EN - User's manual

CHAUVIN ARNOUX

CA 8345

Three-phase electrical network analyser

Measure up

Thank you for purchasing this **CA 8345 three-phase power quality analyser**.
For best results from your instrument:
- **read** these operating instructions carefully,
- comply with the precautions for use.

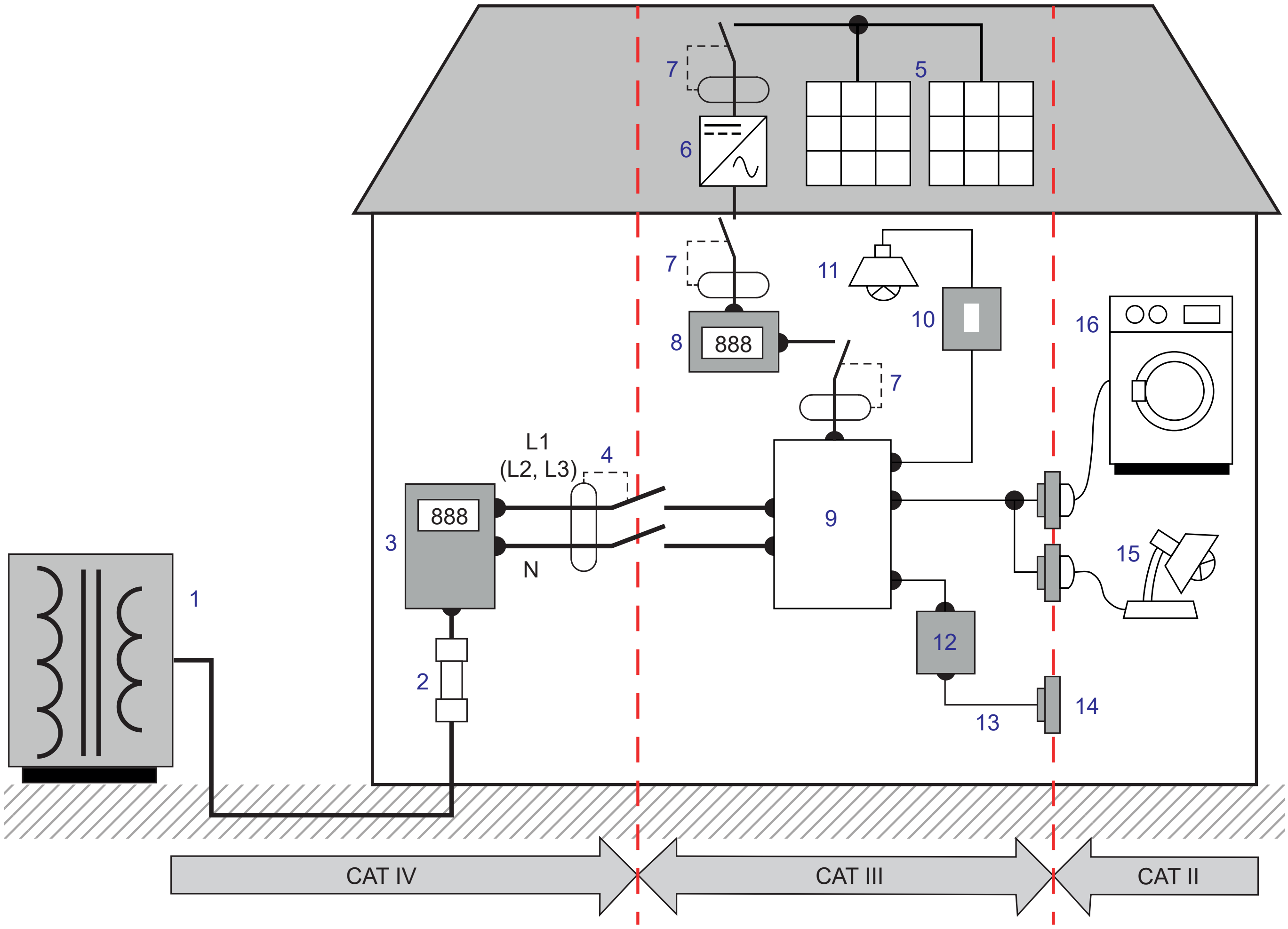
⚠	WARNING, risk of DANGER! The operator must refer to these instructions whenever this danger symbol appears.
⚡	WARNING, risk of electric shock. The voltage applied to parts marked with this symbol may be hazardous.
	USB connector / USB key.
	Kensington anti-theft lock.
	Ethernet connector (RJ45).
⏚ **GND**	Earth.
i	Useful information or tip.
SD	SD card.
	Chauvin Arnoux has designed this instrument in the context of a global Eco-Design approach. A life cycle analysis was carried out to master and optimize the impact of this product on the environment. More precisely, the product exceeds the requirements of regulations as regards recycling and valuation.
♲	The product is declared recyclable following an analysis of the life cycle in accordance with standard ISO 14040.
CE	The CE marking certifies that the product is in compliance with the requirements applicable in the Union European, in particular as regards Low Voltage Directive 2014/35/EU, Electromagnetic Compatibility Directive 2014/30/EU, Radio Equipment Directive 2014/53/EU, and Restriction of Hazardous Substances Directives 2011/65/EU and 2015/863/EU.
UK CA	The UKCA marking certifies that the product is in compliance with the requirements applicable in the United Kingdom as regards Low Voltage, Electromagnetic Compatibility, and Restriction of Hazardous Substances.
	The rubbish bin with a line through it means that in the European Union, the product must undergo selective disposal in compliance with Directive WEEE 2012/19/UE.

CONTENTS

Definition of measurement categories

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

Example to identify locations of measurement categories



1 Low voltage supply source	9 Distribution board
2 Service fuse	10 Light switch
3 Tariff meter	11 Lighting
4 Mains circuit breaker or isolator switch *	12 Junction box
5 Photovoltaic panel	13 Socket wiring
6 Inverter	14 Socket outlets
7 Circuit breaker or isolator switch	15 Plug-in lamps
8 Generation meter	16 Household appliances, portable tools

* : The mains circuit breaker or isolator switch may be installed by the service provider. If not, the demarcation point between CAT IV and CAT III is the first isolating switch in the distribution board.

PRECAUTIONS FOR USE

This instrument is compliant with safety standard IEC/EN 61010-2-030 or BS EN 61010-2-030, the leads are compliant with IEC/EN 61010-031 or BS EN 61010-031, and the current sensors are compliant with IEC/EN 61010-2-032 or BS EN 61010-2-032, for voltages up to 1000V in category IV.

Failure to observe the precautions for use may create a risk of electric shock, fire, explosion, and/or 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.
- Do not use the instrument without its battery.
- 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.
- Before using your instrument, check that it is perfectly dry. If it is wet, it must be thoroughly dried before it can be connected or used.
- Use only the leads and accessories supplied. The use of leads (or accessories) of a lower voltage or category limits the voltage or category of the combined instrument and leads (or accessories) to that of the leads (or accessories).
- Use personal protection equipment systematically.
- Keep your hands away from the terminals of the instrument.
- When handling the leads, test probes, and crocodile clips, keep your fingers behind the physical guard.
- Use only the mains power unit and battery pack provided by the manufacturer. These items have specific safety devices.
- Some current sensors must not be placed on or removed from bare conductors at hazardous voltages: refer to the data sheet of the sensor and comply with the handling instructions.
- All troubleshooting and metrological checks must be performed by competent and accredited personnel.

1. COMMISSIONING

1.1. DELIVERY CONDITION

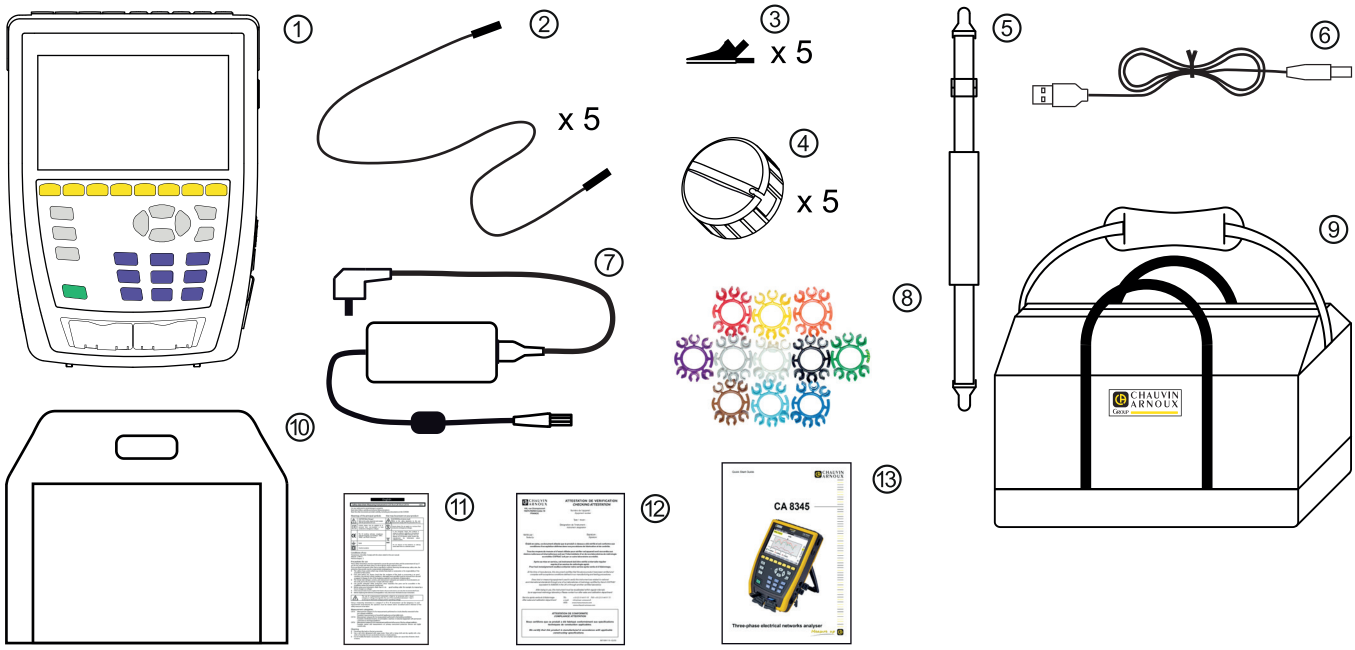
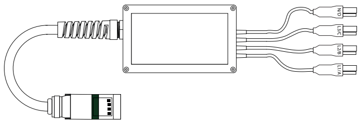


Figure 1

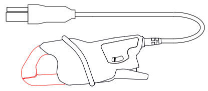
1. One CA 8345 with its battery, one SD card, and a protective film on the display unit.
2. 5 black straight-straight banana-banana safety leads attached with a Velcro tie.
3. 5 black crocodile clips.
4. 5 cable reels
5. One hand strap.
6. One USB A-B cord.
7. One specific mains power unit with mains cord, PA40W-2 or PA32ER depending on the order.
8. 12 sets of inserts and rings to mark the current leads and sensors according to their phases.
9. One carrying bag.
10. One carrying bag for the instrument.
11. One multilingual safety data sheet
12. One test report.
13. One multilingual quick start guide

1.2. ACCESSORIES

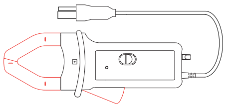
- Three-phase 5 A adapter
- Essailec® 5A three-phase adapter



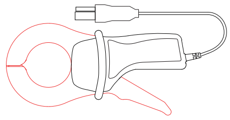
- MN93 clamp
- MN93A clamp



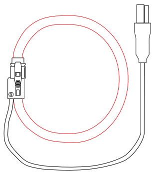
- PAC93 clamp



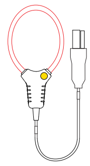
- C193 clamp



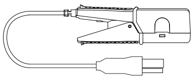
- AmpFlex® A193 450 mm
- AmpFlex® A193 800 mm



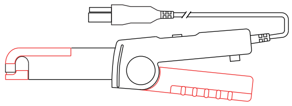
- MiniFlex MA194 250 mm
- MiniFlex MA194 350 mm
- MiniFlex MA194 1000 mm



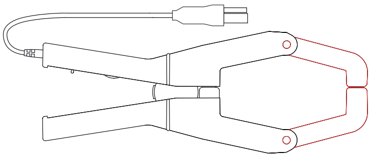
- E3N MINI94



- E94 clamp

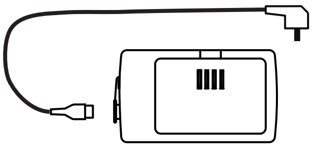


- J93 clamp

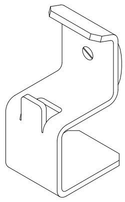


- Functional earth USB cable

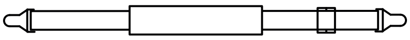
- Charging dock for the battery



- Magnetized hook

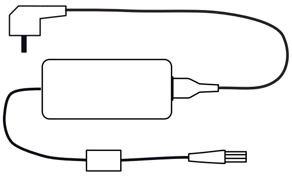


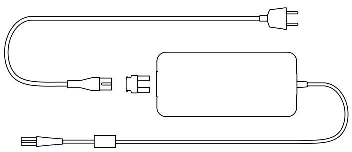
- Hand strap for the instrument
- Data View Software

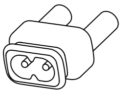


1.3. SPARE

- Li-ion battery, 10.8V, 5700mAh
- USB-A USB-B cord
- One PA40W-2 specific mains power unit with mains cord
- One PA32ER power supply unit per phase
- SDHC card, 16 GB
- No. 22 carrying case
- No. 21 carrying case
- Set of 5 black straight-straight banana-banana safety cables, 5 crocodile clips, and 12 inserts and rings to identify the phases, the voltage leads, and the current sensors
- Set of inserts and rings to identify the phases, the voltage leads, and the current sensors
- Adapter, C8 jack to 2 banana jacks
- 5 cable reels







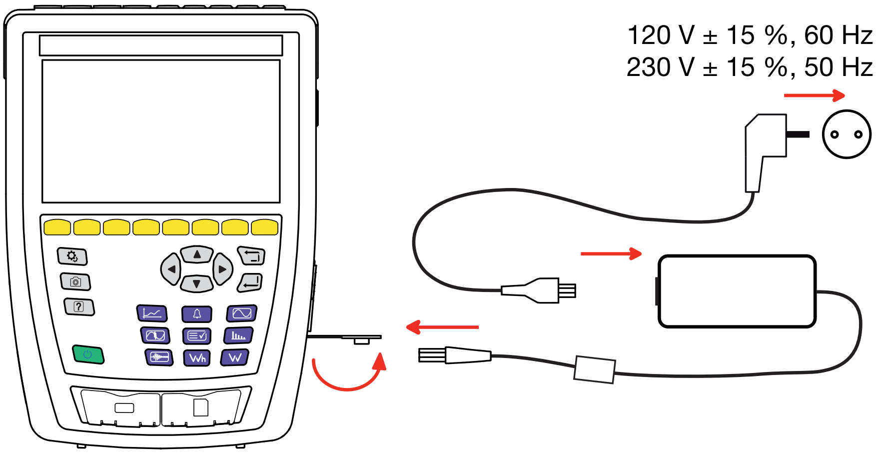
For accessories and spares, check out our Web site:
www.chauvin-arnoux.com

1.4. CHARGING THE BATTERY

Before the first use, start by fully charging the battery.

- Remove the plastic film that prevents connecting the battery to the instrument. For this, refer to § 18.3, which explains how to remove the battery from the instrument.
- Connect the mains cord to the power supply unit and to mains.
- Open the elastomer hatch protecting the mains power socket and connect the special 4-point connector of the power supply unit to the instrument.

The ⏻ button blinks and the display unit indicates the progress of charging. They will go off only when the battery is fully charged.

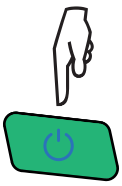


When the battery is completely discharged, the charging time is approximately 6 hours.

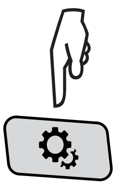
Figure 2

1.5. CHOICE OF LANGUAGE

Before using the instrument, start by choosing the display language.



Press the On/Off button to switch the instrument On.



Press the Configuration (Settings) key.

Press the second yellow function key, then, to open the language menu. More than 20 languages are available, choose yours.

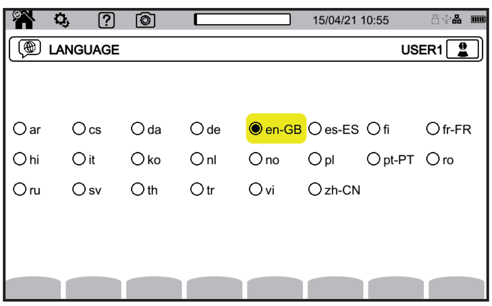


Figure 3

2. DESCRIPTION OF THE INSTRUMENT

2.1. FUNCTIONS

The CA 8345 is a portable three-phase power quality analyser with built-in rechargeable battery. It has been certified to comply with IEC 61000-4-30 edition 3, Amendment 1 (2021) in class A requirements. The certificate can be viewed on our website: www.chauvin-arnoux.com.

The CA 8345 is used:

- to measure the RMS values, powers, and disturbances of power distribution networks.
- to take a snapshot of the main specifications of a three-phase network.
- to track variations of the different parameters over time.

The measurement uncertainty of the instrument is better than 0.1% for voltage measurements and 1% for current measurements.

The instrument provides a large choice of current sensors, for measurements from a few milliamperes up to several kiloamperes.

The instrument is compact and impact-resistant.

The ergonomics and simplicity of its user interface make it a pleasure to use. The CA 8345 has a large colour touch screen graphic display unit. It can also manage 3 user profiles.

The SD card can store a large quantity of measurements and photographs, which can be read directly on a PC. It is also possible to use a USB key (optional).

The instrument can communicate by USB, Wi-Fi, or Ethernet.

The instrument has a remote user interface (VNC) allowing remote control from a PC, a tablet, or a smartphone.

The PAT3 application software processes the recorded data and generates reports.

2.1.1. RECORDING FUNCTIONS

These serve to make the following measurements and calculations:

- Measurement of the RMS values of AC voltages up to 1000 V between terminals. Using ratios, the instrument can reach hundreds of gigavolts.
- Measurement of the RMS values of AC currents up to 10,000 A (neutral included). Using ratios, the instrument can reach hundreds of kiloamperes.
- Automatic detection of the type of current sensor and powering of the sensor if necessary.
- Measurement of the DC component of voltages and currents (neutral included).
- Calculation of direct, inverse, and zero sequence voltage/ current unbalances.
- Measurement of inrush current, for motor start-up.
- Measurement of peak values of voltages and currents (neutral included).
- Measurement of the frequency of 50-Hz and 60-Hz networks.
- Measurement of the current and voltage crest factors (neutral included).
- Calculation of the harmonic loss factor (FHL), range of application transformers in the presence of harmonic currents.
- Calculation of the K factor (FK), range of application transformers in the presence of harmonic currents.
- 40 alarms per user profile.
- Log of events such as voltage dips, voltage swells, interruptions, transients, rapid voltage changes (RVC), and synchronisation.
- Measurement of the total harmonic distortion of currents and of voltages (except for neutral) referred to the fundamental (THD in %f).
- Measurement of the total harmonic distortion of currents and of voltages (neutral included) referred to the AC RMS value (THD in %r)
- Measurement of active, reactive (capacitive and inductive), non-active, distorting, and apparent power, per phase and total (except for neutral).
- Measurement of the power factor (PF) and of the displacement factor (DPF or cos φ) (except for neutral).
- Measurement of the distorting RMS value (d) for currents and voltages (except for neutral).
- Measurement of the short-term flicker of voltages (P_{st}) (except for neutral).
- Measurement of the long-term flicker of voltages (P_{lt}) (except for neutral).

- Measurement of active, reactive (capacitive and inductive), non-active, distorting, and apparent energy, per phase and total (except for neutral).
- Valuation of the energy directly in currency (€, $, £, etc.), with a basic rate and 8 special rates.
- Measurement of current and voltage harmonics (neutral included) up to order 127: RMS value, percentages referred to the fundamental (%f) (except for neutral) or to the total RMS value (%r), minimum and maximum and harmonic sequence level.
- Measurement of apparent harmonic power (except for neutral) up to order 127: percentages referred to the fundamental apparent power (%f) or to the total apparent power (%r), minimum and maximum of the level of each order.
- Measurement of current and voltage inter-harmonics (neutral included) up to order 62.
- Synchronisation with UTC time, with a choice of time zone.
- Monitoring mode, used to check the compliance of the voltages.
- Measurement of signaling frequency levels (PLC or Power Line Carrier) on the mains (MSV = Mains Signaling Voltage).

2.1.2. DISPLAY FUNCTIONS

- Display of waveforms (voltages and currents).
- Bargraphs of voltage and current harmonics.
- Screenshots.
- Display of information about the instrument: serial number, software version, MAC, Ethernet, and Wi-Fi addresses, etc.
- Display of recordings: trend, alarm, transients, and inrush current.

2.1.3. MEASUREMENT FUNCTIONS

- Trend recording function with time-stamping and programming of the beginning and end of a record. Representation, in the form of barcharts or curves, of the mean values of many parameters as a function of time, with or without the MIN-MAX. 4 configurations per user profile.
- Transients function. Detection and transient recording (up to 1000 per record) for a chosen duration and on a chosen date (programming of the beginning and end of the transient recording). Recording of 4 complete cycles (one before the event triggering the transient and three after) in the 8 acquisition channels.
  Possibility of capturing surges up to 12kV over a duration of 1ms.
- Alarm function: List of alarms recorded (20,000 alarms at most) as a function of the thresholds programmed in the configuration menu. Programming of the beginning and end of monitoring of an alarm. 40 alarms per user profile.
- Inrush current function: display of parameters useful for studying motor start-up
  - Instantaneous value of the current and voltage at the instant designated by the cursor.
  - Absolute maximum instantaneous current and voltage (over the entire starting event).
  - RMS current and voltage (without neutral) of the half-cycle (or lobe) on which the cursor is placed.
  - Maximum half-cycle RMS current and voltage (over the entire starting event).
  - Instantaneous network frequency at the instant designated by the cursor.
  - Maximum, mean, and minimum instantaneous network frequency (over the entire starting event).
  - Time at which motor start-up begins.
- Monitoring function: trend, transient and alarm recording.

2.1.4. CONFIGURATION FUNCTIONS

- Setting the date and time
- Brightness adjustment.
- Choice of colours of the curves.
- Management of screen auto-off.
- Choice of night mode display.
- Choice of language.
- Choice of calculation methods: non-active quantities broken down or not, choice of the unit of energy, choice of coefficients for the calculation of the K factor, choice of reference for levels of harmonics, calculation of PLT (sliding window or not).
- Choice of distribution system (single-phase, two-phase, three-phase with or without measurement of neutral) and connection method (standard, 2 elements or 2½ elements).
- Configuration of recordings, alarms, inrush currents, and transients.
- Erasure of the data (total or partial).
- Display of current sensors: detected, not detected, not managed, simulated, or impossible to simulate (2-element connection method). Adjustment of voltage and current ratios, transduction ratios, and sensitivity.
- Configuration of communication links (Wi-Fi, Ethernet).

2.2. OVERALL VIEW

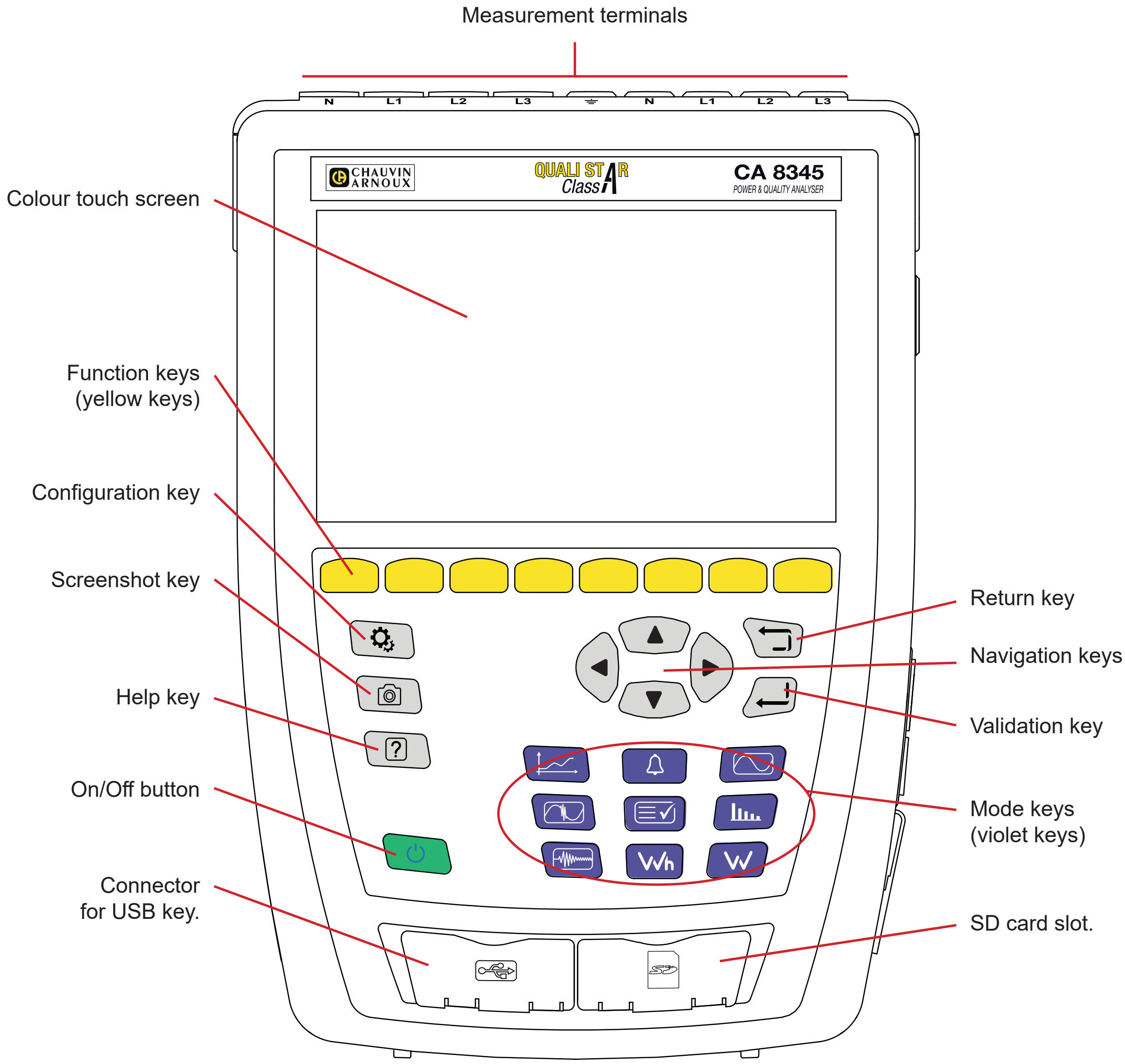


Figure 4

2.3. MEASUREMENT TERMINALS

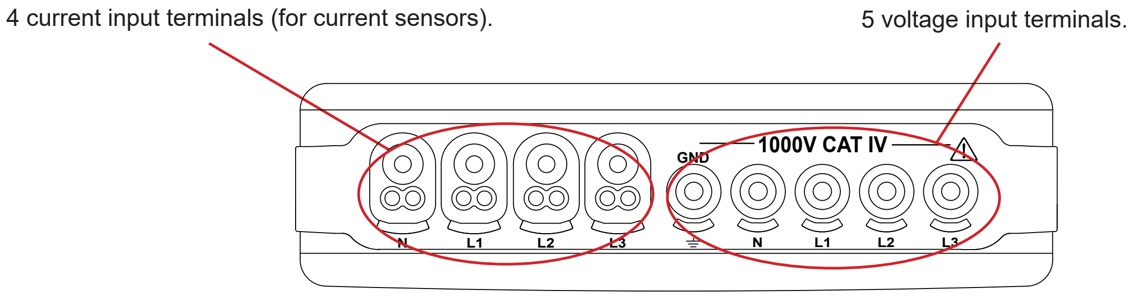


Figure 5

2.4. CONNECTORS ON SIDE

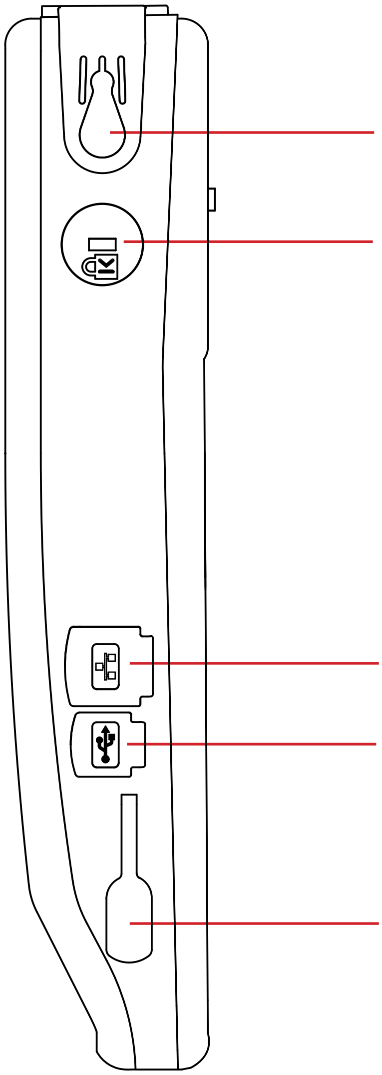


Figure 6

2.5. BATTERY

The instrument can operate either on its own battery or on mains power. It can operate on the battery while the latter is being recharged. It must never be used without its battery, which contributes to the user's safety.

