buttons, then press the  button to confirm.
2. Use the ▲ and ▼ buttons to select the alarm channel, then press the  button to confirm the choice.
3. To navigate horizontally, use the ◀ and ▶ buttons, then confirm with . Select the values with the ▲ and ▼ buttons, then confirm with .
4. When an alarm channel is changed, the  Record icon is disabled. To enable the recording of the alarm, select the alarm number and press .

For each alarm to define, select:

- The type of alarm (Vah, Ah, Uh, Vh, Tan, PF, DPF, VA, VAR, W, Athd, Uthd, Vthd, KF, Hz, Aunb, Vunb, Vrms, Acf, Ucf, Vcf, PST, Arms, Urms, and Vrms).
  - The harmonics range (between 0 and 50 for Vah, Ah, Uh and Vh).
  - The alarm filter (3L: 3 individually monitored phases or N: monitoring neutral or Sigma/2 or Sigma/3 or Sigma).
  - The meaning of the alarm (> or < for Arms, Urms, Vrms, Hz only, otherwise the direction is unique).
  - The threshold for triggering the alarm (10 possible settings of the alarm in the following cases: W, VAR and VA).
  - The minimum duration for exceeding alarm validation threshold (in minutes, seconds, or for Vrms, Urms and Arms, in hundredths of seconds).
  - The hysteresis value (corresponds to the percentage added or taken away from the alarm threshold chosen that will stop the alarm in the event of overrun - value 1, 2, 5, or 10%).
  - Activating the alarm (read item) or deactivating it.
5. After the configuration has been completed, activate the alarm by positioning the yellow cursor in the first column on the left using the ◀ button, press . Activation is confirmed if there is a filled in  to the left of the alarm.
  6. To display the alarm screen pages, press the yellow buttons corresponding to the  and  icons.

### 3.2.9 ERASING MEMORY

When  Erase Memory is selected, the following screen appears:

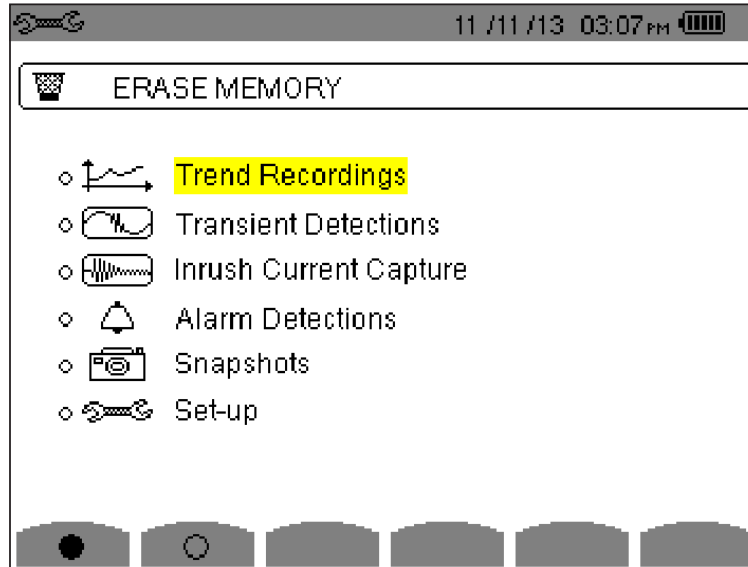



Figure 3-19


There are six types of data stored in the Model 8435 memory:

- Trend Recordings
- Transient Detections
- Inrush Current Capture
- Alarm Detections
- Snapshots
- Set-up

You can erase some or all of this data. To erase all the data at once, press the yellow button corresponding to the ● icon. Validation is confirmed by the ◆ to the left of all parameters. To erase selected data, highlight it using the ▲ and ▼ buttons, then press .

To complete the deletion, press the yellow button corresponding to the  icon, then press the  button to confirm.


---

 **WARNING:** By choosing to delete all data, **all** detected alarms, screen snapshots, captured transient states and all recordings are deleted.

---

To leave this screen without deleting anything, press the  button.

### 3.2.10 ABOUT

The  About screen displays information about the Model 8435 instrument:

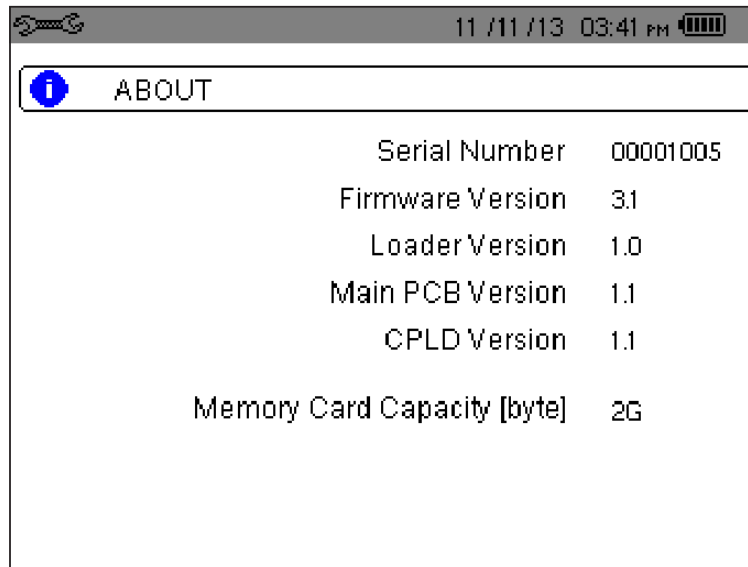


Figure 3-20

## 4. DISPLAY MODES

To select parameters in all modes, use the ◀ ▶ ▲ ▼ buttons to move to the desired parameter and use the ↵ button to confirm selections.

### 4.1 WAVEFORM CAPTURE MODE

Press the Waveform Display mode  button. The Waveform Capture screen appears.

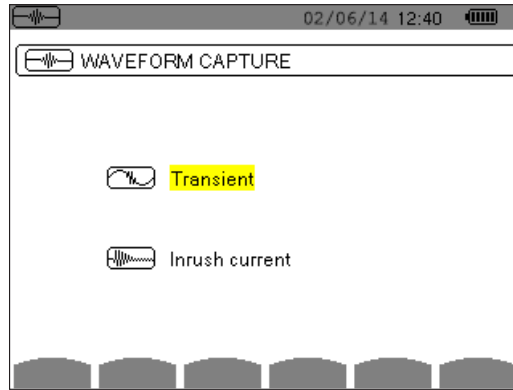


Figure 4-1

Select either the **Transient mode** (§ 4.1.1) or the **Inrush Current mode** (§ 4.1.2) using the ▲ and ▼ buttons, then confirm with ↵. To return to the Waveform Capture screen, press ↶.

#### 4.1.1 TRANSIENT MODE

This mode enables transients to be recorded. It lists recorded transients to be viewed and (if necessary) deleted. All tracks are stored in memory for each transient (regardless of the connection configuration). You can record up to 210 transients.

**NOTE:** When the Transient mode is selected, the display screen will depend on the following conditions:

if ...	then ...
no record has been made	the <i>Detection Schedule</i> screen is displayed
transients have been recorded	the <i>Recording List</i> screen is displayed

##### 4.1.1.1 PROGRAMMING AND STARTING A SEARCH

To program the search for a transient, select Transient by pressing the ↵ button in the Waveform Capture screen (see Figure 4-1). The Detection Schedule screen is displayed.

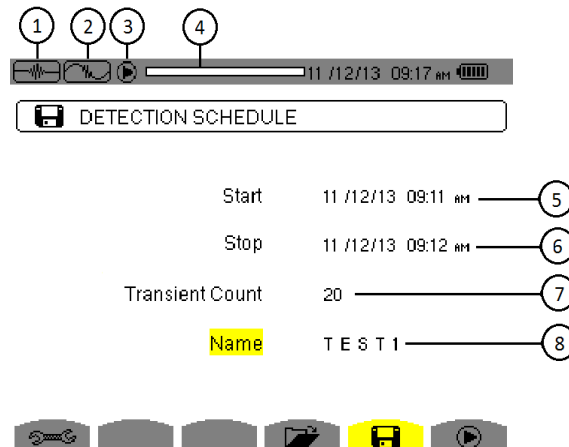








Figure 4-2

Item	Function
1	Reminder of the mode used
2	Display of sub-mode used
3	Flashing  icon: indicates that the search has been started
4	Memory indicator. Black area = used memory; White area = available memory
5	Transients search start time
6	Transients search end time
7	Number of transients
8	Name of transient

To configure and start the programming of a search:



1. Select and set the desired configurations for the start/stop date and time, count, and series name. Use the ▲ and ▼ buttons to navigate from one field to another, the ↵ button to select the field, the ◀ and ▶ buttons to navigate within the field, and the ▲ and ▼ buttons to enter numbers and letters into the field. For example, in the **Name** field the ▲ and ▼ buttons cycle up and down through the alphabet and numbers 0 through 9.
2. To start programming a search between the start and end times which you have defined press the yellow button for the  icon.
  - The  icon disappears and the  icon appears instead.
  - When the start time is reached the message **Detection in progress** is displayed.
  - When the stop time is reached, the  icon is displayed again. It is then possible to program a new search.

---

 Transients are recorded in relation to the voltage and/or the current in accordance with the configured activation thresholds. If an activation occurs in relation to the current, a record of the current waveform and voltage is made.


---

#### 4.1.1.2 STOPPING A SEARCH

The search can be manually stopped before the end time and date by pressing the  icon's yellow button. The  icon will reappear in the same location.

### 4.1.1.3 DISPLAYING A TRANSIENT

To display the recorded transient, proceed as follows:

1. Display the Detection List screen by pressing the  button.

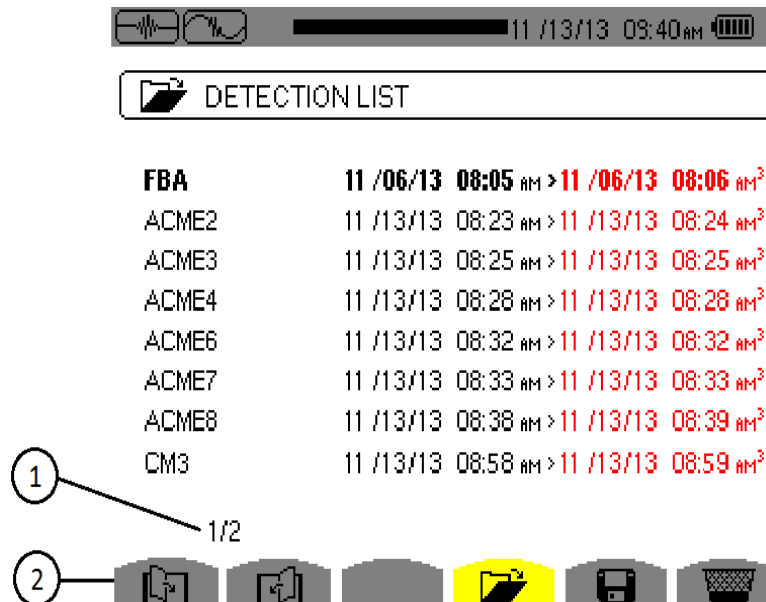



Figure 4-3

Item	Function
1	The displayed value indicates the page number and the number of pages.
2	These icons let you browse through the previous and next screens. Press the yellow buttons corresponding to these icons to display the pages.

2. Each item in the Detection List represents a search in which transients have been detected. To display a list of transients, select the search (the name appears in bold text) and press . The Transient List screen appears.

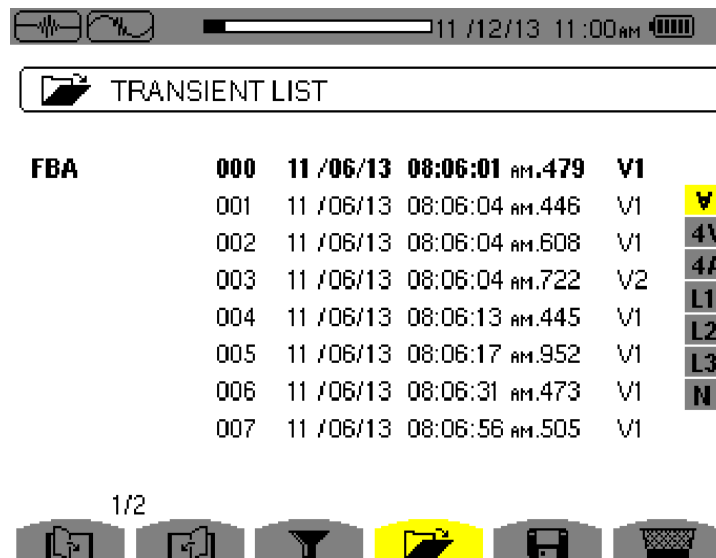


Figure 4-4

3. Use the ▲ and ▼ buttons to scroll through the list. The ▼ button activates the set of display filter buttons listed on the right side of the screen. When these filters are activated, you can select them by pressing the ▲ and ▼ buttons.
4. Press  to view the selected transient.

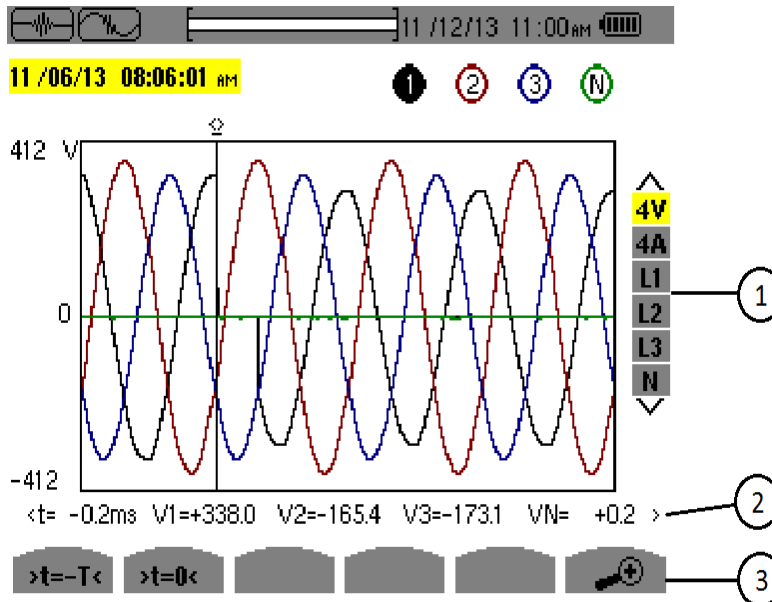


Figure 4-5

Item	Function
1	Selection of display filters - <b>4V</b> : displays the 4 single voltages during the transient (here in a 5-wire tri-phase connection) - <b>4A</b> : displays the 3 phase currents and the neutral current during the transient - <b>L1, L2 or L3</b> : displays the current and the single voltage successively in relation to phases 1, 2 and 3 - <b>N</b> : displays neutral
2	Instantaneous value of the signals according to the position of the cursor on the scale. To move the cursor use the ◀ and ▶ buttons.
3	🔍⊖: Zoom Out - To zoom out press the yellow button for this icon. 🔍⊕: Zoom In - To zoom in press the yellow keypad button for the icon.

5. To return to the Transient List screen, press ↶.

#### 4.1.1.4 DELETING A TRANSIENT

- From the Detection List screen, select the transient to be deleted using the ▲ and ▼ buttons, then press ⏏.
- Press the 🗑️ icon's yellow button to delete the selected transient.
- To leave this screen without deleting, press any of the Mode buttons on the Model 8435.

To return to the Waveform Capture screen, press ↶.

#### 4.1.2 INRUSH CURRENT MODE 📶

The 📶 mode is used to capture (record) Inrush currents and to view and delete the recordings. Only a single Inrush current capture is kept in memory.

**NOTE:** When Inrush Current mode is selected the display screen will depend on the following conditions:

if ...	then ...
no capture has been made	the <i>Capture Schedule</i> screen is displayed
captures have been made	the <i>Capture Parameters</i> screen is displayed



#### 4.1.2.1 PROGRAMMING A CAPTURE

To program the capture of an Inrush current, proceed as follows:

1. At the Waveform Capture screen, select Inrush Current. The Capture Schedule screen is displayed.

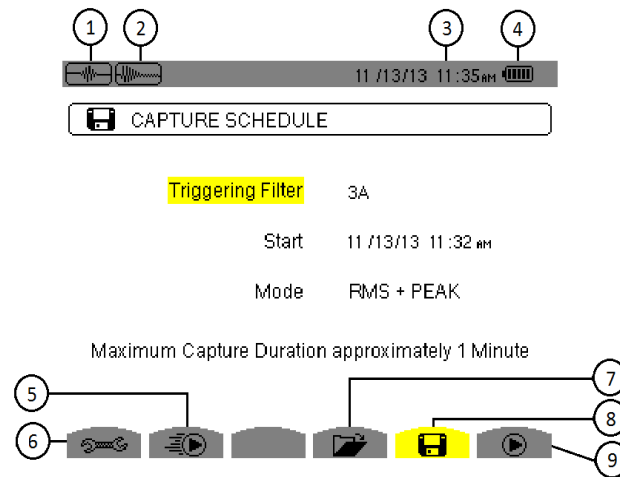





Figure 4-6

Item	Function
1	Reminder of the mode used
2	Display of sub-mode used
3	Current date and time
4	Battery charge level
5	Rapid programming and starting of a capture. When this button is pressed, the recording starts immediately with a current threshold of 0A and a hysteresis of 100%
6	Displays Configuration screen to set triggering thresholds
7	Displays the parameters of the capture
8	Programs the capture
9	 confirms programming of a capture  deletes a capture (this icon is displayed if a capture has been made)

2. To program a capture, enter the triggering filter (3A, A1, A2, or A3), the start date and time, and the recording mode (RMS + PEAK or RMS only).





The RMS + PEAK recording mode is used to produce a trend recording of the half-period RMS values and a trend recording of the samples (envelopes and waveforms). The maximum duration of such a recording depends on the frequency and is on average about one minute.

In the RMS only recording mode, the recording of the samples is eliminated in favour of a longer maximum capture duration. This mode records only the half-period RMS values and its maximum duration is about ten minutes.

3. To modify an item, move the yellow cursor to it using the ▲ and ▼ buttons, then validate with the  button. Change the value using the ◀ ▶ ▲ ▼ buttons, then validate again.


**NOTE:** The triggering filter appears in red if it is not available because of an incompatibility with the configuration (connection, type of sensors, or current ratio).

#### 4.1.2.2 STARTING A CAPTURE

As noted in the preceding table, you can press the  button to start a recording immediately. When you do this, the current threshold is set to 0A and the hysteresis is 100%. To start the capture at a previously specified date and time, press the  button. The icon on the status bar blinks to indicate that the capture has been started. The  button replaces the  button and can be used to stop the capture before it is finished.

- When the activation conditions are met and the start time is reached, the message *Capture pending* is displayed and the memory indicator appears at the top of the screen.



- The indicator is displayed **only** during the capture and disappears when the capture is completed.
- If the capture is completed with a stop event or if the memory is full, the capture stops automatically. The Capture Schedule screen with the  button displayed again.


---

 The Model 8435 can keep only a single Inrush capture in memory. If you want to make another capture, delete the previous one first.

---

To return to the Waveform Capture screen, press .

#### 4.1.2.3 MANUALLY STOPPING A CAPTURE

The capture can be manually stopped by pressing the  icon's yellow button. The  button will reappear in the same location.

#### 4.1.2.4 DISPLAYING THE PARAMETERS OF A CAPTURE

In capture display mode, two sub-menus **RMS** and **PEAK** are available. To display the parameters of a capture, proceed as follows:

1. Select the sub-menu by pressing the  icon's yellow button. The Capture Parameters screen is displayed.

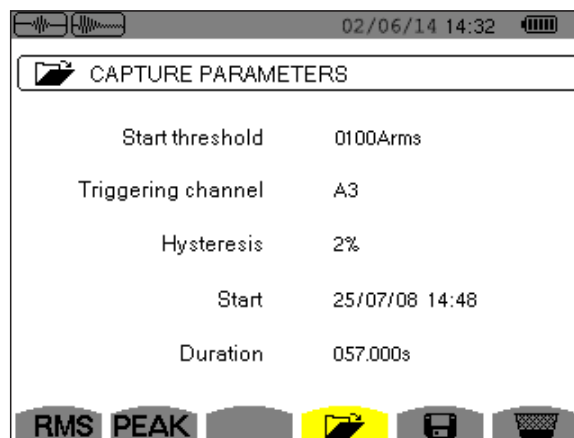


Figure 4-7

2. Choose the type of display, **RMS** or **PEAK**, by pressing the yellow button corresponding to the icon. The Model 8435 displays curves on which you can move the time cursor and zoom in and out.

In the **PEAK** display, the available information is:

- The instantaneous current and voltage at the time indicated by the cursor (in a “waveform” representation).
- The maximum instantaneous current and voltage in the half-cycle indicated by the cursor (in an “envelope” representation).
- The maximum instantaneous absolute value of the current and voltage (over the entire capture).

**In the RMS display, the available information is:**

- The instantaneous frequency at the time indicated by the cursor.
- The minimum, mean, and maximum instantaneous values of the frequency over the entire capture.
- The RMS current and voltage in the half-cycle (or lobe) on which the cursor is positioned.
- The maximum half-cycle RMS current and voltage (over the entire capture).



A voltage must be present on the phase before the motor start-up for a stable and correct frequency control.

**4.1.3 TRUE RMS CURRENT AND VOLTAGE**

The **RMS** mode displays the record of the trend of the true half-cycle RMS current and voltage and the frequency trend curve.

**4.1.3.1 RMS DISPLAY SCREEN (3A)**

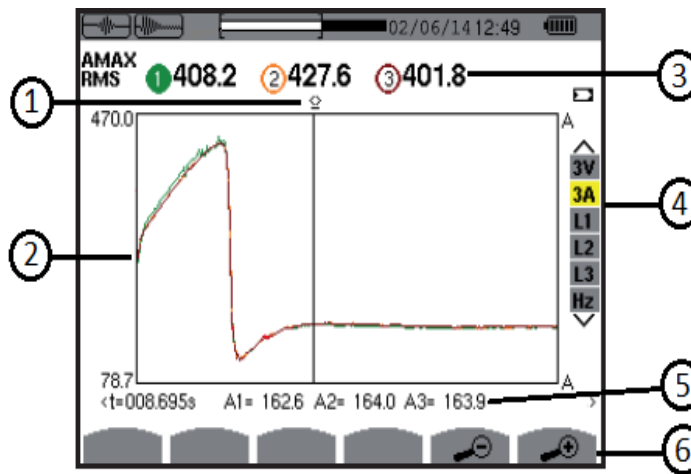


Figure 4-8

Item	Function
1	Instantaneous value cursor; change values with the cursor using the ◀ and ▶ buttons
2	Scale of values
3	- Maximum half-period RMS value of the Inrush current capture - Indicator of number attributed to the displayed curve - Value of the measured current
4	Selection of curves to be displayed: - <b>3V</b> : displays the 3 voltages during the Inrush current capture - <b>3A</b> : displays the 3 phase currents during the Inrush current capture - <b>L1, L2, L3</b> : display the current and voltage in phases 1, 2, and 3, respectively - <b>Hz</b> : displays the evolution of the network frequency vs time
5	- <b>t</b> : relative time position of the cursor (t = 0 corresponds to the start of the Inrush capture) - Values at the position of the cursor. In the example shown in Figure 4-8, <b>A1, A2,</b> and <b>A3</b> are the RMS values of currents 1, 2, and 3.
6	⊖ : Zoom Out - Zooms out on the graph at the current cursor position ⊕ : Zoom In - Zooms in on the graph at the current cursor position

#### 4.1.3.2 RMS DISPLAY SCREEN (L1)

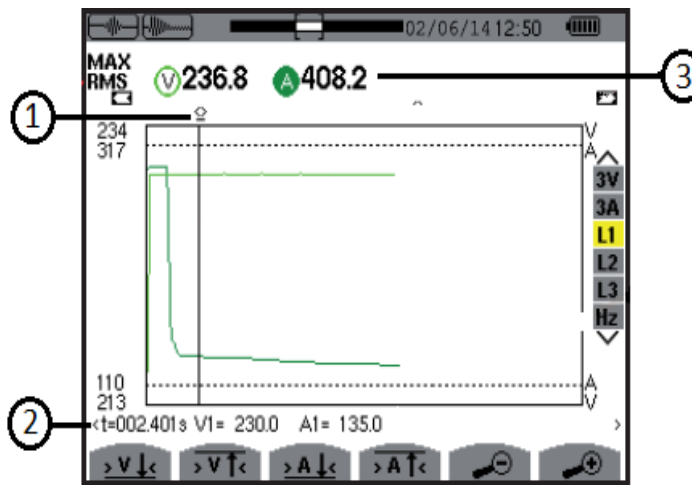


Figure 4-9

Item	Function
1	Instantaneous value cursor; change values with the cursor using the ◀ and ▶ buttons
2	<ul style="list-style-type: none"> <li>- <b>t</b>: relative time position of the cursor (t = 0 corresponds to the start of the Inrush capture)</li> <li>- Values at the position of the cursor. In the example shown in Figure 4-9, <b>V1</b>: RMS value of voltage 1 in the half-cycle at the position of the cursor; <b>A1</b>: RMS value of current 1 in the half-cycle at the position of the cursor</li> </ul>
3	<ul style="list-style-type: none"> <li>- <b>MAX</b>: maximum half-cycle RMS value of the Inrush current capture</li> <li>- <b>V</b>: measured voltage</li> <li>- <b>A</b>: measured current</li> </ul>

**NOTE:** Filters L2 and L3 display the trend of the true half-cycle RMS current and voltage of phases 2 and 3. The screen is identical to the one displayed for filter L1.

The  $\overline{V} \downarrow$ ,  $\overline{V} \uparrow$ ,  $\overline{A} \downarrow$ , and  $\overline{A} \uparrow$  buttons are used to go to the first occurrence of a minimum or maximum voltage or current value.

#### 4.1.4 INSTANTANEOUS INRUSH CURRENT

The **PEAK** mode is used to display the envelopes and waveforms of the Inrush current capture.

##### 4.1.4.1 PEAK DISPLAY SCREEN (4A)

The **PEAK** display of an Inrush current capture provides two possible types: Envelope and Waveform.

Switching between the two types is automatic, and is determined by the zoom. In the case shown, there is enough zoom in to force the waveform type of representation. The display filters along the right edge of the screen depend on the type of representation, and on the zoom.

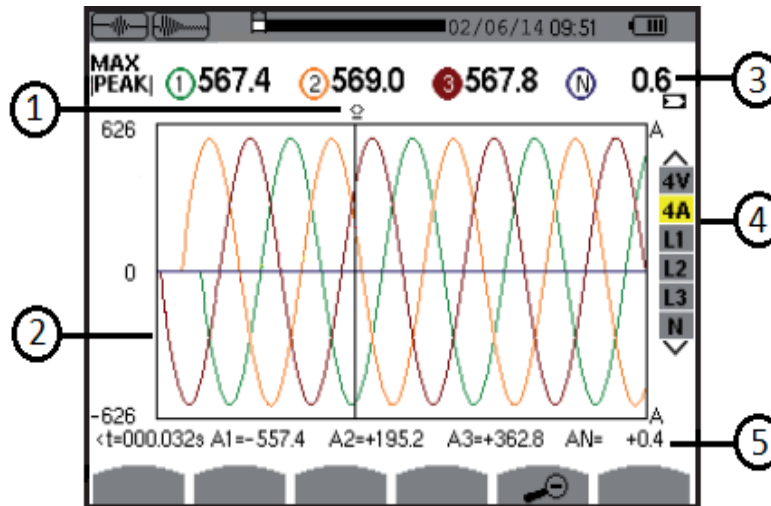


Figure 4-10

Item	Function
1	Instantaneous value cursor; change values with the cursor using the ◀ and ▶ buttons
2	Scale of values
3	<ul style="list-style-type: none"> <li>- <b>MAX</b>: absolute value</li> <li>- Indicator of number attributed to the displayed curve</li> <li>- Value of the measured current</li> </ul>
4	Selection of curves to be displayed: <ul style="list-style-type: none"> <li>- <b>4V</b>: displays the 4 voltages during the Inrush current capture</li> <li>- <b>4A</b>: displays the 4 currents during the Inrush current capture</li> <li>- <b>L1, L2, L3</b>: displays the current and voltage in phases 1, 2, and 3, respectively</li> <li>- <b>N</b>: displays the neutral current and neutral voltage during the Inrush current capture</li> </ul>
5	<ul style="list-style-type: none"> <li>- <b>t</b>: relative time position of the cursor (<math>t = 0</math> corresponds to the start of the Inrush capture)</li> <li>- Values at the position of the cursor. In the example shown in Figure 4-10, <b>A1, A2, A3</b>: instantaneous values of currents 1, 2, and 3 at the position of the cursor</li> </ul>

#### 4.1.4.2 PEAK DISPLAY SCREEN (A1)

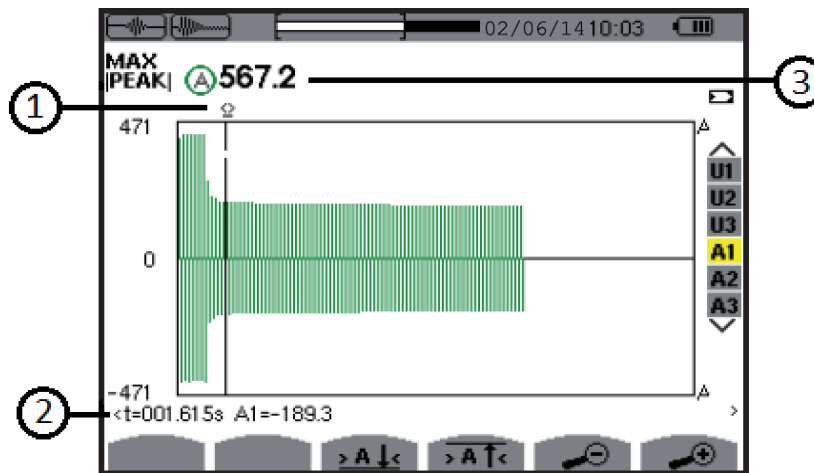


Figure 4-11

Item	Function
1	Instantaneous value cursor; change values with the cursor using the ◀ and ▶ buttons
2	- t: relative time position of the cursor (t = 0 corresponds to the start of the Inrush capture) - Values at the position of the cursor. In the example shown in Figure 4-11, <b>A1</b> : maximum instantaneous current of the half-cycle identified by the cursor
3	- <b>MAX</b> : maximum instantaneous absolute value of the Inrush current capture

**NOTE:** Filters A2 and A3 display the record of the current envelope of phases 2 and 3. The screen is identical to the one displayed for filter A1.

## 4.2 HARMONICS MODE

Press the  (Harmonic) button to select the type of harmonic analysis.

- V - Phase-to-neutral voltage harmonics
- A - Harmonics of the current harmonics
- VA - Apparent power of the harmonics
- U - Phase-to-phase voltage harmonics

The  and  buttons allow the user to zoom in or out, in increments of 2%, 5%, 10%, 20%, 50% and 100%.

### 4.2.1 PHASE-TO-NEUTRAL VOLTAGE HARMONIC

The V sub-menu displays the harmonics of the phase-to-neutral voltage.

**NOTE:** The choice of curves to be displayed depends on the type of connection (see § 4.2.4):

- Single-phase: no choice (L1)
- Split-phase: 2L, L1, L2
- Three-phase, 3-, 4-, or 5-wire: 3L, L1, L2, L3, -, +

The example screen displays and sub-menus in this section illustrate a three-phase connection.

#### 4.2.1.1 PHASE-TO-NEUTRAL HARMONICS DISPLAY SCREEN (3L)

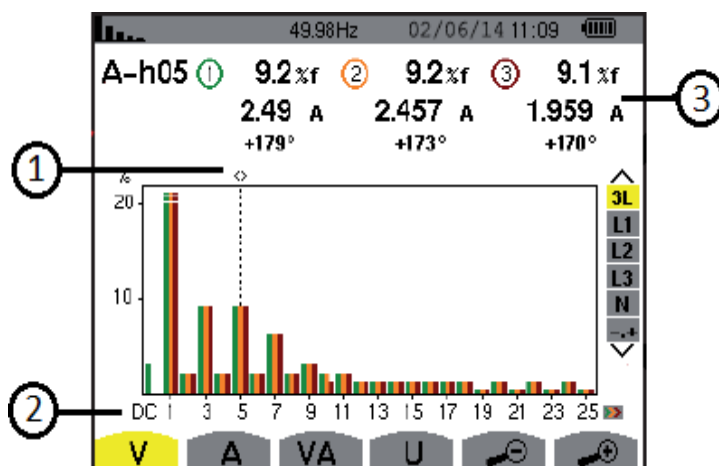


Figure 4-12

Item	Function
1	Harmonic selection cursor; change values with the cursor using the ◀ and ▶ buttons
2	The horizontal axis indicates the orders of the harmonics (odd marking). Display of the level of the harmonics as a percentage of the fundamental (order 1) - DC: DC component - 1 to 25: harmonics of order 1 to 25; when the cursor exceeds order 25, order 26 to 50 appears
3	- Vh 05: harmonic number - %: ratio of the harmonic to the fundamental - V: RMS voltage of the harmonic in question - +000°: phase shift with respect to the fundamental (order 1)

Display in expert mode -.+ (on the right-hand side) is available for 3-phase hookups by pressing the ▲ and ▼ buttons.