Battery charge level check light

Battery fully charged, or a new battery whose level is unknown.

, , , Battery charge level check light

Battery discharged. Charge completely in this case.

Battery charging: one bar blinks.

When the remaining charge of the battery is too low to ensure correct operation of the instrument, a message is displayed. If you do not connect the instrument to mains, it switches off a minute after the message.

2.6. DISPLAY UNIT

The CA 8345 has a large colour touch-screen display unit (WVGA).
Below, a typical screen.
The status bar at the top of the screen reports the status of the instrument.

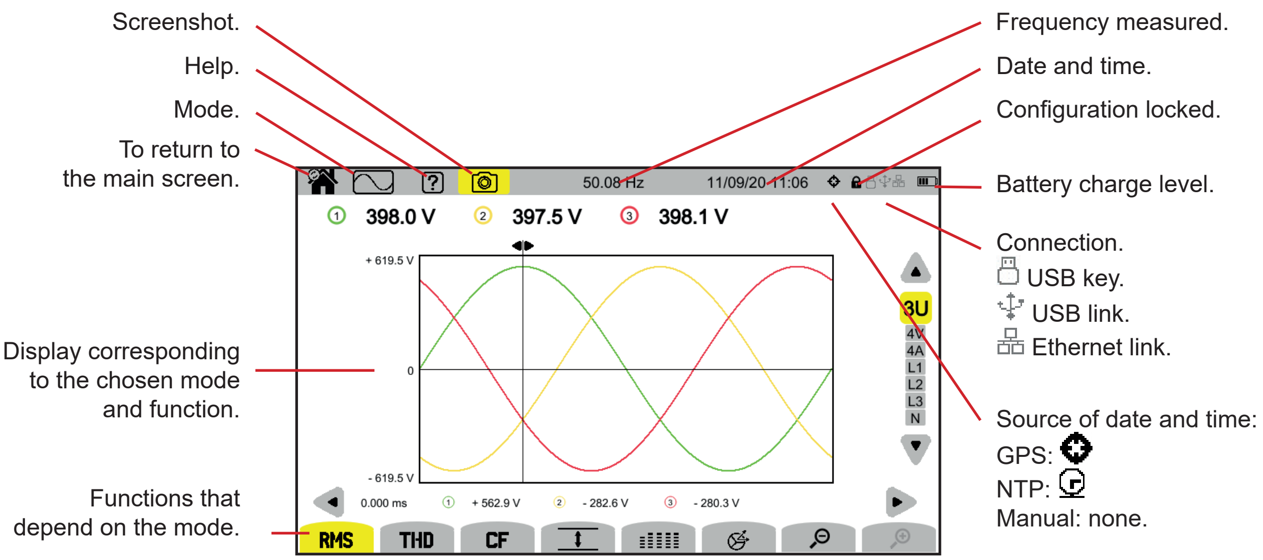


Figure 7

2.7. ON/OFF BUTTON

Pressing the ⏻ button switches the instrument on. The ⏻ button blinks orange during starting up.

When the battery is charging, the ⏻ button blinks green. When it is lit steadily, the battery is fully charged.

If the instrument is cut off, suddenly (interruption of mains power when the battery is discharged) or automatically (battery low), an information message is displayed when it is next switched on.

Pressing the ⏻ key again switches off the instrument. If the instrument is recording, metering energy (even if metering is suspended), recording transients or alarms, or capturing an inrush current, it requests confirmation.

If you confirm the Power-off command, the records are finalized and the instrument is switched off. Recording resumes automatically the next time the instrument is switched on.

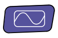
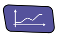
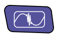
If the instrument is connected to mains when switched off, it starts charging the battery.

If, exceptionally, the display freezes and the instrument can no longer be switched off by pressing the ⏻ button, you can force it off by keeping the ⏻ button pressed for 10 seconds. This may cause a loss of the recordings in progress on the SD card.

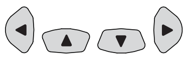
2.8. KEYPAD

2.8.1. MODE KEYS (PURPLE KEYS)

These 9 keys are used to access specific modes:

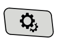
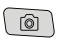
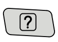
Key	Function	See
	Waveform mode	§ 5
	Harmonic mode	§ 6
	Power mode	§ 7
	Energy mode	§ 8
	Trend mode	§ 9
	Transient mode	§ 10
	Inrush current mode	§ 11
	Alarm mode	§ 12
	Monitoring mode	§ 13

2.8.2. NAVIGATION KEYS

Key	Function
	4 directional arrows.
	Validation key.
	Return key.

2.8.3. THE OTHER KEYS

The functions of the other keys on the keypad are as follows:

Key	Function	See
	Configuration key.	§ 4
	Screenshot.	§ 14
	Help key.	§ 15

2.8.4. THE FUNCTION KEYS (8 YELLOW KEYS)

The functions of the yellow keys change according to the mode and the context.

2.9. INSTALLING COLOUR MARKERS

To identify the cords and the input terminals, you can mark them using the coloured markers provided with the instrument.

- Break off the sector and insert it in the two holes provided for this purpose near the terminal (the large one for the current terminal and the small one for the voltage terminal).

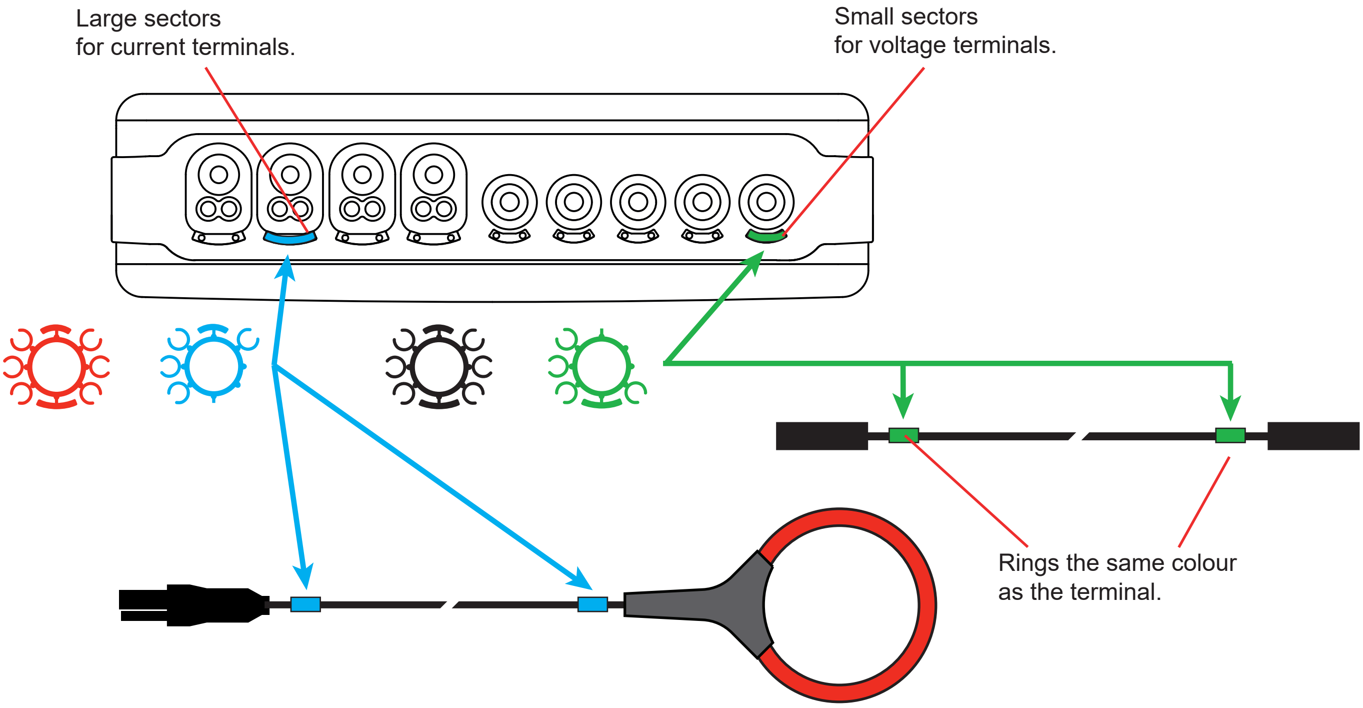


Figure 8

- Clip a ring of the same colour onto each end of the cord you are going to connect to the terminal.
  A set of 12 different coloured markers is available to match all standard phase/neutral colour codes.

2.10. MEMORY CARD

The instrument accepts SD (SDSC), SDHC, and SDXC memory cards in FAT16, FAT32 or exFAT format as required. The instrument is delivered with a formatted SD card. The memory card is essential for recording measurements.

If you want to install a new SD card:

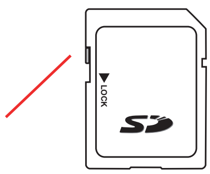
- Open the elastomer cap marked SD.
- Disconnect the SD card in place, following the procedure explained in 3.5. The red indicator goes off.
- Press on the memory card to remove it from its slot.
- Slide the new SD card all the way home in its slot. The red indicator lights.
- Then close the elastomer cap.

SD card present indicator.

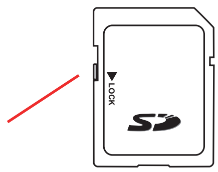
Figure 9

Write-protect the memory card when you remove it from the instrument. Unprotect the write-protected card before inserting it in the instrument.

Unprotected memory card.



Protected memory card.



2.11. PROP

There is a retractable prop on the back of the instrument to hold it at an angle of 60°.

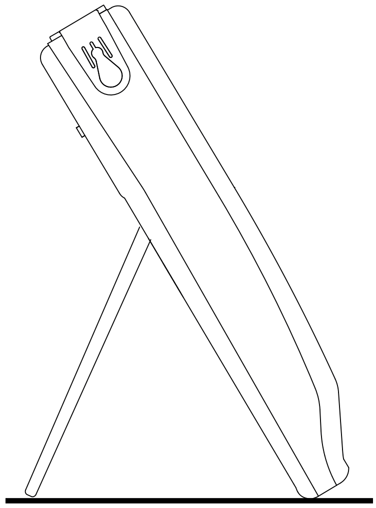


Figure 10

2.12. MAGNETISED HOOK (OPTIONAL)

The magnetised hook can be used to suspend the instrument from the top of a door or attach it to a metallic surface.

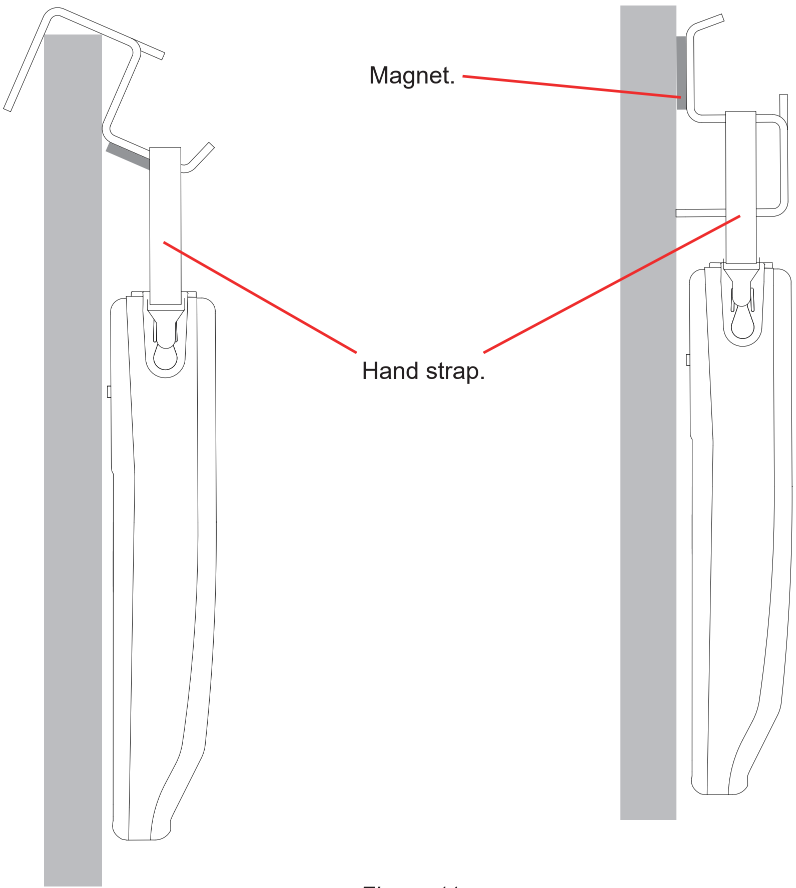


Figure 11

3. CONFIGURATION

Before using it, you must configure your instrument.

The CA 8345 has 2 configuration menus:

- the configuration of the instrument itself,
- Configuration of the measurements.

Press the key.

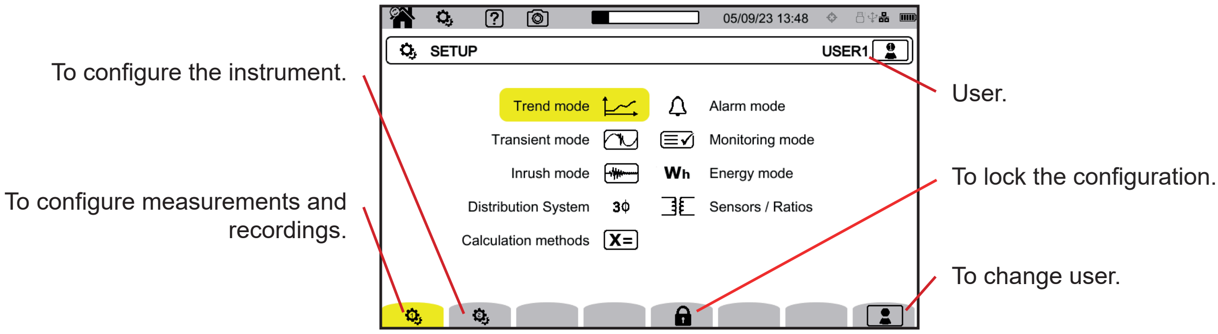


Figure 12

3.1. NAVIGATION

To configure the instrument, you can use the navigation keys (◄, ►, ▲, ▼) to select and modify the parameters, especially if you are wearing gloves, or you can use the touch screen.
The key is used to validate.
The key is used to abort or to return to the previous screen.

3.2. INPUT KEYBOARD

When a text entry is required, the instrument displays a virtual keyboard.
The available characters depend on the context.

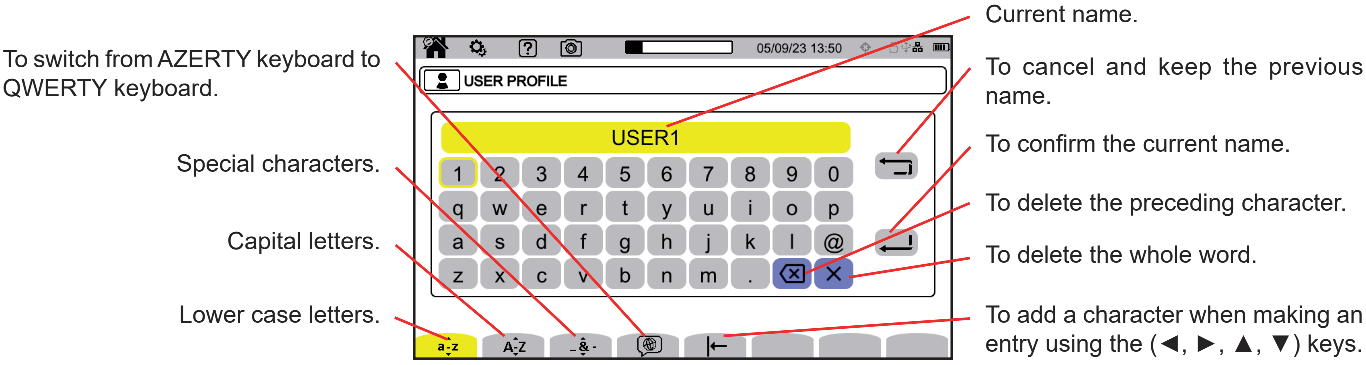


Figure 13

3.3. USERS

The CA 8345 lets 3 different users configure the instrument and the measurements.
Select on a configuration screen and select your user number.

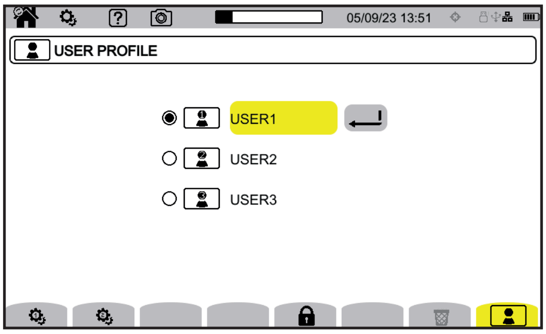


Figure 14

Select the user name and change it.

When you return to your user profile, you recover your complete configuration.

3.4. CONFIGURATION OF THE INSTRUMENT

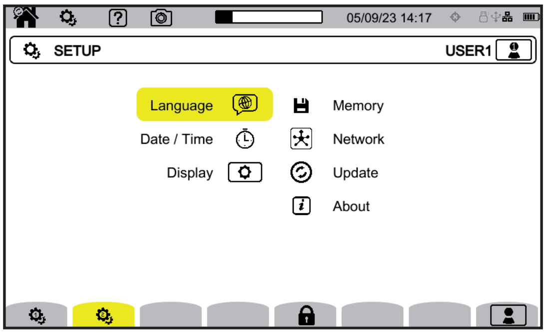
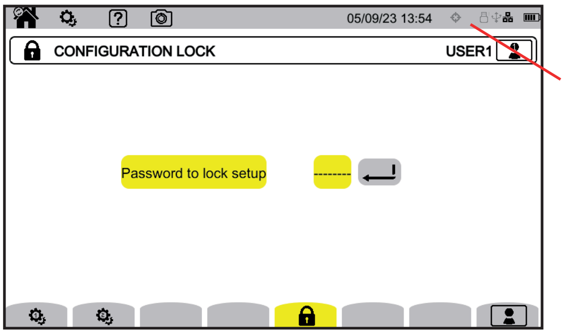


Figure 15

Except for the display and the language, the configuration of the instrument cannot be changed if the instrument is recording, metering energy (even if metering is suspended), recording transients or alarms, or capturing an inrush current.

3.4.1. LOCK CONFIGURATION

Once your instrument is configured, you can lock the configuration by pressing and entering a password.



The symbol indicates configuration is locked.

Figure 16

No further configuration parameters can be modified.

ℹ	Keep your password safe, otherwise you will no longer be able to configure your instrument.

To unlock configuration, press 🔒 again and enter the password.
If you forget your password, you can unlock the instrument using PAT3 software, provided it is connected via USB.

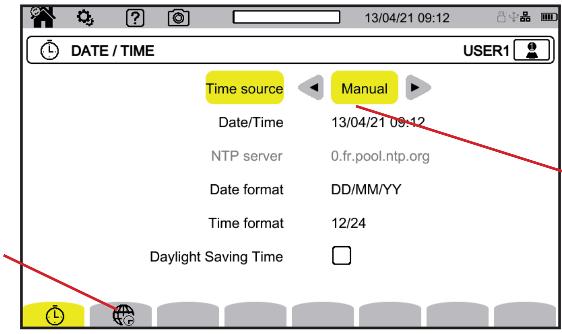
3.4.2. LANGUAGE

To choose the language of your instrument, select 🌐.
Choose your language, then validate using the ↵ key.

3.4.3. DATE AND TIME.

To set the date and time, select ⏱.

Choice of time zone.



The time can be set automatically (GPS or NTP) or by hand.

Figure 17

Choose one of the 73 time zones proposed.

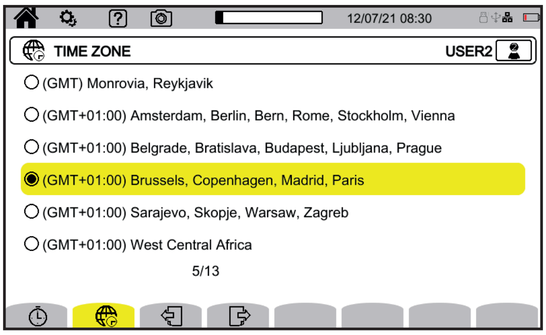


Figure 18

3.4.3.1. Manual mode

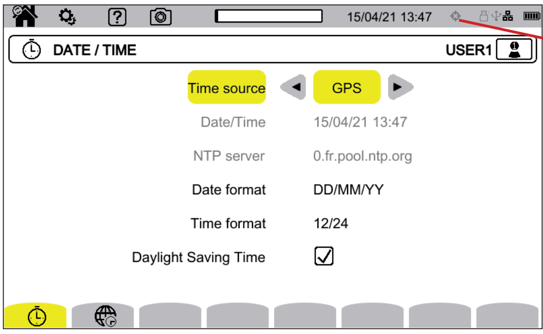
This mode allows the date and time to be manually entered.
For Class A internal clock accuracy and drift (according to IEC 61000-4-30), select the GPS mode.

3.4.3.2. GPS mode

The GPS mode is necessary to guarantee that your instrument is class A (per IEC 61000-4-30). The instrument must be exposed at least once to the GPS satellites, so that the receiver can recover the date and time. Correct synchronisation may take up to 15 minutes. Accuracy is then maintained, even if the satellites are no longer accessible, in the following situations:

Satellite reception	Maximum drift for Class A	Drift of the CA8345
No satellite in view	±1s / 24h	± 24ms / 24h
At least one satellite in view	±16.7ms vs UTC, at all times	±60ns / s, corrected at all times

To avoid time discontinuities, automatic setting of the time is blocked when recording is in progress.



Status of time synchronisation by GPS.

Figure 19

The satellite reception status is indicated by an icon in the status bar, with the following meanings:

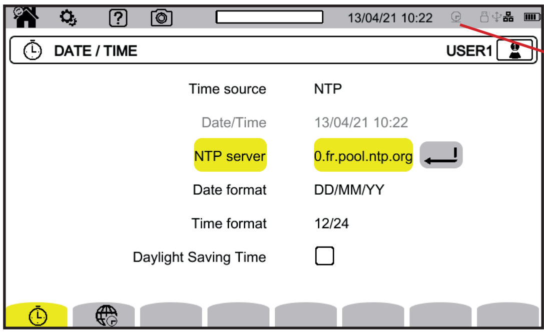
GPS synchronisation	Not synchronised		Synchronised	
Satellite	No satellite in view	At least one satellite in view	No satellite in view	At least one satellite in view
No recording				
Recording in progress				

At the end of 40 days without exposure to a GPS satellite, the synchronisation icon ( ) changes over to unsynchronised status ( ).

Receiving GPS signals from satellites can be problematic inside a building. If the GPS icon never goes into synchronized state, it is likely that the satellites are out of range. In this case, use a GPS signal repeater, with an antenna placed outside or near a building window.

3.4.3.3. NTP mode

If you choose time synchronisation by NTP, enter the address of the NTP server in the **NTP server** field (for example 0.fr.pool.ntp.org), taking care to use your country's time zone, then connect the instrument to this server using the Ethernet connector or by Wi-Fi.



Status of time synchronisation by NTP:
Not synchronised
Synchronised
Synchronised and recording in progress.

Figure 20

3.4.4. DISPLAY

Select [icon] to open the display configuration menu.

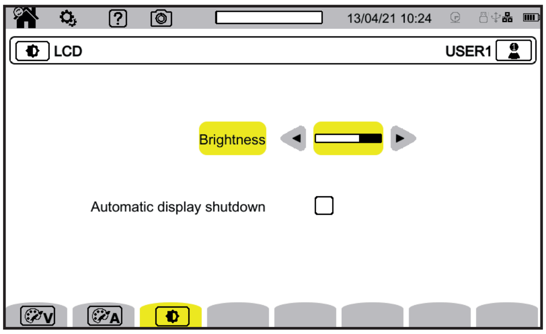


Figure 21

3.4.4.1. Colours of the voltage curves

To choose the colours of the voltage curves, select [V icon].
Choose one colour for each of the 3 phases and for the neutral. You can choose from among about thirty colours.