#### 4.2.1.2 PHASE VOLTAGE HARMONICS DISPLAY SCREEN (L1)

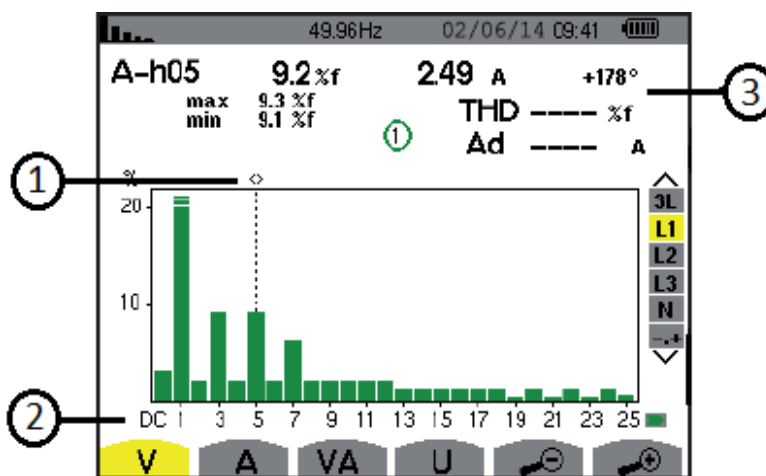



Figure 4-13

Item	Function
1	Harmonic selection cursor; change values with the cursor using the ◀ and ▶ buttons
2	The horizontal axis indicates the orders of the harmonics (odd marking). Display of the level of the harmonics as a percentage of the fundamental (order 1) - DC: DC component - 1 to 25: harmonics of order 1 to 25; when the cursor exceeds order 25, order 26 to 50 appears - ■: indicator of the presence of non-zero harmonics of order higher than 25

- 3
- **Vh 03**: harmonic number
  - %**: ratio of the harmonic to the fundamental
  - V**: RMS voltage of the harmonic in question
  - +000°**: phase shift with respect to the fundamental (order 1)
  - max – min**: maximum and minimum levels of the harmonic in question (reset when the harmonic number is changed or the  button is pressed)
  - THD**: total harmonic distortion

**NOTE:** Filters L2 and L3 display the harmonics of the phase-to-neutral voltage for phases 2 and 3, respectively. The screen is identical to the one displayed for filter L1.

## 4.2.2 CURRENT

The **A** sub-menu displays the harmonics of the current.

### 4.2.2.1 CURRENT HARMONICS DISPLAY SCREEN (3L)

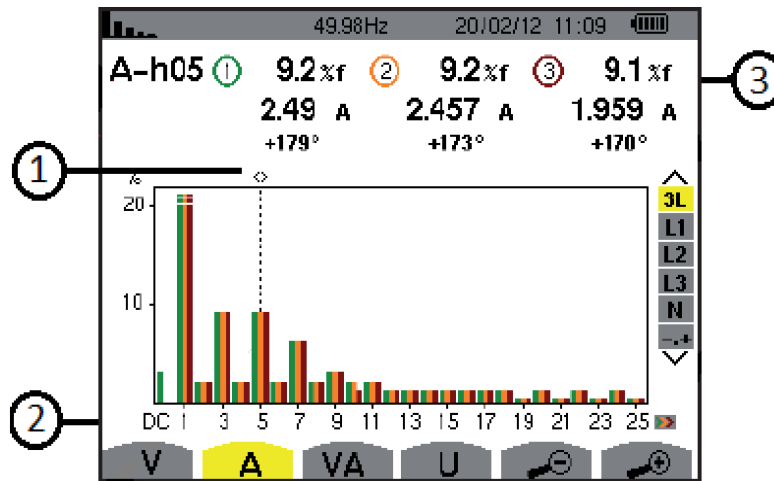


Figure 4-14

Item	Function
1	Harmonic selection cursor; change values with the cursor using the ◀ and ▶ buttons
2	The horizontal axis indicates the orders of the harmonics (odd marking). Display of the level of the harmonics as a percentage of the fundamental (order 1) - <b>DC</b> : DC component - <b>1 to 25</b> : harmonics of order 1 to 25; when the cursor exceeds order 25, order 26 to 50 appears
3	- <b>Ah 05</b> : harmonic number - <b>%</b> : ratio of the harmonic to the fundamental - <b>A</b> : RMS current of the harmonic in question - <b>+000°</b> : phase shift with respect to the fundamental (order 1)



#### 4.2.2.2 CURRENT HARMONICS DISPLAY SCREEN (L1)

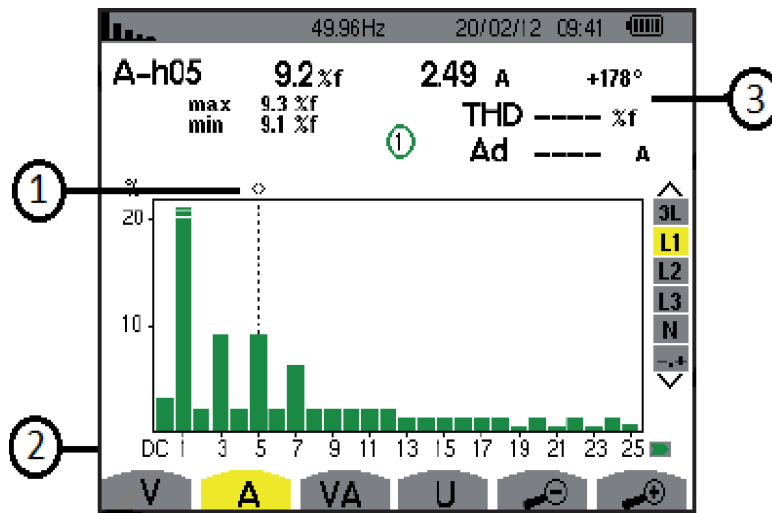


Figure 4-15

Item	Function
1	Harmonic selection cursor; change values with the cursor using the ◀ and ▶ buttons
2	The horizontal axis indicates the orders of the harmonics (odd marking). Display of the level of the harmonics as a percentage of the fundamental (order 1) - <b>DC</b> : DC component - <b>1 to 25</b> : harmonics of order 1 to 25; when the cursor exceeds order 25, order 26 to 50 appears - <b>■</b> : indicator of the presence of non-zero harmonics of order higher than 25
3	- <b>Ah 05</b> : harmonic number %: ratio of the harmonic to the fundamental <b>A</b> : RMS current of the harmonic in question +000°: phase shift with respect to the fundamental (order 1) <b>max – min</b> : maximum and minimum levels of the harmonic in question (reset when the harmonic number is changed or the ↵ button is pressed) <b>THD</b> : total harmonic distortion

**NOTE:** Filters L2 and L3 display the current harmonics of phases 2 and 3, respectively. The screen is identical to the one displayed for filter L1.

### 4.2.3 APPARENT POWER

The VA sub-menu displays the harmonics of the apparent power.

#### 4.2.3.1 APPARENT POWER HARMONICS DISPLAY SCREEN (3L)

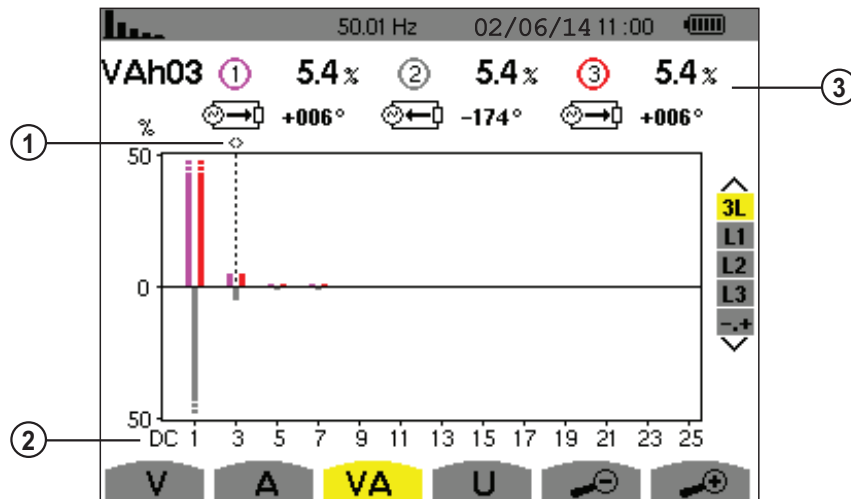


Figure 4-16

Item	Function
1	Harmonic selection cursor; change values with the cursor using the ◀ and ▶ buttons
2	The horizontal axis indicates the orders of the harmonics (odd marking). Display of the level of the harmonics as a percentage of the fundamental (order 1) - DC: DC component - 1 to 25: harmonics of order 1 to 25; when the cursor exceeds order 25, order 26 to 50 appears
3	- Vah 03: harmonic number - %: ratio of the harmonic to the fundamental - +000°: phase shift of the voltage harmonic with respect to the current harmonic for the order in question ◀→: Indicator of energy generated for this harmonic →: Indicator of energy consumed for this harmonic

#### 4.2.3.2 APPARENT POWER HARMONICS DISPLAY SCREEN (L1)

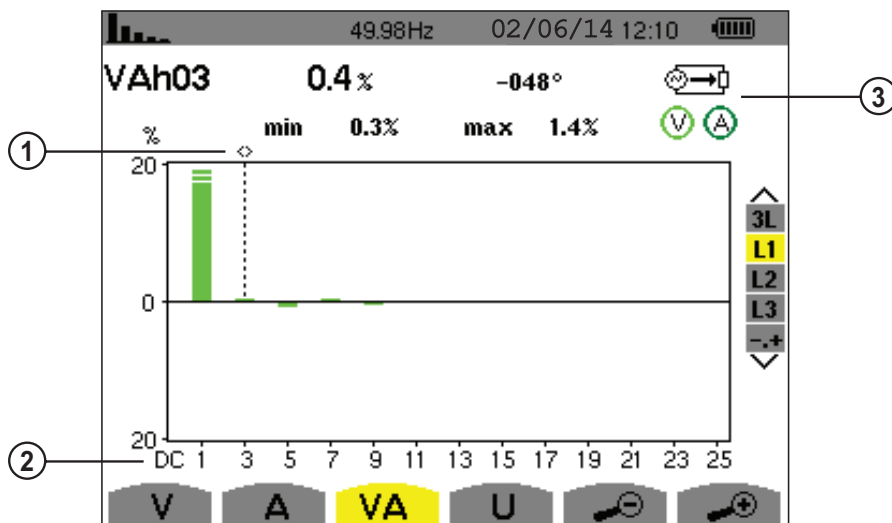


Figure 4-17

Item	Function
1	Harmonic selection cursor; change values with the cursor using the ◀ and ▶ buttons
2	The horizontal axis indicates the orders of the harmonics (odd marking). Display of the level of the harmonics as a percentage of the fundamental (order 1) - <b>DC</b> : DC component - <b>1 to 25</b> : harmonics of order 1 to 25; when the cursor exceeds order 25, order 26 to 50 appears ↔: Indicator of energy consumed for this harmonic
3	- <b>Vah 03</b> : harmonic number %: ratio of the harmonic to the fundamental <b>+000°</b> : phase shift of the voltage harmonic with respect to the current harmonic for the order in question <b>max – min</b> : maximum and minimum levels of the harmonic in question (reset when the harmonic number is changed or the ↵ button is pressed)

**NOTE:** Filters L2 and L3 display the apparent power of the harmonics for phases 2 and 3, respectively. The screen is identical to the one displayed for filter L1.

#### 4.2.4 PHASE-TO-PHASE VOLTAGE

The **U** sub-menu is available only for three-phase connections, when the voltage ratios of phases 1, 2, and 3 are equal. This sub-menu displays the harmonics of the phase-to-phase voltage.

##### 4.2.4.1 PHASE-TO-PHASE VOLTAGE HARMONICS DISPLAY SCREEN (3L)

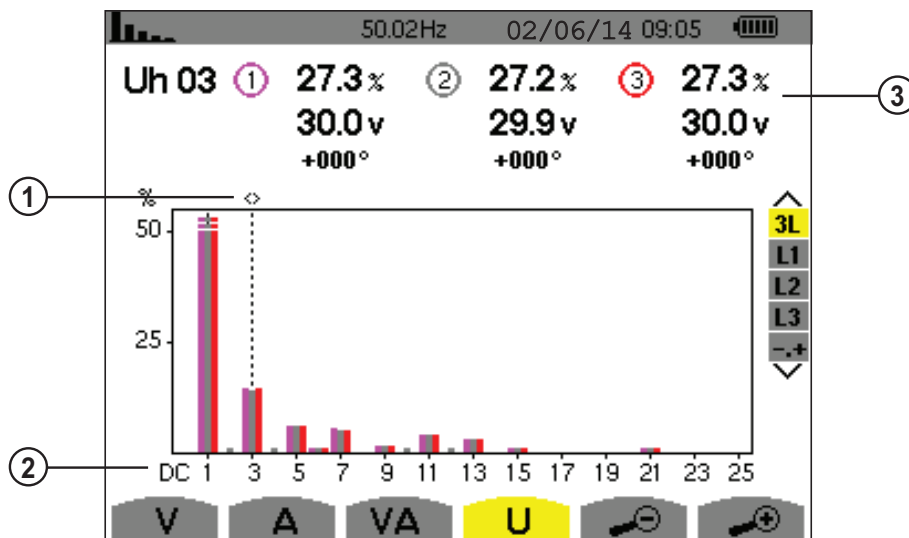


Figure 4-18

Item	Function
1	Harmonic selection cursor; change values with the cursor using the ◀ and ▶ buttons
2	The horizontal axis indicates the orders of the harmonics (odd marking). Display of the level of the harmonics as a percentage of the fundamental (order 1) - <b>DC</b> : DC component - <b>1 to 25</b> : harmonics of order 1 to 25; when the cursor exceeds order 25, order 26 to 50 appears
3	- <b>Uh 03</b> : harmonic number - %: ratio of the harmonic to the fundamental - <b>V</b> : RMS voltage of the harmonic in question - <b>+000°</b> : phase shift with respect to the fundamental (order 1)

#### 4.2.4.2 PHASE-TO-PHASE VOLTAGE DISPLAY SCREEN (L1)

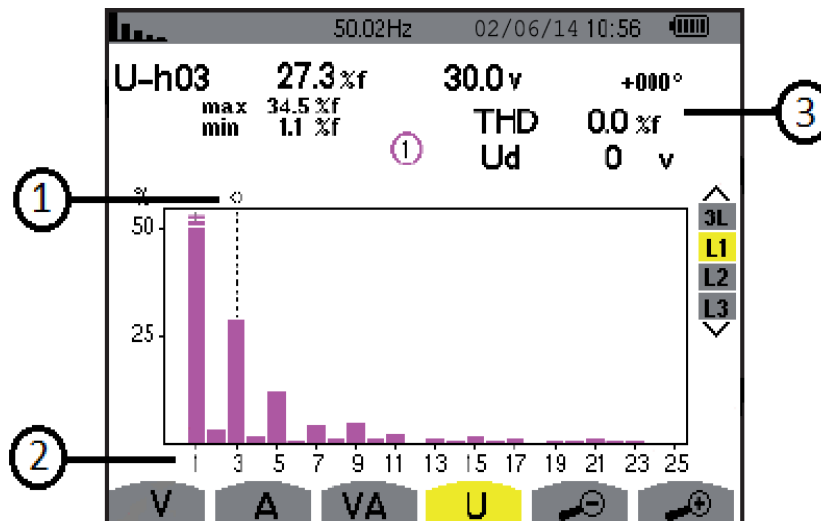


Figure 4-19

Item	Function
1	Harmonic selection cursor; change values with the cursor using the ◀ and ▶ buttons
2	<p>The horizontal axis indicates the orders of the harmonics (odd marking). Display of the level of the harmonics as a percentage of the fundamental (order 1)</p> <ul style="list-style-type: none"> <li>- <b>DC</b>: DC component</li> <li>- <b>1 to 25</b>: harmonics of order 1 to 25; when the cursor exceeds order 25, order 26 to 50 appears</li> <li>- <b>█</b>: indicator of the presence of non-zero harmonics of order higher than 25</li> </ul>
3	<ul style="list-style-type: none"> <li>- <b>Uh 03</b>: harmonic number</li> <li>- <b>%</b>: ratio of the harmonic to the fundamental</li> <li>- <b>V</b>: RMS voltage of the harmonic in question</li> <li>- <b>+000°</b>: phase shift with respect to the fundamental (order 1)</li> <li>- <b>max – min</b>: maximum and minimum levels of the harmonic in question (reset when the harmonic number is changed or the ↵ button is pressed)</li> <li>- <b>THD</b>: total harmonic distortion</li> </ul>

**NOTE:** Filters L2 and L3 display the harmonics of the phase-to-neutral voltage for phases 2 and 3, respectively. The screen is identical to the one displayed for filter L1.

## 4.2.5 HARMONIC ANALYSIS IN EXPERT MODE

The  $-,+$  (Expert) mode is available with a 3-Phase connection only. It is used to display the influence of the harmonics on the heating of the neutral and on rotating machines.

Press on the  $\blacktriangle \blacktriangledown$  buttons to select “ $-,+$ ” and then either the **V** or **A** sub-menu.

Example of a typical display:

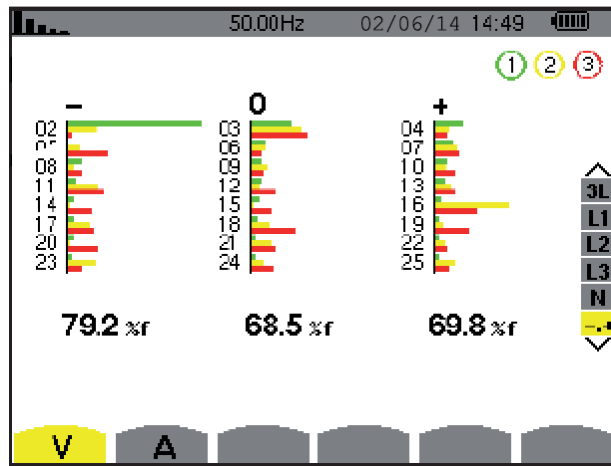


Figure 4-20

- **Column One:** The harmonics inducing a negative sequence.
- **Column Two:** Those inducing a zero sequence (triplens added into the neutral).
- **Column Three:** Those inducing a positive sequence.

## 4.3 WAVEFORM MODE

This mode displays the current and voltage curves, along with the values measured and those calculated from the voltages and currents (except for power, energy and harmonics).

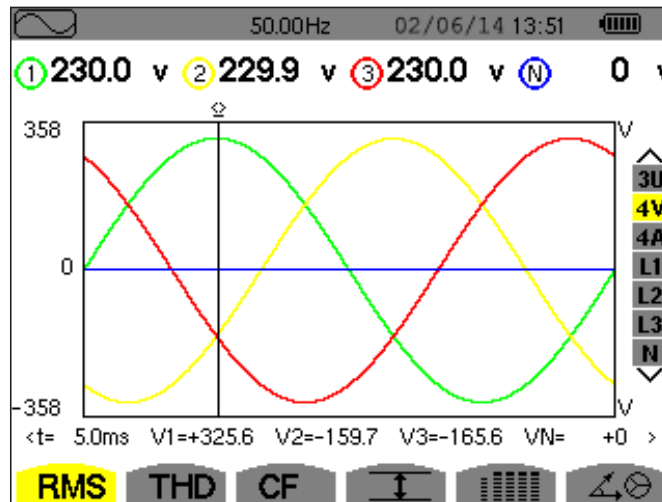









Figure 4-21

Item	Measurement Type
<b>RMS</b>	Measurement of the true RMS value
<b>THD</b>	Measurement of total harmonic distortion
<b>CF</b>	Measurement of the peak factor
	Display of Min/Max, RMS and peak values (see § 4.3.4)
	Simultaneous display of voltage and current measurements (see § 4.3.5)
	Display of Fresnel diagram of signals (see § 4.3.6)

### 4.3.1 RMS MEASUREMENT

This sub-menu displays the waveforms over a period of the measured signals and the true effective values of the voltage and the current.

 The choice of graphs to be displayed depends on the type of electrical connection that was set up during the configuration (see § 3.2.4).

- Single-phase: no choice (L1)
- Two-phase: 2V, 2A, L1, L2
- Tri-phase 3 or 4 wires: 3U, 3V, 3A, L1, L2, L3
- Tri-phase 5 wires:
  - For **THD**, **CF** and  : 3U, 3V, 3A, L1, L2 and L3
  - For **RMS**,  and  : 3U, 4V, 4A, L1, L2, L3 and N

The screen captures shown in this section are examples of those obtained with a 3-Phase 5-Wire connection.

#### 4.3.1.1 RMS DISPLAY SCREEN (3U)

This screen displays the three phase-to-neutral voltages of a 3-phase system when the voltage ratios of phases 1, 2, and 3 are equal.

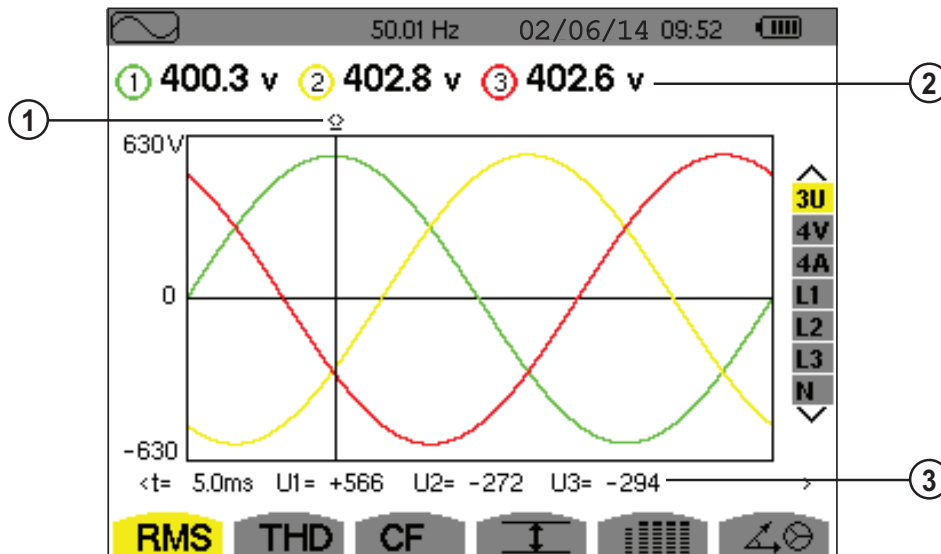


Figure 4-22

Item	Function
1	Instantaneous value cursor; change values with the cursor using the ◀ and ▶ buttons
2	RMS phase-to-phase voltages
3	Instantaneous value of the signals at the intersection of the cursor and the curves <b>t</b> : time relative to the start of the period (expressed in milliseconds) <b>U1</b> : instantaneous phase-to-phase voltage between phases 1 and 2 ( $U_{12}$ ) <b>U2</b> : instantaneous phase-to-phase voltage between phases 2 and 3 ( $U_{23}$ ) <b>U3</b> : instantaneous phase-to-phase voltage between phases 3 and 1 ( $U_{31}$ )

### 4.3.1.2 RMS DISPLAY SCREEN (4V)

This screen displays the three phase-to-phase voltages and the neutral-to-earth voltage of a 3-phase system.

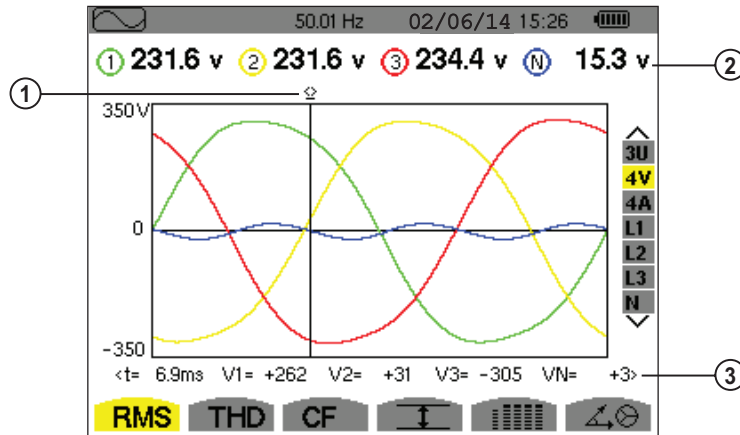


Figure 4-23

Item	Function
1	Instantaneous value cursor; change values with the cursor using the ◀ and ▶ buttons
2	Effective phase-to-neutral voltages
3	Instantaneous value of the signals at the intersection of the cursor and the curves <b>t</b> : time relative to the start of the period (expressed in milliseconds) <b>V1</b> : instantaneous phase-to-neutral voltage of curve 1 <b>V2</b> : instantaneous phase-to-neutral voltage of curve 2 <b>V3</b> : instantaneous phase-to-neutral voltage of curve 3 <b>VN</b> : instantaneous neutral voltage

### 4.3.1.3 RMS DISPLAY SCREEN (4A)

This screen displays the three phase currents and the neutral current of a 3-phase system.

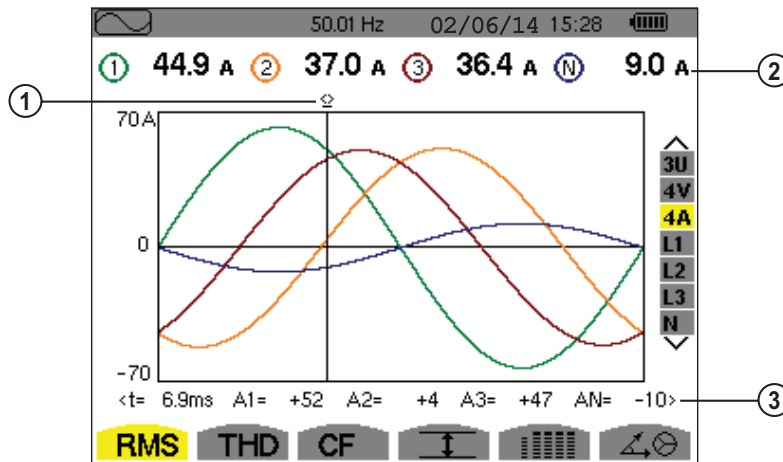


Figure 4-24

Item	Function
1	Instantaneous value cursor; change values with the cursor using the ◀ and ▶ buttons
2	RMS currents
3	Instantaneous value of the signals at the intersection of the cursor and the curves <b>t</b> : time relative to the start of the period (expressed in milliseconds) <b>A1</b> : instantaneous current of phase 1 <b>A2</b> : instantaneous current of phase 2 <b>A3</b> : instantaneous current of phase 3 <b>AN</b> : instantaneous neutral voltage

### 4.3.1.4 RMS DISPLAY SCREEN (NEUTRAL)

This screen displays the neutral voltage relative to earth and the neutral current.

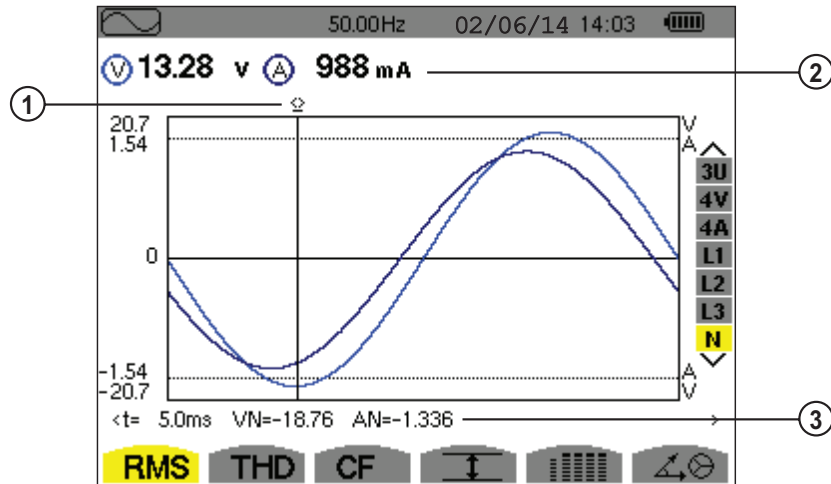


Figure 4-25

Item	Function
1	Instantaneous value cursor; change values with the cursor using the ◀ and ▶ buttons
2	Effective values of currents
3	Instantaneous value of the signals at the intersection of the cursor and the graphs <b>t</b> : time relative to the start of the period (expressed in milliseconds) <b>VN</b> : instantaneous neutral voltage <b>AN</b> : instantaneous neutral current

### 4.3.2 THD MEASUREMENT OF TOTAL HARMONIC DISTORTION

The THD sub-menu displays the waveforms over a period of the measured signals and the total harmonic distortion rates for voltage and current.

#### 4.3.2.1 THD DISPLAY SCREEN (3U)

This screen displays the phase-to-phase voltage waveforms for one period and the total harmonic distortion values.

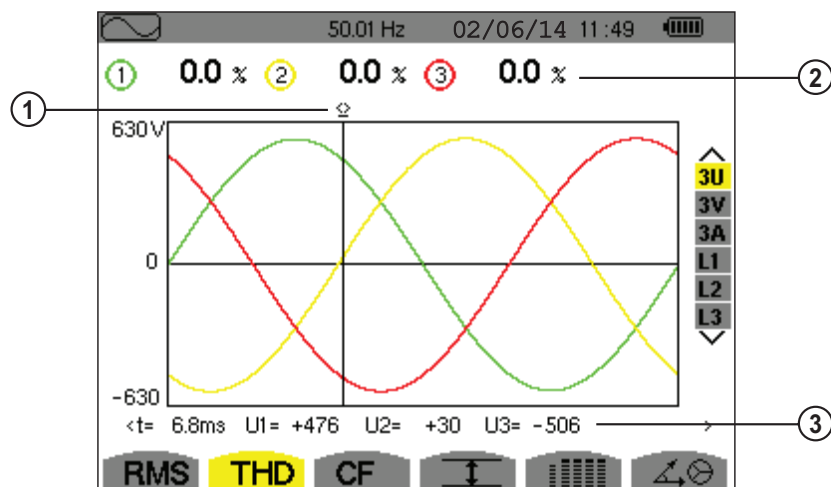


Figure 4-26



Item	Function
1	Instantaneous value cursor; change values with the cursor using the ◀ and ▶ buttons
2	Harmonic distortion rate for each curve
3	Instantaneous value of the signals at the intersection of the cursor and the curves <b>t</b> : time relative to the start of the period (expressed in milliseconds) <b>U1</b> : instantaneous phase-to-phase voltage between phases 1 and 2 ( $U_{12}$ ) <b>U2</b> : instantaneous phase-to-phase voltage between phases 2 and 3 ( $U_{23}$ ) <b>U3</b> : instantaneous phase-to-phase voltage between phases 3 and 1 ( $U_{31}$ )

#### 4.3.2.2 THD DISPLAY SCREEN (3V)

This screen displays the phase-to-neutral voltage waveforms for one period and the total harmonic distortion values.

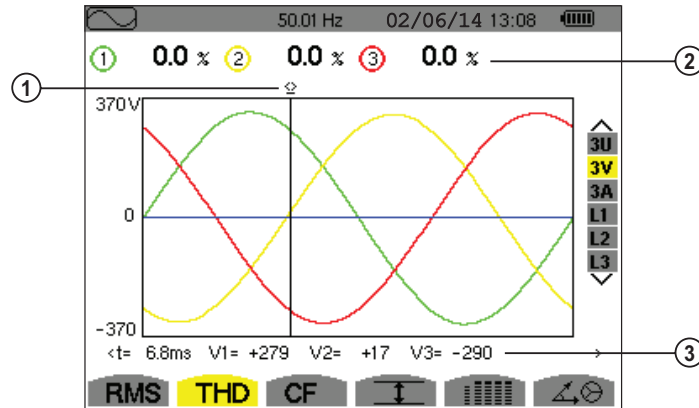


Figure 4-27

Item	Function
1	Instantaneous value cursor; change values with the cursor using the ◀ and ▶ buttons
2	Harmonic distortion rate for each curve
3	Instantaneous value of the signals at the intersection of the cursor and the curves <b>t</b> : time relative to the start of the period (expressed in milliseconds) <b>V1</b> : instantaneous phase-to-neutral voltage of curve 1 <b>V2</b> : instantaneous phase-to-neutral voltage of curve 2 <b>V3</b> : instantaneous phase-to-neutral voltage of curve 3

#### 4.3.2.3 THD DISPLAY SCREEN (3A)

This screen displays the phase current waveforms for one period and the total harmonic distortion values.