In night mode, the white background turns black and the colours are reversed.

3.4.4.2. Colours of the current curves

To choose the colours of the current curves, select [A icon].
Choose one colour for each of the 4 current inputs. You can choose from among about thirty colours.

In night mode, the white background turns black.

3.4.4.3. Screen brightness and auto-off

To adjust the brightness of the display unit and the screen auto-off, select [icon].

You can activate or deactivate screen auto-off. The screen is switched off after 10 minutes with no user action. This prolongs battery life. If a recording is in progress, the screen is not switched off.

To switch the screen back on, press any key.

3.5. MEMORY (SD CARD, USB KEY)

Access to the contents of the memory (SD card or USB key) in the instrument configuration menu. Press the [icon] key then the second function key [icon],

All recordings are made in the external memory. Select [icon] to access them.

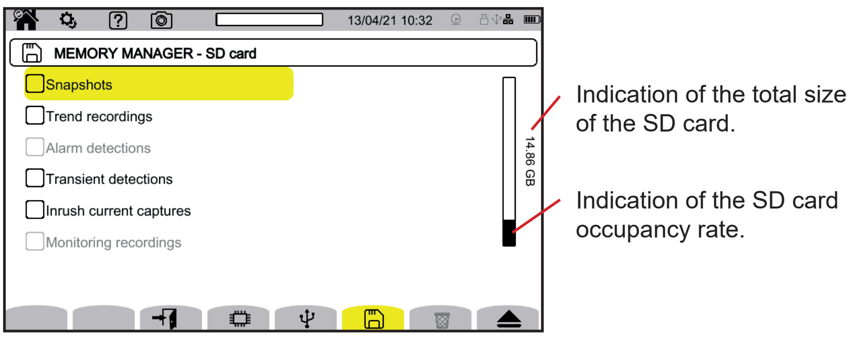


Figure 22

The screen indicates the content of the SD card [icon] or of the USB key [icon].

To eject the SD card or the USB key, press ⏏.

> **i** You must eject the SD card before removing it from the instrument, since otherwise you risk losing part or all of its content.

When the SD card is removed, the red SD card present indicator goes off and the ⚠ symbol is displayed in the status bar.

You can erase all or part of the content of these memories. To do this, make a selection and press 🗑 The instrument requests confirmation 🗑. Press ↵ to confirm or ↩ to abort.

You can also delete a user profile by pressing ▦. Deleting a user profile is equivalent to returning it to factory configuration.

To view an item in detail, select it, then press ➔▮.
You can erase all or part of the content 🗑.

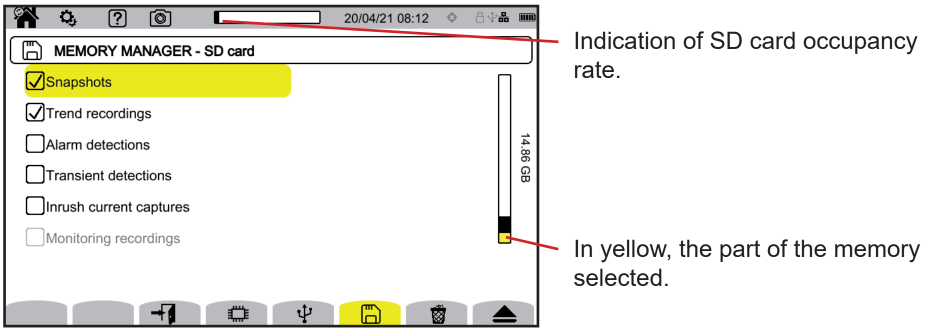


Figure 23

You can also copy all or part of the contents of the SD card to a USB key 🖫➔ψ.

3.6. INFORMATION

Information about the instrument can be found in the instrument configuration. Press the ⚙ key then the second function key ⚙.

Select ⓘ to view information about the instrument.

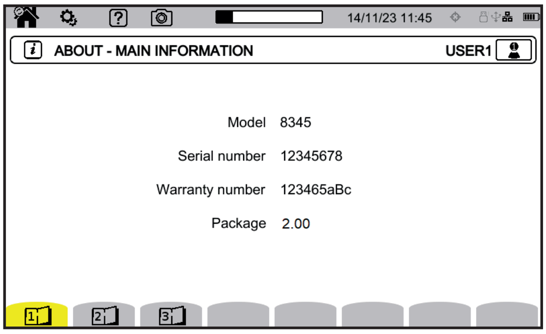


Figure 24

The information pages (1, 2, 3, etc.) let you look up complete information about the instrument, such as:

- the warranty number,
- the serial number,
- the software and hardware versions,
- the MAC, Ethernet, and Wi-Fi addresses.

3.7. COMMUNICATION

The instrument can communicate:

- via USB
- via WiFi
- via an Ethernet connection

It can also send emails when alarm setpoints are exceeded.

Communication configuration can be found in the instrument configuration.
Press the key then the second function key ,

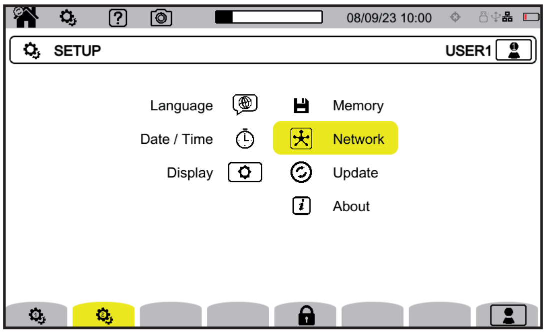
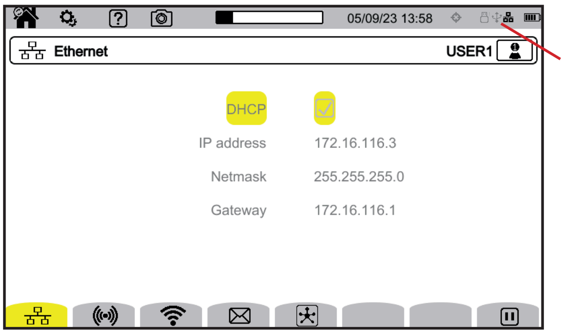


Figure 25

Select to open the network configuration menu of the instrument.
The following screen will be displayed:



Connection status.

Figure 26

enables connection via an Ethernet connection.
enables configuration of the WiFi access point (WAP).
enables WiFi connection.
is used to configure email.
is used to connect to the IRD server (DataViewSync™).

Only one link (Ethernet, WiFi or WiFi access point) can be activated at a time.

For example, if you want to activate a WiFi link while an Ethernet link is already activated, the instrument suggests you turn off the Ethernet link by displaying . Confirm with the key or cancel by pressing any other key.

You can also stop a link manually by pressing .

3.7.1. ETHERNET LINK

The symbol indicates that the link is active.
The symbol indicates that the link is inactive and that it can be activated.

To modify a link, it must be stopped by pressing .

- Check the DHCP (Dynamic Host Configuration Protocol) box and the instrument requests the IP address of a DHCP server. If no DHCP server replies, an IP address will be generated automatically.
- Uncheck the DHCP box to assign this address manually.

Then press to reactivate the link.

3.7.2. WIFI ACCESS POINT (WAP) LINK

The instrument creates a local WiFi network that allows it to connect to a PC, smartphone or tablet.

To select an access point operating frequency.

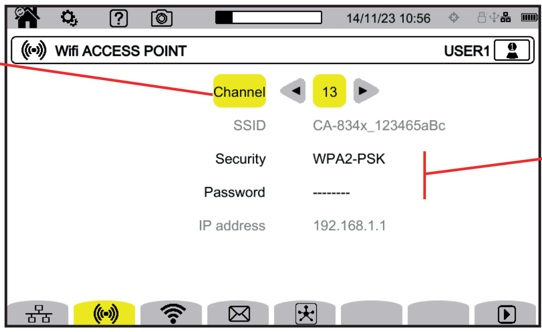


Figure 27

Select the security type:
- **WPA2-PSK** secure protocol and enter the password
- **Open** without password.

Press to activate the link.

3.7.3. WI-FI LINK

The WiFi link allows connection of the instrument to an existing WiFi network.

Choose your network by clicking on SSID. The instrument shows you all available Wi-Fi networks.
If you do not see your network, press to search.

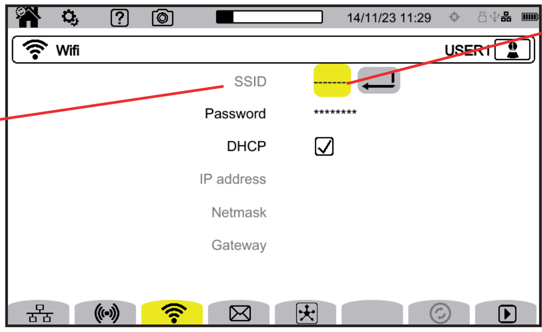


Figure 28

If it is a hidden network, enter its name.
To select the **SSID** or network name, use the ◄ ► keys or the touch screen.

Only one link (Ethernet, WiFi or WiFi access point) can be activated at a time. As a result, the display of networks available for connection does not work (SSID greyed out) if another type of link is already activated.

Then enter the password if required.

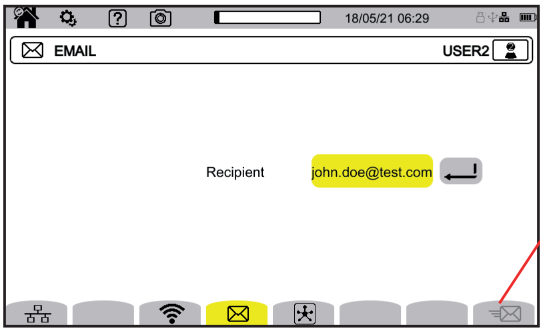
- Check the DHCP (Dynamic Host Configuration Protocol) box and the instrument requests the IP address of a DHCP server. If no DHCP server replies, an IP address will be generated automatically.
- Uncheck the DHCP box to assign this address manually.

The symbol indicates that the link is active.
The symbol indicates that the link is inactive and that it can be activated.

To change a link, it must be stopped by pressing . Uncheck DHCP to select manual and modify the parameters. Then press to reactivate the link.

3.7.4. EMAIL

Enter the email address for notifications if an alarm threshold is exceeded. The instrument must be connected to an IRD server.

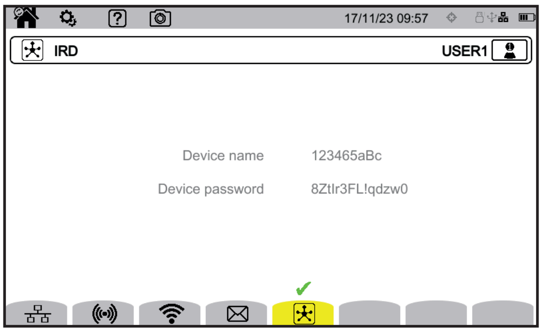


Enables checking operation of the IRD link by sending a test email to the configured email address.

Figure 29

3.7.5. IRD SERVER (DATAVIEWSYNC™)

IRD (Internet Relay Device) is a protocol used for communication between two peripherals located in two distinct sub-networks (for example a PC and a measuring instrument). Each peripheral connects to an IRD server and this server links the two peripherals.



This screen displays the instrument identifier (its warranty number). You can choose the password. There is a password for each user.

Figure 30

The password must contain at least 12 characters, including an upper case letter, a lower case letter, a number and a special character. If the password is incorrect, it will be displayed in red. To change it, deactivate the active link.

Connection to the IRD server is automatic as soon as an Ethernet, WiFi or WiFi access point link is activated. When the connection is made, the ✔ symbol is displayed above the button.

The connection to the IRD server will be used to launch a remote measurement campaign. To connect to the instrument, you will need to enter its identifier and password.

To change the password, you must disconnect the instrument from the IRD server and therefore stop the active connection.

3.8. UPDATING THE EMBEDDED SOFTWARE

Select to update the embedded software.
To obtain the latest version, refer to § 18.5.

When the instrument locates software on the USB key or SD card, it displays the information and offers to install it.
For example, if you have recorded an update on the SD card, the instrument finds it and displays the following screen.

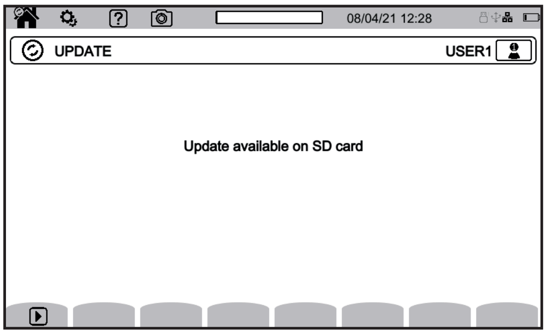


Figure 31

Press . The instrument shuts down and the next time it starts up, it will boot into a mode specifically for software updates.

Figure 32

This specific mode can also be forced by starting the instrument and holding down the and keys until the screen shown above appears.

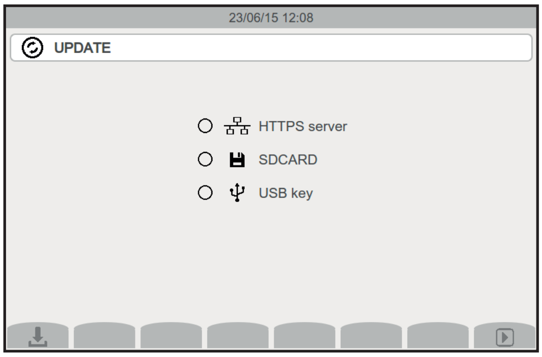


Figure 33

Select:
- to update from the Chauvin Arnoux web site via the Ethernet link.
- to update from the SD card.
- to update from the USB key.

Press to download the file (this may take several minutes) then press to start the update.

3.9. CONFIGURATION OF THE MEASUREMENTS

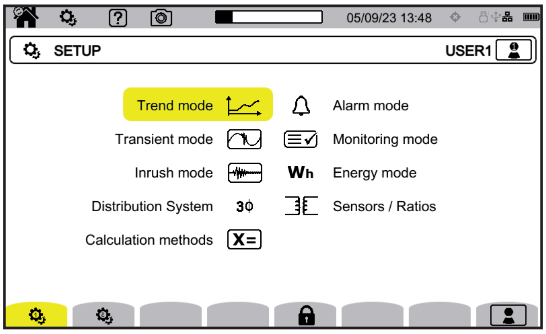


Figure 34

Before making measurements, you must specify or adapt the following parameters:

- The calculation methods,
- The distribution network and the type of connection,
- The voltage ratios, the current sensors, their ranges and their ratios.

The measurement configuration cannot be changed if the configuration is locked or if the instrument is recording, counting energy (even if counting is suspended), recording transients, alarms or capturing inrush current.

3.9.1. CALCULATION METHODS

To choose the calculation methods, select X=.

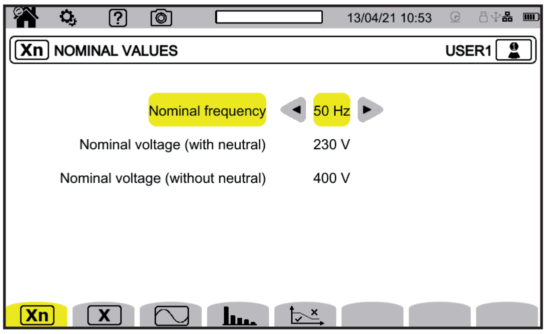


Figure 35

Xn to specify the nominal values.

- The nominal frequency (50 or 60 Hz)
- The nominal voltage,
- The nominal voltage between phases.

Single-phase and phase-to-phase voltage ratings can be set independently. Remember to set them both correctly.

The nominal voltage configured here is the Nominal System Voltage (U_n). Not to be confused with the Nominal Declared Input Voltage (U_{din}) on the terminals of the instrument.
In the case of Medium-Voltage or High-Voltage networks, there may be a stepdown transformer between the network and the measuring instrument.
It is possible to configure U_n between 50V and 650kV, but U_{din} must never exceed 1000V between phases and 400V between Phase and Neutral.
The uncertainty on the ratio of the stepdown transformers affects the accuracy of the measurement: the measurement is guaranteed only when the ratio is equal to 1 and $U_{din} = U_n$.

to choose the values displayed:

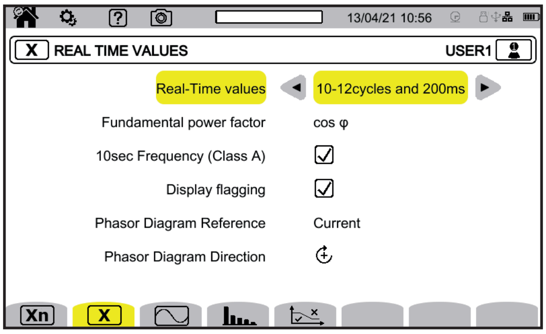


Figure 36

- For **Real-time values**, choose between **10-12 cycles and 200ms** and **150-180 cycles and 3s**. This choice will apply to the calculation and display of the values in most of the modes.
- For the **Fundamental power factor**, choose between **DPF**, **PF_1** and **cos φ** for the display.
- **Frequency over 10s:** calculation of the frequency over 10s (per IEC 61000-4-30 class A) or not. If you measure only the current, deactivate this choice.
- Choose whether or not to activate **Display flagging**. When this is done, all quantities that undergo voltage dips, voltage swells, and interruptions are reported (see § 3.10.8).
- For the **Phasor Diagram Reference**, choose between **Current** and **Voltage**.
- For the **Phasor Diagram Direction**, choose between (clockwise) or (anticlockwise).

to specify the waveform mode.

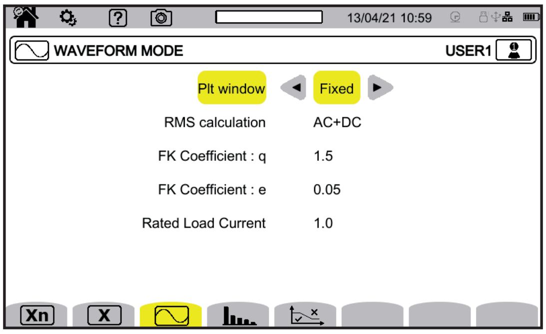


Figure 37

- The way the long-term flicker P_{lt} is calculated (fixed or sliding window),
  - **sliding** window: the P_{lt} will be calculated every 10 minutes. The first value will be available 2 hours after the instrument is switched on, because 12 values of P_{st} are needed to calculate P_{lt}.
  - **fixed** window: the P_{lt} will be calculated every 2 hours, aligned on even-numbered UTC hours. If the local time has an odd-numbered offset to UTC time, then P_{lt} values will be available every 2 hours aligned on odd-numbered local time hours.
- Calculation of the RMS value,
- The coefficient **q** for the calculation of the K factor (between 1.5 and 1.7), q is an exponential constant that depends on the type of winding and the frequency. The value of 1.7 is suitable for transformers whose the conductor cross sections are round or square. The value of 1.5 is suitable for transformers whose the low-voltage windings are in foil form.
- The coefficient **e** for the calculation of the K factor (between 0.05 and 0.10). e is the ratio of Eddy current losses (at the fundamental frequency) to resistive losses, both evaluated at the reference temperature. The default values (q = 1.7 and e = 0.10) are suitable for most applications.
- Rated load current. It is a transformer parameter that is used in the calculation of the K factor.

to specify:

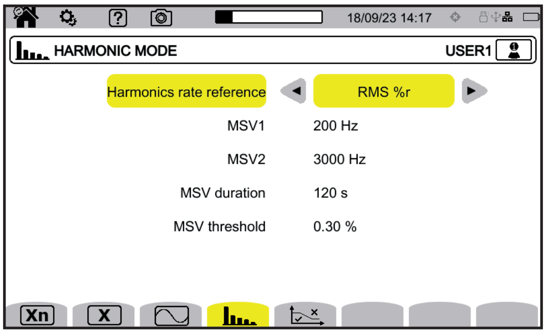


Figure 38

- The harmonic reference level (the level of the fundamental **%f** or the RMS value **%r**),
- **MSV1**: First Mains Signalling Frequency to be monitored.
- **MSV2**: Second Mains Signalling Frequency to be monitored. When the frequency is zero, the MSV2 display disappears.
- The MSV duration (1 - 120 seconds). This is the duration during which the MSV is examined to determine its maximum value, from the moment the threshold was crossed.
- The MSV threshold (0 - 15% nominal voltage). The nominal voltage is that defined in § 3.9.1. This may be a phase-neutral voltage (V) or a phase-phase voltage (U) depending on the type of connection.

The MSV duration and threshold apply to both monitored MSV frequencies. As soon as the threshold is crossed, the voltage concerned (MSV1, MSV2 or both) is monitored for the requested duration. The maximum will be recorded in the event log.

to specify the curve of maximum MSV voltages as a function of frequency.

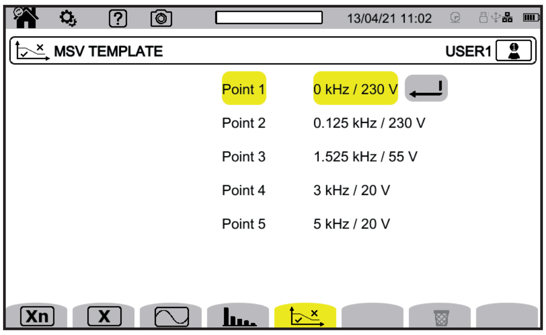
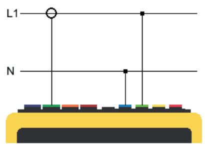
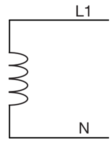
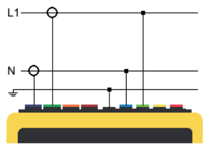
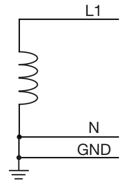
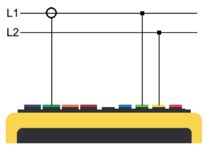
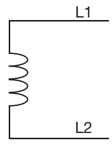
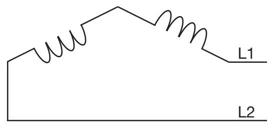
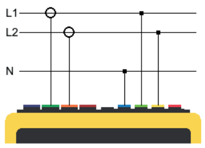
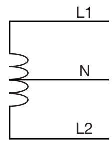
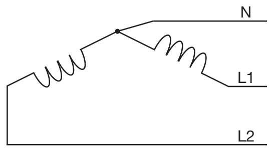
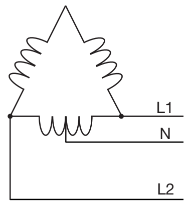
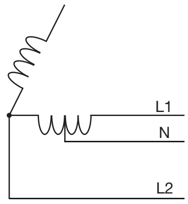


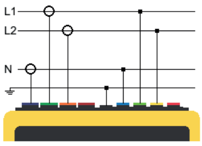
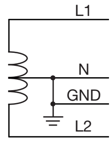
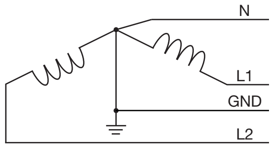
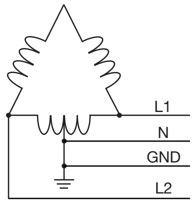
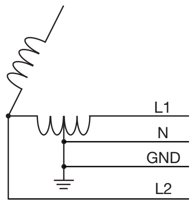
Figure 39

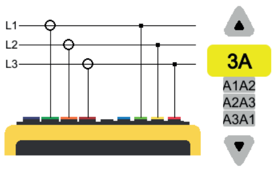
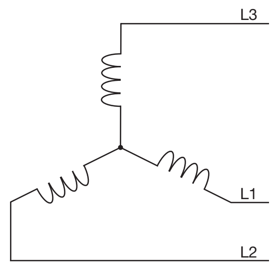
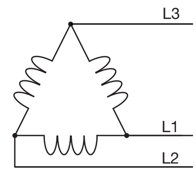
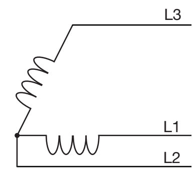
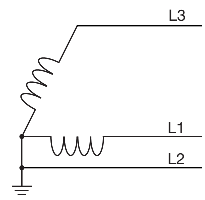
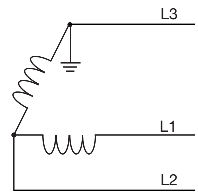
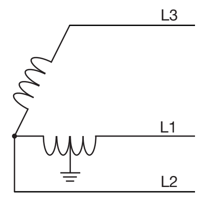
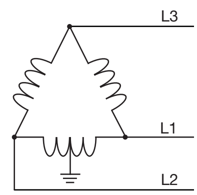
There are 5 preset points that you can modify.
This curve will be displayed with the MSV versus frequency curve.

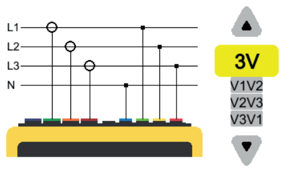
3.9.2. THE DISTRIBUTION NETWORK AND THE TYPE OF CONNECTION,

To choose the connection of the instrument according to the distribution network, select **3ϕ**.
One or more types of network correspond to each distribution system.

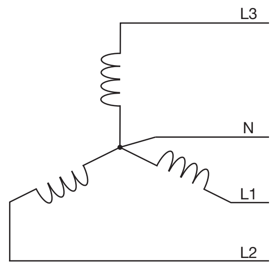
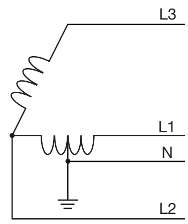
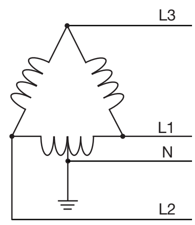
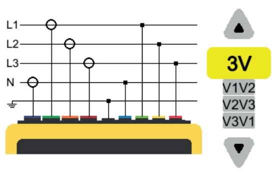
Distribution system	Network	Electrical diagram
Single-phase, 2 wires (L1 and N) 	Single-phase, 2 wires with neutral, without earth	
Single-phase, 3 wires (L1, N, and earth) 	Single-phase, 3 wires with neutral and earth	
Two-phase, 2 wires (L1 and L2) 	Two-phase, 2 wires	
	Three-phase, 2 wires in open star	
Two-phase, 3 wires (L1, L2, and N) 	Two-phase, 3 wires with neutral, without earth	
	Two-phase, 3 wires in open star with neutral, without earth	
	Two-phase, 3 wires in "high leg" delta with neutral, without earth	
	Two-phase, 3 wires in open "high leg" delta with neutral, without earth	

<table>
<tr><th>Distribution system</th><th>Network</th><th>Electrical diagram</th></tr>
<tr><td rowspan="4">Two-phase, 4 wires
(L1, L2, N, and earth)
</td><td>Two-phase, 4 wires with neutral and earth</td><td></td></tr>
<tr><td>Three-phase, 4 wires in open star with neutral and earth</td><td></td></tr>
<tr><td>Three-phase, 4 wires in "high leg" delta with neutral and earth</td><td></td></tr>
<tr><td>Three-phase, 4 wires in open "high leg" delta with neutral and earth</td><td></td></tr>
</table>

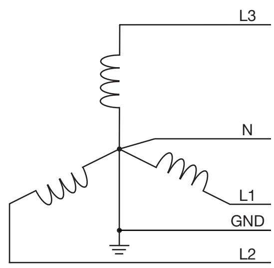
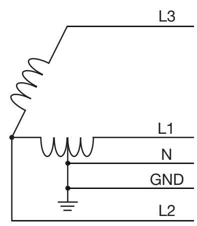
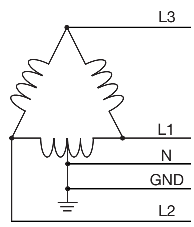
Distribution system	Network	Electrical diagram
Three-phase, 3 wires (L1, L2, and L3)  For three-phase, 3 wires, indicate which current sensors will be connected: all 3 sensors (**3A**) or only 2 (**A1 and A2**, or **A2 and A3**, or **A3 and A1**). If 3 sensors are connected, the calculation will be done by the **3 wattmeters with virtual neutral** method. If 2 sensors are connected, the calculation will be done by the **Aron** method. For a 2-sensor connection, the third sensor is not needed if the other two are identical (same type, same range, and same ratio). Otherwise, the third sensor must be connected for current measurements.	Three-phase, 3 wires in star	
	Three-phase, 3 wires in delta	
	Three-phase, 3 wires in open delta	
	Three-phase, 3 wires in open delta with link to earth between phases	
	Three-phase, 3 wires in open delta with link to earth on the phase	
	Three-phase, 3 wires in open "high leg" delta	
	Three-phase, 3 wires in "high leg" delta	

<table>
<tr><th>Distribution system</th><th>Network</th><th>Electrical diagram</th></tr>
<tr><td rowspan="3">Three-phase, 4 wires
(L1, L2, L3, and N)


Indicate which voltages will be connected: all 3 voltages (3V) or only 2 (V1V2, V2V3 or V3V1).

If you connect only 2 voltages, the 3 phases must be balanced (2½ elements method).</td><td>Three-phase, 4 wires with neutral, without earth</td><td>
</td></tr>
<tr><td>Three-phase, 4 wires in open "high leg" delta with neutral, without earth</td><td>
</td></tr>
<tr><td>Three-phase, 4 wires in "high leg" delta with neutral, without earth</td><td>
</td></tr>
<tr><td rowspan="3">Three-phase, 5 wires
(L1, L2, L3, N, and earth)


Indicate which voltages will be connected: all 3 (3V) or only 2 (V1V2, V2V3 or V3V1).

If you connect only 2 voltages, the 3 phases must be balanced (2½ elements method).</td><td>Three-phase, 5 wires in star with earth and neutral</td><td>
</td></tr>
<tr><td>Three-phase, 5 wires in open high leg delta with earth and neutral</td><td>
</td></tr>
<tr><td>Three-phase, 5 wires in delta with earth and neutral</td><td>
</td></tr>
</table>

3.9.3. SENSORS AND RATIOS

To choose the voltage ratios, the current sensor ratios, and the range of the sensor, select ⊐⊏.

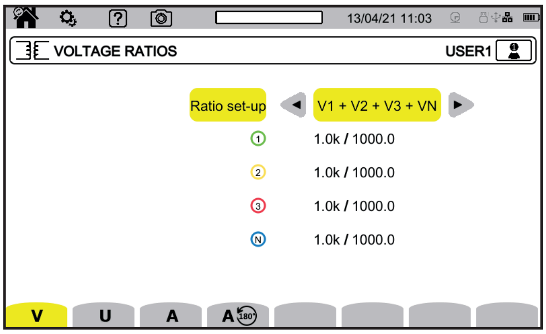


Figure 40

3.9.3.1. Voltage ratio

Voltage ratios are used when the voltages to be measured are too high for the instrument and voltage transformers are used to lower them. The ratio lets you display the true voltage and use it in the calculations.

To choose the voltage ratios, select **V** for phase-to-neutral voltages (with neutral) or **U** for phase-to-phase voltages (without neutral).

- **4V 1/1** or **3U 1/1**: all channels have the same ratio, unity.
- **4V** or **3U**: all channels have the same ratio, to be programmed.
- **3V+VN**: all channels have the same ratio; the neutral has a different ratio.
- **V1+V2+V3+VN** or **U1+U2+U3**: each channel has a different ratio, to be programmed.

For the ratios, the primary voltages are expressed in V and can be assigned a multiplier factor:

- nothing = x1,
- k = x 1,000,
- M = x 1,000,000.

Secondary voltages are expressed in V.

To avoid calculations, you can use a multiplier $1/\sqrt{3}$ both for the primary voltages and for the secondary voltages.

ℹ The ratios for single voltages **V** and the ratios for composite voltages **U** can be set separately. Don't forget to set these 2 ratios if you intend to measure these two types of voltage.

3.9.3.2. Current sensors

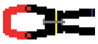
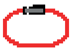
To choose the ratios and ranges of current sensors, select **A**.
The instrument automatically displays the current sensor models detected.

Current ratios are used (only for the sensors concerned) when the currents to be measured are too high for the instrument and current transformers are used to lower them. The ratio lets you display the true current and use it in the calculations.

- **4A, 3A, 2A**: all channels have the same ratio, to be programmed.
- **3A+AN, 2A+AN**: all channels have the same ratio; the neutral has a different ratio.
- **A1+A2+A3+AN**: each channel has a different ratio, to be programmed.

For the ratio, the primary current cannot be less than the secondary current.

The different current sensors are:

	MINI94 clamp 200 A	
	MN93 clamp 200 A	
	MN93A clamp 100 A	
	MN93A clamp 5 A	Ratio, to be programmed: [1 to 60,000] / {1; 2; 5}
	C193 clamp 1000 A	
	J93 clamp 3500 A	
	PAC93 clamp 1000 A	
	E94 clamp	Choice of sensitivity: ■ sensitivity 10 mV/A, range 100 A ■ sensitivity 100 mV/A, range 10 A
	AmpFlex® A193 MiniFlex MA194	Choice of range: ■ 0.10 A - 100.0 A ■ 1.0 A - 1000 A ■ 10 A - 10.00 kA
	Three-phase adapter: 5 A	Ratio, to be programmed: [1 to 60,000] / {1; 2; 5}

In the case of a three-phase, 3-wire set-up, when only 2 current sensors are connected, if these 2 sensors are of the same type and have the same ratio, the instrument simulates the third sensor, giving it the same specifications as the two others. The connection configuration must indicate which sensors will be present. The third sensor will then be shown as simulated.

This menu appears only for the sensors concerned (see the table above).

3.9.3.3. Reversal of current

To reverse a current sensor, select A 180°.

If you have connected your current sensors and find during the measurements that one or more sensors are not in the right direction. You can easily reverse them without having to turn them round.

3.10. CONFIGURING RECORDINGS

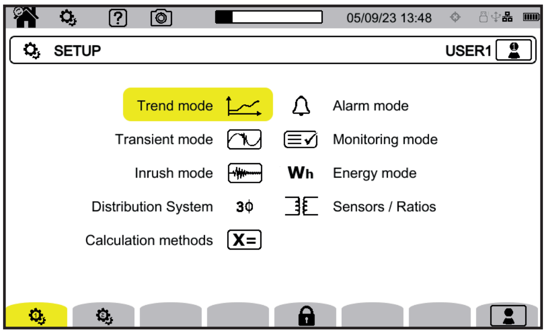


Figure 41

Before taking recordings, the following settings must be defined or adapted:
- The values to be recorded, in the trend mode,
- The triggering levels for the transient and inrush current capture modes,
- The alarm thresholds, for the alarm mode,
- The units and the ranges for the energy mode,
- The parameters of the monitoring mode (using the PAT3 application software).

Recording mode settings can also be changed within each recording mode.

> The recording configuration cannot be changed if the configuration is locked or if the instrument is recording, counting energy (even if counting is suspended), recording transients, alarms or capturing inrush current.

3.10.1. QUICK PROGRAMMING OF A RECORDING (QUICKSTART)

For repeated recordings of trends, transients, alarms and inrush current, it is possible to pre-configure certain recording parameters using the quick configuration (QuickStart).

These parameters are:
- duration,
- choice of one of the 4 possible configurations (for trend recordings),
- maximum number of events to be recorded (for transient and alarm recordings),
- the aggregation period (for trend recordings),
- the name of the recording.

In this way, you can quickly start a recording without having to programme the date and time for the start and for the end of the recording.

The recording will start:
- in the next 10 seconds in call inrush mode,
- at the end of the current minute + one minute for trend, transient, alarm and monitoring modes.

3.10.2. TREND MODE

The trend mode is used to record different quantities for a specified duration.
To configure the trend mode, select .

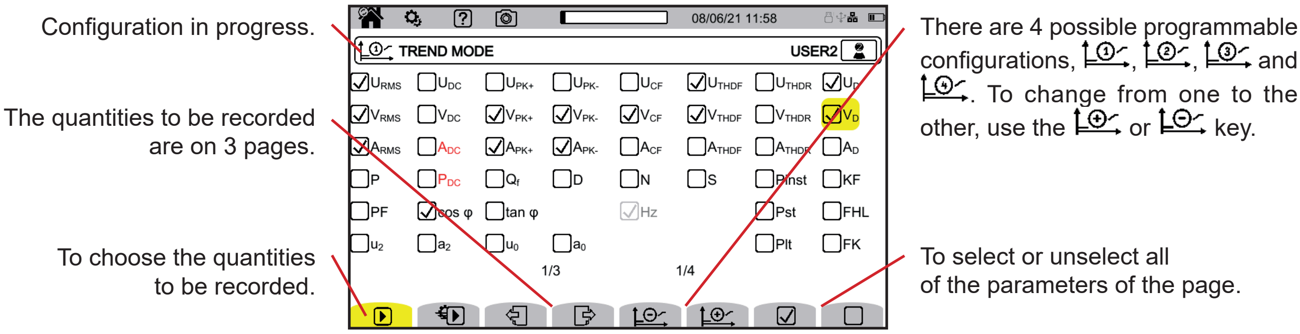


Figure 42

All of the quantities the instrument measures can be recorded. Check those you want to record. The frequency (Hz) is always selected.

For more information about these quantities, refer to the glossary in § 20.12.

The quantities displayed in red are incompatible with the chosen configuration or the current sensors used and will not be recorded.

Pages 2 and 3 concern the recording of harmonics and inter-harmonics. For each of these quantities, it is possible to select the ranks of the harmonics or inter-harmonics to be recorded (between 0 and 127) and, if required, the odd-numbered harmonics only.

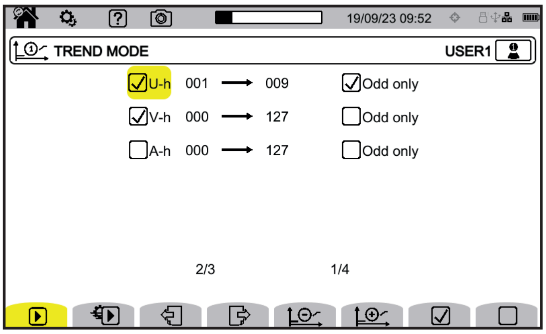


Figure 43

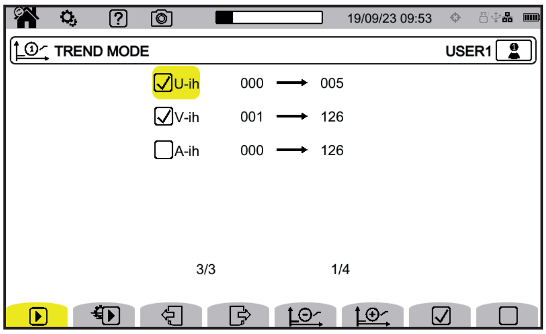


Figure 44

Levels of harmonics of order 01 will only be displayed if values are expressed in %r.

For repeated recordings, (QuickStart) can be used to set:

- the duration of the recording,
- the configuration, from among the 4 possible,
- the recording period, between 200ms and 2h,
- the name of the records.

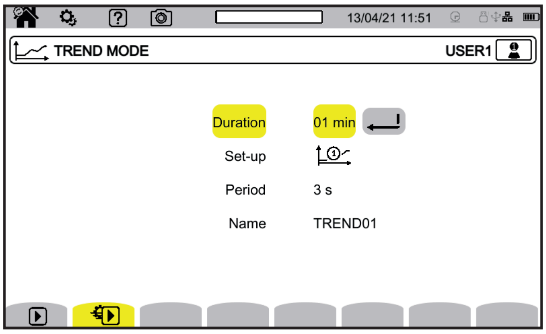


Figure 45

3.10.3. TRANSIENT MODE

The transient mode is used to record voltage or current transients for a specified duration. It can also record fast transients (surges) if the hookup includes an earth connection.
To configure the transient mode, select .

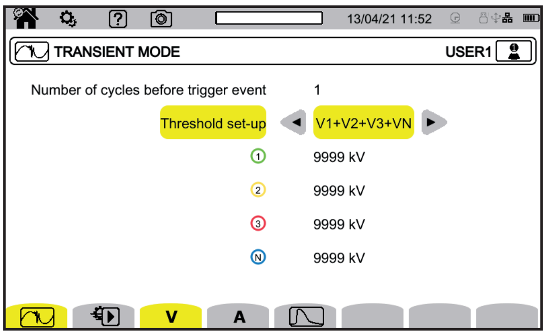


Figure 46

3.10.3.1. Voltage thresholds

To configure the voltage thresholds, select **V** or **U**.

Choose the number of cycles before the transient recording is triggered (1, 2 or 3).

- **4V** or **3U**: all of the voltage inputs have the same threshold, to be programmed.
- **3V+VN**: all of the voltage inputs have the same threshold; the neutral has a different threshold.
- **V1+V2+V3+VN** or **U12+U23+U31**: each input voltage has a different threshold, to be programmed.

3.10.3.2. Current thresholds

To configure the current thresholds, select **A**.

Choose the number of cycles before the transient recording is triggered (1, 2 or 3).

- **4A**: all of the current inputs have the same threshold, to be programmed.
- **3A+AN**: all of the current inputs have the same threshold; the neutral has a different threshold.
- **A1+A2+A3+AN**: each current input has a different threshold, to be programmed.

3.10.3.3. Surge thresholds

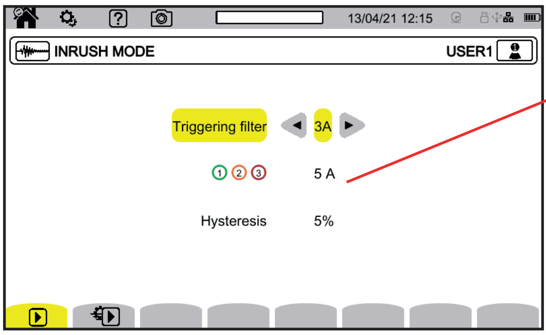
To configure the voltage thresholds of surges with respect to earth, select .
- **4VE** all of the voltage inputs have the same threshold, to be programmed.
- **3VE+VNE**: all of the voltage inputs have the same threshold; the neutral has a different threshold.
- **V1E+V2E+V3E+VNE**: each input voltage has a different threshold, to be programmed.

3.10.3.4. Rapid programming of capture

For repeated recordings, (QuickStart) can be used to set:
- the duration of the capture (between 1 minute and 99 days),
- the maximum number of transients in the capture,
- the name of the capture.

3.10.4. INRUSH CURRENT MODE

The inrush current mode is used to capture an inrush current.
To configure the inrush current mode, select .



The threshold takes into account the present current, in order to detect the appearance of an additional current.

Figure 47

Choose whether the inrush current threshold applies to all 3 current inputs (3A) or only one of them (A1, A2, or A3). Specify this threshold and the hysteresis. The capture triggers when the level of the current rises above the threshold. The capture stops when the level of the current drops below the stop threshold (= threshold + hysteresis).

For more information about the hysteresis, refer to § 20.6. Setting the hysteresis to 100% is equivalent to not having a stop threshold.

For repeated recordings, (QuickStart) can be used to set:

- the duration of the capture (between 1 minute and 99 days),
- the name of the records.

The number of captures is always 1.

3.10.5. ALARM MODE

The alarm mode is used to monitor one or more quantities, either in absolute value or in signed value. Each time a quantity crosses the threshold you have defined, the instrument records the information about the crossing.
To configure the alarms, select .

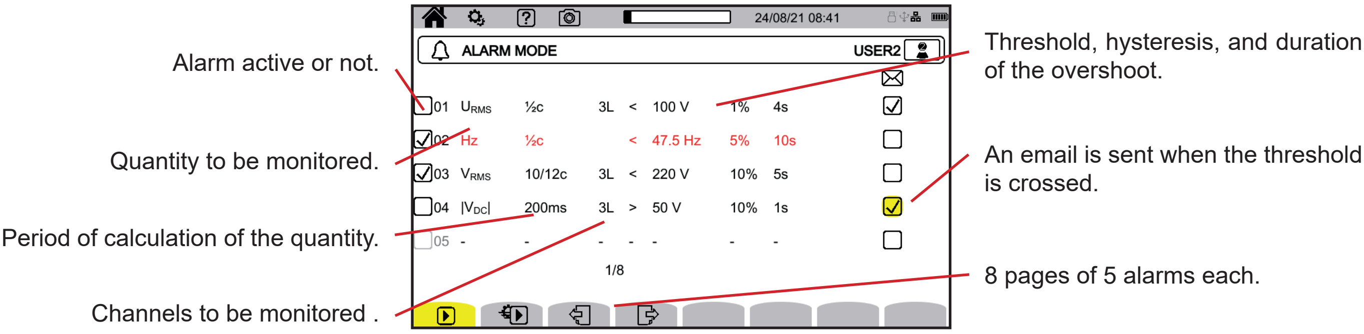


Figure 48

There are 40 possible alarms.

For each of them you must specify:

- The quantity to be monitored from among the following quantities:
  - Hz,
  - URMS, VRMS, ARMS,
  - |UDC|, |VDC|, |ADC|,
  - |UPK+|, |VPK+|, |APK+|, |UPK-|, |VPK-|, |APK-|,
  - UCF, VCF, ACF,
  - UTHDF, VTHDF, ATHDF, UTHDR, VTHDR, ATHDR,
  - |P|, |PDC|, $|Q_f|$, N, D, S,
  - |PF|, |cos φ | (or |DPF| or $|PF_1|$), |tan φ|, P_{st}, P_{lt}, FHL, FK, KF,
  - u_2, a_2, u_0, a_0,
  - VMSV1, UMSV1, VMSV2, UMSV2,
  - Ud, Vd, Ad,
  - U-h, V-h, A-h, U-ih, V-ih, A-ih.

  For more information about these quantities, please refer to the glossary in § 20.12.
- The order of the harmonic (between 0 and 127), for U-h, V-h, A-h, U-ih, V-ih and A-ih only.
- The period of calculation of the value.
  For AC signals:
  - 1/2c: 1 cycle every half-cycle. The value is measured over one cycle, starting at a passage through zero of the fundamental component, and refreshed every 1/2 cycle.
  - 10/12c: 10 cycles for 50 Hz (42.5 to 57.5 Hz), or 12 cycles for 60 Hz (51 to 69 Hz),
  - 150/180c: 150 cycles for 50 Hz (42.5 to 57.5 Hz), or 180 cycles for 60 Hz (51 to 69 Hz).
  - 10s.

  For DC signals:
  - 200ms
  - 3s
- The channel(s) to be monitored. The instrument proposes a list according to the connection you have specified.
  - 3L: each of the 3 phases,
  - N: the neutral,
  - 4L: each of the 3 phases and the neutral,
- The direction of the alarm (< or >).
- The threshold.
- The hysteresis: 1%, 2%, 5% or 10%.
- The minimum duration of the threshold overshoot.

Then choose whether to activate the alarm or not by checking the box.

You can also choose to have an email sent ✉ when the alarm is triggered. If there are several alarms, they can be grouped in a single email to limit the rate of sending to a maximum of one email every 5 minutes. To specify an email address, refer to § 3.7.4.

When an alarm configuration line is red, it means that the quantity requested is not available.

For repeated recordings, (QuickStart) can be used to set:
- the duration of the capture (between 1 minute and 99 days),
- the maximum number of alarms (between 1 and 20,000),
- the name of the recording.

3.10.6. ENERGY MODE

The energy mode Wh is used to calculate the energy consumed or produced during a specified period of time.
To configure the energy mode, select **Wh**.

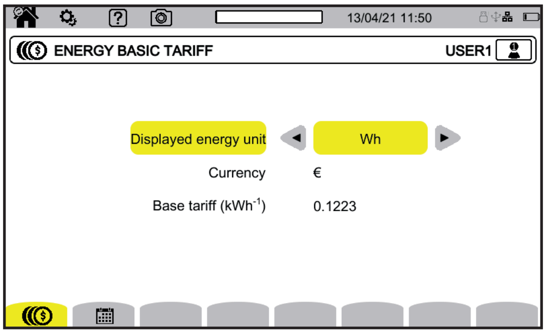


Figure 49

Select to specify the energy calculation parameters:
- the unit of energy:
  - Wh: watt-hour
  - Joule
  - toe (nuclear): ton of nuclear oil equivalent
  - toe (non-nuclear): ton of non-nuclear oil equivalent
  - BTU: British Thermal Unit
- the currency ($, €, £, etc),
- the base rate per kW/h.

Select to define specific tariff rates (for example off hours).

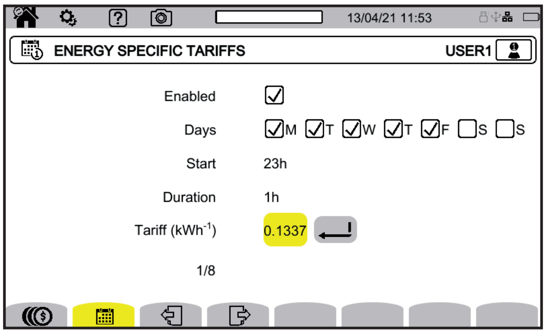


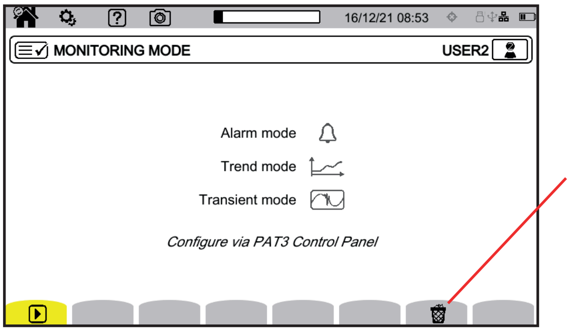
Figure 50

You can define 8 different ranges and activate them ☑ or not ☐:
- the days of the week,
- the starting time,
- the duration,
- the rate.

3.10.7. MONITORING MODE

The monitoring mode is used to check the conformity of the voltage for a specified duration.
A monitoring campaign contains a trend record, a transients record, alarm detection, a log of events, and a statistical analysis of a specific set of measurements.

The monitoring mode is configured using the PAT3 application software (see § 16).



Allows the current configuration to be deleted and replaced by the default configuration (that of the EN 50160-BT standard). It is not possible to modify the configuration if a recording is in progress.

Figure 51

3.10.8. FLAGGING

Class A flagging is used to flag the measurements.

During a dip, swell, interruption or rapid voltage change, the measurement algorithm for other parameters (for example, frequency measurement) might produce an unreliable value.

The flagging concept applies to the measurement of power frequency, voltage magnitude, flicker, supply voltage unbalance, voltage harmonics, voltage interharmonics and mains signalling.

If during a given time interval any value is flagged, the aggregated value which includes that value is also flagged.

Real-time flagged measurements affected by disturbances are indicated using the flag icon .

Furthermore the instrument can be configured to monitor the supply voltage for compliance with EN 50160 using the PAT3 application software (see § 16). The monitoring configuration allows for adjustment of thresholds, hysteresis and durations.

4. USE

4.1. STARTING UP

To switch the instrument on, press the ⏻ button. The home screen is displayed.

Figure 52

Then the Waveform screen is displayed.

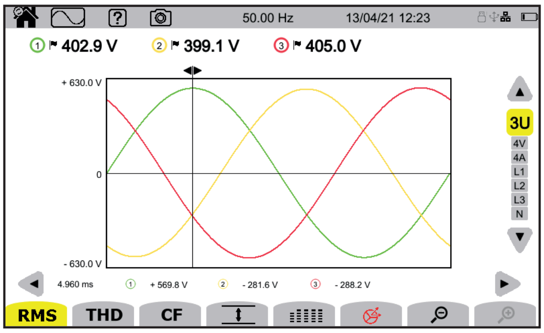


Figure 53

4.2. NAVIGATION

To navigate in the various menus of the instrument, you can use:

- the keypad,
- the touch screen,
- the remote user interface (VNC).

4.2.1. KEYPAD

The keys of the keypad are described in § 2.8.

The functions of the function keys are indicated at the bottom of the screen. They change according to the mode and the context. The active key is yellow.

4.2.2. TOUCH SCREEN

opens the following screen:

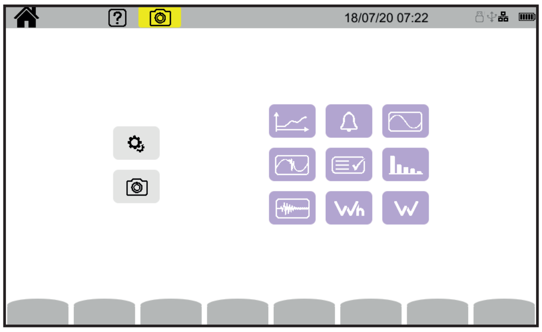


Figure 54

You can then access all functions of the instrument without using the keys.

4.2.3. REMOTE USER INTERFACE

Remote navigation is possible from a PC, a tablet, or a smartphone.
You can then control the instrument remotely.

From a PC via an Ethernet link

- Connect the instrument to the PC using an Ethernet cable (see § 2.4).
- On the PC, in a web browser, enter http://IP_address_instrument.
  To find this address, refer to § 3.7.1.
  - go to configuration (key),
  - then, in the instrument configuration (second yellow function key:),
  - then in the network configuration, ,
  - then in the Ethernet link ,
  - Check that the link is in fact active (display shaded and at bottom right),
  - Note the IP address.