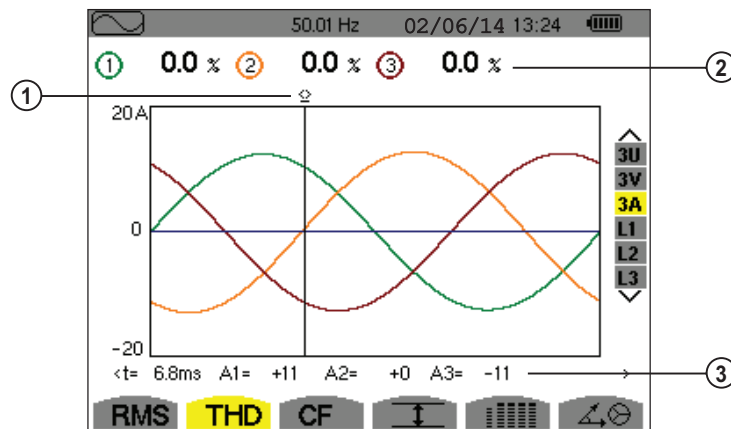


Figure 4-28

Item	Function
1	Instantaneous value cursor; change values with the cursor using the ◀ and ▶ buttons
2	Harmonic distortion rate for each curve
3	Instantaneous value of the signals at the intersection of the cursor and the curves <b>t</b> : time relative to the start of the period (expressed in milliseconds) <b>A1</b> : instantaneous current of phase 1 <b>A2</b> : instantaneous current of phase 2 <b>A3</b> : instantaneous current of phase 3

**Note:** Filters L1, L2, and L3 display the total current and voltage harmonic distortion for phases 1, 2, and 3, respectively.

### 4.3.3 MEASUREMENT OF THE PEAK FACTOR (CF)

The CF sub-menu displays the waveforms of the signals measured over one period and the voltage and current peak factors.

#### 4.3.3.1 CF DISPLAY SCREEN (3U)

This screen displays the phase-to-phase voltage waveforms of one period and the peak factors.

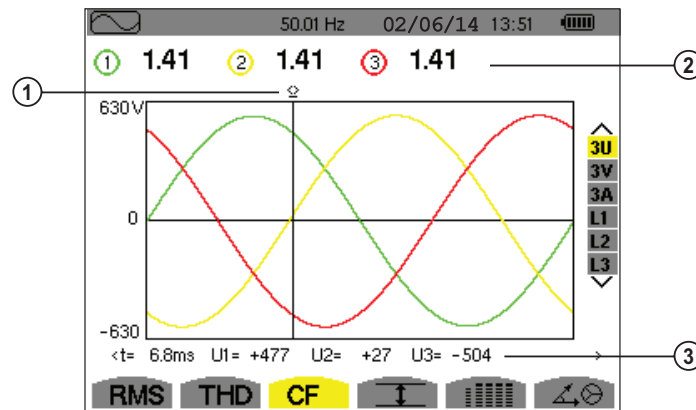


Figure 4-29

Item	Function
1	Instantaneous value cursor; change values with the cursor using the ◀ and ▶ buttons
2	Peak factor for each curve
3	Instantaneous value of the signals at the intersection of the cursor and the graphs <b>t</b> : time relative to the start of the period (expressed in milliseconds) <b>U1</b> : instantaneous voltage peak factor between phases 1 and 2 ( $U_{12}$ ) <b>U2</b> : instantaneous voltage peak factor between phases 2 and 3 ( $U_{23}$ ) <b>U3</b> : instantaneous voltage peak factor between phases 3 and 1 ( $U_{31}$ )

### 4.3.3.2 CF DISPLAY SCREEN (3V)

This screen displays the phase-to-neutral voltage waveforms of one period and the peak factors.

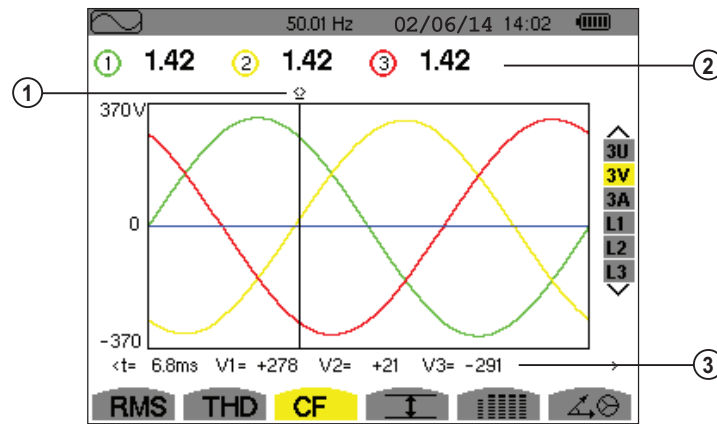


Figure 4-30

Item	Function
1	Instantaneous value cursor; change values with the cursor using the ◀ and ▶ buttons
2	Peak factor for each curve
3	Instantaneous value of the signals at the intersection of the cursor and the curves <b>t</b> : time relative to the start of the period (expressed in milliseconds) <b>V1</b> : instantaneous phase-to-neutral voltage of phase 1 <b>V2</b> : instantaneous phase-to-neutral voltage of phase 2 <b>V3</b> : instantaneous phase-to-neutral voltage of phase 3

### 4.3.3.3 CF DISPLAY SCREEN (3A)

This screen displays the current waveforms of one period and the peak factors.

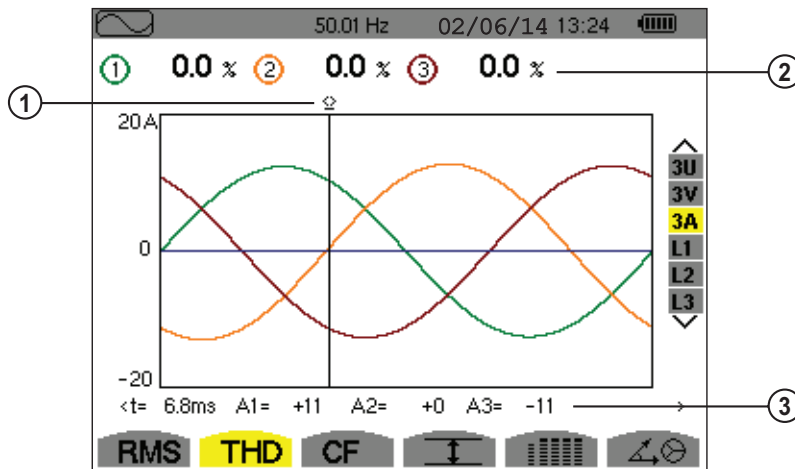


Figure 4-31

Item	Function
1	Instantaneous value cursor; change values with the cursor using the ◀ and ▶ buttons
2	Peak factor for each curve
3	Instantaneous value of the signals at the intersection of the cursor and the graphs <b>t</b> : time relative to the start of the period (expressed in milliseconds) <b>A1</b> : instantaneous current of phase 1 <b>A2</b> : instantaneous current of phase 2 <b>A3</b> : instantaneous current of phase 3

**Note:** L1, L2 and L3 display the peak factors of the current and of the voltage respectively for phases 1, 2 and 3.

#### 4.3.4 MEASUREMENT OF MIN, MAX, AVERAGE, VOLTAGE AND CURRENT VALUES

This sub-menu displays the RMS, maximum, minimum and average values for voltage and current, together with those for the instantaneous positive and negative voltage and current peaks.

 **NOTE:** The display screen varies depending on which value is selected.

- **3U:** Displays the one-second mean and half-cycle maximum and minimum RMS values and the instantaneous positive and negative phase-to-phase voltage peaks.
- **4V:** Displays the one-second mean and half-cycle maximum and minimum RMS values and the instantaneous positive and negative peaks of the phase-to-neutral voltages and of the neutral.
- **4A:** Displays the one-second mean and half-cycle maximum and minimum RMS values and the positive and negative instantaneous peak values of the phase and neutral currents.
- **L1/L2/L3:** Displays the one-second mean and half-cycle maximum and minimum RMS values and the instantaneous positive and negative peaks of the phase-to-neutral voltage and of the current of phase 1.
- **N:** Displays the RMS values and the positive and negative instantaneous peaks of the neutral relative to earth.

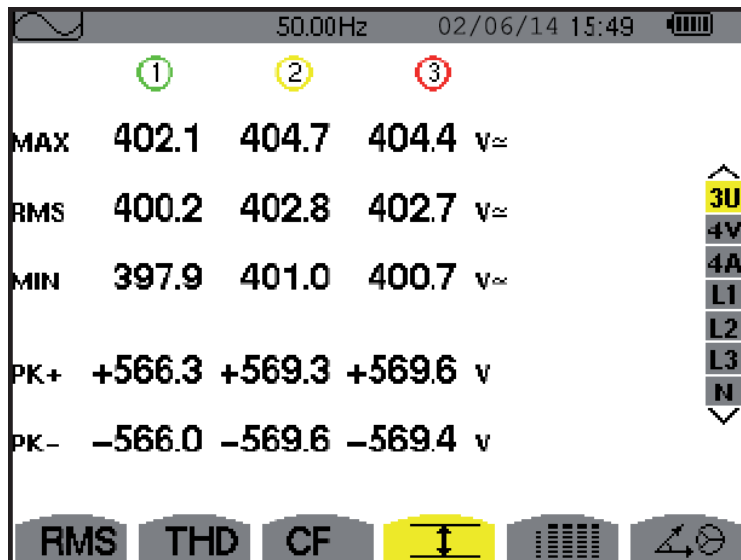




Figure 4-32

The columns display the values relative to each voltage, current or neutral graph.

Item	Function
MAX	Maximum RMS value of the voltage or current from powering of the Model 8435 or from the last time the  button is pressed.
RMS	True effective value of voltage or current
MIN	Minimum RMS value of the voltage or current from powering of the Model 8435 or from the last time the  button is pressed.
PK+	Maximum peak value of the voltage or current
PK-	Minimum peak value of the voltage or current

**NOTE:** The MAX and MIN RMS measurements are calculated every half-period (e.g. every 10ms for a signal at 50Hz). The measurements are refreshed every 250ms.

To reset the MIN and MAX on the display, press the  button.

### 4.3.5 SIMULTANEOUS DISPLAY

This sub-menu displays all the voltage and current measurements (RMS, DC, THD, DF, CF, PST, KF).



**NOTE:** The display screen varies depending on which value is selected.

- **3U:** Displays the RMS, DC, THD, DF, and CF values of the phase-to-phase voltages.
- **4V:** Displays the RMS, DC, THD, DF, CF and PST values of the phase-to-neutral voltages and of the neutral.
- **4A:** Displays the RMS, DC, THD, DF, CF, and KF values of the phase and neutral currents.
- **L1/L2/L3:** Displays the RMS, THD, DF, and CF values of the phase-to-neutral voltage and of the current, the DC and PST parameters of the phase-to-neutral voltage, and the DC value (if the current sensor allows) and KF of the current for phase 1.
- **N:** Displays the RMS voltage and current of the neutral, the DC component of the neutral voltage, and (if the current sensor allows) the DC component of the neutral current.

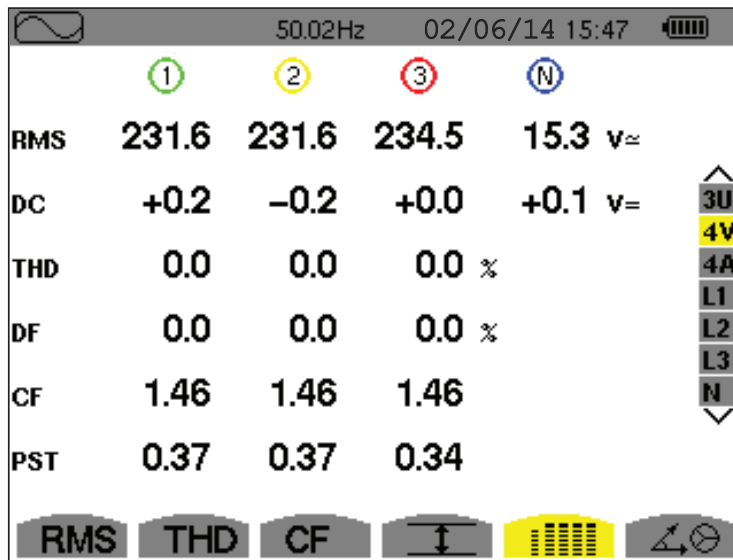


Figure 4-33

Item	Function
<b>RMS</b>	True effective value of voltage or current
<b>DC</b>	Direct component
<b>THD</b>	Total harmonic distortion rate
<b>DF</b>	Distortion factor
<b>CF</b>	Peak factor calculated in relation to the displayed waveform
<b>PST</b>	Short-term flicker (over 10 minutes)
<b>KF</b>	K factor - Oversizing of transformer relative to harmonics

**NOTE:** L2 and L3 give information concerning simultaneous display of the current and of the voltage respectively for phases 2 and 3.

### 4.3.6 DISPLAY OF PHASOR DIAGRAM

This sub-menu displays the absolute values of the voltages and currents at the fundamental frequency, the phase displacement of the voltages relative to the currents and the unbalances of the voltages and currents.

 **NOTE:** The display screen varies depending on which value is selected.

- **3U:** Displays a vector representation of the fundamentals of the phase-to-phase voltages and of the currents. It indicates their associated quantities (modulus and phase of the phase-to-phase voltage vectors) and the voltage unbalance. The reference vector of the representation (at 3 o'clock) is U1.
- **3V:** Displays a vector representation of the fundamentals of the phase-to-neutral voltages and of the currents. It indicates their associated quantities (modulus and phase of the phase-to-neutral voltage vectors) and the voltage unbalance. The reference vector of the representation (at 3 o'clock) is V1.
- **3A:** Displays a vector representation of the fundamentals of the phase-to-neutral voltages and of the currents. It indicates their associated quantities (modulus and phase of the current vectors) and the current unbalance. The reference vector of the representation (at 3 o'clock) is A1.
- **L1/L2/L3:** Displays a vector representation of the fundamentals of the phase-to-neutral voltages and the currents of one phase. It indicates their associated quantities (modulus and phase of the current and phase-to-neutral voltage vectors). The reference vector of the representation (at 3 o'clock) is the current vector.

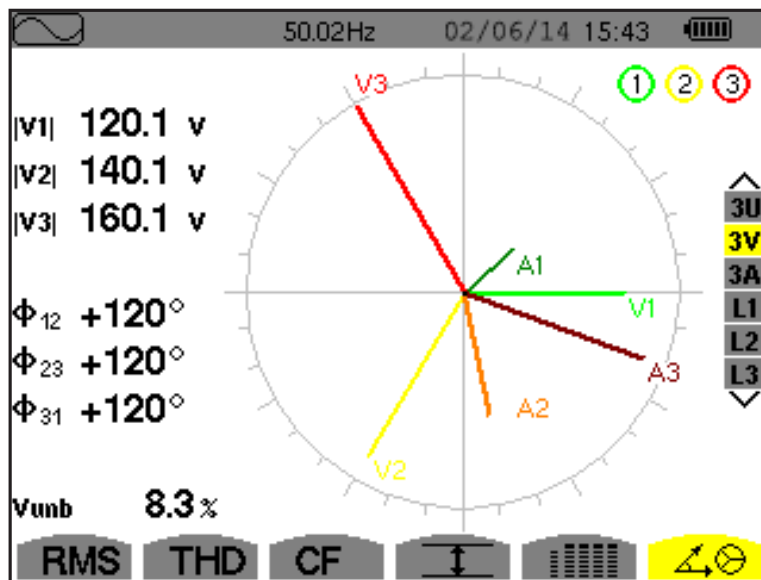


Figure 4-34

Item	Function
<b>U1, U2, U3</b>	Absolute values of the voltages at fundamental frequency
<b>V1, V2, V3</b>	Absolute values of the voltages at fundamental frequency
<b>A1, A2, A3</b>	Absolute values of the current at fundamental frequency
$\phi_{12}$	Phase displacement of phase 1 relative to phase 2
$\phi_{23}$	Phase displacement of phase 2 relative to phase 3
$\phi_{31}$	Phase displacement of phase 3 relative to phase 1
$\phi_{VA}$	Phase displacement of voltage (V) relative to current (A)
<b>Unb</b>	Unbalance of line voltages

**NOTE:** L2 and L3 display vector representations of the fundamentals of the phase-to-neutral voltages and the currents of phases 2 and 3, respectively. They indicate their associated quantities (modulus and phase of the current and phase-to-neutral voltage vectors of phases 2 and 3, respectively). The reference vector of the representation (at 3 o'clock) is the current vector (A2 and A3, respectively).

## 4.4 ALARM MODE

This mode detects the type of alarm that you wish to monitor (Vah, Ah, Uh, Vh, Tan, PF, DPF, VA, VAR, W, Athd, Uthd, Vthd, KF, Hz, Aunb, Vunb, Vrms, Acf, Ucf, Vcf, PST, Arms Urms and Vrms – see Appendix B: Glossary of Terms).

 All alarms recorded can be downloaded to a PC with DataView® software (see § 5). Up to 10,000 alarms can be captured.

### 4.4.1 PROGRAMMING AN ALARM

1. Press the Alarm mode button . The Detection Schedule screen will appear.

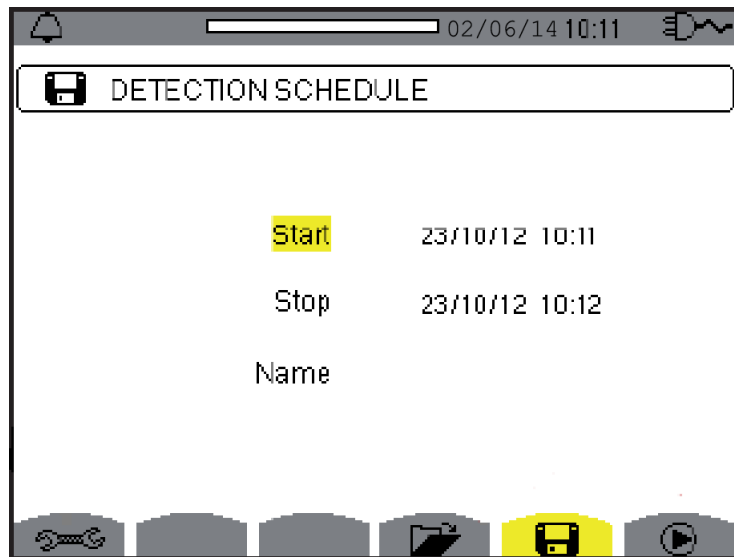


























Figure 4-35

Item	Measurement Type
	Configures alarms
	Displays alarm log
	Programs an alarm
	Validates the programming of an alarm (after  is selected, the  icon appears)
	Manually stops an alarm that is in progress


 To program/display alarms, they must first be configured (see § 3.2.8)

2. With the start field highlighted in yellow, press  to enter the date and time.
3. Use the  and  buttons to increase or decrease the value. Use the  and  buttons to move to the next parameter.
4. When completed, confirm the Start alarm schedule with .
5. Use the  button to set the Stop alarm settings, then repeat the previous steps.
6. Highlight the Name field, and use the , , , and  buttons to enter a name for the alarm detection campaign.

#### 4.4.2 STARTING AN ALARM



1. Press the  icon's yellow button to launch the alarm campaign between the start and end times that you specified.
2. The  icon disappears and the  icon appears instead.
3. The **Detection on standby** message is displayed while awaiting start time and the  icon blinks on the screen's top display bar.
4. The **Detection running** message is displayed when start time begins.
5. The Detection Schedule screen with the  icon are displayed when the end time is reached. You can then program a new alarm detection campaign.

#### 4.4.3 MANUALLY STOPPING AN ALARM

An alarm can be manually stopped before the stop date and time by pressing the  icon's yellow button. The **OK** icon will reappear in the same location.

#### 4.4.4 DISPLAYING AN ALARM LOG

Press the  icon's yellow button to view the alarm log. The log can contain a maximum of 10,920 alarms.

 **NOTE:** The type of connection selected in the configuration mode  does not affect the possibilities of alarm filter choice and monitored parameter. Users are responsible for these choices.

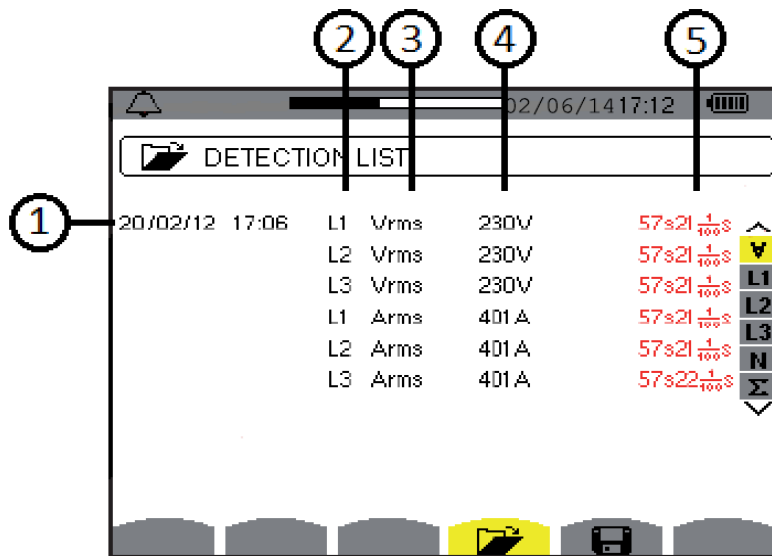





Figure 4-36

Item	Function
1	Alarm date and time
2	Alarm filter
3	Monitored parameter (Vrms, etc.)
4	Amplitude (min or max)
5	Alarm duration





#### 4.4.5 DELETING AN ALARM LOG

1. Press the  icon's yellow button.
  2. Select the alarm to be deleted using the ▲ or ▼ button, then press the  button to confirm deletion.
- To leave this screen without deleting any alarm, press the  button.

#### 4.5 TREND MODE

##### 4.5.1 PROGRAMMING AND STARTING A RECORDING

 **NOTE:** The ON/OFF light will blink when the recording is in progress. When the recording is done, the ON/OFF light will turn off. You will need to press it again to restart the instrument.

This mode enables all the parameters previously configured in the Configuration mode  to be recorded (see § 3.2).











1. Press the Trend mode button - .



Figure 4-37

2. Select the Configuration that was previously set-up (see § 3.2.7) by using the ▲ or ▼ button to highlight **Set-up**, then press the  button.
3. Use the ▲ or ▼ button to choose Configuration 1, 2, 3, or 4, then press .
4. Select the **Start** field using the ▼ button. Press  to select the date and time field, then use the appropriate arrow buttons to change the date and time. Press  when finished.
5. Using the same method as steps 1, 2, and 3, use the arrow buttons and the  button to change the values for **Stop**, **Period**, and **Name**.
6. Press the  icon's yellow button to begin recording between your specified start and end times. The  icon disappears and the icon  appears.
7. The **Recording on Standby** message is displayed and the icon blinks on the top display bar. Once the start time has been reached, the Recording running message is displayed.
8. When the recording is finished, the **Programming a recording** screen will appear and the  icon reappears.

### 4.5.2 MANUALLY STOPPING A RECORDING

An alarm can be manually stopped by pressing the  icon's yellow button. The  icon will reappear in the same location.

### 4.5.3 DISPLAYING THE RECORDING LIST

Press the  icon's yellow button to view the recording list.

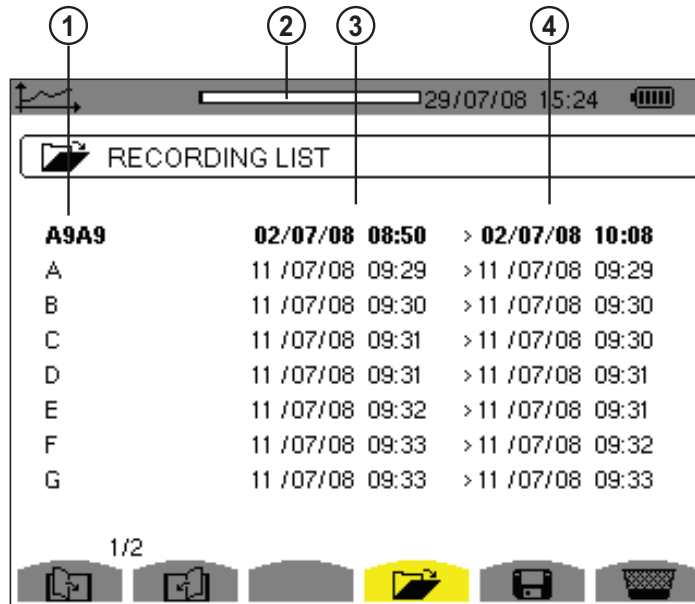







Figure 4-38

Item	Function
1	Recording name
2	Memory usage
3	Recording start time
4	Recording end time

### 4.5.4 DELETING A RECORDING

1. Press the  icon's yellow button
2. Select the recording to be deleted using the  or  button, then press the  button to confirm deletion.

To leave this screen without deleting any alarm, press the  button.

## 4.6 POWER AND ENERGY MODE

This screen displays power and energy measurements. Note that the fields in this screen depend on which filter is selected:

- For 2- and 3-wire single-phase connections and for the 2-wire two-phase connection, only the filter selection L1 is available. The filter is therefore not displayed; but the display is the same as for L1.
- For the 3-wire three-phase connection, only the  $\Sigma$  filter selection is available. The filter is therefore not displayed, but the display is the same as for  $\Sigma$ .

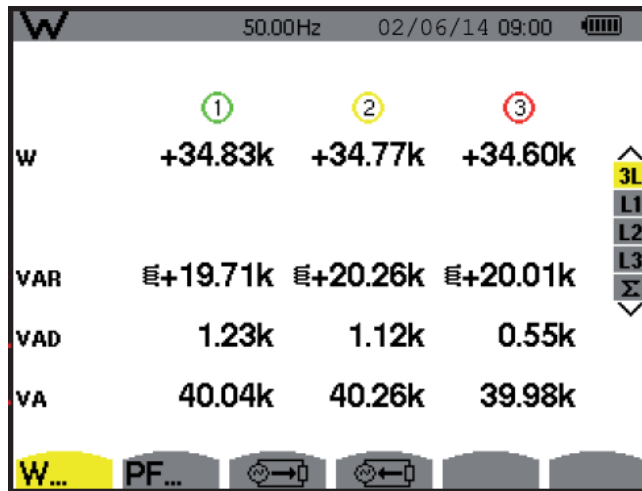


Figure 4-39

At the bottom of the Power and Energy screen are several buttons:

Item	Function
W...	Power
PF...	Power Factor (this button is only available for the 3L filter)
Wh...	Energy Meters (this button is not available for the 3L filter)
⊖→⊞	Energy consumed (active, reactive, and apparent power) (this button is only available for the 3L filter)
⊖←⊞	Energy generated (active, reactive, and apparent power) (this button is only available for the 3L filter)

Each of these buttons displays a sub-screen containing power and energy values.

On the right side of the screen are a set of filters: 3L, L1, L2, L3, and  $\Sigma$ . Use the ▲ and ▼ buttons to choose the filter. The values displayed on the Power and Energy screens are dependent on which of these filters is selected; different data will appear for different filters. The following sections describe how these screens appear for the 3L, L1/L2/L3 (all three display the same fields), and  $\Sigma$  filters.

#### 4.6.1 3L FILTER

By default, the Power and Energy screen opens with the Powers screen displayed (see Figure 4-39). The values in this screen are as follows:

Item	Function
W	Active power
VAR	Reactive power
VAD	Distortion power. This value only appears when the <b>Non-Active Values</b> setting is set to <b>Separated</b> in the <b>VAR</b> tab of the Calculation Methods screen. If this setting is set to <b>Combined</b> , the VAD value does not appear and the VAR label corresponds to the non-active power (N). This non-active power is unsigned and has no inductive or capacitive effect.
VA	Apparent power

The screen also shows DC energy if a DC sensor is connected to the Model 8435.

#### 4.6.1.1 3L POWER FACTOR

The PF (Power Factor) screen displays the quantities associated with powers.

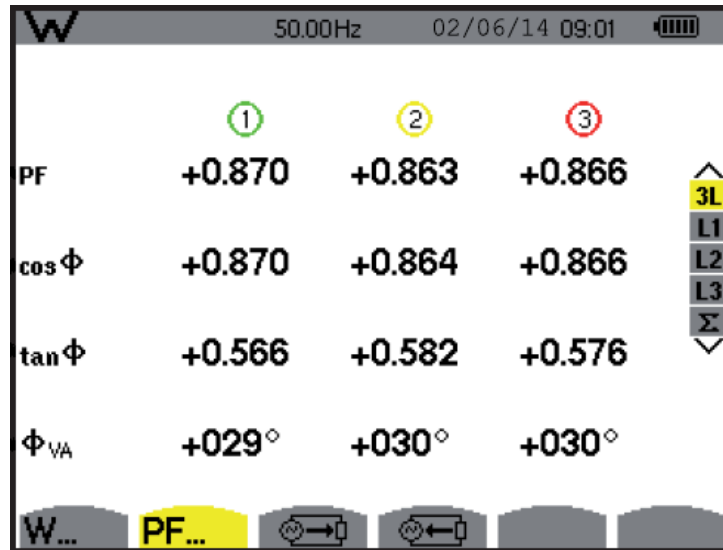


Figure 4-40

The values in this screen are as follows:

Item	Function
PF	Power factor
cos $\Phi$	Fundamental power factor (also called DPF - displacement factor)
tan $\Phi$	Phase shift of the voltage with respect to current
$\Phi_{VA}$	Phase shift of phase-to-neutral voltage with respect to current

#### 4.6.1.2 3L ENERGY CONSUMED

The Energy Consumed screen displays the meters of energy consumed by the load.

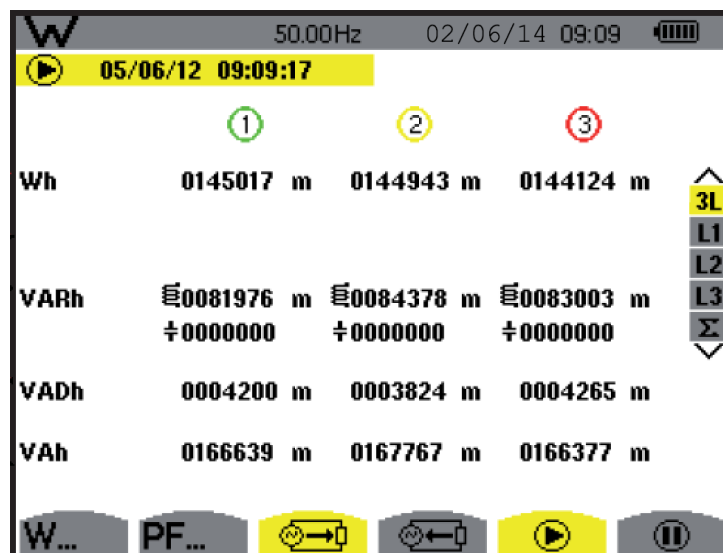




Figure 4-41

The values in this screen are as follows:

Item	Function
Wh	Active energy consumed
VARh	Reactive energy consumed
VADh	Distortion energy. This value only appears when the <b>Non-Active Values</b> setting is set to <b>Separated</b> in the <b>VAR</b> tab of the Calculation Methods screen. If this setting is set to <b>Combined</b> , the VADh value does not appear and the VARh label corresponds to the non-active power (N). This non-active power is unsigned and has no inductive or capacitive effect.
VAh	Apparent energy consumed
	Inductive reactive effect
	Capacitive reactive effect

The screen also shows DC energy if a DC sensor is connected to the Model 8435.

#### 4.6.1.3 3L ENERGY GENERATED

The  Energy Generated screen displays the meters of the energy generated by the load.

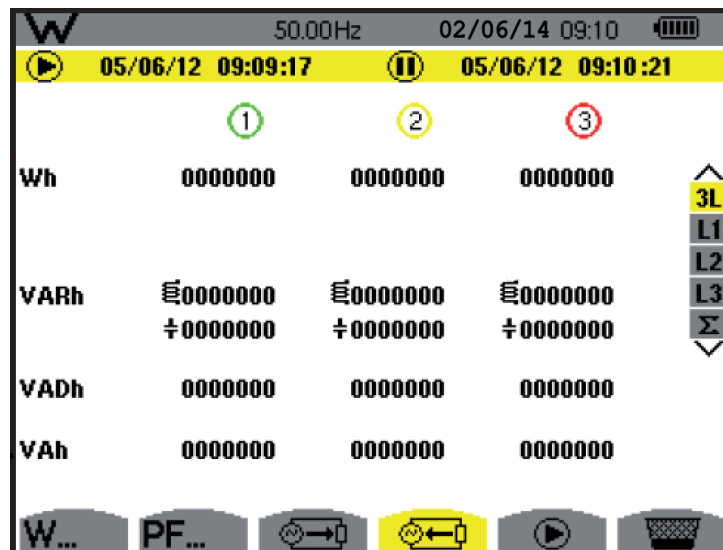




Figure 4-42

The values in this screen are as follows:

Item	Function
Wh	Active energy generated
VARh	Reactive energy generated
VADh	Distortion energy. This value only appears when the <b>Non-Active Values</b> setting is set to <b>Separated</b> in the <b>VAR</b> tab of the Calculation Methods screen. If this setting is set to <b>Combined</b> , the VADh value does not appear and the VARh label corresponds to the non-active power (N). This non-active power is unsigned and has no inductive or capacitive effect.
VAh	Apparent energy consumed
	Inductive reactive effect
	Capacitive reactive effect

The screen also shows DC energy if a DC sensor is connected to the Model 8435.