With a tablet or a smartphone and a Wi-Fi link

- Share a Wi-Fi connection with the tablet or the smartphone
- In a web browser, enter http://IP_address_instrument.
  To find this address, refer to § 3.7.3.
  - go to configuration (key),
  - then, in the instrument configuration (second yellow function key),
  - then in the network configuration, ,
  - then in the Wi-Fi link, ,
  - Choose the Wi-Fi network of your smartphone or your tablet.
  - Check that the link is in fact active (display shaded and at bottom right),
  - Note the IP address.

Only one link (Ethernet or Wi-Fi) can be activated at time.

Enter the IP address of your instrument in a browser.
The remote browser (VNC) is activated.

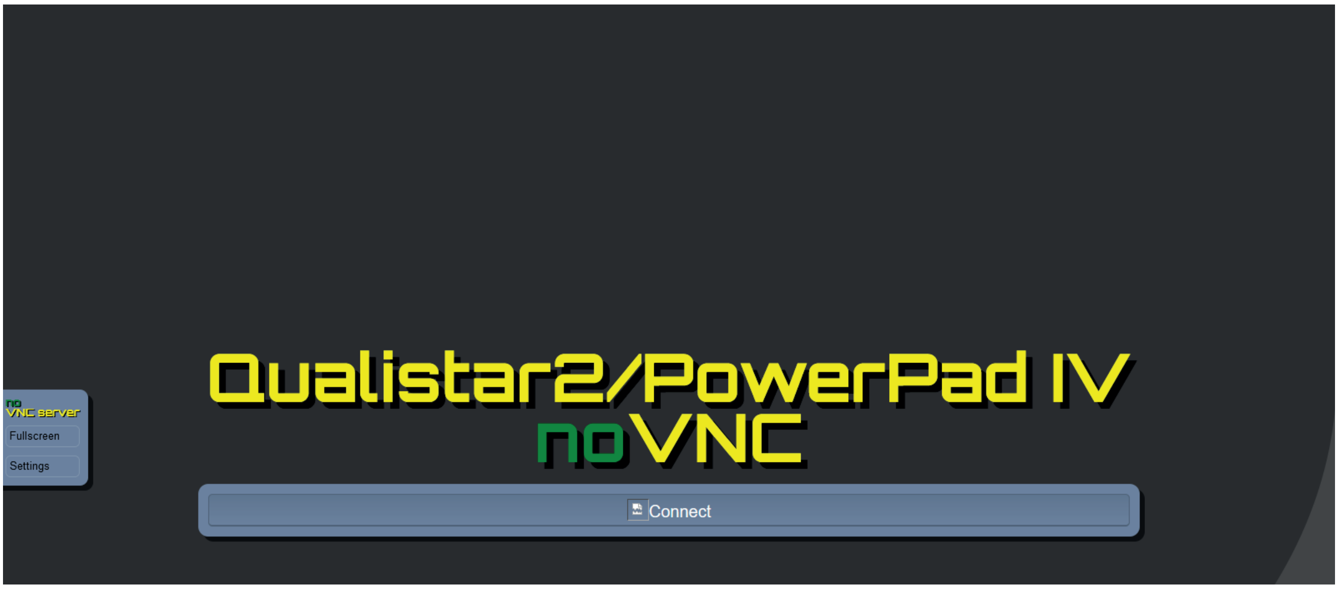


Figure 55

In the left-hand tab,
- click on **Fullscreen** to adjust the size of the display window on your screen.
- click on **Settings then** check **Shared Mode** to control the instrument, or **View Only** just to see the screen of the instrument.

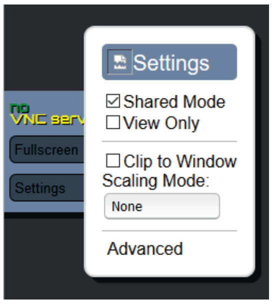


Figure 56

- Click on Settings again to close the configuration menu.

Then click on Connect. You will then see the screen of the C.A 8345 on your screen.

4.3. CONFIGURATION

Refer to the preceding paragraph to configure your instrument.

Before making any measurement, remember to specify:
- the connection (§ 3.9.2),
- the current sensors used and the voltage and current ratios (§ 3.9.3),
- the calculation method, if necessary (§ 3.9.1).

For the recording modes, remember to specify:
- the parameters to be recorded,
- the starting time and duration of the recording,
- the recording conditions.

4.4. CONNECTIONS

Make sure that all of your leads and sensors are correctly marked (see § 2.9), then connect them to the circuit to be measured as shown by the following diagrams.

4.4.1. SINGLE-PHASE NETWORK

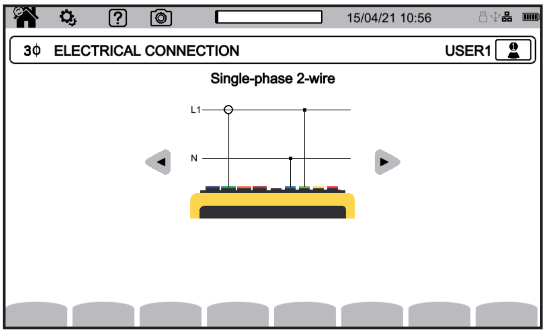


Figure 57

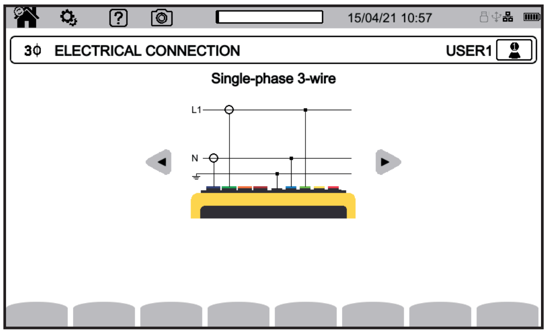


Figure 58

4.4.2. TWO-PHASE NETWORK

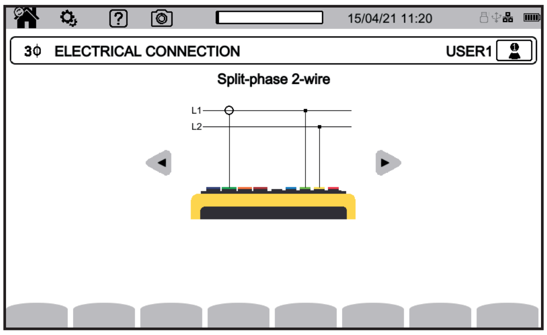


Figure 59

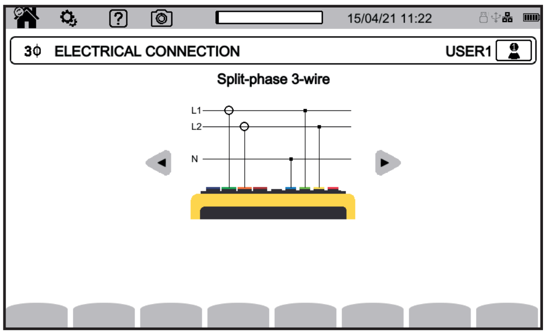


Figure 60

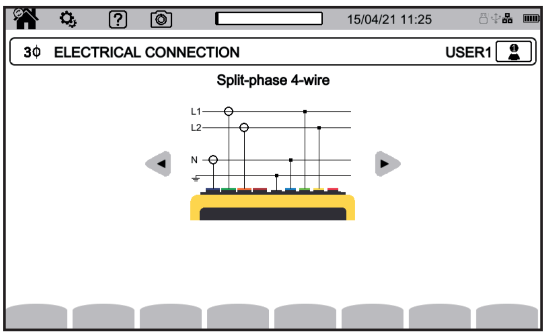


Figure 61

4.4.3. THREE-PHASE NETWORK

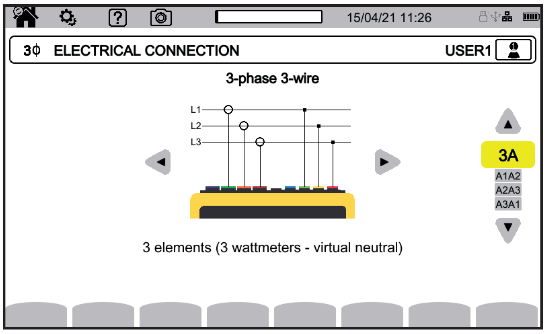


Figure 62

For three-phase, 3 wires, indicate which current sensors will be connected: all 3 sensors (3A) or only 2 (A1 and A2, or A2 and A3, or A3 and A1).

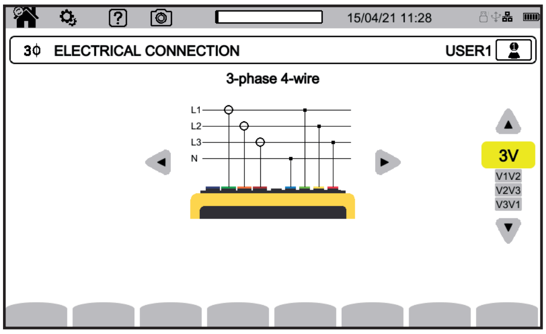


Figure 63

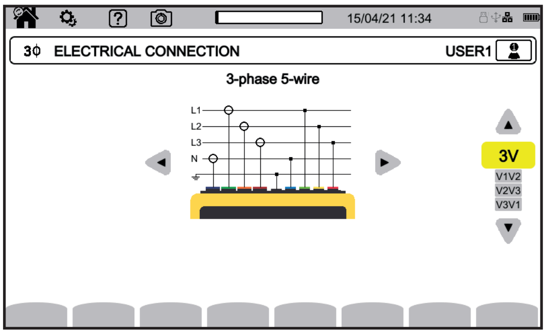


Figure 64

For three-phase 4 and 5 wires, indicate which voltages will be connected: all 3 voltages (3V) or only 2 (V1 and V2, or V2 and V3, or V3 and V1).

4.4.4. CONNECTION PROCEDURE

Depending on the network, not all of the terminals and sensors need be connected.

> **i** In the case of a connection without neutral, connect the **N** and **GND** terminals together.

The CA 8345 has a very high level of safety and protection against incorrect and dangerous connections: all inputs, including earth, are protected by a series impedance. However, this has the disadvantage that when an input is accidentally disconnected, the corresponding channel may show a non-zero voltage.

To prevent this, make sure you connect your device to earth. To do this, connect the optional functional earth cable to the USB A socket on the front panel.

Following the procedure described below holds connection errors to a minimum and avoids wasting time.

- Connect the earth lead between the ⏚ terminal and the network earth.
- Connect the neutral lead between voltage terminal **N** and the network neutral.
- Connect the neutral current sensor to the current terminal **N**, then clamp the neutral cable.
- Connect the phase L1 lead between voltage terminal **L1** and network phase L1.
- Connect the phase L1 current sensor to current terminal **L1**, then clamp the phase L1 cable.
- Connect the phase L2 lead between voltage terminal **L2** and network phase L2.
- Connect the phase L2 current sensor to current terminal **L2**, then clamp the phase L2 cable.
- Connect the phase L3 lead between voltage terminal **L3** and network phase L3.
- Connect the phase L3 current sensor to current terminal **L3**, then clamp the phase L3 cable.

If you connect a current sensor in reverse, you can correct this connection directly in the configuration.
Press , , and **A** in turn (see § 3.9.3.3).

Disconnection procedure:
- Proceed in the reverse of the order of connection, always ending by disconnecting the earth and/or the neutral.
- Disconnect the leads from the instrument.

4.5. FUNCTIONS OF THE INSTRUMENT

4.5.1. MEASUREMENTS

Make sure that you have correctly configured the instrument for the measurements you want to make.

You can then make one or more of the following measurements:

- View the waveforms of a signal .
- View the harmonics of a signal .
- View power measurements .
- Meter energy .
- Record a trend .
- Record transients .
- Capture an inrush current .
- Detect alarms .
- Monitor a network .

There are 4 real-time modes: , , and .
And 5 recording modes, , , , and .

Some functions cannot be run simultaneously:

- The real-time modes (waveform, harmonics, power, and energy) can be activated while recordings are in progress.
- If an inrush current capture is in progress, it is not possible to start the recording of a trend, transients, alarms or a monitoring.
- If a recording of a trend, transients, alarms or a monitoring is in progress, it is not possible to start an inrush current capture.

4.5.2. SCREENSHOT

Any screen can be recorded by a long press on the key.
The symbol turns yellow , then black . You can then release the key.

You can also click on the icon in the status bar at the top of the screen.

The snapshots are recorded on the SD card in directory 8345\ Photograph.

Real-time screens that are likely to vary (curves, metering) are captured in bursts (up to 5). This lets you choose the one that suits you best.

The screenshot also records measurements and waveform data that can be used with PAT3 application software.

4.5.3. HELP

You can press the help key at any time.
The help screen provides information about the functions and the symbols used for the display mode in progress.The help screen provides information about the functions and the symbols used for the display mode in progress.

4.6. SWITCHING OFF

To switch the instrument off, press the button.

If the instrument is recording, metering energy (even if metering is suspended), recording transients or alarms, or capturing inrush current, it requests confirmation before switching off.

If you confirm the Power-off command, the records will be finalized and the instrument is switched off. If the instrument is switched back on before the scheduled end of recording sessions, these will be resumed automatically.

4.7. SAFETY STATUS OF THE INSTRUMENT

If there is an overload on the inputs, the instrument changes to safety status; a red line under the status bar reports this event.

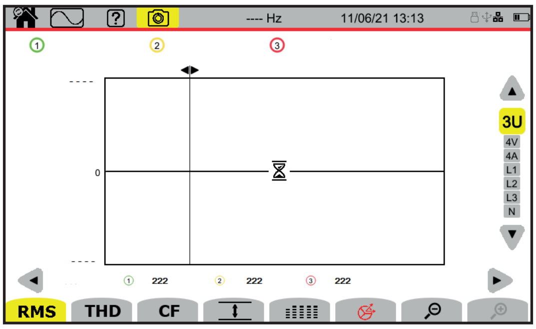


Figure 65

This line indicates that the sum of all voltage inputs exceeds 1450 V. This condition is not reached with signals ranging up to 1000 VRMS. On the other hand, if you accidentally connect the 3 voltage inputs to the same phase, the safety threshold will be exceeded.

When the overload has been eliminated, the safety status disappears after approximately 10 seconds and you can once again use your instrument normally.

5. WAVEFORM

The waveform mode is used to display voltage and current curves, and values measured and calculated from the voltages and currents (except for harmonics, powers, and energies).
This is the screen that appears when the instrument is powered up.

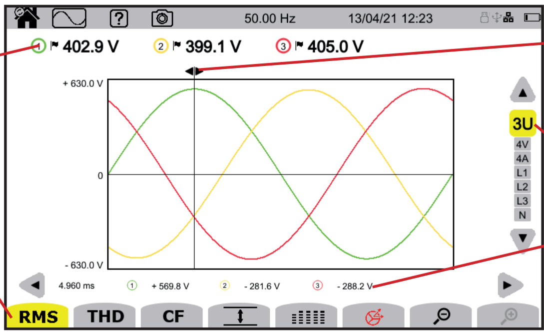


Figure 66

The functions:
RMS: display of curves and RMS values.
THD: display of curves and harmonic distortion.
CF: display of curves and crest factor.
: display in table form of the maximum (MAX), RMS, minimum (MIN), and peak (PK+ and PK-) values.
: display in table form of the RMS, DC, THD, CF, P_{st} inst, P_{st}, P_{lt}, FHL, FK and KF values.
: display of the phasor diagram of the signals.
: reduces or increases the time scale of the curves.

To move the time cursor, use the ◄ ►keys.

To change the display filter, use the ▲ ▼ keys.

5.1. DISPLAY FILTER

The display filter depends on the connection chosen:

Connection	Display filter	Display filter for function
Single-phase, 2 wires Two-phase, 2 wires	L1 (no choice)	L1 (no choice)
Single-phase, 3 wires	2V, 2A, L1, N	
Two-phase, 3 wires	U, 2V, 2A, L1, L2	2V, 2A, L1, L2
Two-phase, 4 wires	U, 3V, 3A, L1, L2, N	2V, 2A, L1, L2
Three-phase, 3 wires	3U, 3A	3U, 3A
Three-phase, 4 wires	3U, 3V, 3A, L1, L2, L3	3U, 3V, 3A, L1, L2, L3
Three-phase, 5 wires	3U, 4V, 4A, L1, L2, L3, N	3U, 3V, 4A, L1, L2, L3

5.2. RMS FUNCTION

The **RMS** function is used to display the signals measured in a period, along with their RMS values, averaged over 200ms or 3s depending on what has been configured (see § 3.9.1).
The cursor can be used to check the instantaneous values along the curves displayed.
To move the cursor, use the ◄ ► keys.

Here are a few examples of screens for the **RMS** function according to the display filter for a three-phase, 5-wire connection.
To change the display filter, use the ▲ ▼ keys.

The numbers of the channels 1 are saturation indicators. The solid circle 1 indicates that the channel being measured is saturated or that at least one channel used in calculating it is saturated.

The ⚑ symbol near the channel number indicates that the voltage and all quantities that depend on it are doubtful. The associated current channel and the associated combined voltages are also flagged. For example, if V1 is marked, then A1, U1 and U3 will be also marked.
Flaggings concern voltage dips, voltage swells, interruptions, and rapid voltage changes.

To reduce or increase the time scale of the curves, use .

RMS 3U display filter
Displays the instantaneous curves of phase-to-phase voltages and their RMS values.

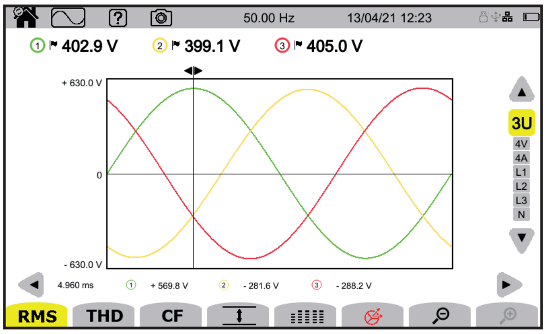


Figure 67

RMS 4V display filter
Displays the instantaneous curves of phase-to-neutral voltages and their RMS values.

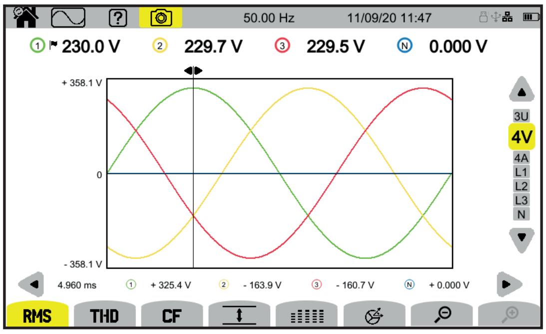


Figure 68

RMS 4A display filter
Displays the instantaneous curves of currents and their RMS values.

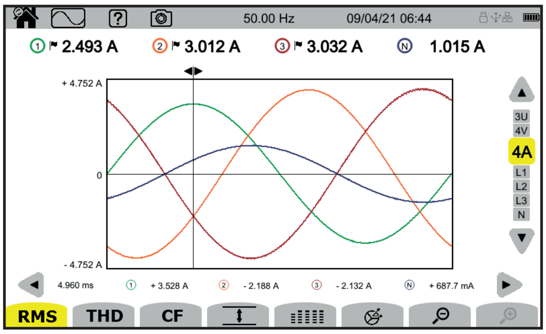


Figure 69

RMS L3 display filter
Displays the instantaneous voltage and current curves of phase 3 and their RMS values.
There are 3 curves each time, often superimposed: the maximum curve, the nominal curve, and the minimum curve.

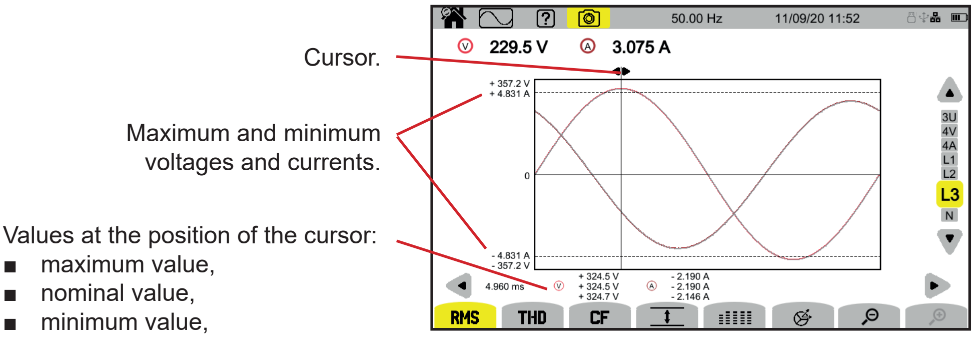


Figure 70

The L1, L2 and N display filters are similar but concern phase 1, phase 2, and the neutral.

5.3. THD FUNCTION

The **THD** function displays the signals measured in a period, along with their total harmonic distortion.
The THD is displayed with as reference either the RMS value of the fundamental (**%f**) or the RMS value without DC (**%r**), depending on what you have configured (see § 3.9.1.).
The harmonic distortion rates on the neutral are always calculated in relation to the RMS value without reference DC (%r).

The screens are similar to the **RMS** screens and depend on the display filter chosen.

5.4. CF FUNCTION

The **CF** function displays the signals measured in a period, along with their crest factors.

The screens are similar to the **RMS** screens and depend on the display filter chosen.

5.5. MIN-MAX FUNCTION

The ⭥ function is used to display the RMS, maximum (MAX), minimum (MIN), positive peak (PK+) and negative peak (PK-) values of the voltage and of the current.

Here are a few examples of screens for the Min-Max function, depending on the display filter, for a three-phase, 5-wire connection. To change the display filter, use the ▲ ▼ keys.

> **i** The search for the extreme values starts when the instrument is switched on. To reset the values, press the 🗑 key.

If a value cannot be calculated (for example because the instrument is not connected to the network), the instrument displays - - -.

⭥ 3U display filter
Displays the extreme values of the phase-to-phase voltages.

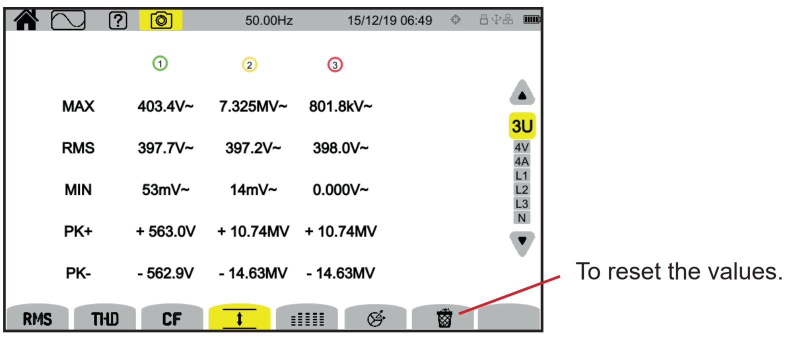


Figure 71

4V display filter
Displays the extreme values of the phase-to-neutral voltages.

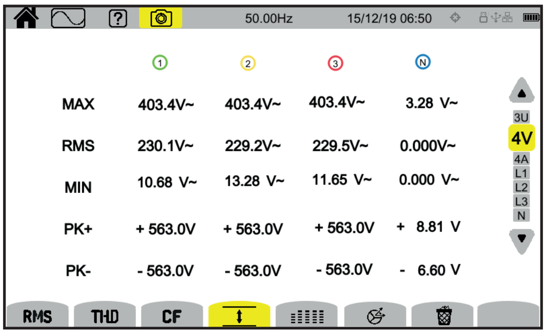


Figure 72

4A display filter
Displays the extreme values of the currents.

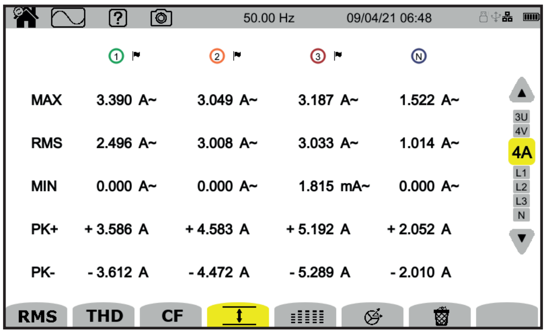


Figure 73

L1 display filter
Displays the extreme values of the voltage and current of phase 1.

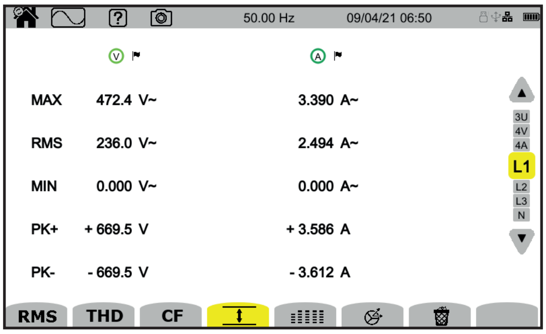


Figure 74

The L2, L3 and N display filters are similar but concern phase 2, phase 3, and the neutral.The L1, L2, and N display filters are similar but concern phase 1, phase 2, and the neutral.

5.6. SUMMARY FUNCTION

The function displays:

- for voltages:
  - the RMS value,
  - the DC component,
  - the total harmonic distortion referred to the RMS value of the fundamental (THD %f),
  - the total harmonic distortion referred to the RMS value without DC (THD %r) ,
  - the crest factor (CF),
  - the short-term instantaneous flicker (P_{st} inst). For more information about the flicker, refer to § 20.4.
  - the short-term flicker (P_{st}),
  - the long-term flicker (P_{lt}).

- for currents:
  - the RMS value,
  - the DC component,
  - the total harmonic distortion referred to the RMS value of the fundamental (THD %f) ,
  - the total harmonic distortion referred to the RMS value without DC (THD %r) ,
  - the crest factor (CF),
  - the harmonic loss factor (FHL),
  - the factor K (FK).
  - the K-factor (KF).

Depending on the display filter, not all of these parameters are displayed.

> **i** The calculations start when the instrument is switched on.

If a value cannot be calculated (for example because the instrument is not connected to the network), the instrument displays - - -.

When a value is not specified (for example the DC component for an AC signal) or not yet calculated (for example the PLT), the instrument displays - - - .

Here are a few examples of screens for the Summary function, depending on the display filter, for a three-phase, 5-wire connection. To change the display filter, use the ▲ ▼ keys.

4V display filter

Displays the data of the phase-to-neutral voltages.

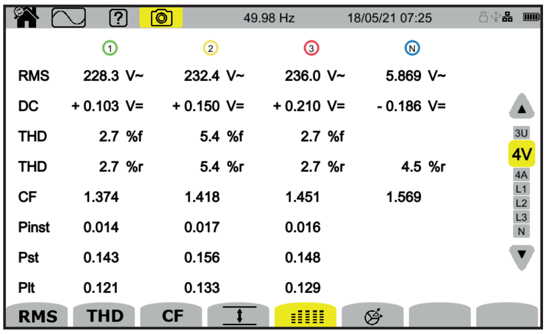


Figure 75

The energy calculation starts at fixed times: 00.00, 00.10, 00.20, 00.30, 00.40, 00.50, 01.00, 01.10, etc. So if you switch your instrument on at 08.01, the first P_{st} will be displayed at 08.20.

The calculation of the P_{lt} starts at fixed times: 00.00, 02.00, 04.00, 06.00, 08.00, 10.00, 12.00, etc. So if you switch your instrument on at 08.01, the first P_{lt} will be displayed at 12.00 in the case of a fixed window and at 10.10 in the case of a sliding window. Only the calculation done with the fixed window is recognised by IEC standard 61000-4-30.

4A display filter

Displays the extreme values of the currents.

The DC value is only displayed if the current sensor is able to measure direct current.

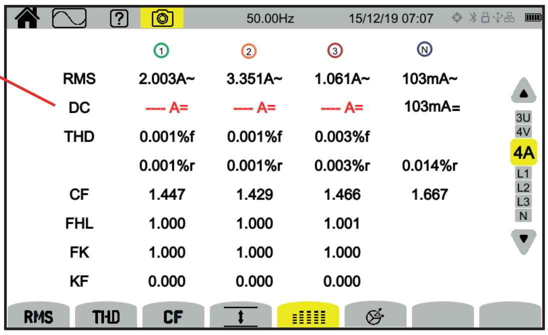


Figure 76

L2 display filter

Displays the voltage and current data of phase 2.

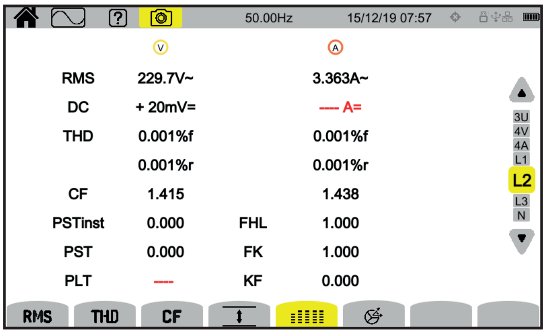


Figure 77

The L1, L3 and N display filters are similar but concern phase 1, phase 3, and the neutral.

5.7. PHASOR FUNCTION

The function displays:

- the phasor diagram of the signals,
- the absolute values of the voltages or currents,
- the phase differences between the voltages or between the currents,
- the unbalance ratio and/or the inverse unbalance ratio of the voltages or of the current.

Here are a few examples of screens for the phasor function, depending on the display filter, for a three-phase, 5-wire connection. To change the display filter, use the ▲ ▼ keys.

3U display filter

Displays the phasor diagram of the phase-to-phase voltages. U1 is reference.

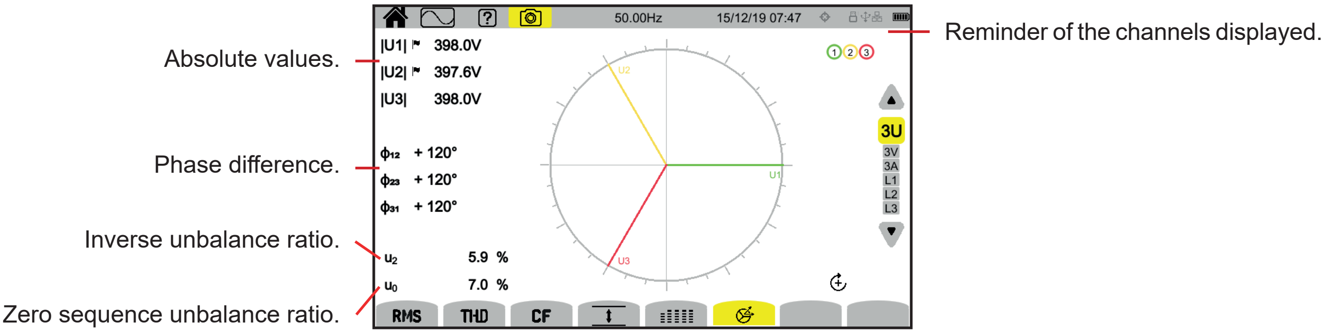


Figure 78

3V display filter

Displays the phasor diagram of the phase-to-neutral voltages and of the currents. V1 is reference.

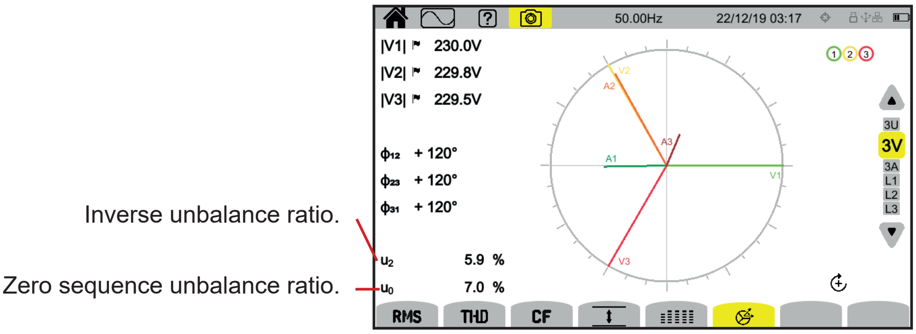


Figure 79

3A display filter

Displays the phasor diagram of the currents and of the phase-to-neutral voltages.

A1 is reference. The choice of current or voltage as reference can be changed in the configuration (see § 3.9.1).

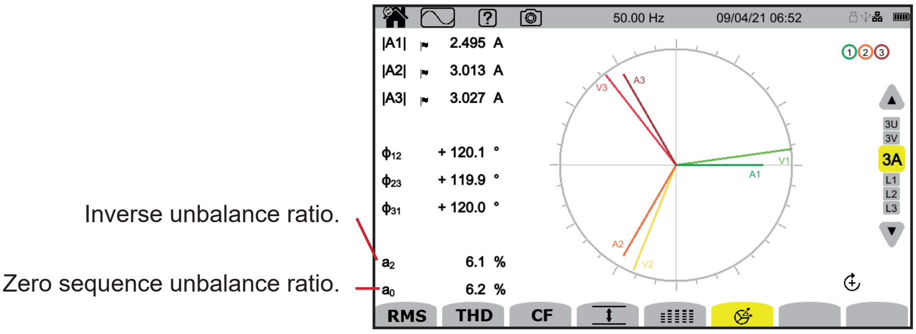


Figure 80

L3 display filter

Displays the phasor diagram of the voltage and of the current of phase 3.

A3 is reference. The choice of current or voltage as reference can be changed in the configuration (see § 3.9.1).

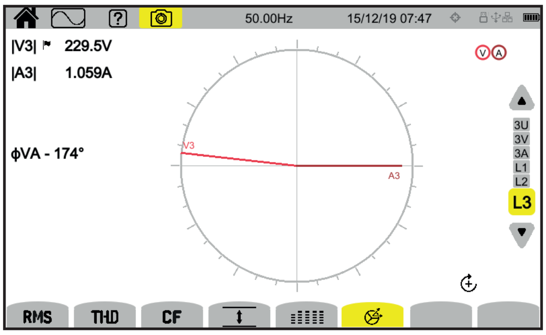


Figure 81

The L1 and L2 display filters are similar but concern phase 1 and phase 2.

6. HARMONIC

The voltages and currents can be analysed as sum of sine waves at the network frequency and multiples thereof. Each multiple is a harmonic of the signal. It is characterized by its frequency, its amplitude, and its phase difference with respect to the fundamental frequency (network frequency).

If the frequency of one of these sine waves is not a multiple of the fundamental frequency, it is an inter-harmonic

The harmonic mode displays a representation in bargraph form of the harmonics, order by order, of the voltage, of the current and of the mains signalling voltage (MSV).

It is used to determine the harmonic currents produced by nonlinear loads and analyse the problems caused by these same harmonics, as a function of their order (overheating of neutrals, of conductors, of motors, etc.).

The CA8345 displays harmonics up to rank 127 and inter-harmonics up to rank 126. Harmonics and inter-harmonics are calculated in accordance with standard IEC 61000-4-7 (see § 20).

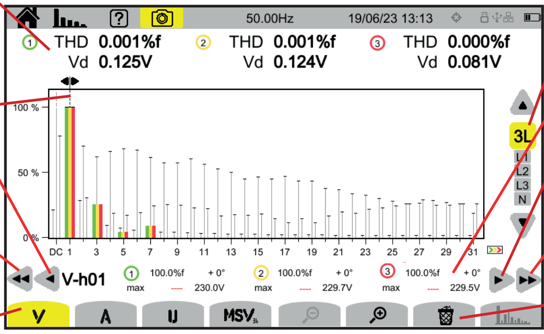
Display of the harmonic distortion rate and distorting voltage with indication of saturation.

Cursor.

To move the cursor to the preceding harmonic.

To move back to the preceding 32 harmonics.

Functions.



Display filter.

Values at the position of the cursor.

To move the cursor to the next harmonic.

To move forward to the next 32 harmonics.

Resetting of the maximum values.

Figure 82

The different functions are:

V to display:

- the harmonics, order by order, of the phase-to-neutral voltages,
- the total harmonic distortion, referred to either the RMS value of the fundamental (**%f**) or the RMS value without DC (**%r**), depending on what you have configured (see § 3.9.1).
- the distorting phase-to-neutral voltages.

For each cursor position, the following values are displayed:

- The harmonic or inter-harmonic ratio (expressed in %f or %r)
- The phase difference with respect to the first harmonic (fundamental)
- The maximum value reached by the harmonic or inter-harmonic ratio (expressed in %f or %r)
- The amplitude of the harmonic or inter-harmonic.

A to display:

- the harmonics, order by order, of the currents,
- the total harmonic distortion, referred to either the RMS value of the fundamental (**%f**) or the RMS value without DC (**%r**), depending on what you have configured (see § 3.9.1).
- the distorting currents.

U to display:

- the harmonics, order by order, of the phase-to-phase voltages,
- the total harmonic distortion, referred to either the RMS value of the fundamental (**%f**) or the RMS value without DC (**%r**), depending on what you have configured (see § 3.9.1).
- the distorting phase-to-phase voltages.

MSV: to display the spectral level (curve) and RMS values at the MSV1 and MSV2 frequencies configured in § 3.9.1.

: to stretch or shrink the % scale of the barchart.

: when the display filter concerns only one phase (L1, L2, L3, or N), this function is used to view/hide the inter-harmonics.

: in the **MSV** function, this function is used to view/hide the profile of the limits of the level of V or of U according to the frequency you configured (see § 3.9.1.).

The numbers of the channels ① are saturation indicators. The interior of the circle is coloured ❶ when the channel measured is saturated or when at least one channel used to calculate it is saturated.

To move the harmonic order cursor, use the ◄ ► keys. To move the cursor by an entire screen (32 harmonics), use ◄◄ or ►►.

To change the display filter, use the ▲ ▼ keys.

> **i** The calculation of the harmonics starts when the instrument is switched on. To reset the values, press the 🗑 key.

6.1. DISPLAY FILTER

The display filter depends on the connection chosen:

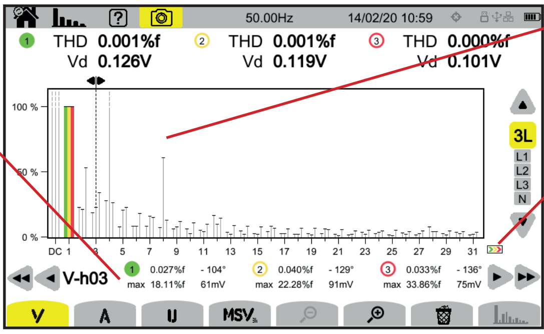
Connection	Display filter for **V**	Display filter for **A**	Display filter for **U**	Display filter for **MSV**
Single-phase, 2 wires	L1 (no choice)	L1 (no choice)	-	L1 (no choice) on V
Single-phase, 3 wires	L1, N	L1, N	-	L1 (no choice) on V
Two-phase, 2 wires	-	L1 (no choice)	L1 (no choice)	L1 (no choice) on U
Two-phase, 3 wires	2L, L1, L2	2L, L1, L2	L1 (no choice)	L1, L2 on V L1 (no choice) on U
Two-phase, 4 wires	2L, L1, L2, N	2L, L1, L2, N	L1 (no choice)	L1, L2 on V L1 (no choice) on U
Three-phase, 3 wires	-	3L, L1, L2, L3	3L, L1, L2, L3	L1, L2, L3 on U
Three-phase, 4 wires	3L, L1, L2, L3	3L, L1, L2, L3	3L, L1, L2, L3	L1, L2, L3 on V and on U
Three-phase, 5 wires	3L, L1, L2, L3, N	3L, L1, L2, L3, N	3L, L1, L2, L3	L1, L2, L3 on V and on U

6.2. EXAMPLES OF SCREENS

Here are a few examples of screens for a three-phase, 5-wire connection.

V function with the 3L display filter

Information about harmonic number 3 (pointed to by the cursor):
- level of harmonic (%f or %r),
- phase difference with respect to the harmonic of order 1,
- maximum of the harmonic,
- amplitude of harmonic 3.



Envelope of the maximum of the harmonics.

There are higher harmonics.

Figure 83

A function with the N display filter

Information about harmonic number 0 (DC), pointed to by the cursor.

- level of harmonic (%r),
- maximum of the harmonic,
- amplitude of harmonic 0.

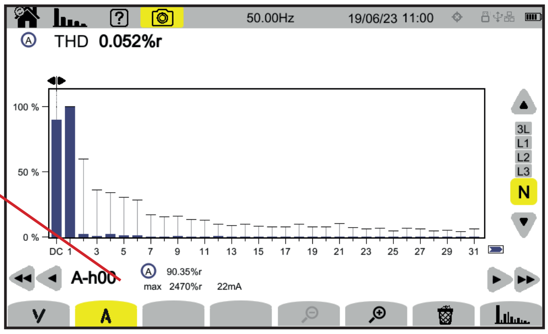


Figure 84

The period displayed by the barcharts is 200ms or 3s, depending on the configuration chosen in § 3.9.1).

U function with the L1 display filter

Information about harmonic number 5 (pointed to by the cursor).

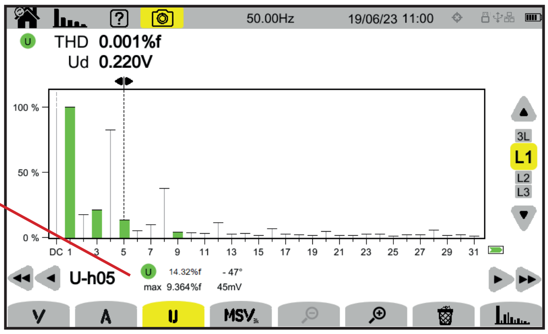


Figure 85

U and inter-harmonic function with the L2 display filter

Information about inter-harmonics i04 (pointed to by the cursor) between harmonics 4 and 5.

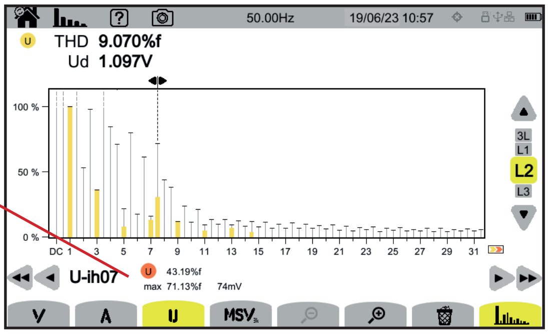


Figure 86

To exit from the function, press the key again.

MSV-V function with the L1 display filter

MSV frequency(ies) monitored, frequency, instantaneous value, maximum value reached since the last reset to zero.

Value at the position of the cursor.

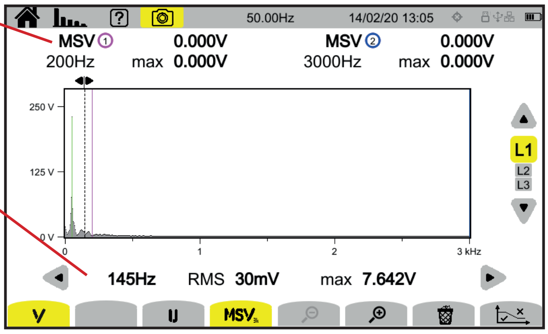
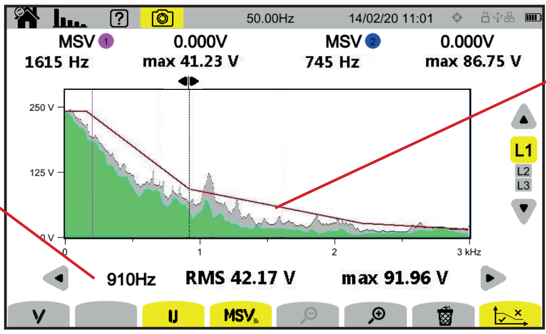


Figure 87

MSV-U curve function with the L1 display filter

Value at the position of the cursor.



Envelope of the curve. What is above the envelope is not correct. Refer to § 3.9.1 to parameterize this envelope.

Figure 88

To exit from the **MSV** function, press the **MSV** key again.

7. POWER

The power mode W displays power measurements **W** and power factor calculations **PF**.

7.1. DISPLAY FILTER

The display filter depends on the connection chosen:

Connection	Display filter
Single-phase, 2 wires Single-phase, 3 wires Two-phase, 2 wires	L1 (no choice)
Two-phase, 3 wires Two-phase, 4 wires	2L, L1, L2, Σ
Three-phase, 3 wires	Σ
Three-phase, 4 wires Three-phase, 5 wires	3L, L1, L2, L3, Σ

The Σ filter is used to learn the value on the whole system (on all of the phases).

7.2. EXAMPLES OF SCREENS

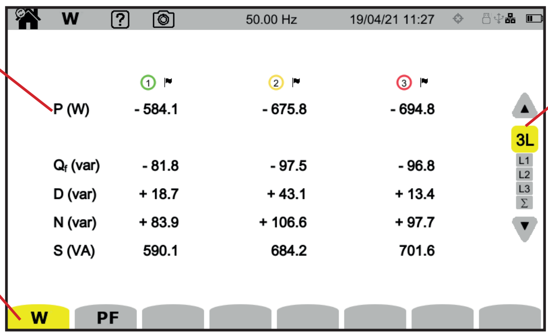
Here are a few examples of screens depending on the display filter, for a three-phase, 5-wire connection.

To change the display filter, use the ▲ ▼ keys.

W function with the 3L display filter

P: active power.
Pdc: DC power (if a DC current sensor is connected).
Q_f: reactive power.
D: distorting power.
N: non-active power.
S: apparent power.

Functions.



Display filter.

Figure 89

PF function with the 3L display filter

PF : power factor = P / S.
DPF or **PF_1** or **cos φ** : fundamental power factor.
The name is chosen in the configuration (see § 3.9.1).
tan φ: tangent of the phase difference.
$φ_{VA}$: phase difference of the voltage with respect to the current.

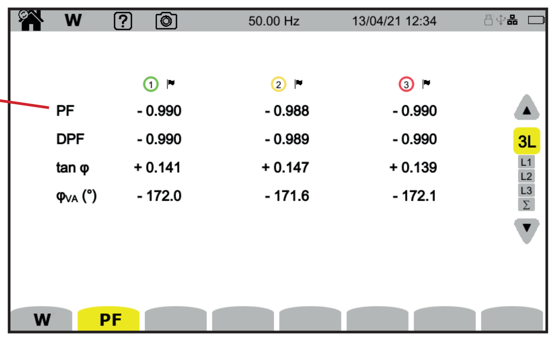


Figure 90

L1 display filter

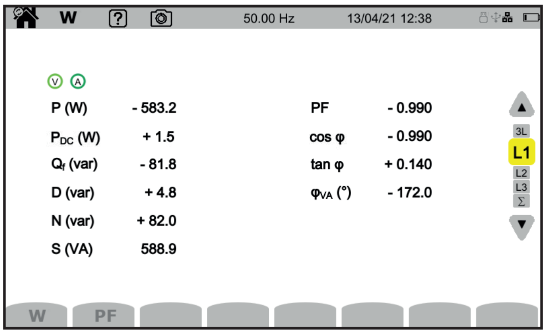


Figure 91

Σ display filter

Sum of the powers in the 3 channels.

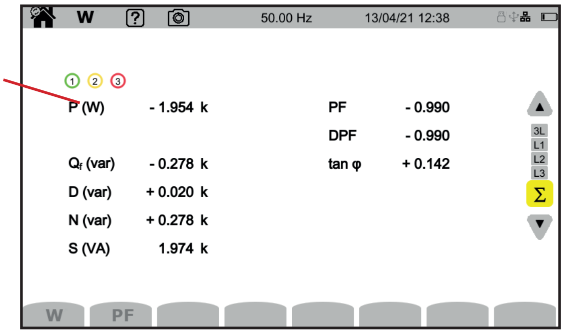


Figure 92

8. ENERGY

The energy mode Wh is used to meter energy, both generated and consumed, over a period of time, and indicate the corresponding price.

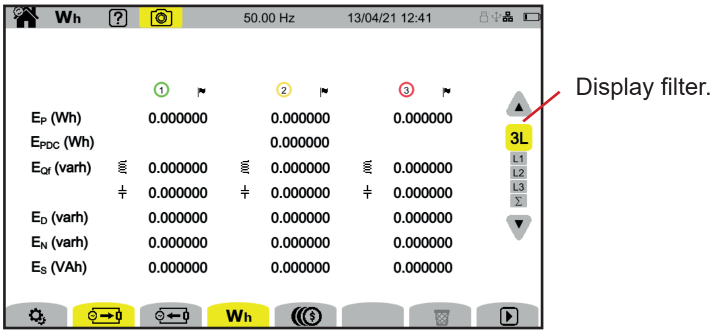


Figure 93

: to access the energy configuration.
For it to be possible to change the configuration, there must not be any metering in progress or suspended. It is first necessary to reset the zero.
An energy meter, even if suspended, is still active, and will prevent the device from being switched off, the configuration from being changed or the user profile from being changed.

: energy consumed (by the load).
: energy produced (by the source).
: price of the energy consumed or produced.
: to reset energy metering to zero.
: to start energy metering.
: to suspend energy metering.

8.1. DISPLAY FILTER

The display filter depends on the connection chosen:

Connection	Display filter
Single-phase, 2 wires Single-phase, 3 wires Two-phase, 2 wires	L1 (no choice)
Two-phase, 3 wires Two-phase, 4 wires	2L, L1, L2, Σ
Three-phase, 3 wires	Σ
Three-phase, 4 wires Three-phase, 5 wires	3L, L1, L2, L3, Σ

The Σ filter can be used to obtain the calculation on the whole system (all phases).

8.2. EXAMPLES OF SCREENS

Here are a few examples of screens depending on the display filter, for a three-phase, 5-wire connection.

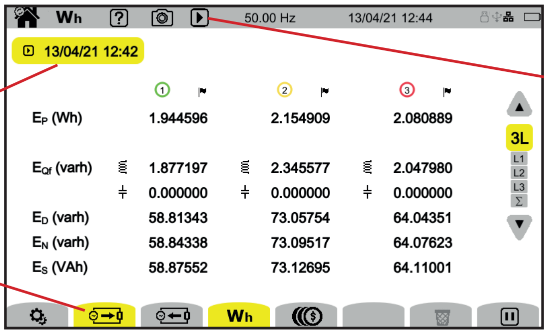
To change the display filter, use the ▲ ▼ keys.

Press to start energy metering.

Wh function with the 3L display filter

Starting date and time of the metering and possibly ending date and time.

Energy consumed.

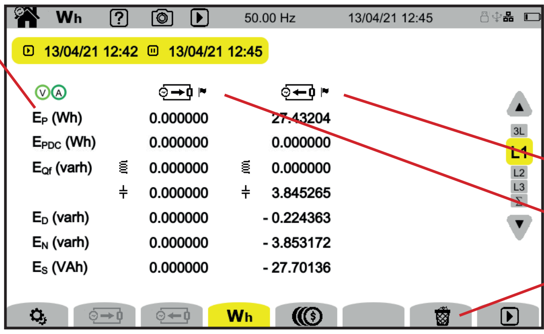


Indication that energy metering is in progress.

Figure 94

Wh function with the L1 display filter

E_P: active energy.
E_{PDC}: DC energy (if a DC current sensor is connected).
E_{Qf}: reactive energy (inductive part and capacitive part).
E_D: distorting energy.
E_N: non-active energy.
E_S: apparent energy.



Energy produced.

Energy consumed.

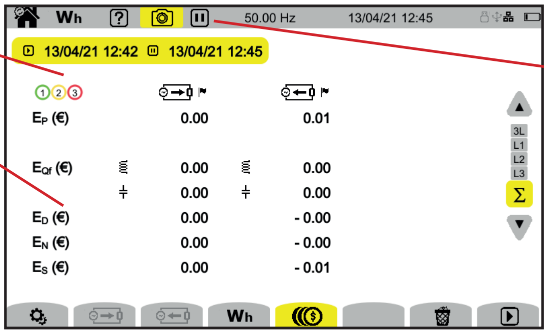
To reset the values.

Figure 95

function with the Σ display filter

Sum of the energies on the 3 channels.

Currency chosen in the configuration (see § 3.10.6).



Indication that energy metering is suspended.

Figure 96

9. TREND MODE

The trend mode records the evolution of the quantities chosen in the configuration (see § 3.10.2) for a specified duration.

The CA 8345 can record a large number of trends, limited only by the capacity of the SD card.

The home screen displays a list of the recordings already made. For the moment, there are none.

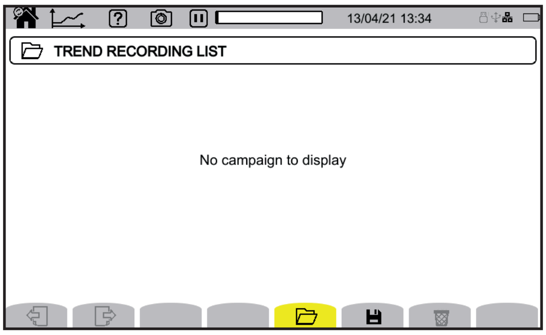


Figure 97

9.1. START OF A RECORDING

Press on to schedule a recording.

QuickStart mode to start the trend recording programmed in the configuration (§ 3.10.2) at the end of the current minute + one minute.

To modify the list of quantities to be recorded.

To configure a recording.

To start the configured recording on the date programmed on this screen.