#### 4.6.2 L1, L2, AND L3 FILTERS

The screens that appear when the L1, L2, or L3 filter is selected all display the same variables. When any of these filters is selected, the Powers screen appears as shown in Figure 4-43:

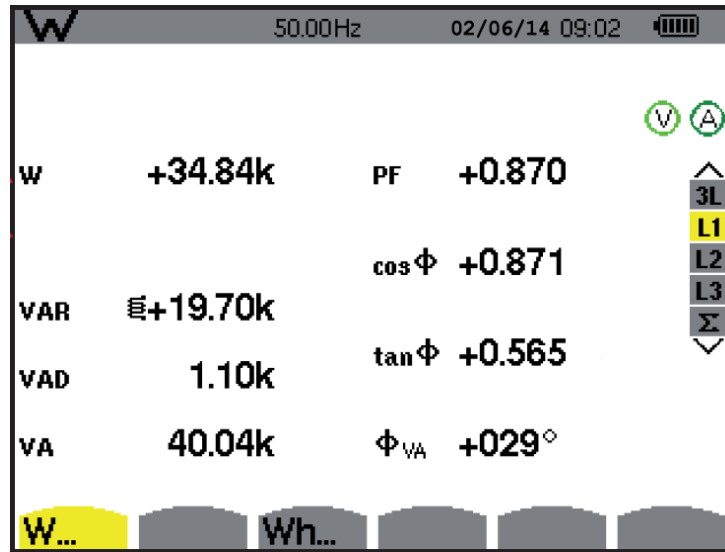


Figure 4-43

The values in this screen are as follows:

Item	Function
<b>W</b>	Active power
<b>VAR</b>	Reactive power
<b>VAD</b>	Distortion power. This value only appears when the <b>Non-Active Values</b> setting is set to <b>Separated</b> in the <b>VAR</b> tab of the Calculation Methods screen. If this setting is set to <b>Combined</b> , the VAD value does not appear and the VAR label corresponds to the non-active power (N). This non-active power is unsigned and has no inductive or capacitive effect.
<b>VA</b>	Apparent power
<b>PF</b>	Power factor
<b>cos Φ</b>	Fundamental power factor (also called DPF - displacement factor)
<b>tan Φ</b>	Tangent of the phase shift
<b>Φ VA</b>	Phase shift of voltage with respect to current (Φ is displayed for the 2-wire two-phase set-up).

The screen also shows DC energy if a DC sensor is connected to the Model 8435.

Φ VA is displayed for the 2-wire 2-phase set-up.

### 4.6.2.1 L1, L2, L3 ENERGY METERS

The Wh... screen displays the energy meters.

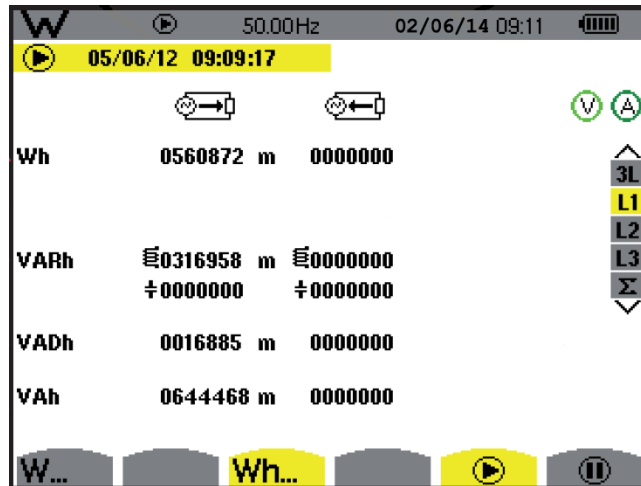


Figure 4-44

The values in this screen are as follows:

Item	Function
	Meters of the energy consumed by the load
	Meters of the energy generated by the load
<b>Wh</b>	Active energy
<b>VARh</b>	Reactive energy
<b>VADh</b>	Distortion energy. This value only appears when the <b>Non-Active Values</b> setting is set to <b>Separated</b> in the <b>VAR</b> tab of the Calculation Methods screen. If this setting is set to <b>Combined</b> , the VADh value does not appear and the VARh label corresponds to the non-active power (N). This non-active power is unsigned and has no inductive or capacitive effect.
<b>VAh</b>	Apparent energy consumed
	Inductive reactive effect
	Capacitive reactive effect

The screen also shows DC energy if a DC sensor is connected to the Model 8435.

Filters L2 and L3 display the same information for phases 2 and 3.

### 4.6.3 Σ FILTER

When the Σ filter is selected, the W... screen appears as shown in Figure 4-45:

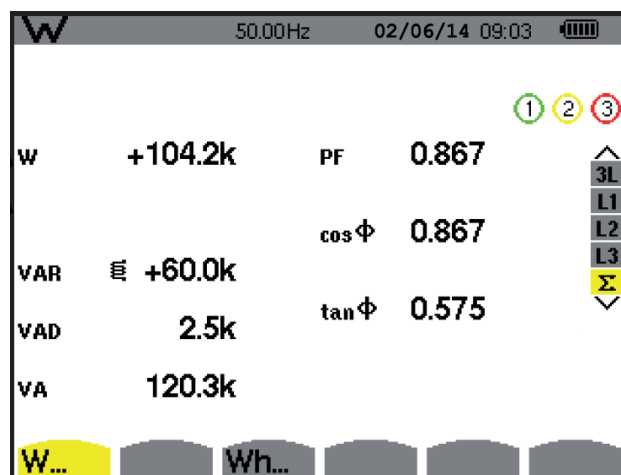


Figure 4-45

The values in this screen are as follows:

Item	Function
W	Active power
VAR	Reactive power
VAD	Distortion power. This value only appears when the <b>Non-Active Values</b> setting is set to <b>Separated</b> in the <b>VAR</b> tab of the Calculation Methods screen. If this setting is set to <b>Combined</b> , the VAD value does not appear and the VAR label corresponds to the non-active power (N). This non-active power is unsigned and has no inductive or capacitive effect.
VA	Apparent power
PF	Power factor
cos $\Phi$	Fundamental power factor (also called DPF - displacement factor)
tan $\Phi$	Tangent

The screen also shows DC energy if a DC sensor is connected to the Model 8435.

#### 4.6.3.1 $\Sigma$ ENERGY METERS

The **Wh...** screen displays the energy meters.

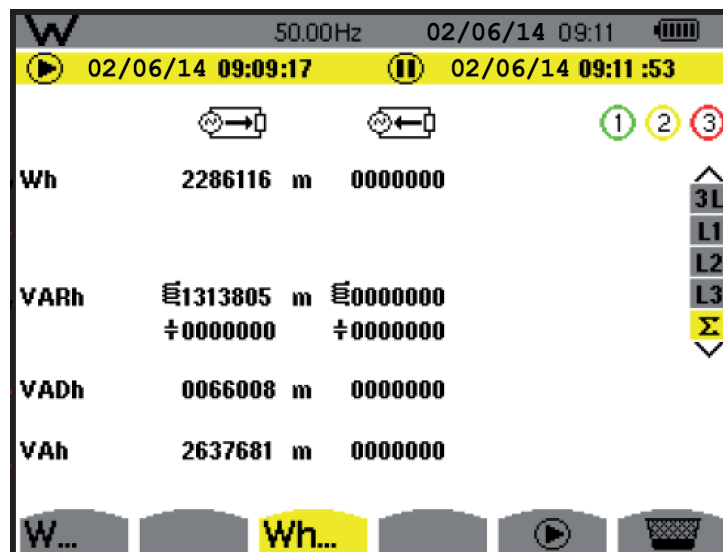


Figure 4-46

The values in this screen are as follows:

Item	Function
$\odot \rightarrow \square$	Meters of the energy consumed by the load
$\odot \leftarrow \square$	Meters of the energy generated by the load
Wh	Active energy
VARh	Reactive energy
VADh	Distortion energy. This value only appears when the <b>Non-Active Values</b> setting is set to <b>Separated</b> in the <b>VAR</b> tab of the Calculation Methods screen. If this setting is set to <b>Combined</b> , the VADh value does not appear and the VARh label corresponds to the non-active power (N). This non-active power is unsigned and has no inductive or capacitive effect.
VAh	Apparent energy consumed
$\equiv$	Inductive reactive effect
$\equiv$	Capacitive reactive effect

The screen also shows DC energy if a DC sensor is connected to the Model 8435.









For the 3-Phase 3-Wire set-up, only the display of total quantities is available; the method of calculation of the powers used is the two-wattmeter method.

Filters L2 and L3 display the same information for phases 2 and 3.






#### 4.6.4 STARTING AND STOPPING ENERGY MEASUREMENTS

To start a measurement:




1. Press the  button while in an energy display (, , or **Wh...**). The date and time at which the measuring starts will appear in the upper left corner of the screen, and the  icon on the screen blinks to indicate that energy metering is in progress.
2. To stop the measurement, press the  button. The date and time at which the measuring stops will appear in the upper right corner of the screen. The  icon is also replaced by the  icon.
3. To resume metering, press the  button again.

---

 **NOTE:** If no recording is in progress, disconnecting the energy metering results in the appearance of the blinking  icon in the status bar (in place of the  icon).





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#### 4.6.5 RESETTING THE ENERGY MEASUREMENT

To reset the measurement, press the  button to stop metering. Then press the  button, and then  to confirm. All energy values (consumed and generated) are reset.

#### 4.7 SNAPSHOT MODE

This button allows 50 snapshots to be saved for future recall and evaluation.


- Press the  button (for about 3s) to capture the current display.
- The  icon is displayed in the top left corner as soon as the operation is successful.
- This icon is replaced by  if there is no space left in the memory to record the display.
- The snapshot will record all measurements present at the input of the meter when you press the  button.

---

 These screens can be downloaded to a computer using DataView®

---

#### 4.7.1 OPENING A PREVIOUSLY SAVED SNAPSHOT

- A **short press** (about 1s) on the  button gives access to the menu of snapshots that have been saved.
- The small icon to the left of each snapshot (date and time) tells you what type of data was stored.

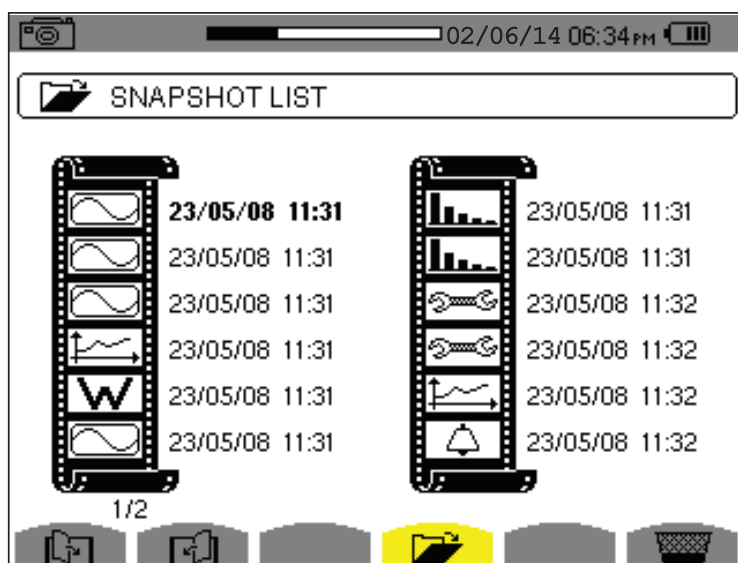






Figure 4-47



- Use the ▲ or ▼ buttons to select the snapshot.
- To display the snapshot, press the  button, then the  button.
- After reviewing the snapshot, press the  button again to return to the list of saved snapshots.


---

 The various storage spaces in the Model 8435 are of a fixed size and are completely independent. There are four memory spaces available (alarms, snapshot, transients and recordings).

---

#### 4.7.2 DELETING A SNAPSHOT

1. Press the  icon's yellow button.
2. Select the snapshot to be deleted using the ▲ or ▼ button, then press the  button to confirm deletion.

To leave this screen without deleting any alarm, press the  button.

#### 4.8 HELP

Press this button to obtain help for the current display mode.

To exit the Help mode, press the  button once again.

---

## 5. DATAVIEW® SOFTWARE

---

### 5.1 INSTALLING DATAVIEW®

**i** DO NOT CONNECT THE INSTRUMENT TO THE PC BEFORE INSTALLING THE SOFTWARE AND DRIVERS.

---

**i** **NOTE:** When installing, the user must have Administrative access rights during the installation. The users access rights can be changed after the installation is complete. DataView® must be reinstalled for each user in a multi-user system.

---

#### 5.1.1 USB FLASH DRIVE INSTALL

1. Insert the USB stick into an available USB port (wait for driver to be installed).
2. If Autorun is enabled then an AutoPlay window should appear as shown.

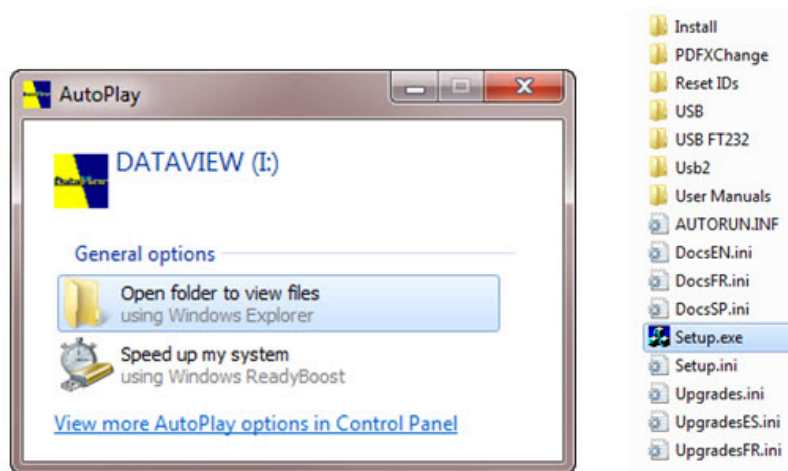


Figure 5-1

**i** **NOTE:** If Autorun is disabled, it will be necessary to open Windows Explorer, then locate and open the USB stick drive labeled “DataView” to view the files on the drive.

---

3. In the AutoPlay window, select **Open Folder to view Files**.
4. Double-click on **Setup.exe** from the opened folder view to launch the DataView setup program.

**i** **NOTE:** Depending on your operating system, the **User Account Control** dialog box may be displayed. Provide a positive response when prompted to proceed.

---

5. A **Set-up** window, similar to the following, will appear.

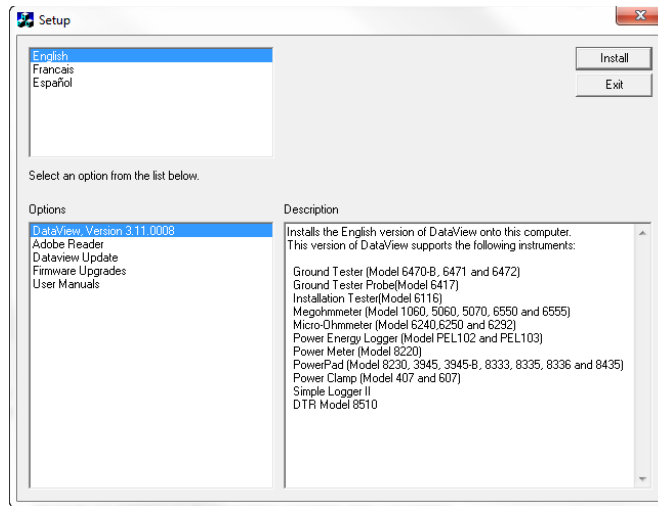


Figure 5-2

There are several different options to choose from. Some options<sup>(\*)</sup> require an internet connection.

- **DataView, Version x.xx.xxxx** - Installs DataView® onto the PC.
- **\*Adobe Reader** - Links to the Adobe® website to download the most recent version of Adobe® Reader to the computer. *Adobe® Reader is required for viewing PDF documents supplied with DataView®.*
- **\*DataView Updates** - Links to the online DataView® software updates to check for new software version releases.
- **\*Firmware Upgrades** - Links to the online firmware updates to check for new firmware version releases.
- **Documents** - Shows a list of instrument related documents that you can view. Adobe® Reader is required for viewing PDF documents supplied with DataView®.

6. **DataView, Version x.xx.xxxx** option should be selected by default. Select the desired language and then click on **Install**.
7. The **Installation Wizard** window will appear. Click **Next**.
8. To proceed, accept the terms of the license agreement and click **Next**.
9. In the **Customer Information** window, enter a Name and Company, then click **Next**.
10. In the **Setup Type** window that appears, select the **Complete** radio button option, then click **Next**.
11. In the **Select Features** window that appears, select **Power & Quality Analyzers** (and any other instrument control panel(s) that you want to install). You can also deselect any Control Panel that you don't need. Then click **Next**.



**NOTE:** The **PDF-XChange** option must be selected to be able to generate PDF reports from within DataView®.

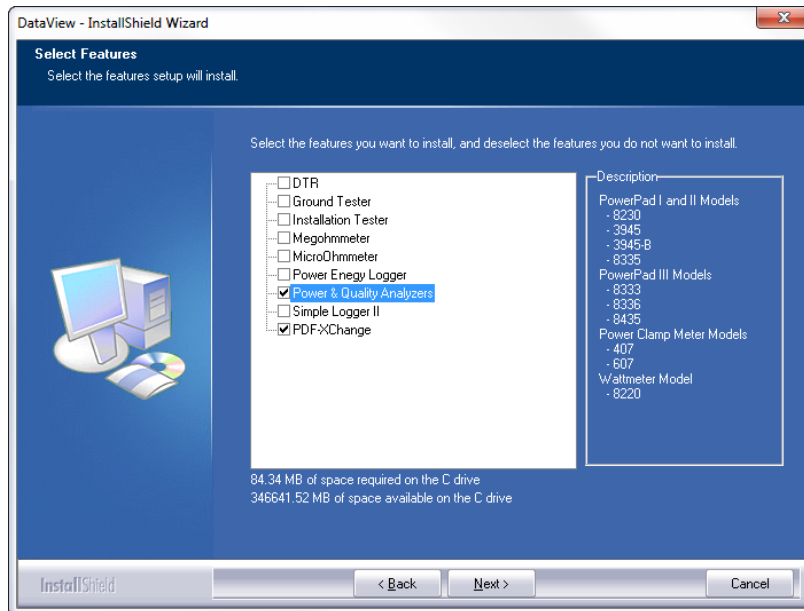


Figure 5-3

12. In the **Ready to Install the Program** window, click on **Install**.

13. If the instrument selected for installation requires the use of a USB port, a warning box will appear, similar to Figure 5-4. Click **OK**.

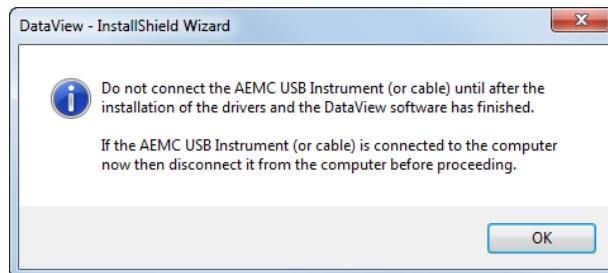


Figure 5-4

---

**NOTE:** The installation of the drivers may take a few moments. Windows may even indicate that it is not responding, however it is running. Please wait for it to finish.

---

14. When the drivers are finished installing, the **Installation Successful** dialog box will appear. Click on **OK**.

15. Next, the **Installation Wizard Complete** window will appear. Click on **Finish**.

16. A **Question** dialog box appears next. Click **Yes** to read the procedure for connecting the instrument to the USB port on the computer.

---

**NOTE:** The Set-up window remains open. You may now select another option to download (e.g. Adobe® Reader), or close the window.

---

17. **Restart** your computer, then connect the instrument to the USB port on the computer.

18. Once connected, the **Found New Hardware** dialog box will appear. Windows will complete the driver installation process automatically.

Shortcuts for DataView® and each instrument control panel selected during the installation process have been added to your desktop.

---

**NOTE:** If you connected your instrument to the computer before installing the software and drivers, you may need to use the **Add/Remove Hardware** utility to remove the instrument driver before repeating the process.

---

## 5.2 CONNECTING THE MODEL 8435 TO YOUR COMPUTER

The Model 8435 is supplied with a USB cable required for connecting the instrument to the computer.


To connect the instrument to your computer:

1. Connect the USB cable to the port on the front panel of the instrument.
2. Connect the other end of the USB cable to a USB port on your computer.
3. Turn the instrument on.

You are now ready to use the DataView® software with the Model 8435.

## 5.3 OPENING THE CONTROL PANEL

To open the PowerPad III Control Panel:

1. Double-click the **PowerPad III** icon  that was created during installation, located on the desktop.
2. The **Connection** window will appear (see Figure 5-5). Once the communication link is established, DataView® will automatically identify the instrument that it is connected to.

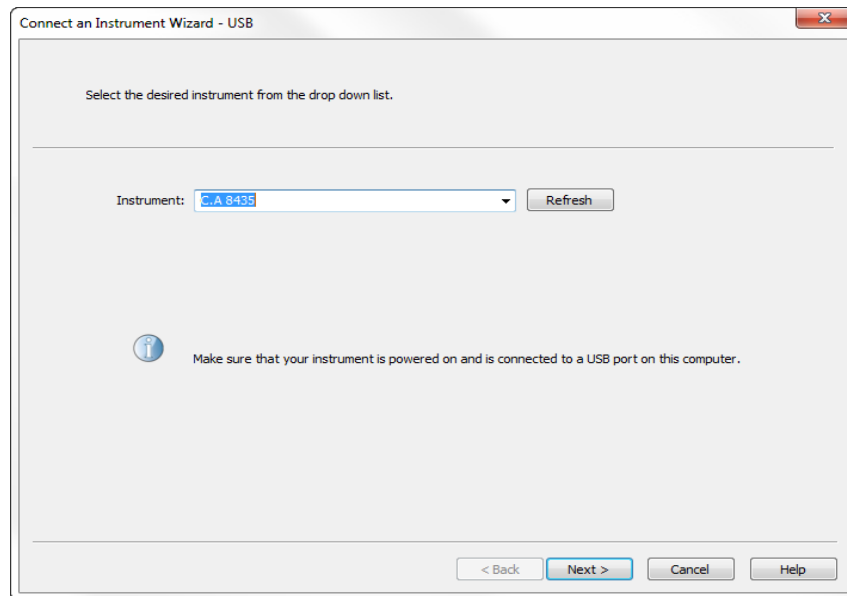


Figure 5-5

3. Make sure the communications port displayed in the dialog box matches the instrument you plugged the USB cable into. If the correct port is not selected, click on the drop-down menu to select it.
4. Click **Next**, then click **Finish** when DataView® indicates it has successfully connected to the instrument. The PowerPad III Control Panel appears.

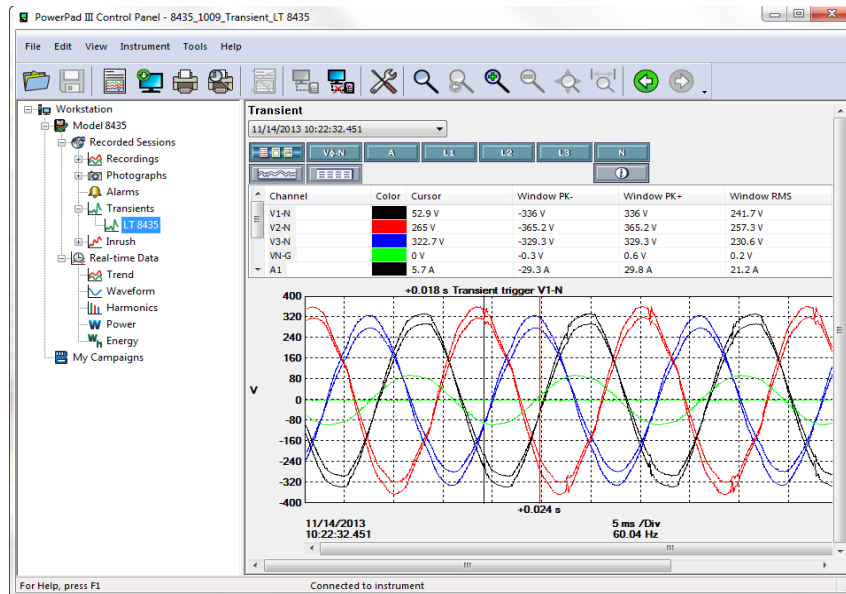


Figure 5-6

The Control Panel user interface consists of multiple components for displaying, modifying, saving, and navigating data recorded on the Model 8435.

- At the very top of the Control Panel is the title bar. The title bar displays the name of the application and the path to the open data file (if any).
- Below the Title bar is the menu bar. The menu bar contains six drop-down menus: File, Edit, View, Instrument, Tools, and Help. Each command in these drop-down menus is associated with the menu name. For example, instrument specific commands are listed under the Instrument menu.
- Below the menu bar is the toolbar. The toolbar contains iconic representations of menu commands; each icon performs the same function as its associated menu command when selected.
- Below the toolbar and to the left is the navigation tree frame. The navigation tree operates much like Windows Explorer does when exploring the folders on your computer. The selected entry in the navigation tree determines what information is displayed in the data frame to the right. For example, selecting the My Open Sessions entry in the navigation tree displays a list of the open sessions (if any) in the data frame. Other data shown in the data frame includes data recorded from the instrument (recordings, photographs, alarms, transients, inrush), real-time data currently being reported by the instrument (trend, waveform, harmonics, power, energy), campaigns, and DataView® reports.
- Below the navigation and data frames is the status bar. The status bar displays a single line of help information (to the left) and instrument connection status (to the right).

## 5.4 CONFIGURING THE INSTRUMENT

The PowerPad III Control Panel also enables you to configure every aspect of the Model 8435. Each field is identical to the programmable features available from the instrument's front panel itself. Several of the functions are configured by typing the appropriate value in the field provided. Others are configured by clicking on the appropriate radio button or icon.

To configure the instrument, select **Instrument** from the menu bar, then click **Configure**. This displays the Configure Instrument dialog box.

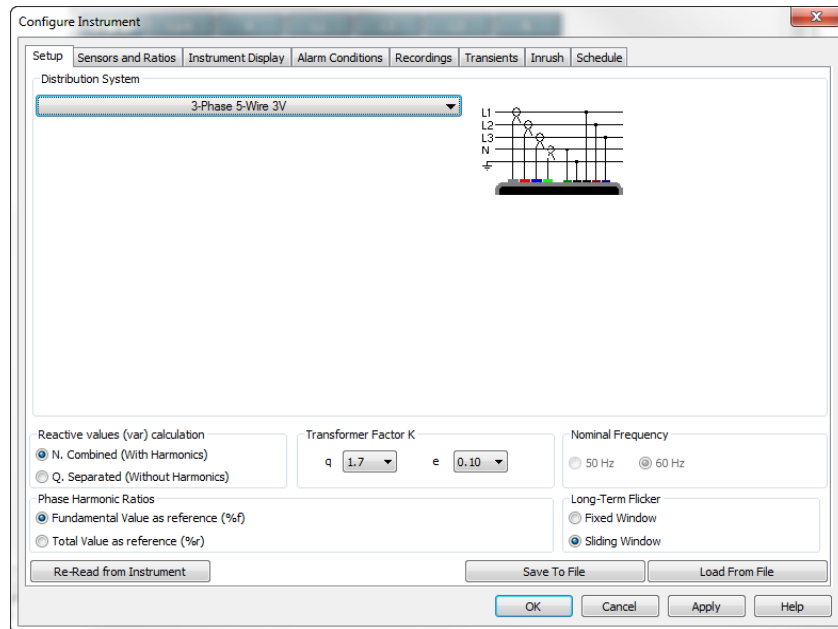


Figure 5-7

The Configure Instrument dialog box consists of eight tabs: Setup, Sensors and Ratios, Instrument Display, Alarm Conditions, Recordings, Transients, Inrush, and Schedule.

At the bottom of each of these tabs are a set of buttons that perform the following tasks:

- **Re-Read from Instrument:** Reads the current configuration of the connected Model 8435.
- **Save to File:** Saves the current configuration. This file will reside on the computer's disk drive. Saving different configuration setups can be useful for future functions and tests.
- **Load from File:** Retrieves a saved file from the computer's disk drive to be used in programming the Model 8435.
- **OK:** Writes the current configuration to the instrument and closes the open dialog box.
- **Cancel:** Exits the dialog box without writing the configuration to the instrument.
- **Apply:** Programs the instrument using the current settings without closing the window.
- **Help:** Opens the online Help.

### 5.4.1 SETUP

The **Setup** tab (shown in Figure 5-7) enables you to select the distribution system and associated parameters. This tab includes the following selections:

- **Distribution System** defines the hook-up to be tested. Options are 1-Phase (2 and 3 wire), 2-Phase (2, 3, and 4 wire), and 3-Phase (3, 4, and 5 wire).
- **Transformer Factor K** sets the q and e settings for the factor K (also called K-factor).
- **Nominal Frequency:** 50 or 60Hz. This parameter determines the correction coefficients used for calculating power and energy.



- **Phase Harmonics Ratio:** Options are **Fundamental Value as reference (%f)** and **Total Value as reference (%)**.
- **Long-Term Flicker:** Options are **Fixed Window** and **Sliding Window**.

### 5.4.2 SENSORS AND RATIOS

The Sensors and Ratios tab defines the voltage ratios and current ratios (when available) so final values can be adjusted, recorded, and displayed with correct magnitudes. The ability to set the current probe ratio is dependent on the type of probe used.

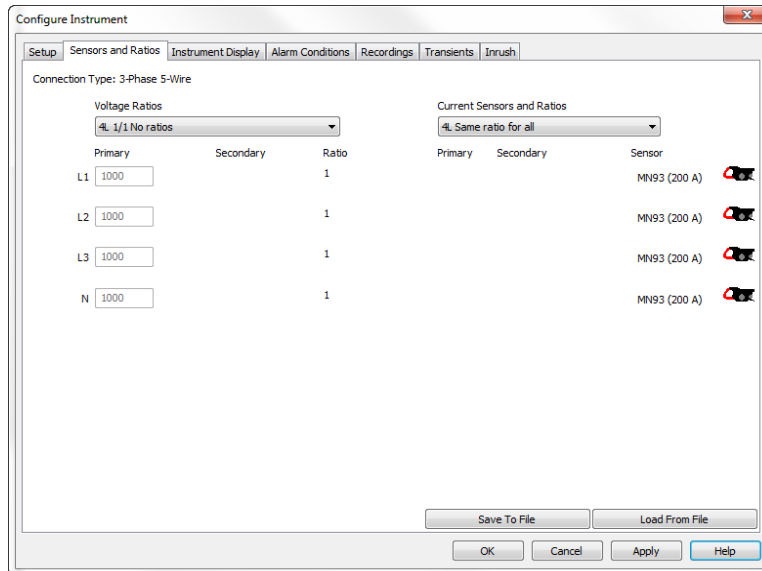


Figure 5-8

**NOTE:** For detailed instructions and descriptions for any feature in this and any other Control Panel dialog box, click on the **Help** button (lower right-side of the dialog box).

### 5.4.3 INSTRUMENT DISPLAY

The Instrument Display tab allows you to customize the display (colors, clock, language and contrast) and specify energy units to use.

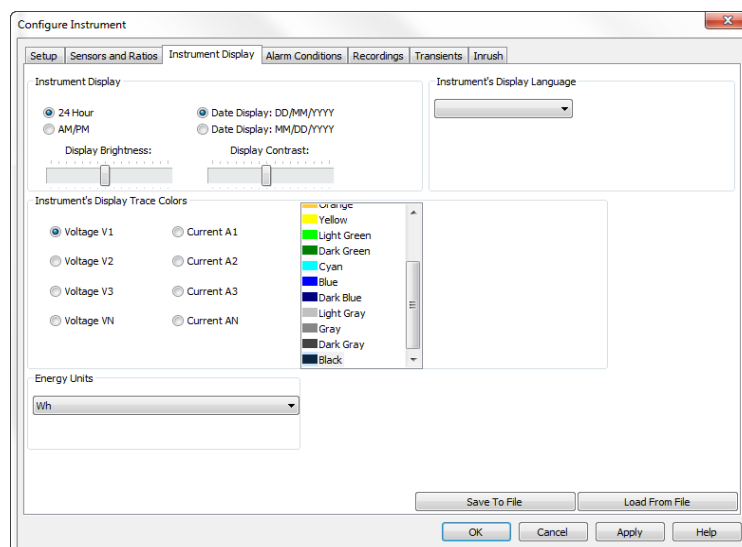


Figure 5-9

## 5.4.4 ALARM CONDITIONS

The Alarm Conditions tab allows you to set up 40 alarm configurations.

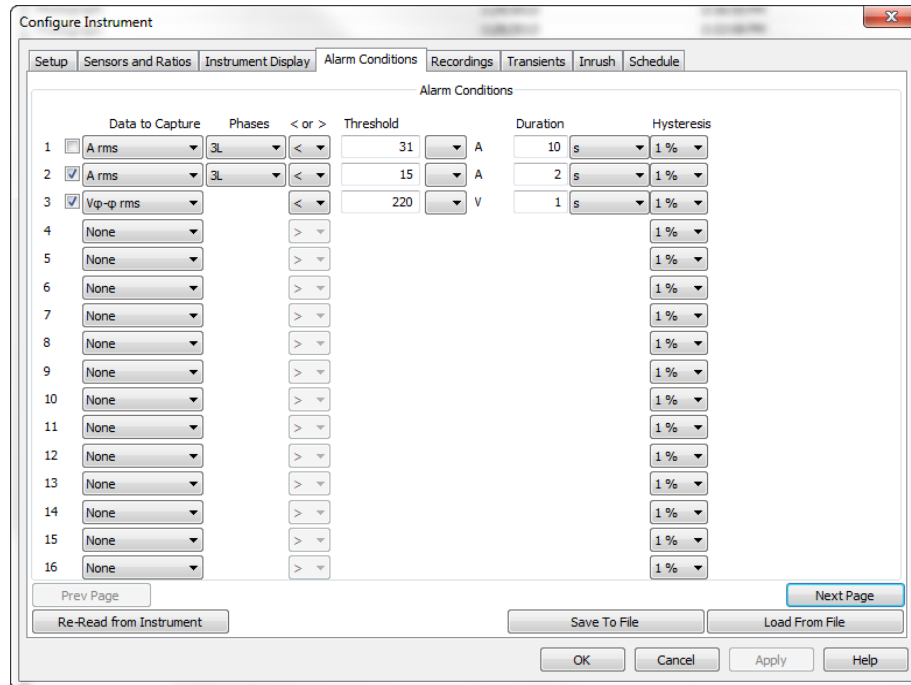


Figure 5-10

- **Prev Page & Next Page:** Move between the 3 pages of alarms with 16 alarms per page.
- **Data to Capture:** The alarm will be triggered based on the value of the selected parameter. Choices include:

**None:** no alarm

**A CF:** current crest factor

**A DC:** DC current

**A Hf:** current harmonic factor

**A rms:** current root mean squared

**A pk+:** maximum peak value of the current

**A pk-:** minimum peak value of the current

**A THDf:** harmonic distortion of the current with the RMS value of the fundamental as reference

**A THDr:** harmonic distortion of the current with the total RMS value without DC as reference

**Aunb (u2):** unbalance in current

**Hz:** frequency

**P DC (W):** Power (DC)

**PF:** power factor

**Plt:** long-term severity

**Pst:** short-term severity

**P (W):** power

**Q (var):** voltage/ampere reactive

**S (VA):** volt/ampere

**Tan  $\Phi$ :** Tangent of the phase shift of the voltage with respect to the current

**V $\Phi$ - $\Phi$  CF:** phase-to-phase voltage crest factor

**V $\Phi$ - $\Phi$  rms:** phase-to-phase voltage root mean squared

**V $\Phi$ - $\Phi$  THDf:** harmonic distortion of the phase-to-phase voltage with the fundamental RMS value as reference

**V $\Phi$ - $\Phi$  THDr:** harmonic distortion of the phase-to-phase voltage with the total RMS value without DC as reference

**V $\Phi$ -N CF:** phase-to-neutral voltage crest factor

**V $\Phi$ -N DC:** DC phase-to-neutral voltage

**V $\Phi$ -N Hf:** phase-to-neutral voltage harmonic factor

**V $\Phi$ -N pk+:** maximum phase-to-neutral voltage

**V $\Phi$ -N pk-:** minimum phase-to-neutral voltage

**V $\Phi$ -N rms:** phase-to-neutral voltage root mean squared

**V $\Phi$ -N THDf:** harmonic distortion of the phase-to-neutral voltage with the fundamental RMS value as reference

<b>D (var):</b>	<b>VΦ-Φ DC:</b> DC phase-to phase voltage	<b>VΦ-N THDr:</b> harmonic distortion of the phase-to-neutral voltage with the total RMS value without DC as reference
<b>DPF (cos Φ):</b> displacement factor	<b>VΦ-Φ Hf:</b> phase-to-phase voltage harmonic factor	<b>VΦ-N un<sub>b</sub> (2):</b> phase-to-neutral voltage unbalance
<b>FHL:</b> harmonic loss factor	<b>VΦ-Φ pk+:</b> maximum phase-to-phase voltage	<b>VA Hf:</b> Apparent power harmonic factor
<b>FK:</b> factor K (K factor)	<b>VΦ-Φ pk-:</b> minimum phase-to-phase voltage	

- **Phases:** Options are 3L, N, and 4L.
- **< or >:** Determines whether the alarm condition is triggered when the measurement exceeds or falls below the threshold alarm setting.
- **Threshold:** The value that must be reached to start an alarm. For “>” alarms, the value or higher must be reached. For “<” alarms, the value or lower must be reached. To the right of this setting is a button that displays a drop-down menu from which you can select the appropriate unit of measurement.
- **Duration:** The alarm will only be recorded if the duration of the parameter meeting the threshold criteria exceeds the duration. The minimum alarm duration can be in minutes or seconds. In the case of Vrms, Urms, or Arms not using neutral current, this setting can also be in hundredths of a second. For Vrms, Urms, and Arms, it can be useful to set a duration of 0 seconds. In that case an event as short as a half cycle can be detected (8 milliseconds at 60Hz). For all other parameters, the minimum duration that can be detected is 1 second.
- **Hysteresis:** This value for alarms is set to prevent multiple recordings of an event that goes above the threshold and a certain percentage below it at times.

---

**Example:** Alarm threshold is 100 Volts or higher, hysteresis is 1%. When the voltage goes up to 100V, the alarm condition starts. When it goes back down to 99V, the alarm condition stops.

---

**NOTE:** You can configure alarms, recordings, Inrush, and transient searches while testing is in progress.

## 5.4.5 RECORDINGS

The Recordings tab shows the parameters for a recording session.

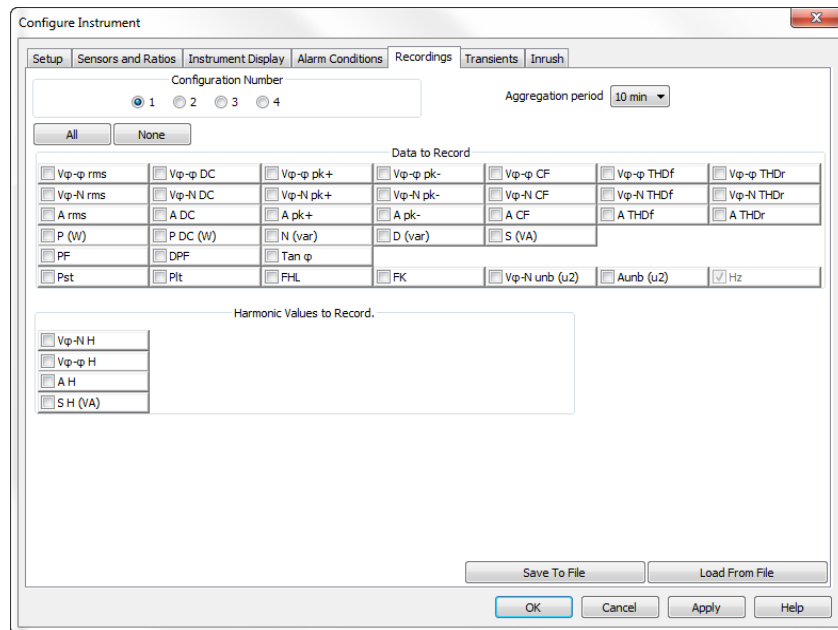


Figure 5-11

Four different configurations are available. More configurations can be saved by pressing **Save to File** and recalled later by pressing **Load From File**.

1. Select the configuration to set up: 1, 2, 3, or 4.
2. Check the box for each parameter desired in the **Data to Record** section.
3. Configure the harmonic values to be recorded, if desired.
4. Choose an **Aggregation Period** for the recording, which sets how often the recording updates while it is running.

**i** The Model 8435 loses its scheduled recording if it is powered off before the recording begins. If it is powered off during the recording, a partial recording will usually still exist but with the first letter of its name changed to “@”. The start and end times requested for the recording might be adjusted by the Model 8435 to be in even multiples of the averaging period. For instance, if an integration period of 10 minutes was requested, and the start time was 9:03, the recording might not actually begin until 9:10.

## 5.4.6 TRANSIENTS

The Transients tab allows you to set up the criteria for capturing transients.

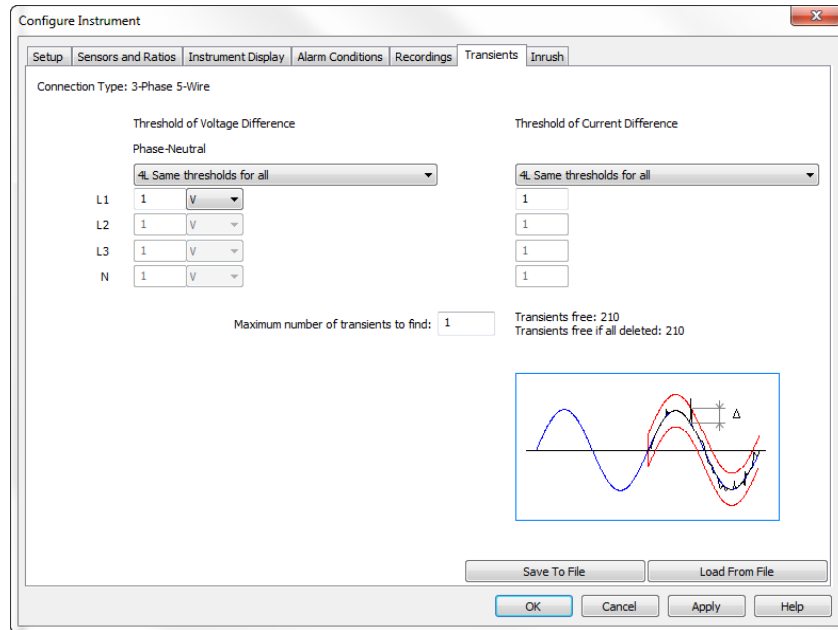


Figure 5-12

1. In the **Threshold of Voltage Difference** section of the dialog box, select from the drop-down menu one of the following options: **4L Same thresholds for all**, **3L+N Same except N has its own threshold**, or **L1+I2+I3+N Separate thresholds**.
2. Based on the preceding selection, fill in appropriate values for L1, L2, L3, and N. (Some of these may be grayed out and inactive, depending on the selected connection type.)
3. Select **Maximum number of transients to find**. If previous transients are stored in the memory, the maximum available will be reduced appropriately. The information is available on the screen.
4. In the **Threshold of Current Difference** section of the dialog box, select the appropriate option in the drop-down menu. Available options are the same as those in the Threshold of Voltage Difference drop-down menu.

The configuration settings can be saved to a file by clicking the **Save to File** button and selecting a file name. A previously saved configuration can be loaded by clicking the **Load From File** button. A present configuration in the instrument (if connected) can be read by clicking **Re-Read From Instrument**.

## 5.4.7 INRUSH

The Inrush tab shows the dialog box used to configure the parameters for an Inrush search.

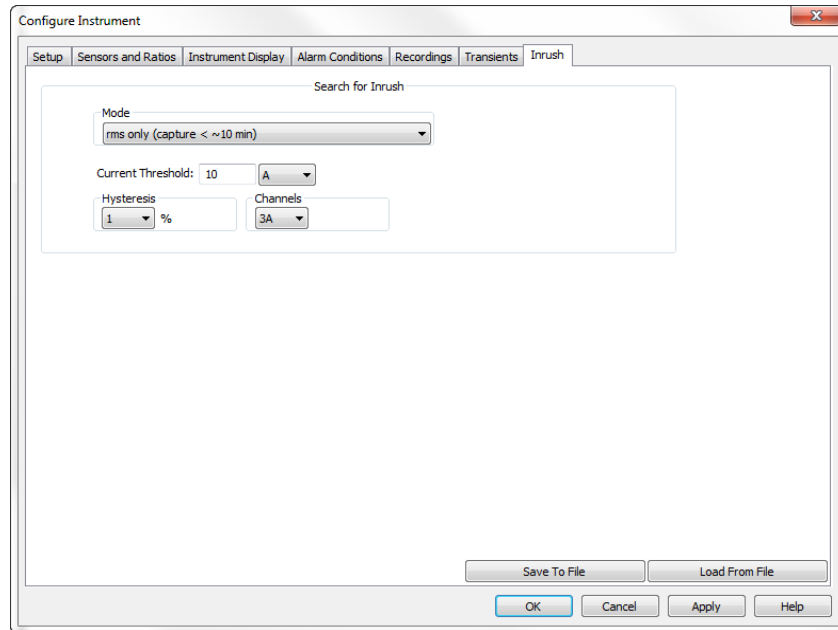



Figure 5-13

Inrush current is measured when the power is first turned on. Depending on the type of load, the Inrush current may be very high for some time when compared with steady state current later on. The parameters can be set up here.

- **Mode:** Select **RMS+ Peak (< ~1 min Capture)** or **RMS Only (<~10 min Capture)**.
- **Current Threshold:** Type in the appropriate value, and select the units from the adjacent drop-down menu (mA, A, kA).
- **Hysteresis:** Select the percentage from the drop-down menu (0, 1, 2, 5, 10, 20, 50, or 100).
- **Channel:** Select the number for the the Inrush recording.

Click **OK** to write the configurations to the instrument and close the Configuration dialog box.

---

 **NOTE:** For more information about configuring the Model 8435 from the PowerPad III Control Panel, consult the Help file within the software.

---

## 5.5 REAL-TIME DATA

When your setup is completed, you can display different views on the screen of real-time data and waveforms.

### 5.5.1 TREND

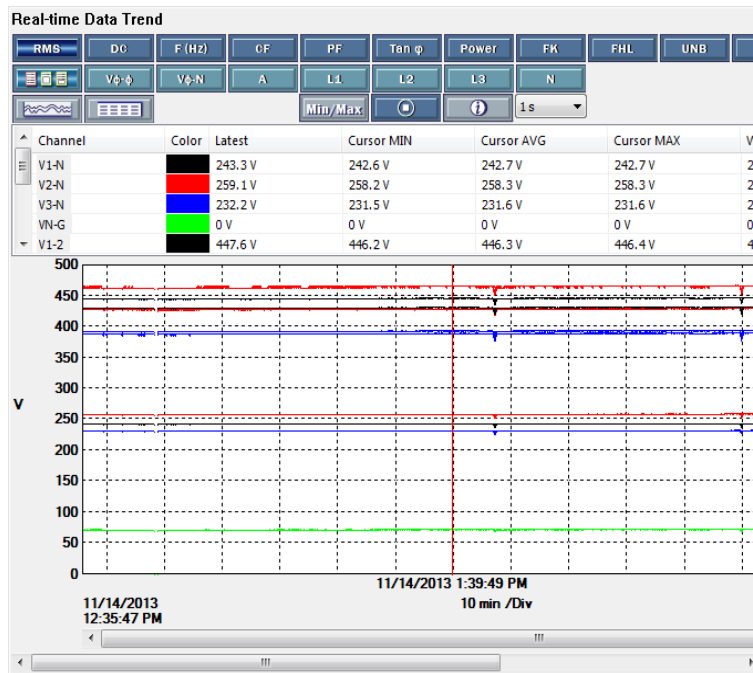


Figure 5-14

This display shows a real-time trend of data from the Model 8435. The data is an average of waveforms downloaded to the PC whose scale adjusts constantly to fit all the data it has received.

### 5.5.2 WAVEFORM

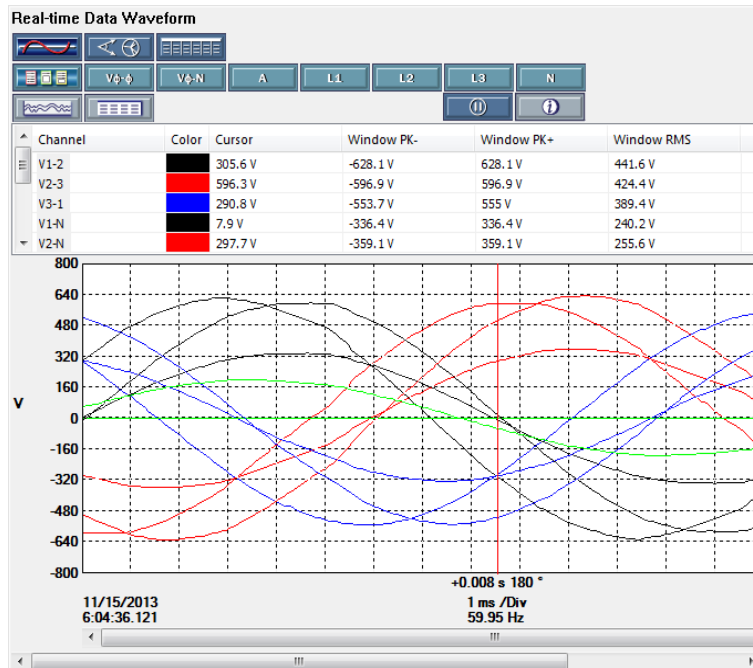




Figure 5-15

You can select the type of data to display using the buttons at the top of the Waveform display. Stop the update with the  (Pause) button, and resume with the  (Play) button.

### 5.5.3 HARMONICS

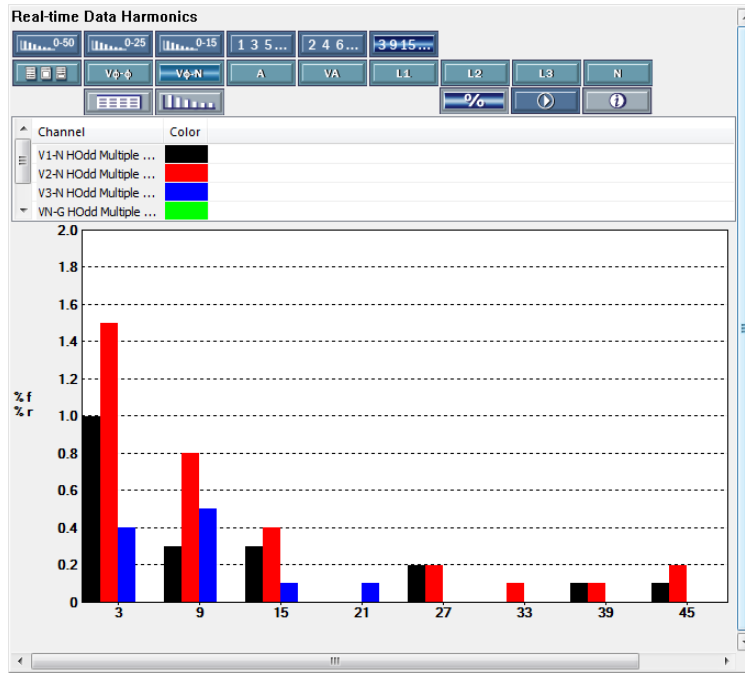


Figure 5-16

This screen displays harmonic data up to the 50th harmonic for voltage or current for selected phase(s) of the available channels or neutral (N). The voltage harmonics can be selected for phase-to-phase voltage or phase-to-neutral voltage or neutral-to-ground voltage. The Harmonics is displayed as a % of the fundamental (%f) as default. Harmonics are displayed as absolute voltage by pressing % button. Similarly, the current harmonics can be selected for each phase and neutral.

### 5.5.4 POWER

The Real-time Data Power window displays a table of accumulated power data for two lines. The data is as follows:

Date:	Time:	Parameter	Line 1	Line 2
11/15/2013	8:00:13 AM	Power		
		P (W)	5.097 kW	5.765 kW
		P DC (W)	---	---
		N (var)	0.2506 kvar	0.2908 kvar
		S (VA)	5.103 kVA	5.772 kVA
		PF	0.999	0.999
		Cos $\phi$	0.999	0.999
		Tan $\phi$	0.047	0.049
		$\phi$ (A, V $\phi$ -N)	3°	3°

Figure 5-17

The Real-time Data Power window displays accumulated power data. The data can be started or stopped using the (Pause) and (Play) buttons, and the results can be downloaded to a database and viewed on the screen, selected by phase.





The data for all available phases are downloaded to a database or spreadsheet, not just what is shown on the screen.

### 5.5.5 ENERGY

Real-time Data Energy

Date:	Time:	Parameter	Line 1	Line 2	Line 3
11/25/2013	9:10:01 AM	Energy Start			
11/25/2013	9:10:21 AM	Energy Stop			
		P (Wh) Net	0 Wh	0 Wh	0 Wh
		P (Wh) Load	0 Wh	0 Wh	0 Wh
		P (Wh) Source	0 Wh	0 Wh	0 Wh
		P DC (Wh) Net	0 Wh	0 Wh	0 Wh
		P DC (Wh) Load	0 Wh	0 Wh	0 Wh
		P DC (Wh) Source	0 Wh	0 Wh	0 Wh
		Q (varh) Net	0 varh	0 varh	0 varh
		Q (varh) Inductive Load (q1)	0 varh	0 varh	0 varh
		Q (varh) Capacitive Source (q2)	0 varh	0 varh	0 varh
		Q (varh) Inductive Source (q3)	0 varh	0 varh	0 varh
		Q (varh) Capacitive Load (q4)	0 varh	0 varh	0 varh
		D (varh) Net	0 varh	0 varh	0 varh
		D (varh) Load	0 varh	0 varh	0 varh
		D (varh) Source	0 varh	0 varh	0 varh
		S (VAh) Net	0 VAh	0 VAh	0 VAh
		S (VAh) Load	0 VAh	0 VAh	0 VAh
		S (VAh) Source	0 VAh	0 VAh	0 VAh

Figure 5-18

The Real-time Data Energy window resembles the Power window. The Energy window displays accumulated energy data, and can be started or stopped; the results can be downloaded to a database and viewed on the screen, selected by phase.

### 5.6 DOWNLOADING DATA

To download recorded data, select **Instrument** from the menu bar and click **Download Recorded Data**. The Control Panel prompts you to confirm that you want to download all the data from the instrument. Click **Yes** to initiate the download. The Download dialog box appears.

Instrument name	Description	Status of download	Time Added
Model 8435 1005	All 2 recorded data	Completed	11/8/2013 1:09:04 PM
Model 8435 1009	All 15 recorded data	1% Estimated 1 h 25 min 31 s to complete.	11/15/2013 8:07:18 AM

Buttons: Clear, Clear List, Open, Pause/Resume

Figure 5-19

This dialog box lists the recorded sessions, photographs, alarms, transients, and Inrush data stored on the instrument. The download progress is shown in the **Status of download** column. When downloading is complete, click **Open** to view a list of recorded sessions. These appear under Recorded Sessions on the left side of the Control Panel display. Click on the listed item to view its recorded data. You can format this data as a DataView® report by opening the **File** menu and selecting **Create DataView Report**. You can also view the data as an Excel-compatible spreadsheet by selecting **Export to a Spreadsheet** from the **File** menu.

From the Downloads dialog box you can delete files listed in the Downloads dialog box by using the buttons **Clear** (to delete a selected session) or **Clear List** (to delete all sessions from the list). Note that this does not affect the files stored on the Model 8435; any file deleted through the Downloads dialog box remains on the instrument and can be downloaded at a future time.

### 5.6.1 RECORDINGS

**Recordings** in the navigation frame on the left side of the Control Panel lists all recordings downloaded from the Model 8435. A recording can be downloaded to a database on the PC by selecting it and clicking **Save** or **Save As** from the **File** menu. This saves the session as an .icp file within DataView®. This file can later be opened by selecting **File** from the menu bar and clicking **Open**; this displays a dialog box for locating the file to be opened.

### 5.6.2 PHOTOGRAPHS

**Photographs** in the navigation frame displays a list of photographs (snapshots), with the date and time, taken when the camera button was pressed.

Clicking on a recorded snapshot shows the data at the time the camera button was pressed.



Snapshots can only be initiated using the camera button on the Model 8435 itself, not by DataView®.



---

### 5.6.3 ALARMS

Clicking **Alarms** in the navigation frame displays a list of alarms that were recorded on the Model 8435. Details on the alarm search are available by clicking on the desired alarm set, which opens up an alarm window with the search details. Alarm search data can be selected and downloaded to a spreadsheet or a DataView® report by opening the **File** menu and selecting the appropriate commands.

### 5.6.4 TRANSIENTS

The **Transients** tab displays transients stored on the Model 8435. It shows the number and name of the recording, and the time it began and ended. The selected transient(s) can either be downloaded or deleted.

The downloaded data contains many waveforms. Use the navigational buttons in the toolbar (such as zoom in  and zoom out ) to view details in the data. These buttons are available in every graph from recorded data.

### 5.6.5 INRUSH

The **Inrush** tab displays recorded Inrush data that is stored on the Model 8435. Buttons at the top of the data frame are arranged in three rows. The top row selects the measurement group that can be displayed. The buttons in the second row vary based on the selected group and selects which channels in the selected group to display. The third row of buttons selects how the data should be displayed (trend, tabular, bar chart, and so on).

### 5.6.6 EDITING DOWNLOADED DATA

The Control Panel enables you to augment downloaded data with additional information about the recording session, such as operator and site. To do this, highlight the downloaded recording, alarm, transient, or Inrush result listed under Recorded Sessions. Then open the **Edit** menu and click **Edit Address Book**. The Session Properties dialog box appears.

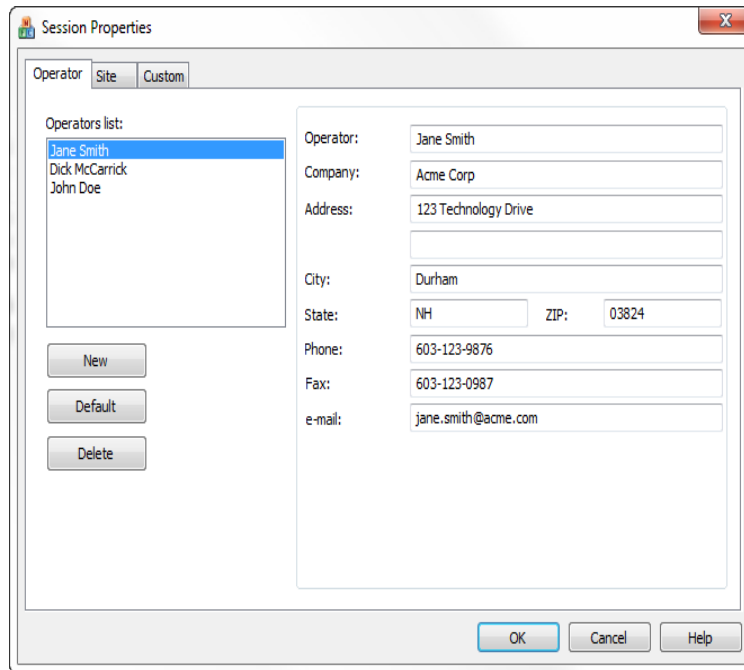


Figure 5-20


The Session Properties dialog box allows you to specify the **Operator**, **Site**, and **Custom** parameters that are to be saved with recorded data. These parameters are used when generating reports. The Operator and Site tabs allow you to maintain lists of operators and sites, saving you time when specifying parameters for reports. On the left of the Operator and Site tabs is the list of previously defined operators and sites. On the right of the Operator and Site tabs is a set of individual parameters that will be saved in an associated database. Only a single set of operator and site fields are saved in the recording database.

The Custom tab contains a list of user defined parameters. Along side each user defined parameter is a check box. Items that are checked will be added to an associated database. Only a single set of custom parameters can be maintained (unlike the Operator and Site lists). The Custom tab allows you to specify any user defined parameters (in addition to the comments field of the Site tab) that are to be used in displaying a report.

## 6. SPECIFICATIONS

### 6.1 REFERENCE CONDITIONS

Parameter	Reference Conditions
Ambient temperature	73°F ± 5°F (23°C ± 3°C)
Humidity (relative humidity)	[45%; 75%]
Atmospheric pressure	[860 hPa; 1060 hPa]
Phase-to-neutral voltage	[50Vrms; 1000Vrms] without DC (< 0.5%)
Standard current circuit input voltage (except AmpFlex® & MiniFlex®)	[30mVrms; 1Vrms] without DC (< 0.5%) *A <sub>nom</sub> ↔ 1Vrms 3 × *A <sub>nom</sub> ÷ 100 ↔ 30mVrms
Rogowski current circuit input voltage (Only AmpFlex® & MiniFlex®)	[11.73 mVrms; 117.3mVrms] without DC (< 0.5%) 3000 Arms ↔ 117.3mVrms to 50Hz 300 Arms ↔ 11.73mVrms to 50Hz
Frequency of electrical network	50/60Hz ± 0.1Hz
Phase shift	0° (active power and energy) 90° (reactive power and energy)
Harmonics	< 0.1%
Voltage unbalance	< 10%
Voltage ratio	1 (unity)
Current ratio	1 (unity)
Power supply	Battery only
Electric field	< 1 V.m-1
Magnetic field	< 40 A.m-1

 **NOTE:** The symbol “U” will be used throughout this manual and in the instrument to refer to phase-to-phase voltage measurement.

The symbol “V” will be used for phase-to-neutral voltage measurement.

\*The values of A<sub>nom</sub> are provided in the next table.