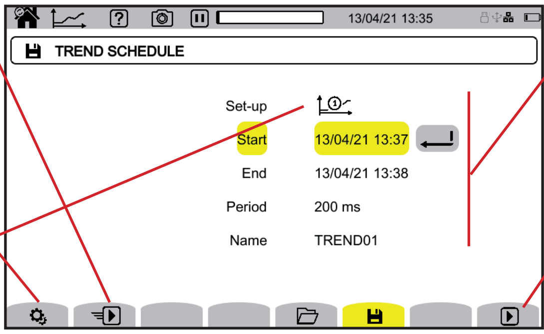


Figure 98

The configuration specifies:

- a list of quantities to be recorded (up to four). Press to modify the list in progress.
- the date and time of the start of the recording, adjustable at the earliest at the end of the current minute + one minute,
- the ending date and time of the recording,
- the recording period, between 200ms and 2h, which determines the quality of the zoom.
  If the recording period exceeds the duration of the recording, the instrument changes the ending date to accommodate the recording period.
- the name of the records.

Press . Recording starts at the programmed time, if there is enough space on the SD card.

indicates that recording has been programmed but not yet started.
indicates that it is in progress.
indicates that it is suspended.

To suspend the recording in progress.

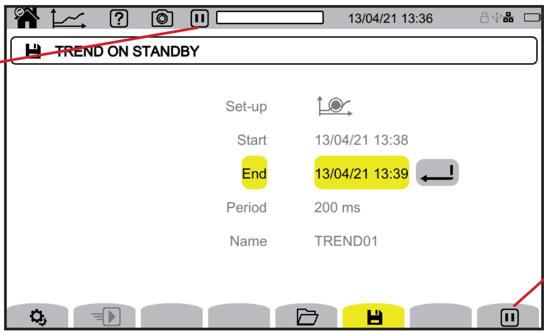


Figure 99

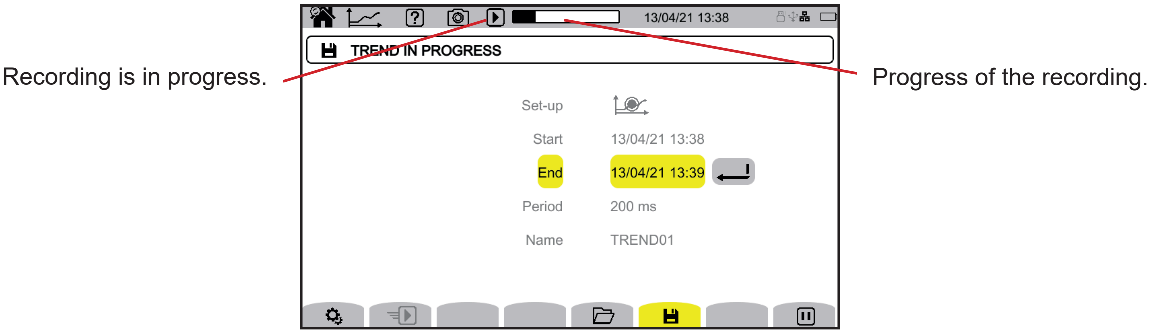


Figure 100

To ensure compliance with IEC 61000-4-30, it is essential that trend recordings are performed with :

- A measurement of the frequency over 10 seconds,
- VRMS, URMS and ARMS selected.

9.2. LIST OF RECORDINGS

Press to view the recordings made.

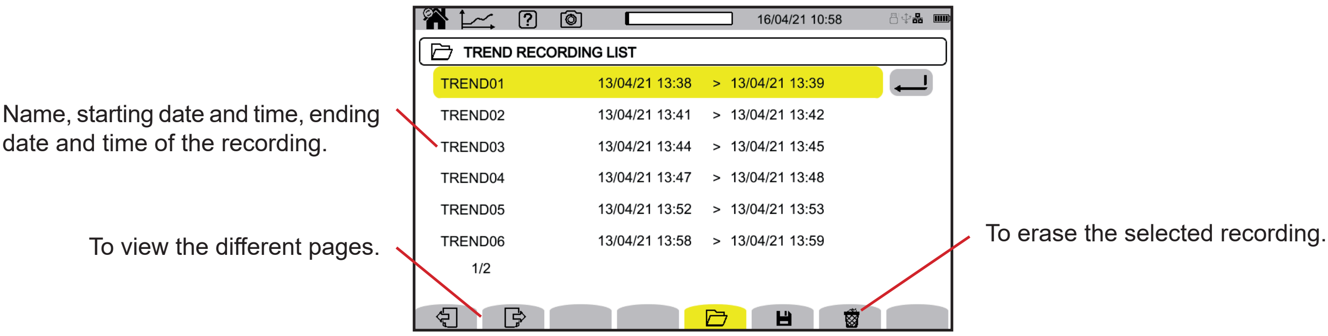


Figure 101

If the ending date is shown in red, it is because recording could not continue up to the planned ending date. To find out what the number indicated corresponds to, use the help button or refer to § 20.12.

To erase all trend recordings at once, refer to § 3.5.

9.3. READING A RECORDING

Select the recording to be read in the list and press the confirm key to open it.

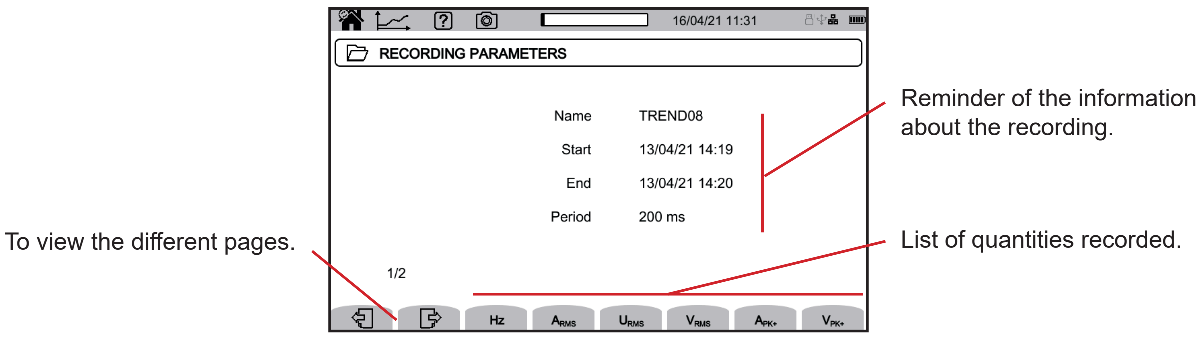


Figure 102

To view the evolution of a quantity, select it.

Below are examples of screens for a three-phase, 5-wire connection.
To change the display filter, use the ▲ ▼ keys.

The cursor lets you view the values along the curves displayed.
To move the cursor, use the ◄ ► keys.

🔍 🔍: to stretch or shrink the time scale. The zoom possibilities depend on the aggregation period and the duration of the recording

⚠: reports a problem during recording. If a quantity could not be correctly recorded, this symbol is displayed above all of the quantities.

ℹ When the duration of the recording is long (more than one day), it may take up to about ten seconds to display the curves.

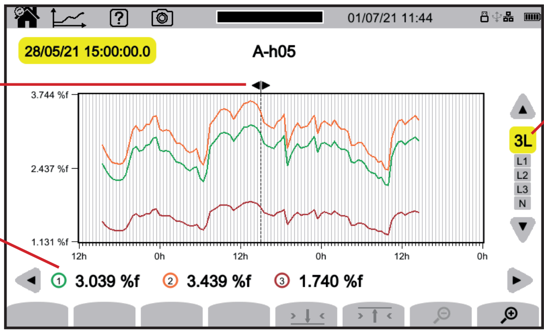
ℹ The first data will be available at the end of the recording period, or between 200ms and 2h.

The CA 8345 measurement records comply with IEC 61000-4-30 edition 3, Amendment 1 (2021). The basic measurement time interval is 10 cycles (for a 50 Hz power system) or 12 cycles (for a 60 Hz power system). These measurements are then aggregated over 150 cycles (for a 50 Hz power system) or 180 cycles (for a 60 Hz power system), then over 10 minutes, etc. In addition, the measurements are resynchronised every 10 round minutes, with type 1 overlaps (10/12 cycles aggregations) and type 2 overlaps (150/180 cycles aggregations). The CA 8345 presents the measurements on a constant time scale (0.2 s, 1 s, 3 s,..., 2 h).

Order 5 current harmonics (A-h05) for a 3L display filter

Cursor.

Value of the curves at the position of the cursor.



Display filter.

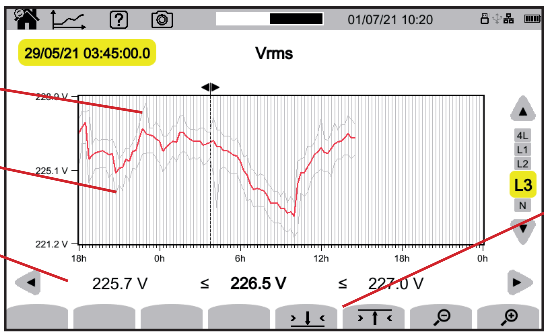
Figure 103

Phase-to-neutral voltages (Vrms) for an L3 display filter
Each time a value is recorded, for each of the phases, the instrument also records the minimum single-cycle RMS value and the maximum single-cycle RMS value. These are the three curves shown in the figure below.

Curve of the maxima.

Curve of the minima.

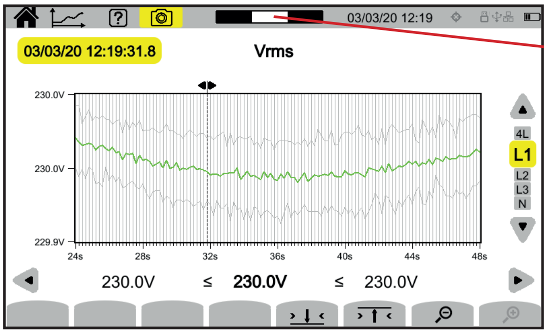
Values at the position of the cursor (minimum, mean, and maximum).



›↓‹: to zoom on the minimum of the curve of minima.
›↑‹: to zoom on the maximum of the curve of maxima.

Figure 104

Phase-to-neutral voltages (Vrms) for an L1 display filter and ›↓‹



Position of the display window in the recording.

Figure 105

Active power (P) for a display filter Σ

The power, like the energy, is displayed in barchart form.

The duration of a bar is 1 second, or one recording period if it is longer than 1s.

To display the active energy (E_P).

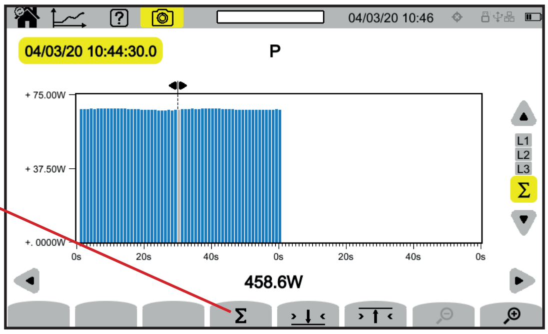


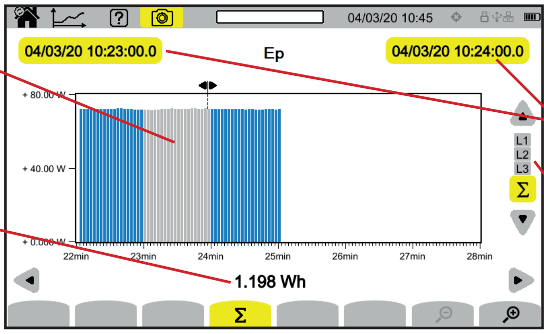
Figure 106

Cumulative active energy (E_P) for a Σ display filter

- Place the cursor on the beginning of the accumulation range.
- Press the Σ key.
- Move the cursor to the end of the energy accumulation range.
- The cumulative total is displayed as it evolves.

Period taken into account in the energy metering.

Cumulative total active energy over the selected duration (one minute).



Starting and end dates of the cumulative total.

The cumulative total can be determined on each of the phases or on all of the phases.

Figure 107

Power factor (PF) for an L1 display filter

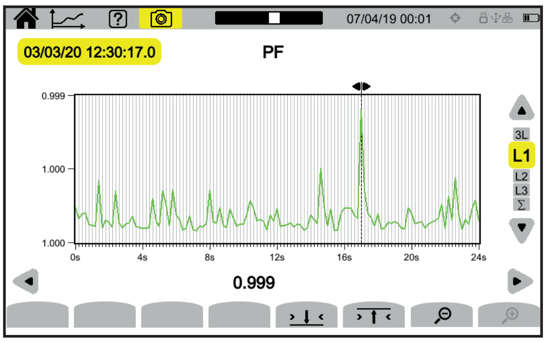


Figure 108

10. TRANSIENT MODE

The transient mode records voltage or current transients for a specified duration determined according to the configuration chosen (see § 3.10.3). It also serves to record surges: very high voltages for a very short time. The trigger mechanisms are explained in § 20.9 and 20.10.

The CA 8345 can record a large number of transients. This number is limited only by the capacity of the SD card.

The home screen displays a list of the recordings already made. For the moment, there are none.

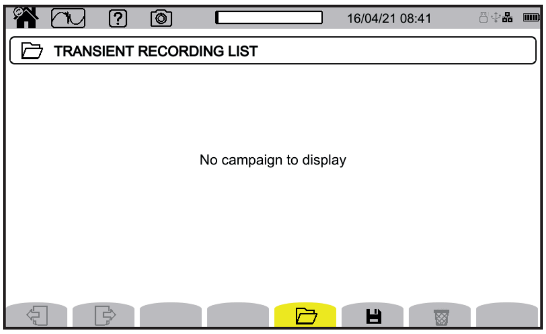


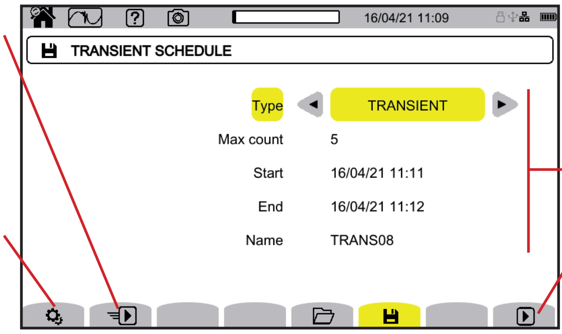
Figure 109

10.1. START OF A RECORDING

Press to schedule a recording.

QuickStart mode for start recording a transient programmed in the configuration (§ 3.10.3) at the end of the current minute + one minute.

To change the voltage, current, or surge thresholds.



To configure a recording.

To start the recording configured on the date programmed on this screen.

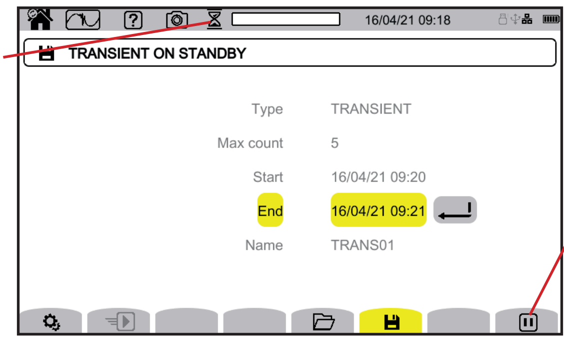
Figure 110

The configuration specifies:

- whether the recording concerns transients, surges, or both,
- the maximum number of transients or surges to be recorded,
- the date and time of the start of the recording, adjustable at the earliest at the end of the current minute + one minute,
- the ending date and time of recording,
- the name of the recording.

Press . Recording will start at the programmed time if there is enough space on the SD card.

indicates that recording has been programmed but not yet started.
indicates that it is in progress.
indicates that it is suspended.



To suspend the recording in progress.

Figure 111

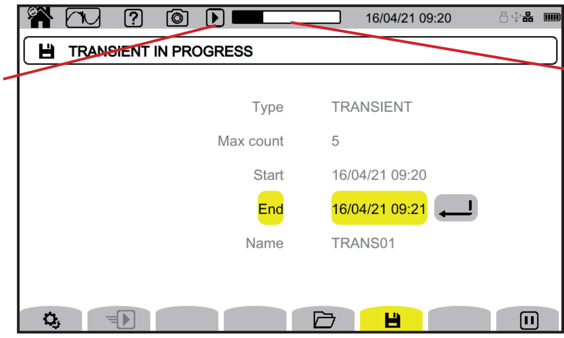


Figure 112

10.2. LIST OF RECORDINGS

Press [folder icon] to view the recordings made.

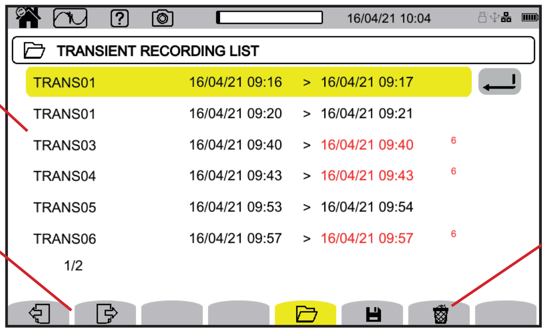


Figure 113

If the ending date is shown in red, it is because recording could not continue up to the planned ending date. To find out what the number indicated corresponds to, use the [?] help button or refer to § 20.12.

To erase all recordings of transients at once, refer to § 3.5.

10.3. READING A RECORDING

Select the recording to be read in the list and press the confirm key [confirm icon] to open it.

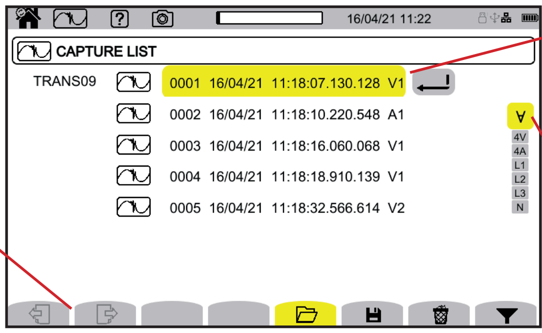
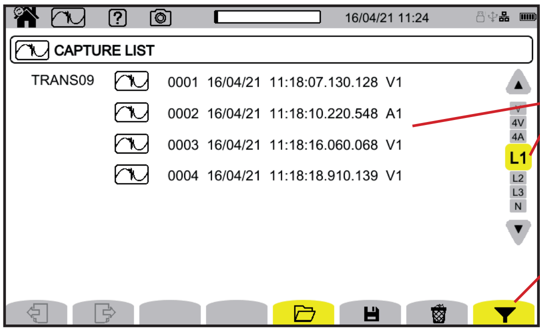


Figure 114

To change the display filter, press the [filter icon] key, then use the ▲ ▼ keys.

- **∀** : to display all of the transients.
- **4 V**: to display the transients triggered by an event in one of the 4 voltage channels.
- **4 A**: to display the transients triggered by an event in one of the 4 current channels.
- **L1, L2** or **L3** : to display the transients triggered by a voltage or current event in phase L1, L2, or L3.
- **N**: to display the transients triggered by a voltage or current event in the neutral.

Confirm by pressing the key again.



Only the transients triggered by an event on the L1 phase are displayed.

The display filter is active.

Figure 115

To display a transient, select it and press the confirm key.

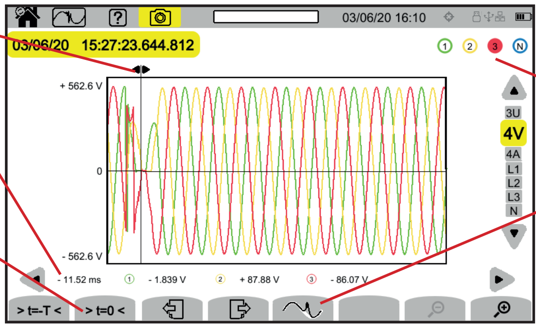
Below are examples of screens for a three-phase, 5-wire connection.

The cursor lets you view the values along the curves displayed.
To move the cursor, use the ◄ ► keys.

To change the display filter, use the ▲ ▼ keys.

: to stretch or shrink the time scale.

Transient event in all of the voltage channels



Cursor.

Values at the position of the cursor.

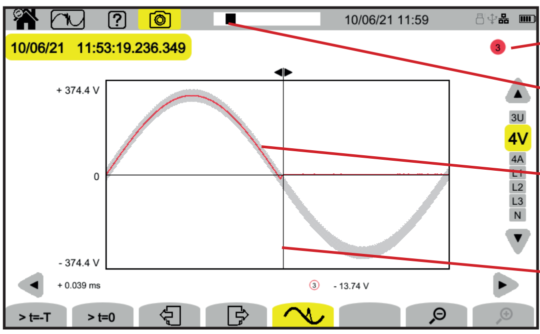
To place the cursor as close as possible to the triggering point.

Channel that triggered the transient capture.

To zoom on the event that triggered the transient capture.
Because the triggering event is on the 3rd voltage channel, this key is active only on 4V and L3.

Figure 116

Zoom on the triggering event



Reminder of the number of the channel that triggered the transient capture.

Location of the zoomed part in the recording.

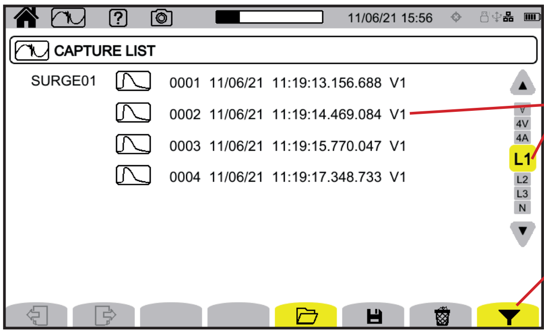
Envelope of the preceding period. When the curve passes outside of the envelope, it triggers capture of the transient.

The cursor goes automatically to the triggering event.

Figure 117

Surge in all of the voltage channels

If you have recorded a surge, it will appear when the record is read.



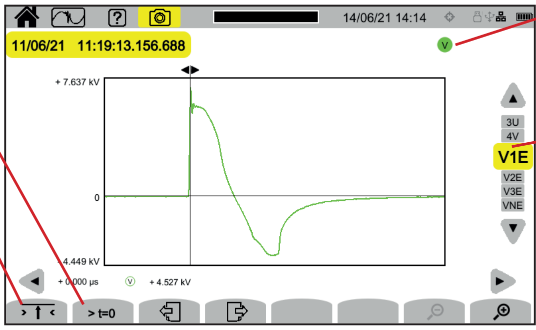
Only surges in phase L1 are displayed.

The display filter is active.

Figure 118

To display the recording of the surge, select it and press the confirm key ↵.

This screen displays the whole of the captured signal for a duration of 1.024 s. The instant of triggering is at one quarter of the screen.



Reminder of the channel that triggered the surge capture.

To place the cursor as close as possible to the triggering point.

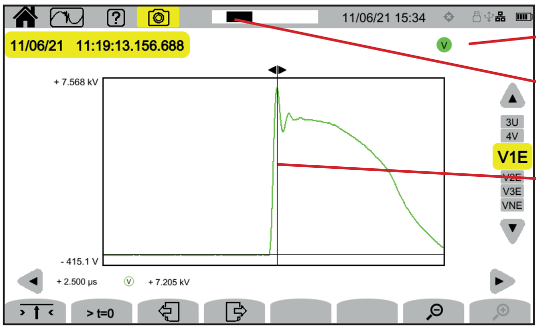
Unlike all the other modes, in which the voltages are referred to the neutral, the voltages are referred to the earth.

To place the cursor on the maximum of the surge.

Figure 119

Zoom on the triggering event or on the maximum value

Press > ↑ < to place the cursor on the triggering element or > t=0 to place the cursor on the maximum. Since the surge builds up very quickly, these two points are often very close together. Then press 🔍, one or more times, to zoom.



Reminder of the channel that triggered the surge capture.

Location of the zoomed part in the recording.

The cursor goes to the centre of the screen.

Figure 120

11. INRUSH CURRENT MODE

The inrush current mode is used to capture and record inrush currents for a duration specified according to the configuration chosen (see § 3.10.4). Capture conditions are explained in § 20.11.

The CA 8345 can record a large number of inrush current captures. This number is limited only by the capacity of the SD card.

The home screen displays a list of the captures already made. For the moment, there are none.

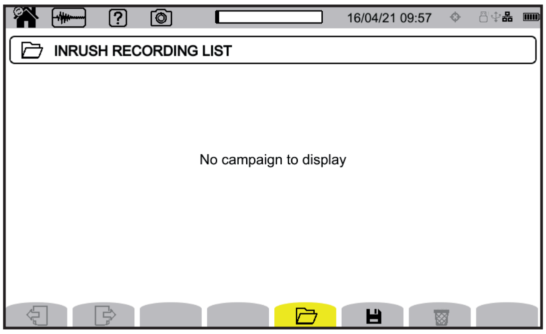


Figure 121

11.1. START OF A CAPTURE

Press to program a capture.

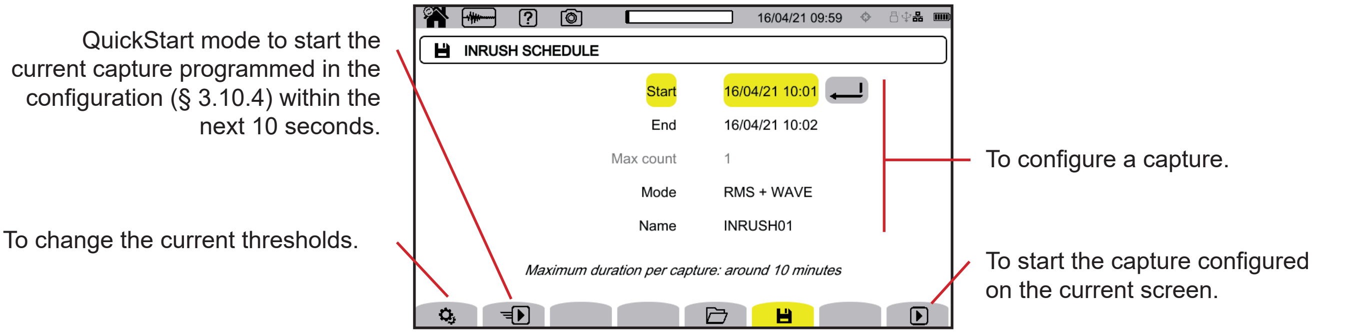


Figure 122

The configuration specifies:

- the date and time of the start of the capture, adjustable at the earliest at the end of the current minute + one minute,
- the ending date and time of the capture,
- whether the capture concerns RMS values or RMS values and instantaneous values,
- the name of the capture.

Press . The capture will start at the programmed time, if the SD card is in place at the time of the press and enough space remains. An inrush current capture cannot be started at the same time as a trend, transient, alarm or monitoring recording.