Current Sensor (excluding AmpFlex® & MiniFlex®)	Nominal RMS current (A <sub>nom</sub> ) [A]
SR clamp	1000
MR clamp	1000
MN93 clamp	200
SL261 clamp (10mV/A)	100
SL261 clamp (100mV/A)	10
MN193 clamp (100A)	100
MN193 clamp (5A)	5
5 A adapter	5

## 6.2 ELECTRICAL SPECIFICATIONS

### Sampling Frequency (256 samples per cycle):

12.8kHz samples/sec per channel @ 50Hz

15.36kHz samples/sec per channel @ 60Hz

**Waveforms:** Displays voltages and currents

**Screen Captures:** 50 max

**Transients:** Detection and recording of transients (up to 210)

**Inrush Current:** Detection and recording of Inrush current (1 max)

**Memory:** 2GB SD Card memory for trend data; additional internal Flash memory for up to 50 screen snapshots, 210 captured transients, and 10,000 alarm events from up to 40 different parameters

**Alarm Function:** 10,000 alarms max

### 6.2.1 VOLTAGE INPUTS

**Range for use:** 0 to 1000Vrms AC+DC phase-to-neutral and neutral-to-earth  
0 to 2000Vrms AC+DC phase-to-phase

(on condition of compliance with 1000Vrms with respect to earth in CAT III)

**Input Impedance:** 969kΩ (between phase and neutral and neutral and earth)

**Admissible Overload:** 1200Vrms constant  
2000Vrms for one second

### 6.2.2 CURRENT INPUTS

**Operating Range:** 0 to 1V

**Input Impedance:** 1MΩ for current probe circuit  
12.4kΩ for AmpFlex® and MiniFlex® circuit

**Overload:** 1.7V

### 6.2.3 ACCURACY SPECIFICATIONS (EXCLUDING CURRENT PROBES)

Measurement		Measurement range without ratio (with unity ratio)		Resolution (with unity ratio)	Accuracy
		Min	Max		
Frequency		40Hz	70Hz	0.01Hz	±(0.01Hz)
RMS Voltage <sup>(5)</sup>	Simple	1V	1200V <sup>(1)</sup>	0.1V V < 1000V	±(0.5% + 0.2V)
				1V V ≥ 1000V	±(0.5% + 1V)
	Compound	1V	2400V <sup>(2)</sup>	0.1V U < 1000V	±(0.5% + 0.2V)
				1V U ≥ 1000V	±(0.5% + 1V)
Direct Voltage (DC) <sup>(6)</sup>	Simple	1V	1697V <sup>(3)</sup>	0.1V V < 1000V	±(1% + 0.5V)
				1V V ≥ 1000V	±(1% + 1V)
	Compound	1V	3394V <sup>(4)</sup>	0.1V U < 1000V	±(1% + 0.5V)
				1V U ≥ 1000V	±(1% + 1V)

Measurement		Measurement range without ratio (with unity ratio)		Resolution (with unity ratio)	Accuracy
		Min	Max		
RMS Current <sup>(5)</sup>	SR clamp MR clamp	1A	1200A	0.1A A < 1000A	±(0.5% + 0.2A)
				1 A A ≥ 1000A	±(0.5% + 1A)
	MN93 clamp	0.2A	240A	0.1A	±(0.5% + 0.2A)
	SL261 clamp (10mV/A) MN193 clamp (100A)	0.1A	120A	0.01A A < 100A	±(0.5% + 0.02A)
				0.1A A ≥ 100A	±(0.5% + 0.1A)
	SL261 clamp (100mV/A)	0.01A	12A	0.001A A < 10A	±(0.5% + 0.002A)
				0.01A A ≥ 10A	±(0.5% + 0.01A)
MN193 clamp (5A) or 5A adapter	0.005A	6A	0.001A	±(0.5% + 0.002A)	
AmpFlex® MiniFlex®	10A	6500A	0.1 A A < 1000A	±(0.5% + 1A)	
			1 A A ≥ 1000A		
Direct Current (DC) <sup>(6)</sup>	MR clamp	1A	1200A <sup>(4)</sup>	0.1A A < 1000A	±(1% + 1A)
				1A A ≥ 1000A	
	SL261 clamp (10mV/A)	0.1A	169.7A <sup>(3)</sup>	0.01A A < 100A	±(1% + 0.1A)
				0.1A A ≥ 100A	
	SL261 clamp (100mV/A)	0.01A	16.97A <sup>(3)</sup>	0.001A A < 10A	±(1% + 0.01A)
				0.01A A ≥ 10A	
Peak factor (PF)	1	9.99	0.01	±(1% + 2ct) CF < 4	
				±(5% + 2ct) CF ≥ 4	

(1) In 1000V<sub>RMS</sub>, CAT III, provided that the voltage between each of the terminals and the ground/earth does not exceed 1000V<sub>RMS</sub>

(2) 2-Phase (opposite phases) – same note as (1)

(3)  $1200 \times \sqrt{2} \approx 1697$ ;  $2400 \times \sqrt{2} \approx 3394$ ;  $120 \times \sqrt{2} \approx 169.7$ ;  $12 \times \sqrt{2} \approx 16.97$

(4) Limitation of the SR clamp

(5) Total RMS value and RMS value of the fundamental

(6) DC harmonic component (n= 0)

Measurement		Measurement range without ratio (with unity ratio)		Resolution (with unity ratio)	Accuracy
		Min	Max		
RMS ½ Voltage	Simple	1V	1200V <sup>(1)</sup>	0.1V V < 1000V	±(0.8% + 1V)
				1V V ≥ 1000V	
	Compound	1V	2400V <sup>(2)</sup>	0.1V U < 1000V	±(0.8% + 1V)
				1V U ≥ 1000V	
Peak Voltage	Simple	1V	1697V <sup>(3)</sup>	0.1V V < 1000V	±(1% + 1V)
				1V V ≥ 1000V	
	Compound	1V	3394V <sup>(3)</sup>	0.1 V U < 1000V	±(1% + 1V)
				1 V U ≥ 1000V	
RMS ½ Current	SR clamp MR clamp	1A	1200A	0.1 A A < 1000A	±(1% + 1A)
				1 A A ≥ 1000A	
	MN93 clamp	0.2A	240A	0.1 A	±(1% + 1A)
	SL261 clamp (10mV/A) MN193 clamp (100A) or 5A adapter	0.1A	120A	0.01A A < 100A	±(1% + 0.1A)
				0.1A A ≥ 100A	
	SL261 clamp (100mV/A)	0.01A	12A	0.001A A < 10A	±(1% + 0.01A)
				0.01A A ≥ 10A	
MN193 clamp (5A) or 5A adapter	0.005A	6A	0.001A	±(1% + 0.01A)	
AmpFlex® MiniFlex®	10A	6500A	0.1A A < 1000A	±(1.5% + 5A)	
			1A A ≥ 1000A		

Measurement		Measurement range without ratio (with unity ratio)		Resolution (with unity ratio)	Accuracy
		Min	Max		
Peak Current	SR clamp MR clamp	1A	1697A <sup>(3)</sup>	1A A < 1000A	±(1% + 1A)
				1A A ≥ 1000A	
	MN93 clamp	0.2A	339.4A <sup>(3)</sup>	0.1A	±(1% + 1A)
	SL261 clamp (10mV/A) MN193 clamp (100A)	0.1A	169.7A <sup>(3)</sup>	0.01A A < 100A	±(1% + 0.1A)
				0.1A A ≥ 100A	
	SL261 clamp (100mV/A)	0.01A	16.97A <sup>(3)</sup>	0.001A A < 10A	±(1% + 0.01A)
0.01A A ≥ 10A					
MN193 clamp (5A) or 5A adapter	0.005A	8.485A <sup>(3)</sup>	0.001A	±(1% + 0.01A)	
AmpFlex® MiniFlex®	10A	9192A <sup>(3)</sup>	0.1A A < 1000A	±(1.5% + 5A)	
			1A A ≥ 1000A		
Severity of Flicker (Pst)		0	12	0.01	See the corresponding table

(1) In 1000Vrms, CAT III, provided that the voltage between each of the terminals and the ground/earth does not exceed 1000Vrms

(2) 2-phase (opposite phases) – same note as (1)

(3)  $1200 \times \sqrt{2} \approx 1697$ ;  $2400 \times \sqrt{2} \approx 3394$ ;  $240 \times \sqrt{2} \approx 339,4$ ;  $120 \times \sqrt{2} \approx 169,7$ ;  $12 \times \sqrt{2} \approx 16,97$ ;  $6 \times \sqrt{2} \approx 8,485$ ;  $6500 \times \sqrt{2} \approx 9192$

Measurement		Measurement range without ratio (with unity ratio)		Resolution (with unity ratio)	Accuracy
		Min	Max		
Active Power <sup>(1)</sup>	Excluding AmpFlex® MiniFlex®	5mW <sup>(3)</sup>	7800kW <sup>(4)</sup>	4 digits at most <sup>(5)</sup>	±(1%) cos Φ ≥ 0.8
					±(1.5% + 10 ct) 0.2 ≤ cos Φ < 0.8
	AmpFlex® MiniFlex®				±(1%) cos Φ ≥ 0.8
					±(1.5% + 10 ct) 0.5 ≤ cos Φ < 0.8
Reactive Power <sup>(2)</sup>	Excluding AmpFlex® MiniFlex®	5mVAR <sup>(3)</sup>	7800kVAR <sup>(4)</sup>	4 digits at most <sup>(5)</sup>	±(1%) sin Φ ≥ 0.5
					±(1.5% + 10 ct) 0.2 ≤ sin Φ < 0.5
	AmpFlex® MiniFlex®				±(1.5%) sin Φ ≥ 0.5
					±(2.5% + 20 ct) 0.2 ≤ sin Φ < 0.5
Apparent Power		5mVA <sup>(3)</sup>	7800kVA <sup>(4)</sup>	4 digits at most <sup>(5)</sup>	±(1%)



<b>Peak Factor (PF)</b>		-1	1	0.001	$\pm(1.5\%)$ $\cos \Phi \geq 0.5$
					$\pm(1.5\% + 10 \text{ ct})$ $0.2 \leq \cos \Phi < 0.8$
<b>Active Energy</b> <sup>(1)</sup>	<b>Excluding AmpFlex<sup>®</sup> MiniFlex<sup>®</sup></b>	1mWh	9,999,999MWh <sup>(6)</sup>	7 digits at most <sup>(5)</sup>	$\pm(1\%)$ $\cos \Phi \geq 0.8$
	<b>AmpFlex<sup>®</sup> MiniFlex<sup>®</sup></b>				$\pm(1.5\%)$ $0.2 \leq \cos \Phi < 0.8$
					$\pm(1\%)$ $\cos \Phi \geq 0.8$
					$\pm(1.5\%)$ $0.5 \leq \cos \Phi < 0.8$
<b>Reactive energy</b> <sup>(2)</sup>	<b>Excluding AmpFlex<sup>®</sup> MiniFlex<sup>®</sup></b>	1mVARh	9,999,999MVARh <sup>(6)</sup>	7 digits at most <sup>(5)</sup>	$\pm(1\%)$ $\sin \Phi \geq 0.5$
	<b>AmpFlex<sup>®</sup> MiniFlex<sup>®</sup></b>				$\pm(1.5\%)$ $0.2 \leq \sin \Phi < 0.5$
					$\pm(1.5\%)$ $\sin \Phi \geq 0.5$
					$\pm(2\%)$ $0.2 \leq \sin \Phi < 0.5$
<b>Apparent energy</b>		1mVAh	9,999,999MVAh <sup>(6)</sup>	7 digits at most <sup>(5)</sup>	$\pm(1\%)$

(1) The stated uncertainties on the active power and energy measurements are max for  $|\cos \Phi| = 1$  and typical for the other phase differences.

(2) The stated uncertainties on the reactive power and energy measurements are max for  $|\sin \Phi| = 1$  and typical for the other phase shifts.

(3) With MN193 clamp (5A) or 5A adapter.

(4) With AmpFlex<sup>®</sup> or MiniFlex<sup>®</sup>.

(5) The resolution depends on the current sensor used and on the value to be displayed.

(6) The energy is equivalent to more than 146 years of the associated maximum power (unity ratios).

Measurement	Measurement Range		Resolution	Accuracy
	Min	Max		
<b>Phase differences of fundamentals</b>	-179°	180°	1°	$\pm(2^\circ)$
<b>cos <math>\Phi</math> (DPF)</b>	-1	1	0.001	$\pm(1^\circ)$ for $\Phi$ $\pm(5\text{ct})$ for DPF
<b>tan F</b>	-32.77 <sup>(1)</sup>	32.77 <sup>(1)</sup>	0.001 $\tan \Phi < 10$	$\pm(1^\circ)$ for $\Phi$
			0.01 $\tan \Phi \geq 10$	
<b>Unbalance (UNB)</b>	0%	100%	0.1%	$\pm(1\%)$

(1)  $|\tan \Phi| = 32,767$  corresponds to  $\Phi = \pm 88.25^\circ + k \times 180^\circ$  ( $k$  being a natural number)

Measurement	Measurement Range		Resolution	Accuracy
	Min	Max		
Voltage Harmonic Ratio (t)	0%	1600%	0.1% $\tau < 999.9\%$	$\pm(2.5\% + 5ct)$
			1% $\tau \geq 1000\%$	
Current Harmonic Ratio (t) (excluding AmpFlex® & MiniFlex®)	0%	1600%	0.1% $\tau < 999.9\%$	$\pm(2\% + (n \times 0.2\%) + 5ct)$ $n \leq 25$
			1% $\tau \geq 1000\%$	$\pm(2\% + (n \times 0.5\%) + 5ct)$ $n > 25$
Current Harmonic Ratio (t) (AmpFlex® & MiniFlex®)	0%	1600%	0.1% $\tau < 999.9\%$	$\pm(2\% + (n \times 0.3\%) + 5ct)$ $n \leq 25$
			1% $\tau \geq 1000\%$	$\pm(2\% + (n \times 0.6\%) + 5ct)$ $n > 25$
Total Voltage Harmonic Distortion THD (THD-F)	0%	999.9%	0.1%	$\pm(2.5\% + 5ct)$
Total current harmonic distortion THD (THD-F) (excluding AmpFlex® & MiniFlex®)	0%	999.9%	0.1%	$\pm(2.5\% + 5ct)$ $si \forall n \geq 1. \tau_n \leq (100 \div n) [\%]$
				or
				$\pm(2\% + (n_{max} \times 0.2\%) + 5ct)$ $n_{max} \leq 25$
				$\pm(2\% + (n_{max} \times 0.5\%) + 5ct)$ $n_{max} > 25$
Total current harmonic distortion THD (THD-F) (AmpFlex® & MiniFlex®)	0%	999.9%	0.1%	$\pm(2.5\% + 5ct)$ $si \forall n \geq 1. \tau_n \leq (100 \div n^2) [\%]$
				or
				$\pm(2\% + (n_{max} \times 0.3\%) + 5ct)$ $n_{max} \leq 25$
				$\pm(2\% + (n_{max} \times 0.6\%) + 5ct)$ $n_{max} > 25$
Voltage distortion factor DF (THD-R)	0%	100%	0.1%	$\pm(2.5\% + 5ct)$
Current distortion factor DF (THD-R) (excluding AmpFlex® & MiniFlex®)	0%	100%	0.1%	$\pm(2.5\% + 5ct)$ $si \forall n \geq 1. \tau_n \leq (100 \div n) [\%]$
				or
				$\pm(2\% + (n_{max} \times 0.2\%) + 5ct)$ $n_{max} \leq 25$
				$\pm(2\% + (n_{max} \times 0.5\%) + 5ct)$ $n_{max} > 25$
Current distortion factor DF (THD-R) (AmpFlex® & MiniFlex®)	0%	100%	0.1%	$\pm(2.5\% + 5ct)$ $si \forall n \geq 1. \tau_n \leq (100 \div n^2) [\%]$
				or
				$\pm(2\% + (n_{max} \times 0.3\%) + 5ct)$ $n_{max} \leq 25$
				$\pm(2\% + (n_{max} \times 0.6\%) + 5ct)$ $n_{max} > 25$
K factor (KF)	1	99.99	0.01	$\pm(5\% + (n_{max} \times 0.3\%) + 5ct)$ $n_{max} \leq 25$
				$\pm(10\% + (n_{max} \times 0.6\%) + 5ct)$ $n_{max} > 25$
Phase shifts of harmonics (order $n \geq 2$ )	-179°	180°	1°	$\pm(1.5^\circ + 1^\circ \times (n \div 12.5))$

N.B.  $n_{max}$  is the highest order for which the harmonic ratio is non-zero.

Measurement		Measurement range (with unity ratio)		Resolution (with unity ratio)	Accuracy
		Min	Max		
RMS Harmonic Voltage (order $n \geq 2$ )	Simple	1V	1200V <sup>(1)</sup>	0.1V $V < 1000V$	$\pm(2.5\% + 1V)$
				1V $V \geq 1000V$	
	Compound	1V	2400V <sup>(2)</sup>	0.1V $U < 1000V$	$\pm(2.5\% + 1V)$
				1V $U \geq 1000V$	
RMS Harmonic Current (order $n \geq 2$ )	SR clamp MR clamp	1A	1200A	0.1A $A < 1000A$	$\pm(2\% + (n \times 0.2\%) + 1A)$ $n \leq 25$
				1A $A \geq 1000A$	$\pm(2\% + (n \times 0.5\%) + 1A)$ $n > 25$
	MN93 clamp	0.2A	240A	0.1A	$\pm(2\% + (n \times 0.2\%) + 1A)$ $n \leq 25$
					$\pm(2\% + (n \times 0.5\%) + 1A)$ $n > 25$
	SL261 clamp (10mV/A) MN193 clamp (100A) or 5A adapter	0.1A	120A	0.01A $A < 100A$	$\pm(2\% + (n \times 0.2\%) + 0.1A)$ $n \leq 25$
				0.1A $A \geq 100A$	$\pm(2\% + (n \times 0.5\%) + 0.1A)$ $n > 25$
	SL261 clamp (100mV/A)	0.01A	12A	0.001A $A < 10A$	$\pm(2\% + (n \times 0.2\%) + 0.01A)$ $n \leq 25$
				0.01A $A \geq 10A$	$\pm(2\% + (n \times 0.5\%) + 0.01A)$ $n > 25$
	MN193 clamp (5A) or 5A adapter	0.005A	6A	0.001A	$\pm(2\% + (n \times 0.2\%) + 0.01A)$ $n \leq 25$
					$\pm(2\% + (n \times 0.5\%) + 0.01A)$ $n > 25$
AmpFlex® & MiniFlex®	10A	6500A	0.1A $A < 1000A$	$\pm(2\% + (n \times 0.3\%) + 1A + (A_{fRMS}^{(3)} \times 0.1\%))$ $n \leq 25$	
			1A $A \geq 1000A$	$\pm(2\% + (n \times 0.6\%) + 1A + (A_{fRMS}^{(3)} \times 0.1\%))$ $n > 25$	

(1) In 1000V<sub>RMS</sub>, CAT III, provided that the voltage between each of the terminals and earth does not exceed 1000V<sub>RMS</sub>.

(2) 2-Phase (opposite phases) – same note as (1).

(3) RMS value of the fundamental.

Max intrinsic error of the flicker severity measurement (Pst)				
Rectangular variations per minute (50% duty cycle)	120V lamp 60Hz network		230V lamp 50Hz network	
	2	Pst ∈ [1;4]	± 5%	Pst ∈ [1;4]
7	Pst ∈ [1;7]	± 5%	Pst ∈ [1;4]	± 5%
39	Pst ∈ [1;12]	± 5%	Pst ∈ [1;10]	± 5%
110	Pst ∈ [1;12]	± 5%	Pst ∈ [1;10]	± 5%
1620	Pst ∈ [1;12]	± 15%	Pst ∈ [1;10]	± 15%

Ratio	Minimum	Maximum
Voltage	100 1000 x $\sqrt{3}$	9,999,900 x $\sqrt{3}$ 0.1
Current <sup>(1)</sup>	1	60,000 / 1

(1) Only for the MN193 clamp (5 A) and the 5A adapter.

Measurement		Measurement Range	
		Minimum with minimum ratio(s)	Maximum with maximum ratio(s)
RMS & RMS ½ Voltage	Simple	58mV	207.8GV
	Compound	58mV	415.7GV
Direct Voltage (DC) & Peak Voltage	Simple	58mV	293.9GV
	Compound	58mV	587.9GV
RMS & RMS ½ Current		5mA	360.0kA
Peak Current		5mA	509.1kA
Active Power		0.289mW	74.82PW
Reactive Power		0.289mVAR	74.82PVAR
Apparent Power		0.289mVA	74.82PVA
Active Energy		1mWh	9,999,999EWh <sup>(1)</sup>
Reactive Energy		1mVARh	9,999,999EVARh <sup>(1)</sup>
Apparent Energy		1mVAh	9,999,999EVAh <sup>(1)</sup>

(1) The energy corresponds to more than 15,000 years of the associated maximum power (max ratios).

## 6.2.4 CURRENT PROBE ACCURACY (TO BE ADDED TO THE MODEL 8435'S ACCURACY)

Sensor errors are offset by a typical correction inside the device. This typical correction, applied to the phase and amplitude, depends on the type of sensor connected (detected automatically) and the gain in the current acquisition channel used.

The RMS current measurement error and phase error are additional errors (which must therefore be added to the device errors), indicated as influences on the calculations carried out by the analyzer (powers, energy, power factors, tangents, etc.).

Sensor Type	TRMS Current	Accuracy on IRMS	Accuracy on $\phi$
<b>MR193 1000A</b>	[1A; 10A]	$\pm(1.5\% + 1A)$	N.S.
	[10A; 100A]		$\pm(2^\circ)$
	[100A; 800A]	$\pm(3\%)$	$\pm(1.5^\circ)$
	[800A; 1200A]	$\pm(5\%)$	
<b>SR193 1000A</b>	[1A; 3A]	$\pm(0.8\%)$	N.S.
	[3A; 10A]		$\pm(1^\circ)$
	[10A; 100A]	$\pm(0.3\%)$	$\pm(0.5^\circ)$
	[100A; 1200A]	$\pm(0.2\%)$	$\pm(0.3^\circ)$
<b>AmpFlex® 3000A</b>	[10A; 100A]	$\pm(3\%)$	$\pm(1^\circ)$
	[100A; 6500A]	$\pm(2\%)$	$\pm(0.5^\circ)$
<b>MiniFlex® 1000A</b>	[10A; 100A]	$\pm(3\%)$	$\pm(1^\circ)$
	[100A; 3000A]	$\pm(2\%)$	$\pm(0.5^\circ)$
<b>MN93 200A</b>	[0.5A; 2A]	$\pm(3\% + 1A)$	N.S.
	[2A; 10A]		$\pm(6^\circ)$
	[10A; 100A]	$\pm(2.5\% + 1A)$	$\pm(3^\circ)$
	[100A; 240A]	$\pm(1\% + 1A)$	$\pm(2^\circ)$
<b>MN193 100A</b>	[100mA; 300mA]	$\pm(0.7\% + 2mA)$	N.S.
	[300mA; 1A]		$\pm(1.5^\circ)$
	[1A; 120A]	$\pm(0.7\%)$	$\pm(0.7^\circ)$
<b>MN193 5A</b>	[5mA; 50mA]	$\pm(1\% + 0.1mA)$	$\pm(1.7^\circ)$
	[50mA; 500mA]	$\pm(1\%)$	$\pm(1^\circ)$
	[500mA; 6A]	$\pm(0.7\%)$	
<b>5A Adapter</b>	[5mA; 50mA]	$\pm(1\%)$	$\pm(1^\circ)$
	[50mA; 6A]	$\pm(0.5\%)$	$\pm(0^\circ)$
<b>SL261 10A (100mV/A)</b>	[0A; 10A]	$\pm(1.5\% + 50mA)$	$\pm(1^\circ)$
<b>SL261 100A (10mV/A)</b>	[0A; 40A]	$\pm(2\% + 50mA)$	$\pm(0.5^\circ)$
	[40A; 100A]	$\pm(5\%)$	

N.S. = Not Specified

## 6.2.5 CURRENT PROBES AND SENSORS

When installing probes, face the arrow on the probe in the direction of the load. Note that only AmpFlex® sensors are watertight; all other probes and sensors are non-watertight.

Model SR193	
Nominal Range	1000A <sub>AC</sub> for f ≤1 kHz
Measurement Range	1A to 1200A <sub>AC</sub> max (I >1000A not continuously)
Probe Output Signal	1 mV <sub>AC</sub> /A <sub>AC</sub>
Maximum Clamping Diameter	2" (52mm)
Safety	EN 61010-2-032, Pollution Degree 2, 600V CAT IV, 1000V CAT III

**NOTE:** Currents <0.5A will be displayed as zero. Neutral current measures down to 0A.

Model MN93	
Nominal Range	200A <sub>AC</sub> for f ≤1 kHz
Measurement Range	2A to 240A <sub>AC</sub> max (I >200A not permanent)
Probe Output Signal	5mV <sub>AC</sub> /A <sub>AC</sub>
Maximum Clamping Diameter	0.8" (20mm)
Safety	EN 61010-2-032, Pollution Degree 2, 300V CAT IV, 600V CAT III

**NOTE:** Currents <0.5A will be displayed as zero. Neutral current measures down to 0A.

Model MR193	
Nominal Range	1000A <sub>AC</sub> , 1400A <sub>DC</sub> max
Measurement Range	10A to 1000A <sub>AC</sub> , 10A to 1300A <sub>PEAK AC+DC</sub>
Probe Output Signal	1 mV/A
Maximum Clamping Diameter	One 1.6" (42mm) or two 0.98" (25.4mm) or two bus bars 1.96 x 0.19" (50 x 5mm)
Safety	EN 61010-2-032, Pollution Degree 2, 300V CAT IV, 600V CAT III

**NOTE:** Currents <1A<sub>AC/DC</sub> will be displayed as zero. Neutral current measures down to 0A.

Model MN193	
Nominal Range	5A and 100A <sub>AC</sub>
Measurement Range	5A: 0.005A to 6A <sub>AC</sub> max (1A to 1200A with ratio 1000/5 selected) 100A: 0.1A to 120A <sub>AC</sub> max
Probe Output Signal	5A: 200mV/A <sub>AC</sub> ; 100A: 10mV/A <sub>AC</sub>
Maximum Clamping Diameter	0.8" (20mm)
Safety	EN 61010-2-032, Pollution Degree 2, 300V CAT IV, 600V CAT III

The 5A range of the MN193 is designed to work with secondary current transformers.

Best accuracy is available when entering the transformer ratio (e.g. 1000/5A). When used to measure 5A direct, the resolution will be limited to 0.1A max.

**NOTE:** Currents < (Primary x 5) ÷ (Secondary x 1000) or <250mA on the 5A range and <0.2A on the 100A range will be displayed as zero with this probe. Power calculations will also be zeroed when the current is zeroed.

AmpFlex® Sensors	
Nominal Range	3000A <sub>AC</sub>
Measurement Range	10A to 6500A <sub>AC</sub>
Probe Output Signal*	140mV <sub>AC</sub> /3000A <sub>AC</sub> at 60Hz
Sensor	Length = 24" (610mm); Ø = 7.64" (190mm) Length = 36" (910mm); Ø = 11.46" (290mm)
Safety	EN 61010-2-032, Pollution Degree 2, 600V CAT IV, 1000V CAT III

\*Output is proportional to the amplitude and frequency of the measured current.

**NOTE:** Currents <10A will be displayed as zero. Neutral current measures down to 0A.

MiniFlex® Sensors	
Nominal Range	1000A <sub>AC</sub>
Measurement Range	10A to 3000A <sub>AC</sub>
Probe Output Signal*	47µV <sub>AC</sub> /1000A <sub>AC</sub> at 60Hz
Sensor	Length = 10" (250mm); Ø = 2.75" (70mm)
Safety	EN 61010-2-032, Pollution Degree 2, 600V CAT IV, 1000V CAT III

\*Output is proportional to the amplitude and frequency of the measured current.

**NOTE:** Currents <10A will be displayed as zero. Neutral current measures down to 0A.

Model SL261	
Nominal Range	10A to 100A <sub>AC</sub>
Measurement Range	100mV/A: 100mA to 10A peak 10mV/A: 1 to 100A peak
Probe Output Signal	1000mV peak max
Maximum Clamping Diameter	0.46" (11.8 mm)
Safety	EN 61010-2-032, Pollution Degree 2, 600V CAT III

**NOTE:** Currents <0.5A will be displayed as zero. Neutral current measures down to 0A.

## 6.2.6 THREE-PHASE 5A ADAPTER BOX (3-CHANNEL USE ONLY)

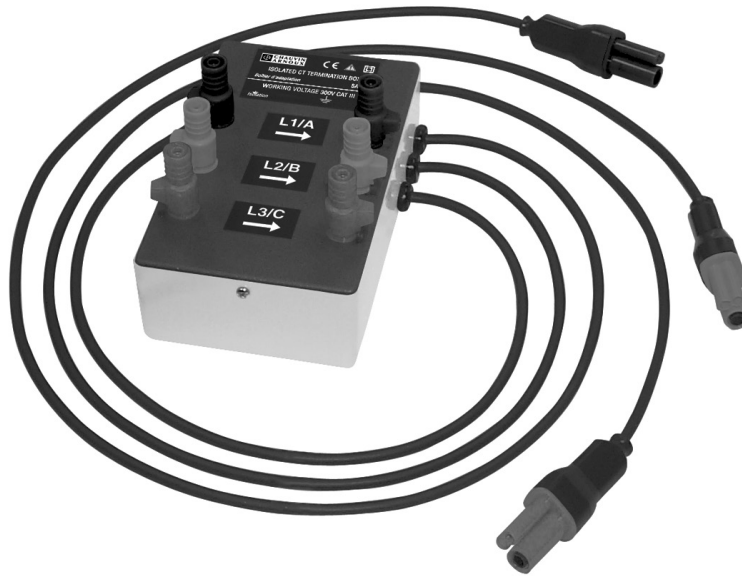


Figure 6-1

This adapter is a three-phase adapter with three 5A<sub>AC</sub> inputs L1, L2, L3, and three AC voltage outputs. All circuits are independent and isolated between input and output. The outputs are equipped with connectors to mate with the Model 8435 current channel inputs.

It facilitates automatic sensor recognition and probe ratio programming for both 1 Amp and 5 Amp output probes. Additionally, the adapter box can be used directly in series in a 5Amp circuit.

---

**!** **WARNING:** This adapter is rated EN 61010, 300V CAT III and permits the use of standard current probes with either a 1 or 5 Amp output.

---

The input connections accept either Ø 4mm male plugs or rigid leads between 1 and 2.5mm inserted in the side hole after pressing the spring loaded connector down to expose the hole.

### Connecting to Secondary Current Transformer (CT):

---

**!** **WARNING:** Use caution when connecting to a secondary current transformer.

---

1. Short the two leads of each secondary current measurement transformer.
2. Never open a secondary circuit of a CT if its primary circuit is connected to a supply voltage. In any case, disconnect the primary measurement transformer circuit from the supply network.
3. Connect each CT secondary to the input of the 5A adapter in the correct order (ground on P2) and the right phase order L1, L2, L3.

### Adapter Box Specifications (add Model 8435 accuracy $\pm 0.5\% \pm 1\text{ct}$ ):

---

**Note:** Currents  $< (\text{Primary} \times 5) \div (\text{Secondary} \times 1000)$  will be displayed as zero on the Model 8435 with this probe.

---

<b>Range:</b>	5A
<b>Output / Input Ratio:</b>	0.2mV/mA <sub>AC</sub>
<b>Dimensions:</b>	6.00 x 3.74 x 3.38" (153 x 95 x 86mm)
<b>Weight:</b>	1.98 lbs (900g)
<b>Impermeability:</b>	IP50 per EN 60529 (electrical IP2X for the terminals)
<b>Electrical safety:</b>	Double Insulation, 300V CAT III Pollution Degree 2 per IEC 61010-1



**Operating Temperature:** 5° to 131°F (-15° to 55°C), 0 to 90% RH

**Storage Temperature:** -40° to 185°F (-40° to 85°C), 0 to 90% RH

**Reference Conditions:** 73°F (23°C) ±3K, 50 to 85% RH, 50/60Hz ±2Hz

#### Current measurement according to IEC 44-1 Class 0.5

Range	5mA to 50mA	50mA to 1A	1A to 6A
Error %	0.35% + 1.5mA	0.25% + 1mA	0.25% + 0.5mA
Phase Error	0.5°	0.4°	0.33°

**Primary Voltage Loss:** < 0.3V

**Permanent Overload:** 10A

**Temperature Influence:** < 0.1% par 25K

Frequency Influence	65Hz to 500Hz	500Hz to 1kHz	1kHz to 5kHz
Error	0.1%	0.3%	0.5%
Phase error	0.1°	0.2°	1°

### 6.2.7 POWER SUPPLY

**AC Power** (external power supply) - 600V CAT IV; 1000V CAT III

**Operating Range:** 230V<sub>AC</sub> ± 10% @ 50Hz and 120V<sub>AC</sub> ± 10% @ 60Hz

**Max Power:** 65VA

**Battery Power** (allows use in the event of an interruption)

**Type:** 8 NiMH 4000mAh min

**Rated Voltage:** 9.6V

**Charge Time:** 5 hrs approx


**Battery Life:** 10 hrs (completely charged) approx  
35 hrs (recording in progress) approx

**Operating Temperature:** 32° to 122°F (0° to 50°C)

**Recharging Temperature:** 50° to 104°F (10° to 40°C)

**Storage Temperature:** -4 to +122°F (-20 to +50°C) for ≤ 30 days

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 **NOTE:** When the charger is connected, the battery starts to charge and the ON/OFF button will stay illuminated. Once the battery is charged, the instrument uses the current supplied by the power supply, without drawing from the battery.

---

### 6.3 MECHANICAL SPECIFICATIONS

**Dimensions:** 7.9 x 9.8 x 2.6" (200 x 250 x 67mm)

**Weight:** 4.3 lb (1950g) with batteries

**Shock and Vibration:** per EN 61010-1

**Tightness:** IP 67 as per EN 60529 with the housing closed and the protecting plugs on the terminals.

IP 54 with cover open, instrument not in operation (terminals not connected and nothing pressed on the buttons).

IP 50 with cover open and instrument in operation.

## 6.4 ENVIRONMENTAL SPECIFICATIONS

**Altitude:** Operating: 0 to 2000 meters (6560 ft)  
Non-Operating: 0 to 10,000 meters (32800 ft)

**Temperature and % RH:**

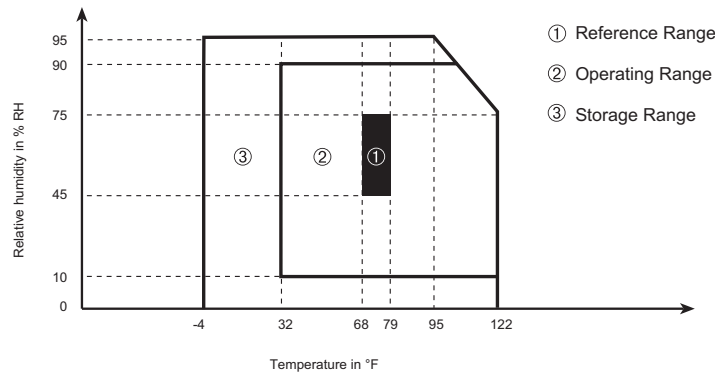


Figure 6-2

**WARNING:** Above 104°F (40°C) the instrument can be used only from the battery or from the battery charger with the battery removed.  
It is not recommended to use the battery and charger at the same time.

## 6.5 SAFETY SPECIFICATIONS

**Electrical Safety**



EN 61010-1; 600V CAT IV\* (probe dependent - see § 3.2.5); Pollution Degree 2

Indoor Use

**\*Warning:** The assigned voltage and measuring category of the “device + current probe” may differ from the characteristics of the device alone.

- The use of the AmpFlex®, MiniFlex® and SR probes rate the “device + probe” at **600V CAT IV** or **1000V CAT III**.
- The use of the MR193, MN93, MN193, J93 and SL261 probes rate the “device + current probe” at **300V CAT IV** or **600V CAT III**.
- The use of the 5A adapter rates the “device + current probe” at **150V CAT IV** or **300V CAT III**.

**Electromagnetic Compatibility**

Immunity: EN 61326-1:2006

- Resistance to electrostatic discharges (EN 61000-4-2)
  - 1<sup>st</sup> level : Gravity - 4 kV in contact
  - Sanctions - CRITERION A
- 2<sup>nd</sup> level : Gravity - 8 kV in the air
- Sanctions - CRITERION A
- Resistance to radiation (per EN 61000-4-3 and EN 61000-4-8)
  - Gravity: 10 V.m<sup>-1</sup>
  - Sanctions: CRITERION B (THD<sub>A</sub> altered on Rogowski chain)
- Resistance to rapid transient bursts (EN 61000-4-4)
- Resistance to electric shocks (per EN 61000-4-5)
- Conducted RF interference (per EN 61000-4-6)
- Voltage interruption (per EN 61000-4-11)

*Specifications are subject to change without notice.*


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## 7. MAINTENANCE

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Use only factory specified replacement parts. AEMC® will not be held responsible for any accident, incident, or malfunction following a repair done other than by its service center or by an approved repair center.




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 Before first use, charge and discharge the instrument one or two cycles to ensure the proper level display of the battery indicator.

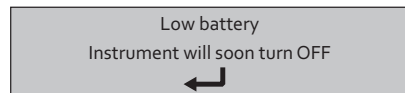
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### 7.1 BATTERY INDICATOR

The number of bars in the battery icon located in the upper right of the screen shows the battery level.


Icon	Battery Charge Status
	Battery charged
	Low battery
	Battery charging

When the capacity of the battery is too low, the following message is displayed:



Press  to confirm. The Model 8435 will shut off after one minute if you do not connect the Model 8435 to the power cord.

---

 The battery may fully discharge when recording for long periods of time while not connected to a power supply. The Model 8435 will continue to record for some time, even if below the minimum battery charge value. However, the display may not come back on, and the instrument will eventually stop saving data when the battery is too low. All data recorded will be saved. During the recording, the ON/OFF button will blink. If the light is not blinking, the recording has stopped and the data has been saved. Do not turn the instrument OFF. Supply power to the Model 8435 with the power cord and press the ON/OFF button.


---

### 7.2 RECHARGING THE BATTERY

Battery life is 10 hours when the battery is completely charged and no recording is in progress. Battery life is approximately 35 hours when recording and the display is off.

The batteries automatically begin recharging when the Model 8435 is connected to the AC power supply. Only use the supplied AC power supply to recharge the batteries of the Model 8435. It will take about five hours to fully charge completely drained batteries. The batteries will not be depleted when the unit is connected to the power supply.

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 The instrument will not recharge if the message “Instrument will soon turn OFF” is displayed on the screen. The Enter button must be pressed or the instrument must be turned OFF before recharging will start.

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### 7.3 CHANGING THE BATTERY

#### WARNING:

- When changing the battery, disconnect all instrument inputs and turn the equipment off. There must be a delay of at least one minute without the battery being connected.
- Do not expose the battery to heat exceeding 212°F (100°C)
- Do not short-circuit the battery terminals

To change the battery, disconnect from any input and make sure the instrument is turned off.

1. Locate the battery compartment cover on the left side of the Model 8435.

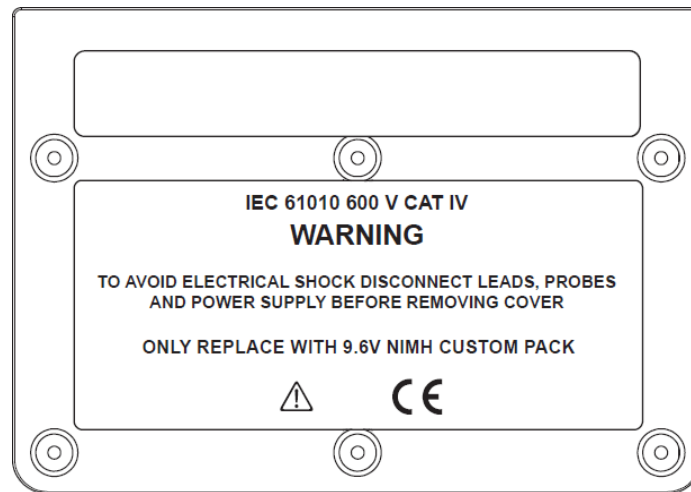



Figure 7-1

2. The cover is held in place by six screws, as shown in Figure 7-1. Remove the covers for these screws and remove the screws with a Phillips screwdriver.
3. Remove the cover. The battery pack is now visible.
4. The battery pack fits snugly in the compartment. Carefully remove the battery pack; this may require gently prying the battery pack from the compartment with a screwdriver or similar implement.
5. The battery pack is connected to the instrument with wires attached to a connector. The connector is plugged into a slot within the compartment. Carefully unplug the connector from the slot.
6. Install the replacement battery pack by plugging its connector into the slot, and then placing the battery within the compartment.

Replace the front cover, including the screw covers.

**NOTE:** The SD-Card is accessible when the battery is removed from the compartment.

## 7.4 CLEANING

 Disconnect the instrument from any source of electricity.


- Use a soft cloth, lightly dampened with soapy water
- Wipe with a damp cloth and then dry with a dry cloth
- Do not splash water directly on the clamp
- Do not use alcohol, solvents or hydrocarbons

## 7.5 UPDATING SOFTWARE & FIRMWARE

To provide our customers the best possible service in terms of performance and technical upgrades, AEMC® offers free software and firmware updates on our website.

- Visit us at: [www.aemc.com](http://www.aemc.com)
- Click on the TECH INFO tab, then click on the Software & Firmware Updates button.

You can also update the software by selecting “Update” from the Help menu within the DataView® software.

 **NOTE:** Updating embedded software or firmware resents the configuration and erases all data stored on the instrument. As a precaution, you should always save stored data to a PC before performing any software or firmware updates.

## 7.6 REPAIR AND CALIBRATION

To ensure that your instrument meets factory specifications, we recommend that it be scheduled back to our factory Service Center at one-year intervals for recalibration, or as required by other standards or internal procedures.

For instrument repair and calibration:

You must contact our Service Center for a Customer Service Authorization Number (CSA#). This will ensure that when your instrument arrives, it will be tracked and processed promptly. Please write the CSA# on the outside of the shipping container. If the instrument is returned for calibration, we need to know if you want a standard calibration, or a calibration traceable to N.I.S.T. (Includes calibration certificate plus recorded calibration data).

**Ship To: Chauvin Arnoux®, Inc. d.b.a. AEMC® Instruments**

15 Faraday Drive • Dover, NH 03820 USA

Phone: (800) 945-2362 (Ext. 360)

(603) 749-6434 (Ext. 360)

Fax: (603) 742-2346 or (603) 749-6309

E-mail: [repair@aemc.com](mailto:repair@aemc.com)

(Or contact your authorized distributor)

Costs for repair, standard calibration, and calibration traceable to N.I.S.T. are available.

**NOTE:** You must obtain a CSA# before returning any instrument.

## 7.7 TECHNICAL AND SALES ASSISTANCE

If you are experiencing any technical problems, or require any assistance with the proper operation or application of your instrument, please call, fax or e-mail our technical support team:

**Chauvin Arnoux®, Inc. d.b.a. AEMC® Instruments**

Phone: (800) 343-1391 • (508) 698-2115

Fax: (508) 698-2118

E-mail: [techsupport@aemc.com](mailto:techsupport@aemc.com)

## 7.8 LIMITED WARRANTY

The Model 8435 is warranted to the owner for a period of one year from the date of original purchase against defects in manufacture. This limited warranty is given by AEMC® Instruments, not by the distributor from whom it was purchased. This warranty is void if the unit has been tampered with, abused or if the defect is related to service not performed by AEMC® Instruments.

Full warranty coverage and product registration is available on our website at: [www.aemc.com/warranty.html](http://www.aemc.com/warranty.html).

**IMPORTANT WARRANTY NOTE:**

By registering online within 30 days from the date of purchase, your warranty will be extended to 3 years

Please print the online Warranty Coverage Information for your records.

**What AEMC® Instruments will do:**

If a malfunction occurs within the one-year period, you may return the instrument to us for repair, provided we have your warranty registration information on file or a proof of purchase. AEMC® Instruments will, at its option, repair or replace the faulty material.

## 7.9 WARRANTY REPAIRS

### What you must do to return an Instrument for Warranty Repair:

First, request a Customer Service Authorization Number (CSA#) by phone or by fax from our Service Department (see address below), then return the instrument along with the signed CSA Form. Please write the CSA# on the outside of the shipping container. Return the instrument, postage or shipment pre-paid to:

#### Ship To: Chauvin Arnoux®, Inc. d.b.a. AEMC® Instruments

15 Faraday Drive • Dover, NH 03820 USA

Phone: (800) 945-2362 (Ext. 360)

(603) 749-6434 (Ext. 360)

Fax: (603) 742-2346 or (603) 749-6309

E-mail: [repair@aemc.com](mailto:repair@aemc.com)

Caution: To protect yourself against in-transit loss, we recommend you insure your returned material.

**NOTE:** You must obtain a CSA# before returning any instrument.

## A.1 Mathematical Formulas for Various Parameters

**NOTE the following abbreviations used in this section:**

**NSHC** = number of samples per half cycle (between two consecutive zeros)

**NSC** = number of samples per cycle

**NSS** = number of samples in a second (multiple of NSC)

**V** = voltage phase to neutral

**U** = voltage phase to phase

### A.1.1 Network Frequency and Sampling

Sampling is controlled by (locked to) the network frequency to deliver 256 samples per cycle from 40 to 70Hz. This locking is essential for many calculations, including reactive power, distorting power, fundamental power factor, unbalance, and harmonic factors and angles.

Instantaneous frequency is measured by analyzing eight consecutive positive-going zero crossings on the signal in question after digital low-pass filtering and digital suppression of the DC component (i.e. seven periods filtered). The time of the zero crossing is determined precisely by linear interpolation between two samples to achieve resolution better than 0.002%.

The device is capable of calculating an instantaneous frequency simultaneously on each of the three phases in voltage (phase-to-neutral for distribution systems with neutral and phase-to-phase for distribution systems without neutral) or in current. It then chooses one from among two or three of them as the official instantaneous frequency.

The network frequency over one second is determined (approximately) as the reciprocal of the arithmetic mean of the instantaneous periods.

The signals are acquired using a 16-bit converter and (for current acquisition) dynamic gain switches.

### A.1.2 Waveform Mode

#### A.1.2.1 RMS VALUES OF HALF-CYCLE VOLTAGE AND CURRENT (EXCLUDING NEUTRAL)

Half-cycle RMS phase-to-neutral voltage of phase (i+1) with  $i \in [0; 2]$ .

$$V_{\text{half}}[i] = \sqrt{\frac{1}{NSHC} \cdot \sum_{n=\text{Zero}}^{(\text{Next Zero})-1} V[i][n]^2}$$

Half-cycle RMS phase-to-phase voltage of phase (i+1) with  $i \in [0; 2]$ .

$$U_{half}[i] = \sqrt{\frac{1}{NSHC} \cdot \sum_{n=Zero}^{(Next\ Zero)-1} U[i][n]^2}$$

Half-cycle RMS current of phase (i+1) with  $i \in [0; 2]$ .

$$A_{half}[i] = \sqrt{\frac{1}{NSHC} \cdot \sum_{n=Zero}^{(Next\ Zero)-1} A[i][n]^2}$$

To avoid missing any fault, these values are calculated for each half-cycle.

### A.1.2.2 MINIMUM AND MAXIMUM HALF-CYCLE RMS VALUES (EXCLUDING NEUTRAL)

Min and max RMS phase-to-neutral voltages of phase (i+1) with  $i \in [0; 2]$ .



$$V_{max}[i] = \max(V_{half}[i]), \quad V_{min}[i] = \min(V_{half}[i])$$

Min and max RMS phase-to-phase voltages of phase (i+1) with  $i \in [0; 2]$ .

$$U_{max}[i] = \max(U_{half}[i]), \quad U_{min}[i] = \min(U_{half}[i])$$

Min and max RMS currents of phase (i+1) with  $i \in [0; 2]$ .

$$A_{max}[i] = \max(A_{half}[i]), \quad A_{min}[i] = \min(A_{half}[i])$$

**NOTE:** The duration of the evaluation is left to the user's discretion (reset by pressing the  button in  MAX-MIN mode).

### A.1.2.3 SEVERITY OF SHORT-TERM FLICKER – 10 MINUTES (EXCLUDING NEUTRAL)

Method based on the IEC 61000-4-15 standard.

The input values are half-period RMS voltages (phase-to-neutral for distribution systems with neutral, phase-to-phase for distribution systems without neutral). Blocks 3 and 4 are generated digitally. The classifier of block 5 has 128 levels.

The value of  $PST[i]$  is updated every 10 minutes (phase (i+1) with  $i \in [0; 2]$ ).

**NOTE:** The user can reset the PST calculation by pressing the  button in  Summary mode.


### A.1.2.4 SEVERITY OF LONG-TERM FLICKER – 2 HOURS (EXCLUDING NEUTRAL)

Method based on the IEC 61000-4-15 standard.

$$PLT[i] = \sqrt[3]{\frac{\sum_{n=0}^{11} PST[i][n]^3}{12}}$$

The values of  $PST[i][n]$  are consecutive and 10 minutes apart. The value of  $PLT[i]$  (phase (i+1) with  $i \in [0; 2]$ ) calculated in a two-hour window is updated either:

- every 10 minutes (sliding long-term flicker: Configuration > Calculation methods > PLT)
- or every 2 hours (non-sliding long-term flicker: Configuration > Calculation methods > PLT)

**NOTE:** The user can reset the PST calculation by pressing the  button in  Summary mode.



### A.1.2.5 PEAK VALUES (NEUTRAL EXCEPT UPP AND UPM – OVER 250MS)

Positive and negative phase-to-neutral peak voltages of phase (i+1) with  $i \in [0 ; 3]$  ( $i = 3 \Leftrightarrow$  neutral)



$$V_{pp}[i] = \max(V[i][n]), V_{pm}[i] = \min(V[i][n]), n \in [0; N]$$

Positive and negative phase-to-phase peak voltages of phase (i+1) with  $i \in [0 ; 2]$

$$U_{pp}[i] = \max(U[i][n]), U_{pm}[i] = \min(U[i][n]), n \in [0; N]$$

Positive and negative peak currents of phase (i+1) with  $i \in [0 ; 3]$  ( $i = 3 \Leftrightarrow$  neutral)

$$A_{pp}[i] = \max(A[i][n]), A_{pm}[i] = \min(A[i][n]), n \in [0; N]$$

**NOTE:** The duration of the evaluation is left to the user's discretion (reset by pressing the  button in  MAX-MIN mode).

### A.1.2.6 PEAK FACTORS (NEUTRAL INCLUDED EXCEPT UCF – OVER ONE SECOND)

Peak factor of phase-to-neutral voltage of phase (i+1) with  $i \in [0 ; 3]$  ( $i = 3 \Leftrightarrow$  neutral-to-earth voltage).

$$V_{cf}[i] = \frac{\max(|V_{pp}[i]|, |V_{pm}[i]|)}{\sqrt{\frac{1}{NSC} \cdot \sum_{n=0}^{NSC-1} V[i][n]^2}}$$

Peak factor of phase-to-phase voltage of phase (i+1) with  $i \in [0 ; 2]$

$$U_{cf}[i] = \frac{\max(|U_{pp}[i]|, |U_{pm}[i]|)}{\sqrt{\frac{1}{NSC} \cdot \sum_{n=0}^{NSC-1} U[i][n]^2}}$$

Peak factor of current of phase (i+1) with  $i \in [0 ; 3]$  ( $i = 3 \Leftrightarrow$  neutral)

$$A_{cf}[i] = \frac{\max(|A_{pp}[i]|, |A_{pm}[i]|)}{\sqrt{\frac{1}{NSC} \cdot \sum_{n=0}^{NSC-1} A[i][n]^2}}$$

**NOTE:** The duration of evaluation of the peak values here is one second.

### A.1.2.7 RMS VALUES (NEUTRAL EXCEPT URMS - OVER ONE SECOND)

RMS phase-to-neutral voltage of phase (i+1) with  $i \in [0 ; 3]$  ( $i = 3 \Leftrightarrow$  neutral-to-earth voltage).

$$V_{rms}[i] = \sqrt{\frac{1}{NSS} \cdot \sum_{n=0}^{NSS-1} V[i][n]^2}$$

RMS phase-to-phase voltage of phase (i+1) with  $i \in [0 ; 2]$ .

$$U_{rms}[i] = \sqrt{\frac{1}{NSS} \cdot \sum_{n=0}^{NSS-1} U[i][n]^2}$$

RMS current of phase (i+1) with  $i \in [0 ; 3]$  ( $i = 3 \Leftrightarrow$  neutral current).

$$A_{rms}[i] = \sqrt{\frac{1}{NSS} \cdot \sum_{n=0}^{NSS-1} A[i][n]^2}$$

### A.1.2.8 REVERSE UNBALANCES (THREE-PHASE CONNECTION – OVER ONE SECOND)

These are calculated from the filtered RMS vector values (over one second) VFrms[i] and AFrms[i] for distribution systems with neutral and UFrms[i] and AFrms[i] for distribution systems without neutral (ideally the fundamental vectors of the signals).

**NOTE:** The operations are vector operations in complex notation with:

$$a = e^{j\frac{2\pi}{3}}$$

Forward phase-to-neutral voltage (vector) in a distribution system with neutral:

$$V_{rms+} = \frac{1}{3}(VFrms[0] + a \cdot VFrms[1] + a^2 \cdot VFrms[2])$$

Reverse phase-to-neutral voltage (vector) in a distribution system with neutral:

$$V_{rms-} = \frac{1}{3}(VFrms[0] + a^2 \cdot VFrms[1] + a \cdot VFrms[2])$$

Phase-to-neutral voltage unbalance in a distribution system with neutral:

$$V_{unb} = \frac{|V_{rms-}|}{|V_{rms+}|}$$

Forward phase-to-phase voltage (vector) in a distribution system without neutral:

$$U_{rms+} = \frac{1}{3}(UFrms[0] + a \cdot UFrms[1] + a^2 \cdot UFrms[2])$$

Reverse phase-to-phase voltage (vector) in a distribution system with neutral:

$$U_{rms-} = \frac{1}{3}(UFrms[0] + a^2 \cdot UFrms[1] + a \cdot UFrms[2])$$

Phase-to-phase voltage unbalance in a distribution system with neutral:

$$U_{unb} = \frac{|U_{rms-}|}{|U_{rms+}|}$$

Forward current (vector):

$$A_{rms+} = \frac{1}{3}(AFrms[0] + a \cdot AFrms[1] + a^2 \cdot AFrms[2])$$

Reverse current (vector):

$$A_{rms-} = \frac{1}{3}(AFrms[0] + a^2 \cdot AFrms[1] + a \cdot AFrms[2])$$

Current unbalance (vector):

$$A_{unb} = \frac{|A_{rms-}|}{|A_{rms+}|}$$

### A.1.2.9 FUNDAMENTAL RMS VALUES (EXCLUDING NEUTRAL – OVER ONE SECOND)

These are calculated from the filtered vector (instantaneous) values. A digital filter made up of six low-pass order 2 infinite pulse response Butterworth filters and one high-pass order 2 infinite pulse response Butterworth filter is used to extract the fundamental components.

### A.1.2.10 FUNDAMENTAL ANGULAR VALUES (EXCLUDING NEUTRAL – OVER ONE SECOND)

These are calculated from the filtered vector (instantaneous) values. A digital filter made up of six low-pass order 2 infinite pulse response Butterworth filters and one high-pass order 2 infinite pulse response Butterworth filter is used to extract the fundamental components. The angular values calculated are those between:

- Two phase-to-neutral voltages
- Two line currents
- Two phase-to-phase voltages
- One phase-to-neutral voltage and one line current (distribution systems with neutral)
- One phase-to-phase voltage and one line current (2-wire two-phase distribution systems)

## A.1.3 Harmonic Mode

### A.1.3.1 HFFT (NEUTRAL INCLUDED EXCEPT FOR UHARM AND VAHARM – OVER 4 CONSECUTIVE PERIODS EVERY SECOND)

Harmonic bins are calculated by FFT with 16 bit resolution (1024 samples on four cycles) with a rectangular window (see IEC61000-4-7). From the real parts  $b_k$  and the imaginary parts  $a_k$ , the harmonic factor is calculated for each order (j) and for each phase (i)  $V_{harm}[i][j]$ ,  $U_{harm}[i][j]$  and  $A_{harm}[i][j]$  with respect to the fundamental and the angles  $V_{ph}[i][j]$ ,  $U_{ph}[i][j]$  and  $A_{ph}[i][j]$  with respect to the fundamental. For the neutral-earth voltage and the neutral current, the level of harmonics is calculated for each order (j)  $V_{harm}[3][j]$  and  $A_{harm}[3][j]$  with respect to the total RMS value (AC+DC) of the complete signal (the harmonic angles are not calculated).

**Note:** The calculations are performed sequentially: {V1; A1} then {V2; A2} then {V3; A3} then {UN ; AN} then {U1; U2} and finally {U3}. In the case of a 2-wire two-phase distribution source, the couple {V1; A1} is replaced by the couple {U1; A1}.

The level in % with respect to the fundamental:

$$[\% f] \Leftrightarrow \tau_k = \frac{c_k}{c_4} 100$$

The level in % with respect to the total RMS value:

$$[\% r] \Leftrightarrow \tau_k = \frac{c_k}{\sqrt{\sum_{m=0}^{50} C_{4m}^2}} 100$$

The angle with respect to the fundamental in degrees:

$$[^\circ] \Leftrightarrow \varphi_k = \arctan\left(\frac{a_k}{b_k}\right) - \varphi_4$$

$$\text{with } \begin{cases} c_k = |b_k + j\dot{u}_k| = \sqrt{a_k^2 + b_k^2} \\ b_k = \frac{1}{512} \sum_{s=0}^{1024} F_s \cdot \sin\left(\frac{k\pi}{512} s + \varphi_k\right) \\ a_k = \frac{1}{512} \sum_{s=0}^{1024} F_s \cdot \cos\left(\frac{k\pi}{512} s + \varphi_k\right) \\ c_0 = \frac{1}{1024} \sum_{s=0}^{1024} F_s \end{cases}$$

$c_k$  is the amplitude of the component of order  $m = \frac{k}{4}$  with a frequency  $f_k = \frac{k}{4} f_4$

$F_s$  is the sampled signal at the fundamental frequency

$c_0$  is the DC component

$k$  is the index of the spectral spike - the order of the harmonic component is  $m = \frac{k}{4}$

**NOTE:** The power harmonic factors are calculated by multiplying the phase-to-neutral voltage harmonic factors by the current harmonic factors. The power harmonic angles (VAharm[i][j] and VAph[i][j]) are calculated by differentiating the phase-to-neutral voltage harmonic angles with the current harmonic angles. In the case of a 2-wire two-phase distribution source, the phase-to-neutral voltage V1 is replaced by the phase-to-phase voltage U1 and one obtains the harmonic power levels UAharm[0][j] and the harmonic power angles UAph[0][j].

### A.1.3.2 HARMONIC DISTORTIONS

Two global values giving the relative quantity of harmonics are calculated: the THD as a proportion of the fundamental (THD-F) and the DF as a proportion of the RMS value (THD-R).

Total harmonic distortion of phase (i+1) with  $i \in [0 ; 2]$  (THD or THD-F).

$$V_{thdf}[i] = \frac{\sqrt{\sum_{n=2}^{50} V_{harm}[i][n]^2}}{V_{harm}[i][1]}, U_{thdf}[i] = \frac{\sqrt{\sum_{n=2}^{50} U_{harm}[i][n]^2}}{U_{harm}[i][1]}, A_{thdf}[i] = \frac{\sqrt{\sum_{n=2}^{50} A_{harm}[i][n]^2}}{A_{harm}[i][1]}$$

Total harmonic distortion of channel (i+1) with  $i \in [0 ; 3]$  (DF or THD-R).

$$V_{thdr}[i] = \frac{\sqrt{\sum_{n=2}^{50} V_{harm}[i][n]^2}}{\sqrt{\sum_{n=1}^{50} V_{harm}[i][n]^2}}, U_{thdr}[i] = \frac{\sqrt{\sum_{n=2}^{50} U_{harm}[i][n]^2}}{\sqrt{\sum_{n=1}^{50} U_{harm}[i][n]^2}}, A_{thdr}[i] = \frac{\sqrt{\sum_{n=2}^{50} A_{harm}[i][n]^2}}{\sqrt{\sum_{n=1}^{50} A_{harm}[i][n]^2}}$$

The THD as a proportion of the RMS-AC value (THD-R) is also called the distortion factor (DF).

### A.1.3.3 HARMONIC LOSS FACTOR (EXCLUDING NEUTRAL - OVER 4 CONSECUTIVE CYCLES EVERY SECOND)

Harmonic loss factor of the phase (i+1) with  $i \in [0 ; 2]$ :

$$FHL[i] = \frac{\sum_{n=1}^{n:50} n^2 \cdot A_{harm}[i][n]^2}{\sum_{n=1}^{n:50} A_{harm}[i][n]^2}$$

### A.1.3.4 K FACTOR (EXCLUDING NEUTRAL – OVER 4 CONSECUTIVE CYCLES EVERY SECOND)

K factor for phase (i+1) with  $i \in [0; 2]$ ,  $e \in [0.05; 0.1]$  and  $q \in [1.5; 1.7]$ .

$$FK [i] = \sqrt{1 + \frac{e}{1+e} \cdot \frac{\sum_{n=2}^{n=50} n^q \cdot Aharm[i][n]^2}{\sum_{n=1}^{n=50} Aharm[i][n]^2}}$$

### A.1.3.5 SEQUENCE HARMONICS (OVER 3 × (4 CONSECUTIVE CYCLES) EVERY SECOND)

Negative-sequence harmonics:

$$Aharm_{-} = \frac{1}{3} \sum_{i=0}^2 \frac{\sum_{j=0}^7 Aharm[i][3j+2]}{Aharm[i][1]}$$

Three phase systems with neutral:

$$Vharm_{-} = \frac{1}{3} \sum_{i=0}^2 \frac{\sum_{j=0}^7 Vharm[i][3j+2]}{Vharm[i][1]}$$

$$Vharm_0 = \frac{1}{3} \sum_{i=0}^2 \frac{\sum_{j=0}^7 Vharm[i][3j+3]}{Vharm[i][1]}$$

$$Vharm_{+} = \frac{1}{3} \sum_{i=0}^2 \frac{\sum_{j=0}^7 Vharm[i][3j+4]}{Vharm[i][1]}$$

Three phase systems without neutral:

$$Uharm_{-} = \frac{1}{3} \sum_{i=0}^2 \frac{\sum_{j=0}^7 Uharm[i][3j+2]}{Uharm[i][1]}$$

$$Uharm_0 = \frac{1}{3} \sum_{i=0}^2 \frac{\sum_{j=0}^7 Uharm[i][3j+3]}{Uharm[i][1]}$$

$$Uharm_{+} = \frac{1}{3} \sum_{i=0}^2 \frac{\sum_{j=0}^7 Uharm[i][3j+4]}{Uharm[i][1]}$$

Zero-sequence harmonics:

$$Aharm_0 = \frac{1}{3} \sum_{i=0}^2 \frac{\sum_{j=0}^7 Aharm[i][3j+3]}{Aharm[i][1]}$$

Positive -sequence harmonics:

$$A_{\text{harm}+} = \frac{1}{3} \sum_{i=0}^2 \frac{\sum_{j=0}^7 A_{\text{harm}}[i][3j+4]}{A_{\text{harm}}[i][1]}$$

#### A.1.4 Powers

Powers without neutral – over one second.

**NSS** = number of samples in a second.

##### A.1.4.1 DISTRIBUTION SYSTEM WITH NEUTRAL

Active power of phase (i+1) with  $i \in [0 ; 2]$ :

$$W[i] = \frac{1}{NSS} \cdot \sum_{n=0}^{NSS-1} V[i][n] \cdot A[i][n]$$

DC power of phase (i+1) with  $i \in [0 ; 2]$ :

$$W_{\text{dc}}[i] = V_{\text{dc}}[i] \cdot A_{\text{dc}}[i]$$

Apparent power of phase (i+1) with  $i \in [0 ; 2]$ :

$$VA[i] = V_{\text{rms}}[i] \cdot A_{\text{rms}}[i]$$

Reactive power (without harmonics) of phase (i+1) with  $i \in [0 ; 2]$ :

$$VAR[i] = \frac{1}{NSS} \cdot \sum_{n=0}^{NSS-1} VF[i][n - \frac{NSC}{4}] \cdot AF[i][n]$$

Distortion power of the phase (i+1) with  $i \in [0 ; 2]$ :

$$VAD[i] = \sqrt{VA[i]^2 - W[i]^2 - VARF[i]^2}$$

Non-active power of phase (i+1) with  $i \in [0 ; 2]$ :

$$VAR[i] = \sqrt{VA[i]^2 - W[i]^2}$$

Reactive powers are calculated using the filtered signals (without harmonics) – VF[i][j] and AF[i][j] - in accordance with EDF (French national electricity company) rules or from the apparent and active powers (with harmonics). The choice of calculation is left up to the user.

Total active power:

$$W[3] = W[0] + W[1] + W[2]$$

Total DC power:

$$W_{\text{dc}}[3] = W_{\text{dc}}[0] + W_{\text{dc}}[1] + W_{\text{dc}}[2]$$

Total apparent power:

$$VA[3] = VA[0] + VA[1] + VA[2]$$

Total reactive power (Non-active quantities broken down):

$$VAR[3] = VARF[3] = VARF[0] + VARF[1] + VARF[2]$$

Total distortion power:

$$VAD[3] = \sqrt{VA[3]^2 - W[3]^2 - VARF[3]^2}$$

Total non-active power :

$$VAR[3] = \sqrt{VA[3]^2 - W[3]^2}$$

#### A.1.4.2 THREE-PHASE SYSTEM WITHOUT NEUTRAL

Three-phase distribution systems without neutral are considered as a whole (no phase-by-phase power calculation). The device therefore displays only the total quantities. The two-wattmeter method (Aron method or two-element method) is applied for the calculation of the total active power, of the total reactive power and of the total DC power.

##### Reference in L1

Active power, wattmeter 1:

$$W[0] = \frac{1}{NSS} \cdot \sum_{n=0}^{NSS-1} U[2][n] \cdot A[2][n]$$

Active power, wattmeter 2:

$$W[1] = \frac{1}{NSS} \cdot \sum_{n=0}^{NSS-1} -U[0][n] \cdot A[1][n]$$

Reactive power, wattmeter 1:

$$VARF[0] = \frac{1}{NSS} \cdot \sum_{n=0}^{NSS-1} UF[2][n - \frac{NP}{4}] \cdot AF[2][n]$$

Reactive power, wattmeter 2:

$$VARF[1] = \frac{1}{NSS} \cdot \sum_{n=0}^{NSS-1} -UF[1][n - \frac{NP}{4}] \cdot AF[2][n]$$

DC power, Wattmeter 1:

$$Wdc[0] = Udc[2] \cdot Adc[2]$$

DC power, Wattmeter 2:

$$Wdc[1] = -Udc[0] \cdot Adc[1]$$

##### Reference in L2

Active power, wattmeter 1:

$$Vthdf[i] = \frac{\sqrt{\sum_{n=2}^{50} Vharm[i][n]^2}}{Vharm[i][1]}, Uthdf[i] = \frac{\sqrt{\sum_{n=2}^{50} Uharm[i][n]^2}}{Uharm[i][1]}, Athdf[i] = \frac{\sqrt{\sum_{n=2}^{50} Aharm[i][n]^2}}{Aharm[i][1]}$$

Active power, wattmeter 2:

$$W[1] = \frac{1}{NSS} \cdot \sum_{n=0}^{NSS-1} -U[1][n] \cdot A[2][n]$$

Reactive power, wattmeter 1:

$$\text{VARF}[0] = \frac{1}{\text{NSS}} \cdot \sum_{n=0}^{\text{NSS}-1} \text{UF}[0][n - \frac{\text{NP}}{4}] \cdot \text{AF}[0][n]$$

Reactive power, wattmeter 2:

$$\text{VARF}[1] = \frac{1}{\text{NSS}} \cdot \sum_{n=0}^{\text{NSS}-1} -\text{UF}[1][n - \frac{\text{NP}}{4}] \cdot \text{AF}[2][n]$$

DC power, Wattmeter 1:

$$\text{Wdc}[0] = \text{Udc}[0] \cdot \text{Adc}[0]$$

DC power, Wattmeter 2:

$$\text{Wdc}[1] = -\text{Udc}[1] \cdot \text{Adc}[2]$$

### Reference in L3

Active power, wattmeter 1:

$$\text{W}[0] = \frac{1}{\text{NSS}} \cdot \sum_{n=0}^{\text{NSS}-1} -\text{U}[2][n] \cdot \text{A}[0][n]$$

Active power, wattmeter 2:

$$\text{W}[1] = \frac{1}{\text{NSS}} \cdot \sum_{n=0}^{\text{NSS}-1} \text{U}[1][n] \cdot \text{A}[1][n]$$

Reactive power, wattmeter 1:

$$\text{VARF}[0] = \frac{1}{\text{NSS}} \cdot \sum_{n=0}^{\text{NSS}-1} -\text{UF}[2][n - \frac{\text{NP}}{4}] \cdot \text{AF}[0][n]$$

Reactive power, wattmeter 2:

$$\text{VARF}[1] = \frac{1}{\text{NSS}} \cdot \sum_{n=0}^{\text{NSS}-1} \text{UF}[1][n - \frac{\text{NP}}{4}] \cdot \text{AF}[1][n]$$

DC power, Wattmeter 1:

$$\text{Wdc}[0] = -\text{Udc}[2] \cdot \text{Adc}[0]$$

DC power, Wattmeter 2:

$$\text{Wdc}[1] = \text{Udc}[1] \cdot \text{Adc}[1]$$

### Calculation of the total quantities

Total active power:

$$\text{W}[3] = \text{W}[0] + \text{W}[1]$$

Total DC power:

$$\text{Wdc}[3] = \text{Wdc}[0] + \text{Wdc}[1]$$

Total apparent power:

$$\text{VA}[3] = \frac{1}{\sqrt{3}} \sqrt{U_{rms}^2[0] + U_{rms}^2[1] + U_{rms}^2[2]} \sqrt{A_{rms}^2[0] + A_{rms}^2[1] + A_{rms}^2[2]}$$



**Note:** This is the total apparent RMS power as defined in IEEE 1459-2010 for distribution systems without neutral.

Total reactive power:

$$\text{VAR}[3] = \text{VARF}[3] = \text{VARF}[0] + \text{VARF}[1]$$

Total distortion power:

$$\text{VAD}[3] = \sqrt{\text{VA}[3]^2 - \text{W}[3]^2 - \text{VARF}[3]^2}$$

Total non-active power:

$$\text{VAR}[3] = \sqrt{\text{VA}[3]^2 - \text{W}[3]^2}$$

### A.1.4.3 TWO-PHASE SYSTEMS WITHOUT NEUTRAL

Two-phase distribution systems without neutral (2-wire two-phase) are treated as single-phase distribution systems having their voltage reference on L2 rather than N (neutral).

Active power:

$$\text{Vthdf}[i] = \frac{\sqrt{\sum_{n=2}^{50} \text{Vharm}[i][n]^2}}{\text{Vharm}[i][1]}, \quad \text{Uthdf}[i] = \frac{\sqrt{\sum_{n=2}^{50} \text{Uharm}[i][n]^2}}{\text{Uharm}[i][1]}, \quad \text{Athdf}[i] = \frac{\sqrt{\sum_{n=2}^{50} \text{Aharm}[i][n]^2}}{\text{Aharm}[i][1]}$$

DC power:

$$\text{Wdc}[0] = \text{Udc}[0] \cdot \text{Adc}[0]$$

Apparent power:

$$\text{VA}[0] = \text{Urms}[0] \cdot \text{Arms}[0]$$

Reactive power:

$$\text{VAR}[0] = \text{VARF}[0] = \frac{1}{\text{NSS}} \cdot \sum_{n=0}^{\text{NSS}-1} \text{UF}[0][n] - \frac{\text{NP}}{4} \cdot \text{AF}[0][n]$$

Distortion power:

$$\text{VAD}[0] = \sqrt{\text{VA}[0]^2 - \text{W}[0]^2 - \text{VARF}[0]^2}$$

Non-active power:

$$\text{VAR}[0] = \sqrt{\text{VA}[0]^2 - \text{W}[0]^2}$$

## A.1.5 Power ratios (excluding neutral – over one second)

### A.1.5.1 DISTRIBUTION SYSTEM WITH NEUTRAL

Power factor of phase (i+1) with  $i \in [0 ; 2]$ :

$$PF[i] = \frac{W[i]}{VA[i]}$$

Fundamental power factor of phase (i+1) or cosine of the angle of the phase-to-neutral voltage fundamental of phase (i+1) with respect to the current fundamental of phase (i+1) with  $i \in [0 ; 2]$ .

$$DPF[i] = \cos(\phi[i]) = \frac{\sum_{n=0}^{NSS-1} VF[i][n] \cdot AF[i][n]}{\sqrt{\sum_{n=0}^{NSS-1} VF[i][n]^2} \cdot \sqrt{\sum_{n=0}^{NSS-1} AF[i][n]^2}}$$

Tangent of phase (i + 1) or tangent of the angle of the phase-to-neutral voltage fundamental of phase (i+1) with respect to the current fundamental of phase (i+1) with  $i \in [0 ; 2]$ .

$$\tan[i] = \tan(\phi[i]) = \frac{\sum_{n=0}^{NSS-1} VF[i][n] \cdot \left[ n - \frac{NP}{4} \right] \cdot AF[i][n]}{\sum_{n=0}^{NSS-1} VF[i][n] \cdot AF[i][n]}$$

Total power factor:

$$PF[3] = \frac{W[3]}{VA[3]}$$

Total fundamental power factor:

$$DPF[3] = \frac{WF[3]}{\sqrt{WF[3]^2 + VARF[3]^2}}$$

with:

$$WF[3] = \sum_{n=0}^{NSS-1} VF[0][n] \cdot AF[0][n] + \sum_{n=0}^{NSS-1} VF[1][n] \cdot AF[1][n] + \sum_{n=0}^{NSS-1} VF[2][n] \cdot AF[2][n]$$

$$VARF[3] = \sum_{n=0}^{NSS-1} VF[0] \left[ n - \frac{NP}{4} \right] \cdot AF[0][n] + \sum_{n=0}^{NSS-1} VF[1] \left[ n - \frac{NP}{4} \right] \cdot AF[1][n] + \sum_{n=0}^{NSS-1} VF[2] \left[ n - \frac{NP}{4} \right] \cdot AF[2][n]$$

Total tangent:

$$\tan[3] = \frac{VARF[3]}{WF[3]}$$

### A.1.5.2 THREE-PHASE SYSTEM WITHOUT NEUTRAL

Total power factor:

$$PF[3] = \frac{W[3]}{VA[3]}$$

Total fundamental power factor:

$$DPF[3] = \frac{WF[3]}{\sqrt{WF[3]^2 + VARF[3]^2}}$$

with:

If reference on L1

$$WF[3] = \frac{1}{NSS} \cdot \sum_{n=0}^{NSS-1} U[2][n] \cdot A[2][n] + \frac{1}{NSS} \cdot \sum_{n=0}^{NSS-1} -U[0][n] \cdot A[1][n]$$

If reference on L2

$$WF[3] = \frac{1}{NSS} \cdot \sum_{n=0}^{NSS-1} U[0][n] \cdot A[0][n] + \frac{1}{NSS} \cdot \sum_{n=0}^{NSS-1} -U[1][n] \cdot A[2][n]$$

If reference on L3

$$WF[3] = \frac{1}{NSS} \cdot \sum_{n=0}^{NSS-1} -U[2][n] \cdot A[0][n] + \frac{1}{NSS} \cdot \sum_{n=0}^{NSS-1} -U[1][n] \cdot A[1][n]$$

Total tangent:

$$\text{Tan}[3] = \frac{VARF[3]}{WF[3]}$$

### A.1.5.3 TWO-PHASE SYSTEM WITHOUT NEUTRAL

Two-phase distribution systems without neutral (2-Wire two-phase) are treated as single-phase distribution systems having the voltage reference on L2 rather than N (neutral).

Power factor:

$$PF[0] = \frac{W[0]}{VA[0]}$$

Total fundamental power factor:

$$DPF[0] = \frac{WF[0]}{\sqrt{WF[0]^2 + VARF[0]^2}}$$

with:

$$WF[0] = \frac{1}{NSS} \cdot \sum_{n=0}^{NSS-1} UF[0][n] \cdot AF[0][n]$$

Tangent:

$$\text{Tan}[0] = \frac{VARF[0]}{WF[0]}$$

## A.1.6 Energy

Energy excluding neutral – over  $T_{int}$  with refresh every second.  $T_{int}$  is the power integration time in energy calculations; the beginning and end of this period are user-controlled.

### A.1.6.1 DISTRIBUTION SYSTEM WITH NEUTRAL

Consumed DC energy of phase (i+1) with  $i \in [0 ; 2]$ :

$$Wdch[0][i] = \sum_n^{T_{int}} \frac{Wdc[i][n]}{3600} \quad \text{with } Wdc[i][n] \geq 0$$

Total consumed DC energy:

$$Wdch[0][3] = Wdch[0][0] + Wdch[0][1] + Wdch[0][2]$$

#### Case 1: Energy consumed other than DC ( $W[i][n] \geq 0$ )

Consumed active energy of phase (i+1) with  $i \in [0 ; 2]$ :

$$Wh[0][i] = \sum_n^{T_{int}} \frac{W[i][n]}{3600}$$

Consumed apparent energy of phase (i+1) with  $i \in [0 ; 2]$ :

$$VAh[0][i] = \sum_n^{T_{int}} \frac{VA[i][n]}{VA600}$$

Consumed inductive reactive energy of phase (i+1) with  $i \in [0 ; 2]$ :

$$VARhL[0][i] = \sum_n^{T_{int}} \frac{VARF[i][n]}{3600} \quad \text{with } VARF[i][n] \geq 0$$

Consumed capacitive reactive energy of phase (i+1) with  $i \in [0 ; 2]$ :

$$VARhC[0][i] = \sum_n^{T_{int}} \frac{-VARF[i][n]}{3600} \quad \text{with } VARF[i][n] < 0$$

Consumed distortion energy of phase (i+1) with  $i \in [0 ; 2]$ :

$$VADh[0][i] = \sum_n^{T_{int}} \frac{VAD[i][n]}{3600}$$

Consumed non-active energy of phase (i+1) with  $i \in [0 ; 2]$ :

$$VARh[0][i] = \sum_n^{T_{int}} \frac{VAR[i][n]}{3600}$$

Total consumed active energy:

$$Wh[0][3] = Wh[0][0] + Wh[0][1] + Wh[0][2]$$

Total consumed apparent energy:

$$VAh[0][3] = VAh[0][0] + VAh[0][1] + VAh[0][2]$$

Total consumed reactive inductive energy:

$$VARhL[0][3] = VARhL[0][0] + VARhL[0][1] + VARhL[0][2]$$

Total consumed capacitive reactive energy:

$$VARhC[0][3] = VARhC[0][0] + VARhC[0][1] + VARhC[0][2]$$

Total consumed distortion energy:

$$\text{VARh}[0][3] = \text{VADh}[0][0] + \text{VADh}[0][1] + \text{VADh}[0][2]$$

Total consumed non-active energy:

$$\text{VARh}[0][3] = \text{VARh}[0][0] + \text{VARh}[0][1] + \text{VARh}[0][2]$$

**Case 2: Generated DC energy of phase (i+1) with  $i \in [0; 2]$**

$$\text{Wdch}[1][i] = \sum_n^{T_{\text{int}}} \frac{-\text{Wdc}[i][n]}{3600}$$

with  $\text{Wdc}[i][n] < 0$

**Case 3: Total generated DC energy**

$$\text{Wdch}[1][3] = \text{Wdch}[1][0] + \text{Wdch}[1][1] + \text{Wdch}[1][2]$$

**Case 4: Energy generated other than DC ( $\text{W}[i][n] < 0$ )**

Generated active energy of phase (i+1) with  $i \in [0; 2]$ :

$$\text{Wh}[1][i] = \sum_n^{T_{\text{int}}} \frac{-\text{W}[i][n]}{3600}$$

Generated apparent energy of phase (i+1) with  $i \in [0; 2]$ :

$$\text{VAh}[1][i] = \sum_n^{T_{\text{int}}} \frac{\text{VA}[i][n]}{3600}$$

Generated inductive reactive energy of phase (i+1) with  $i \in [0; 2]$ :

$$\text{VARhL}[1][i] = \sum_n^{T_{\text{int}}} \frac{-\text{VARF}[i][n]}{3600}$$

with  $\text{VARF}[i][n] < 0$

Generated capacitive reactive energy of phase (i+1) with  $i \in [0; 2]$ :

$$\text{VARhC}[1][i] = \sum_n^{T_{\text{int}}} \frac{\text{VARF}[i][n]}{3600}$$

with  $\text{VARF}[i][n] \geq 0$

Generated distortion energy of phase (i+1) with  $i \in [0; 2]$ :

$$\text{VADh}[1][i] = \sum_n^{T_{\text{int}}} \frac{\text{VAD}[i][n]}{3600}$$

Generated non-active energy of phase (i+1) with  $i \in [0; 2]$ :

$$\text{VARh}[1][i] = \sum_n^{T_{\text{int}}} \frac{\text{VAR}[i][n]}{3600}$$

Total generated active energy:

$$\text{Wh}[1][3] = \text{Wh}[1][0] + \text{Wh}[1][1] + \text{Wh}[1][2]$$

Total generated apparent energy:

$$\text{VAh}[1][3] = \text{VAh}[1][0] + \text{VAh}[1][1] + \text{VAh}[1][2]$$

Total generated inductive reactive energy:

$$\text{VARhL}[1][3] = \text{VARhL}[1][0] + \text{VARhL}[1][1] + \text{VARhL}[1][2]$$

Total generated capacitive reactive energy:

$$\text{VARhC}[1][3] = \text{VARhC}[1][0] + \text{VARhC}[1][1] + \text{VARhC}[1][2]$$

Total generated distortion energy:

$$\text{VADh}[1][3] = \text{VADh}[1][0] + \text{VADh}[1][1] + \text{VADh}[1][2]$$

Total generated non-active energy:

$$\text{VADh}[1][3] = \text{VADh}[1][0] + \text{VADh}[1][1] + \text{VADh}[1][2]$$

### A.1.6.2 DISTRIBUTION SYSTEM WITHOUT NEUTRAL

This section discusses only of total energy, with:

- Three-phase systems without neutral:  $i = 3$
- Two-phase systems without neutral:  $i = 3$  or  $i = 0$

**Note:** Two-phase distribution systems without neutral (2-wire two-phase) are treated as single-phase distribution systems having their voltage reference on L2 rather than N (neutral).

Total consumed DC energy:

$$\text{Wdch}[0][i] = \sum_n^{T_{\text{int}}} \frac{\text{Wdc}[i][n]}{3600}$$

with  $\text{Wdc}[i][n] \geq 0$

#### Case 1: Total energy consumed other than DC ( $\text{W}[i][n] \geq 0$ )

Total consumed active energy:

$$\text{Wh}[0][i] = \sum_n^{T_{\text{int}}} \frac{\text{W}[i][n]}{3600}$$

Total consumed apparent energy:

$$\text{VAh}[0][i] = \sum_n^{T_{\text{int}}} \frac{\text{VA}[i][n]}{3600}$$

Total consumed inductive reactive energy:

$$\text{VARhL}[0][i] = \sum_n^{T_{\text{int}}} \frac{\text{VARF}[i][n]}{3600}$$

with  $\text{VARF}[i][n] \geq 0$

Total consumed capacitive reactive energy:

$$\text{VARhC}[0][i] = \sum_n^{T_{\text{int}}} \frac{-\text{VARF}[i][n]}{3600}$$

with  $\text{VARF}[i][n] < 0$

Total consumed distortion energy:

$$VADh[0][i] = \sum_n^{T_{int}} \frac{VAD[i][n]}{3600}$$

Total consumed non-active energy:

$$VARh[0][i] = \sum_n^{T_{int}} \frac{VAR[i][n]}{3600}$$

### Case 2: Total generated DC energy

$$Wdch[1][i] = \sum_n^{T_{int}} \frac{-Wdc[i][n]}{3600}$$

with  $Wdc[i][n] < 0$

### Case 3: Total energy generated other than DC ( $W[i][n] < 0$ )

Total generated active energy:

$$Wh[1][i] = \sum_n^{T_{int}} \frac{-W[i][n]}{3600}$$

Total generated apparent energy:

$$VAh[1][i] = \sum_n^{T_{int}} \frac{VA[i][n]}{3600}$$

Total generated inductive reactive energy:

$$VARhL[1][i] = \sum_n^{T_{int}} \frac{-VARF[i][n]}{3600}$$

with  $VARF[i][n] < 0$

Total generated capacitive reactive energy:

$$VARhC[1][i] = \sum_n^{T_{int}} \frac{VARF[i][n]}{3600}$$

with  $VARF[i][n] \geq 0$

Total generated distortion energy:

$$VADh[1][i] = \sum_n^{T_{int}} \frac{VAD[i][n]}{3600}$$

Total generated non-active energy:

$$VARh[1][i] = \sum_n^{T_{int}} \frac{VAR[i][n]}{3600}$$

## A.1.7 Hysteresis

Hysteresis is a filtering principle, often used after the threshold detection has occurred. A correct setting of the hysteresis value will avoid repeated triggering when the measurement is varying close to the threshold. The event detection is activated when the measurement goes over the threshold; but it can only be deactivated if the measurement goes under the threshold minus the value of the hysteresis.

The default hysteresis value is 2% of the reference voltage; but it can be set in the range of [1%, 5%] depending on the voltage stability on the system.

### A.1.7.1 SURGE DETECTION

With a hysteresis of 2%, for example, the return level for surge detection is equal to  $(100\% - 2\%)$  or 98% of the reference voltage threshold.

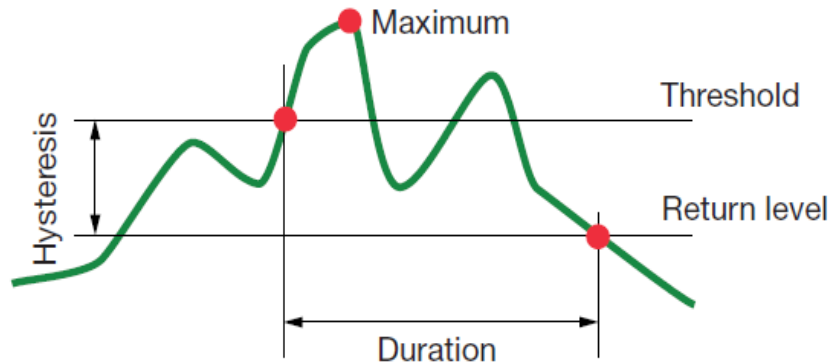


Figure A-1

### A.1.7.2 UNDERVOLTAGE OR BLACKOUT DETECTION

With a hysteresis of 2%, for example, the return level for undervoltage detection is equal to  $(100\% + 2\%)$  or 102% of the  $U_{ref}$  voltage threshold.

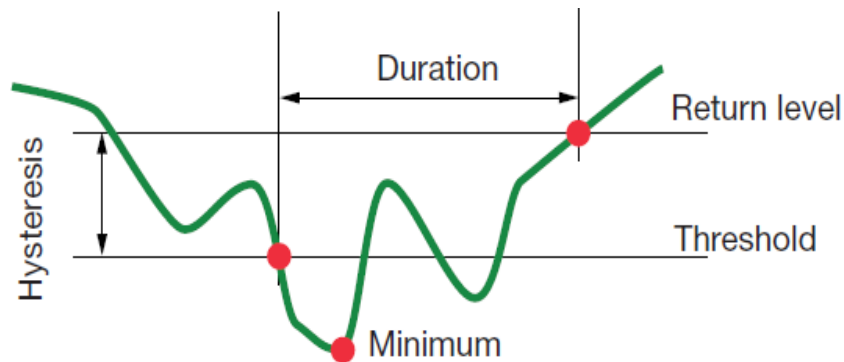


Figure A-2



### A.1.8 Minimum scale values for waveforms and minimum RMS values

Type	Minimum scale value [waveform mode]	Min RMS values
Phase-to-neutral and phase-to-phase voltages	8V <sup>(1)</sup>	5V <sup>(1)</sup>
AmpFlex® & MiniFlex®	90A	10A
SR193	8A	1A
MR193	8A	1A
MN93	2A	0.2A
MN193 (100A)	0.8A	0.1A
SL261 (10mV/A)	0.8A	0.1A
SL261 (100mV/A)	0.08A	0.01A
MN193 (5A)	0.04A <sup>(1)</sup>	0.005A <sup>(1)</sup>
5A Adaptor	0.04A <sup>(1)</sup>	0.005A <sup>(1)</sup>

<sup>(1)</sup> Value to be multiplied by the ratio in effect (if not unity).

### A.1.9 Four-Quadrant Diagram

This diagram is used as part of measuring power and energy.

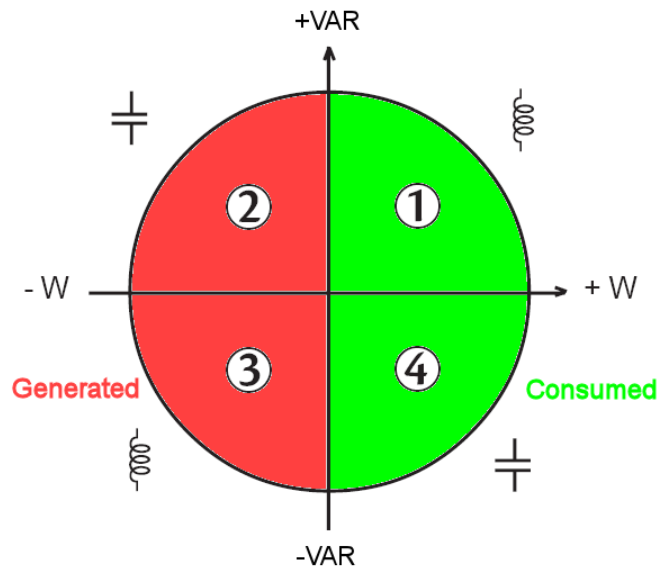


Figure A-3

### A.1.10 Mechanism for triggering transient sensors

The sample rate is a constant value equivalent to 256 samples per cycle. When a transient search is launched, each sample is compared to the sample from the preceding cycle. The preceding cycle matches the middle of the tube; it is used as a reference. As soon as a sample leaves the tube, the trigger event comes; representation of the transient is then captured by the Model 8435. The cycle preceding the event and the three following cycles are saved to memory. The half-width of the envelope for the voltage and current is equal to the threshold programmed in the Transient mode of the configuration.

The following is a graphical representation of the transient capture trigger mechanism:

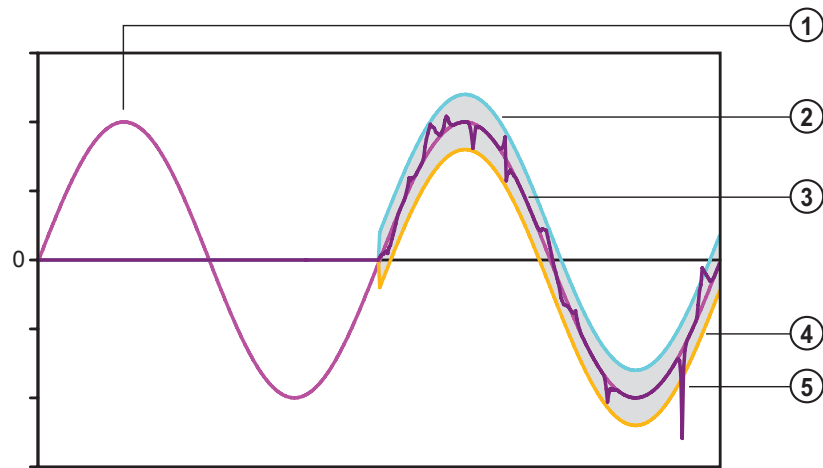


Figure A-4

Item	Function
1	Reference period
2	Top of envelope
3	Cycle monitored
4	Bottom of envelope
5	Triggering event

### A.1.11 Capture Conditions in Inrush Current Mode

Captures depend on the trigger event and a stop event. If the capture ends with a stop event or if the recording memory of the Model 8435 is full, the capture stops automatically.

The stop threshold for capture is calculated as follows:

$$[\text{Stop threshold [A]}] = [\text{Start threshold [A]}] \times (100 - [\text{Stop hysteresis [\%]}]) \div 100$$

The following table shows the conditions for triggering and stopping capture:

Triggering filter type	Start and end conditions
A1	Start condition ⇔ [A1 half-period RMS value] > [Start threshold] Stop condition ⇔ [A1 half-period RMS value] < [Stop threshold]
A2	Start condition ⇔ [A2 half-period RMS value] > [Start threshold] Stop condition ⇔ [A2 half-period RMS value] < [Stop threshold]
A3	Start condition ⇔ [A3 half-period RMS value] > [Start threshold] Stop condition ⇔ [A3 half-period RMS value] < [Stop threshold]
3A	Start condition ⇔ [the half-period RMS value of <b>one</b> current channel] > [Start threshold] Stop condition ⇔ [the half-period RMS values of <b>all</b> current channels] < [Stop threshold]

## A.2 Glossary of Terms

**Ampere:** unit of electrical current intensity (A symbol).

**Bandwidth:** frequency range on which an instrument supplies a precise measurement.

**Blackout:** fall of voltage, at some point in the power network, to below a specified threshold.

**Channel and phase:** a measurement channel corresponding to a difference in potential between two conductors. A phase is a single conductor. In polyphased systems, a measurement channel may be between two phases, or between a phase and neutral, or between a phase and earth, or between neutral and earth.

**Cut:** reduction in voltage at a point in the electrical power network below the cut threshold.

**Dip threshold:** specific voltage value to detect the start and end of a voltage dip.

**Distortion factor (DF):** ratio of the harmonics of a signal to the whole signal without the DC or bias component (THD-R).

**Factor K (also called K factor):** number based on the contents of a harmonic of a charge current that determines the maximum load on a source of energy. The K factor calculated by the Model 8435 is measured and compared with the one specified by the transformer manufacturer. It gives the percentage of "harmonics load" of the transformer.

**Flicker:** a visual effect of voltage variations.

**Frequency:** number of full voltage or current cycles in one second.

**Fundamental component:** component at the fundamental frequency.

**Harmonics:** in electrical systems, voltages and currents at frequencies that are multiples of the fundamental frequency.

**Harmonics level:** whole number equal to the relationship between the frequency of the harmonic and the fundamental frequency.

**Hysteresis:** difference between thresholds for reciprocal changes of state.

**Imbalance in voltage in a polyphased electrical power network:** status where efficient values for voltages between conductors (fundamental component) and/or differences in phase between successive conductors are not equal.

**K factor:** see Factor K.

**Measurement method:** all measurement methods associated to an individual measurement.

**Nominal voltage:** voltage by which a network is named or identified.

**Non-nuclear toe:** non-nuclear tonne oil equivalent.

**Nuclear toe:** nuclear tonne oil equivalent.

**Order of a harmonic:** ratio of the frequency of the harmonic to the fundamental frequency; a whole number.

**Passband:** range of frequencies in which the response of a device exceeds some specified minimum.

**Peak:** maximum (+) or minimum (-) peak value of the signal.

**Peak factor:** relation between the peak value and efficient value of the current.

**Phase:** temporal relationship between current and voltage in alternating current circuits.

**Phase and route:** a measurement route corresponds to a difference in potential between two conductors. A phase is a simple conductor. In polyphased systems, a measurement route can be between two phases, or a phase and neutral, or a phase and earth, or neutral and earth.

**Phase displacement factor:** relationship between the active power and apparent power of the fundamental component.

**Power displacement factor:** expresses the difference between the apparent and active power when and only when the relationship of the voltage phase and current to the fundamental is taken into account.

**Power factor:** relationship between active and apparent power.

**Temporary surge at industrial frequency:** temporary increase in the voltage amplitude at a point in the electrical power network above a given threshold.

**Voltage dip:** temporary reduction in the voltage amplitude at a point in the electrical power network below a given threshold.

**Watt:** unit of measurement for power (W symbol).

### A.3 Symbols and Abbreviations

Meanings of the symbols and abbreviations used:

Symbol	Designation
$\approx$	AC and DC components
$\sim$	AC component only
$\equiv$	DC component only
$\Phi$	Phase shift of phase-to-neutral voltage with respect to phase-to-neutral current
$\text{⌚}$	Inductive phase shift
$\text{⌚}$	Capacitive phase shift
$^{\circ}$	Degree
<b>-.+</b>	Expert mode
<b>   </b>	Absolute value
$\Sigma$	Sum of values
$\bar{x}$	Mean value (arithmetic mean)
<b>%</b>	Percentage
<b>%f</b>	Fundamental value as reference
<b>%r</b>	Total value as reference
$\Phi_{VA}$ or $\Phi_{UA}$	Phase shift of voltage with respect to current
<b>A</b>	Current; also Ampere (unit)
<b>A-h</b>	Current harmonic
<b>Acf</b>	Crest (peak) factor of current
<b>Ad</b>	RMS distortion current
<b>Adc</b>	DC current
<b>Ah</b>	Current harmonic
<b>Apk+</b>	Maximum peak value of the current
<b>Apk-</b>	Minimum peak value of the current
<b>Arms</b>	True RMS current
<b>Athd</b>	Total harmonic distortion of current
<b>Athdf</b>	Harmonic distortion of the current with the RMS value of the fundamental as reference
<b>Athdr</b>	Harmonic distortion of the current with the total RMS value without DC as reference
<b>Aunb</b>	Current unbalance
<b>AVG</b>	Mean value (arithmetic mean)
<b>BTU</b>	British Thermal Unit
<b>CF</b>	Peak factor (current or voltage)
<b>cos <math>\Phi</math></b>	Cosine of the phase shift of voltage with respect to current (DPF)
<b>DC</b>	DC component (current or voltage)
<b>DF</b>	Distortion factor (THD-R)
<b>DPF</b>	Displacement factor (cos $\Phi$ )

<b>FK</b>	K factor (also called Factor K)
<b>FHL</b>	Harmonic loss factor
<b>Hz</b>	Frequency of network studied.
<b>L</b>	Channel (Line)
<b>MAX</b>	Maximum value
<b>MIN</b>	Minimum value
<b>ms</b>	Millisecond
<b>PEAK or PK</b>	Maximum (+) or minimum (-) peak instantaneous value of the signal
<b>PF</b>	Power factor
<b>PLT</b>	Long-term flicker
<b>PST</b>	Short-term flicker
<b>RMS</b>	True RMS value (current or voltage)
<b>t</b>	Relative date of time cursor
<b>tan <math>\Phi</math></b>	Tangent of the phase shift of voltage with respect to current
<b>THD</b>	Total harmonic distortion (THD-F)
<b>U</b>	Phase-to-Phase voltage
<b>U-h</b>	Phase-to-phase voltage harmonic
<b>Ucf</b>	Phase-to-Phase voltage crest factor
<b>Ud</b>	Phase-to-phase RMS distortion voltage
<b>Udc</b>	Phase-to-phase DC voltage
<b>Uh</b>	Phase-to-phase voltage harmonic
<b>Upk+</b>	Maximum peak value of the phase-to-phase voltage
<b>Upk-</b>	Minimum peak value of the phase-to-phase voltage
<b>UNB:</b>	Voltage unbalance in a polyphased electric power network; state in which the RMS voltages between conductors and/or the phase differences between successive conductors are not all equal
<b>Urms</b>	True RMS phase-to-phase voltage
<b>Uthd</b>	Total phase-to-phase voltage harmonic distortion
<b>Uthdf</b>	Total phase-to-phase voltage harmonic distortion in %f
<b>Uthdr</b>	Total phase-to-phase voltage harmonic distortion in %r
<b>Uunb</b>	Phase-to-phase voltage unbalance
<b>V</b>	Phase-to-neutral voltage; also Volt (unit)
<b>V-f</b>	Phase-to-neutral voltage harmonic
<b>V-h</b>	Harmonics in phase-to-neutral voltage
<b>VA</b>	Apparent power
<b>VAD</b>	Distortion power
<b>VADh</b>	Distortion energy
<b>VAh</b>	Apparent energy; also apparent harmonic power
<b>VAR</b>	Reactive power
<b>VARh</b>	Reactive energy
<b>Vcf</b>	Voltage crest (peak) factor
<b>Vd</b>	Phase-to-neutral RMS distortion voltage
<b>Vdc</b>	Phase-to-neutral DC voltage
<b>Vh</b>	Phase-to-neutral voltage harmonic.
<b>Vpk+</b>	Maximum peak value of the phase-to-neutral voltage
<b>Vpk-</b>	Minimum peak value of the phase-to-neutral voltage

<b>Vrms</b>	True RMS phase-to-neutral voltage
<b>Vthd</b>	Total harmonic distortion of phase-to-neutral voltage
<b>Vthdf</b>	Total harmonic distortion of phase-to-neutral voltage in %f
<b>Vthdr</b>	Total harmonic distortion of phase-to-neutral voltage in %r
<b>Vunb</b>	Voltage unbalance
<b>W</b>	Active power
<b>Wdc</b>	DC power
<b>Wdch</b>	DC energy
<b>Wh</b>	Active energy (also watt-hour)

### Prefixes of International System (SI) units

Prefix	Symbol	Multiplies by
<b>milli</b>	m	$10^{-3}$
<b>kilo</b>	k	$10^3$
<b>Mega</b>	M	$10^6$
<b>Giga</b>	G	$10^9$
<b>Tera</b>	T	$10^{12}$
<b>Peta</b>	P	$10^{15}$
<b>Exa</b>	E	$10^{18}$





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