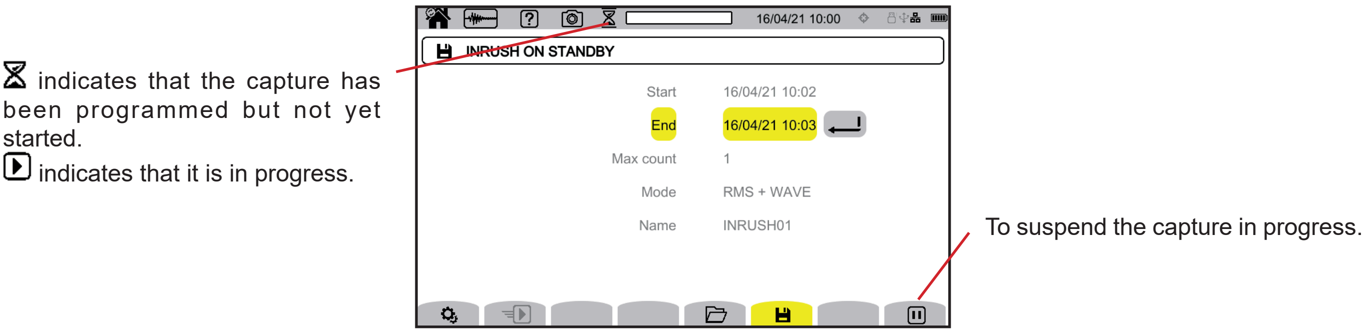
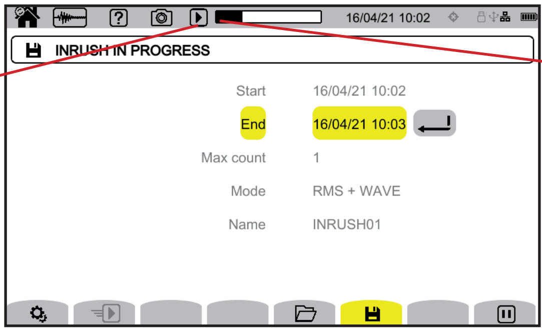


Figure 123

The capture is in progress.



Progress of the capture.

As soon as a current exceeds the programmed threshold, the recording of the capture starts.

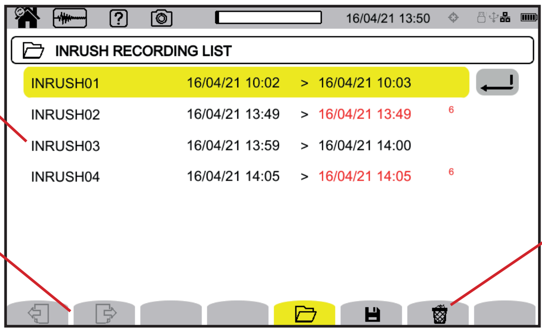
Figure 124

11.2. LIST OF CAPTURES

Press 🗁 to view the captures performed.

Name, starting date and time, ending date and time of the capture.

To view the different pages.



To erase the selected capture.

Figure 125

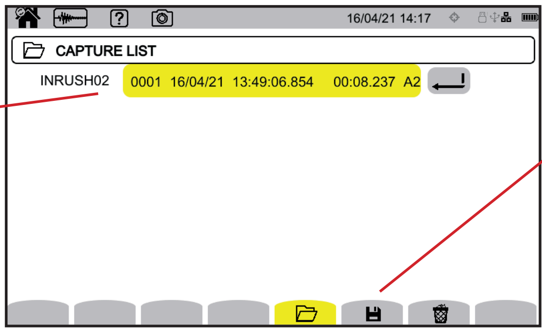
To erase all of the inrush current captures at once, refer to § 3.5.

If the ending date is shown in red, it is because recording could not continue up to the planned ending date. To find out what the number indicated corresponds to, use the [?] help button or refer to § 20.12.

11.3. READING A CAPTURE

Select the capture to be read in the list and press the confirm key ↵ to open it. Captures whose ending date is shown in red may be unusable.

Reminder of information about the capture: name, number of detections of inrush current, starting date and time, duration of the capture, channel that triggered the capture.

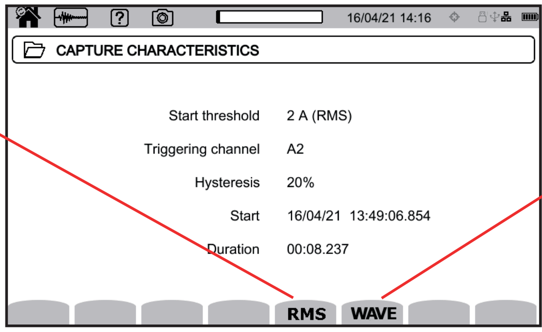


To make a new capture.

Figure 126

Press the confirm key again to display the information about the capture.

To display the RMS curves.



To display the instantaneous value curves according to the configuration.

Figure 127

Below are examples of screens for a three-phase, 5-wire connection.

11.3.1. RMS VALUES

Press the **RMS** key to view the RMS voltage and current values.

To change the display filter, use the ▲ ▼ keys.

- **3V**: to display the 3 phase-to-neutral voltages.
- **3U**: to display the 3 phase-to-phase voltages.
- **3A**: to display the 3 currents.
- **L1, L2, L3**: to display the current and voltage on phases L1, L2, and L3.
- **Hz**: to display the evolution of the network frequency over time.

The cursor lets you view the values along the curves displayed.
To move the cursor, use the ◄ ► keys.

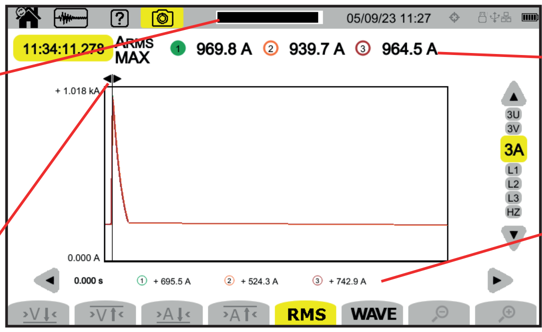
: to stretch or shrink the time scale.

The maximum duration of an RMS recording is 30 minutes. In this case, it can take up to about ten seconds to display the curves.

Capture of inrush current in RMS on 3A

Position of the display window in the recording.

Cursor.



Maximum values.
Disc 2 is solid, meaning that channel A2 triggered the capture.

Values at the position of the cursor.

Figure 128

Capture of RMS inrush current on L2

The ›V↓‹, ›V↑‹, and ›A↑‹›A↓‹ keys are used to place the cursor on the minimum or maximum voltage or current.

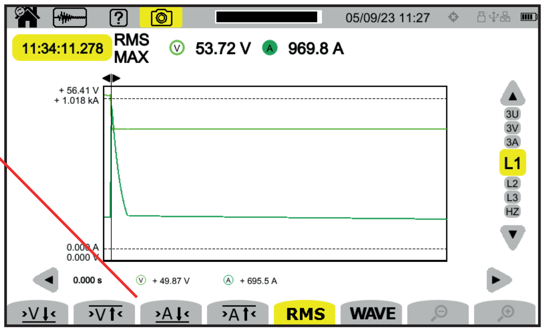


Figure 129

11.3.2. INSTANTANEOUS VALUES

Press the **WAVE** key to view the instantaneous voltage and current values.
This recording displays all of the samples. It is much more precise than **RMS**, which displays only one value per half-cycle.

To change the display filter, use the ▲ ▼ keys.

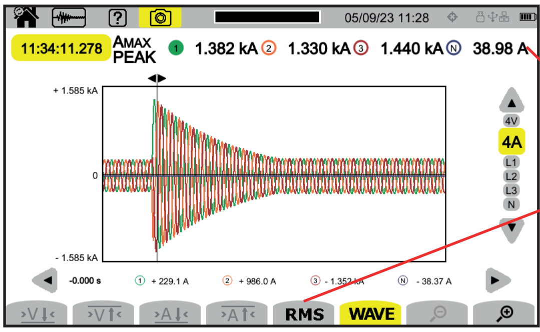
- **4V**: to display the 3 phase-to-neutral voltages and the neutral.
- **3U**: to display the 3 phase-to-phase voltages.
- **4A**: to display the 3 currents and the current of the neutral.
- **L1, L2, L3**: to display the current and voltage on phases L1, L2, and L3.
- **N**: to display the current and the voltage on the neutral.

The cursor lets you view the values along the curves displayed.
To move the cursor, use the ◄ ► keys.

⊖ ⊕: to stretch or shrink the time scale.

The maximum duration of a RMS+WAVE recording is 10 minutes. In this case, opening a **WAVE** capture may take several minutes, or even be refused by the instrument. Remove the SD card from the instrument (see § 3.5), insert it in a PC and open the capture with PAT3 software (see § 16).

Capture of instantaneous inrush current values on 4A



Maximum instantaneous absolute values.

To change to RMS.

Figure 130

Capture of instantaneous inrush current values on L3

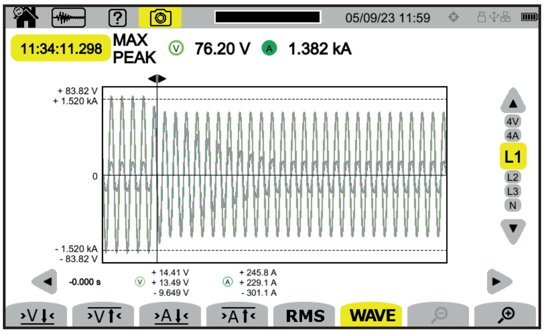


Figure 131

12. ALARM MODE

The alarm mode [bell key] detects and records overshoots of the quantities chosen in the configuration (see § 3.10.5) for a specified duration.

The CA 8345 can record a large number of alarm campaigns (limited only by the capacity of the SD card), each containing up to 20,000 alarms. You can choose this maximum number in the configuration.

The home screen displays a list of the alarm campaigns already performed. For the moment, there are none.

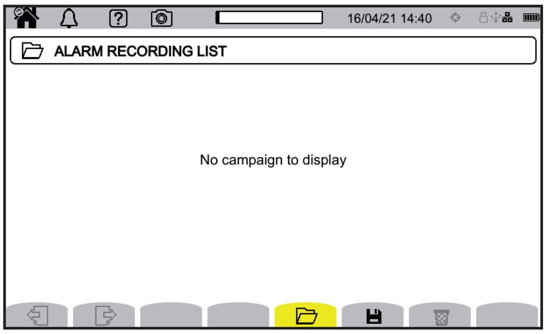


Figure 132

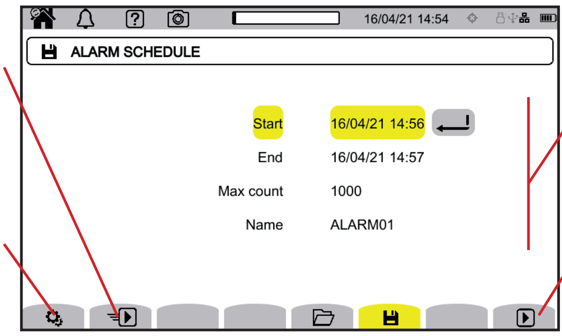
> **i** It is not possible to program an alarm campaign if an inrush current capture is in progress.

12.1. START OF AN ALARM CAMPAIGN

Press [save key] to program an alarm campaign.

QuickStart mode to start the alarm campaign programmed in the configuration (§ 3.10.5) at the end of the current minute + one minute.

To modify the alarms (refer to § 3.10.5).



To configure an alarm campaign.

To start the alarm campaign configured on the date programmed on the current screen.

Figure 133

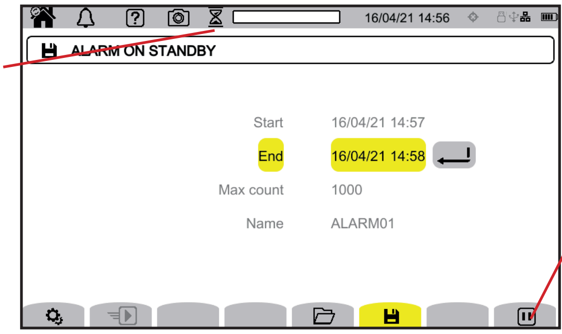
> **i** When you modify an alarm, it is deactivated. Remember to reactivate it.

The configuration specifies:

- the date and time of the start of the alarm campaign, adjustable at the earliest at the end of the current minute + one minute,
- the ending date and time of the alarm campaign,
- the maximum number of alarms to be recorded in the campaign.
- the name of the alarm campaign.

Press ▶. The alarm campaign will start at the programmed time.

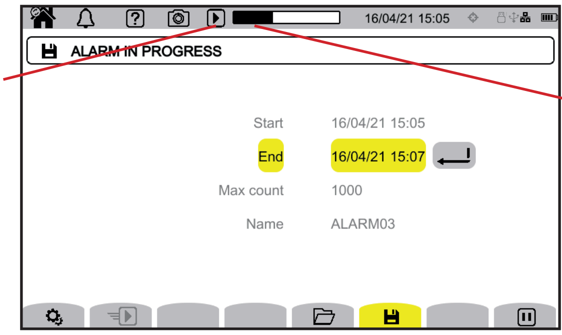
⌛ indicates that the alarm campaign has been programmed but has not yet started.
▶ indicates that it is in progress.
⏸ indicates that it is suspended.



To suspend the alarm campaign in progress.

Figure 134

The alarm campaign is in progress.



Progress of the alarm campaign.

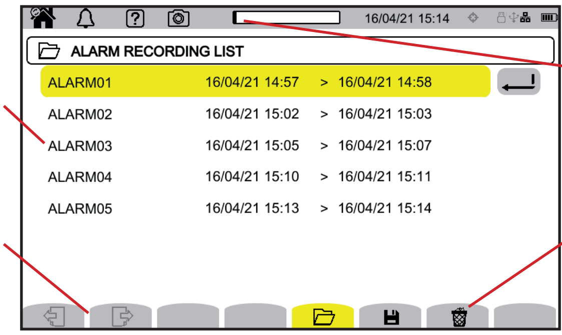
Figure 135

12.2. LIST OF ALARM CAMPAIGNS

Press 🗁 to view the alarm campaigns already performed.

Name, starting date and time, ending date and time of the alarm campaign.

To view the different pages.



Occupancy of the memory.

To erase the selected alarm campaign.

Figure 136

To erase all of the alarm campaigns at once, refer to § 3.5.

If the ending date is shown in red, it is because recording could not continue up to the planned ending date. To find out what the number indicated corresponds to, use the ? help button or refer to § 20.12.

12.3. START OF AN ALARM CAMPAIGN

Select the alarm campaign to be read in the list and press the confirm key ↵ to open it.

Below is an example of a screen.

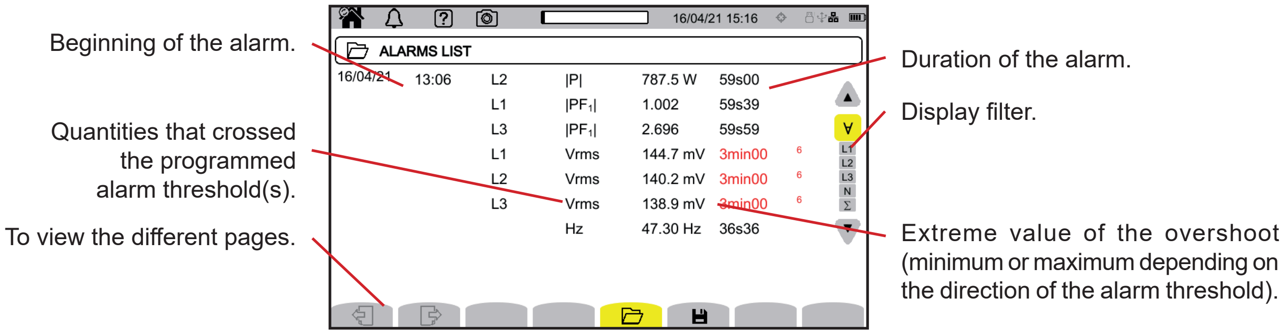


Figure 137

To change the display filter, use the ▲ ▼ keys.

- **∀**: to display the alarms in all channels.
- **L1**, **L2**, **L3**: to display the alarms on phase L1, L2, or L3.
- **N**: to display the alarms on the neutral.
- **Σ**: to display the alarms on the quantities that can be summed, such as the power

If an alarm duration is displayed in red, it means that it was cut off:

- because the alarm campaign ended while the alarm was in progress,
- or because of a power supply problem (the instrument switched off because the battery was low),
- or because of a manual stop of the campaign (⏸ pressed) or because the instrument was intentionally switched off (⏻ key pressed).
- or because the memory was full.
- or because of a measurement error.
- or because of an incompatibility between the quantity monitored and the configuration of the instrument (for example if a current sensor is removed).

In the last two cases, the extreme value is also displayed in red. This indicates the existence of an error, with an error number. To learn the meaning of this number, use the help key ?.

13. MONITORING MODE

The monitoring mode monitors an electrical network per standard EN 50 160. It detects:

- slow variations,
- rapid variations and interruptions
- voltage dips,
- temporary voltage swells,
- and transients.

A monitoring campaign therefore triggers a trend recording, a search for transients, an alarm campaign, and a log of events.

The CA 8345 can record a large number of monitoring campaigns. This number is limited only by the capacity of the SD card.

The home screen displays a list of the monitoring campaigns already performed. For the moment, there are none.

Figure 138

13.1. START OF A MONITORING CAMPAIGN

The monitoring mode is configured using the PAT3 application software (see § 16).

Once the software has been installed and the instrument connected, go to the **Instrument**, **Configure monitoring** menu.

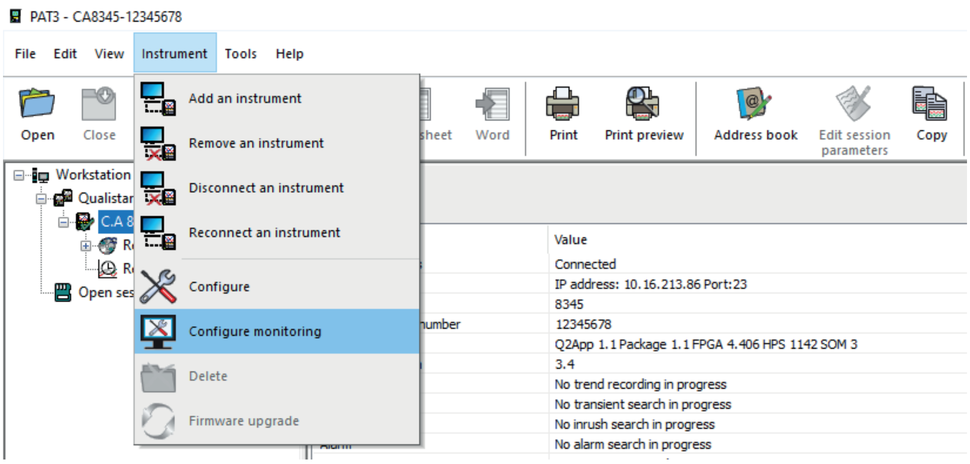


Figure 139

The configuration window opens.

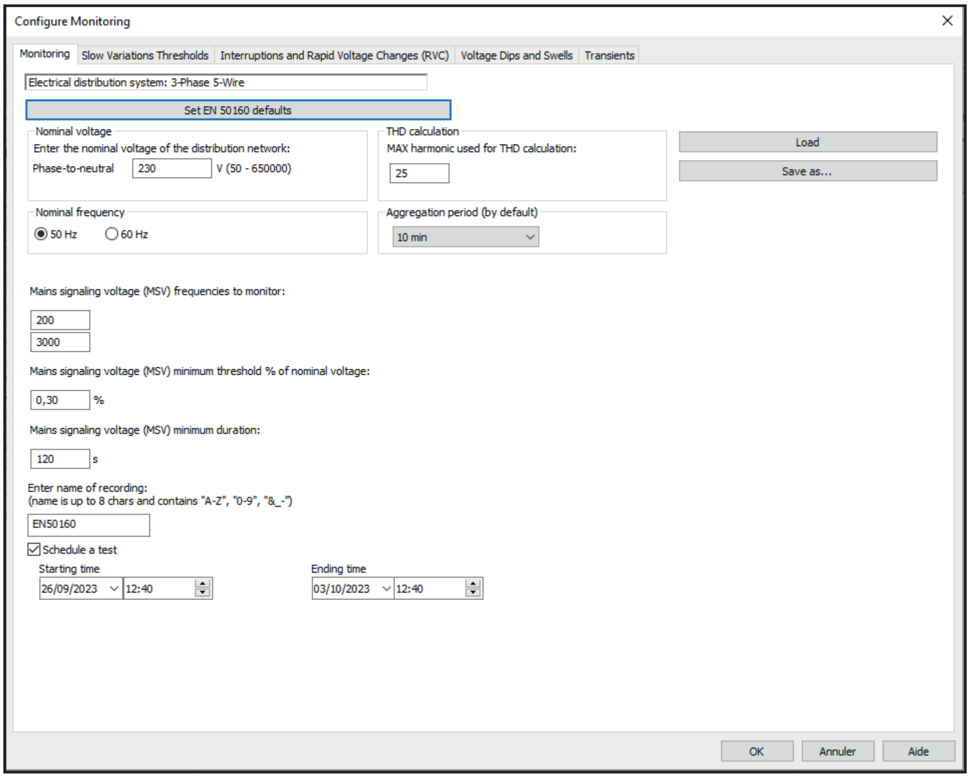


Figure 140

It has 5 tabs:

- Monitoring
- Slow variations thresholds
- Rapid voltage changes and interruptions (RVC = Rapid Voltage Change)
- Dips and swells
- Transients

In the **Monitoring** tab, indicate the nominal voltage, the frequency, and the name of the file that will contain the monitoring campaign.

In the **Slow variations thresholds** tab, the maximum variations of the frequency and of the voltages are already specified, as per the standard, for a duration of one week and for the duration of the monitoring campaign. You can modify them or add quantities to be monitored.

The **Rapid variations of voltages and interruptions** tab specifies the duration of interruptions and rapid voltage changes, which are however slower than transients. You can keep the preset values or modify them.

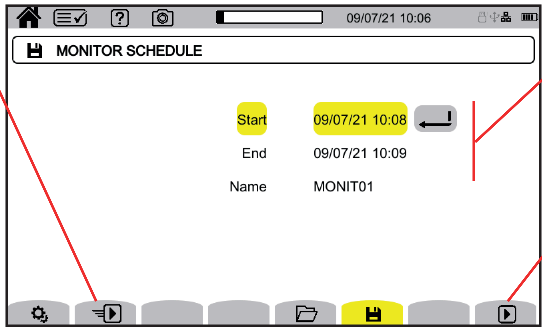
The **Dips and swells** tab specifies the level and duration of the voltage dips and the level and duration of the voltage swells. You can keep the preset values or modify them.

The **Transients** tab is used to specify a search for transients as on the instrument (see § 3.10.3).

When the monitoring campaign is configured, confirm by pressing OK; the configuration is transferred to the instrument.

Then start the monitoring campaign on the instrument by specifying its starting time and its duration.
Press to program a monitoring campaign.

QuickStart mode to start a monitoring campaign at the end of the current minute + one minute.



To configure a recording.

To start the configured recording on the date programmed on this screen.

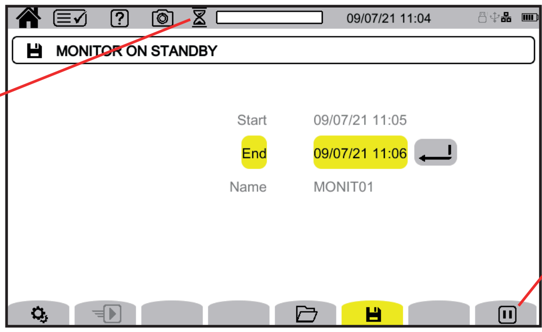
Figure 141

The configuration specifies:

- the date and time of the start of the recording, adjustable at the earliest at the end of the current minute + one minute,
- the ending date and time of the recording,
- the name of the records.

Press . The monitoring will start at the programmed time if there is enough space on the SD card.

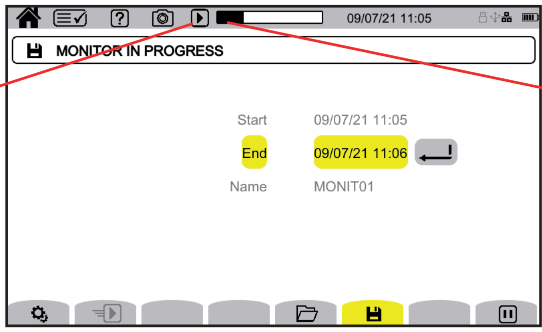
indicates that recording has been programmed but not yet started.
indicates that it is in progress.
indicates that it is suspended.



To suspend the recording in progress.

Figure 142

Recording is in progress.



Progress of the recording.

Figure 143

13.2. LIST OF MONITORING CAMPAIGNS

Press 🗁 to view the monitoring campaigns already done.

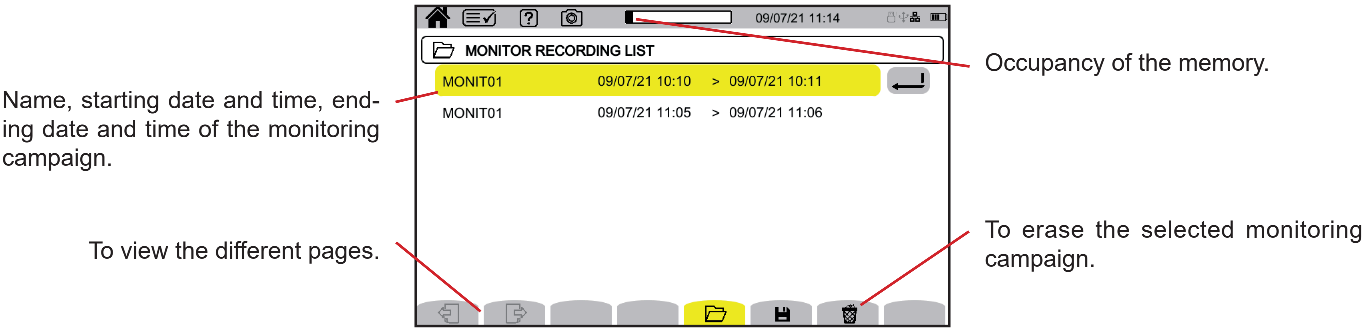


Figure 144

If the ending date is shown in red, it is because recording could not continue up to the planned ending date. To find out what the number indicated corresponds to, use the [?] help button or refer to § 20.12.

To erase all of the monitoring campaigns at once, refer to § 3.5.

13.3. READING A MONITORING CAMPAIGNS

Select the analysis to be read in the list and press the confirm key ↵ to open it.

Below is an example of a screen.

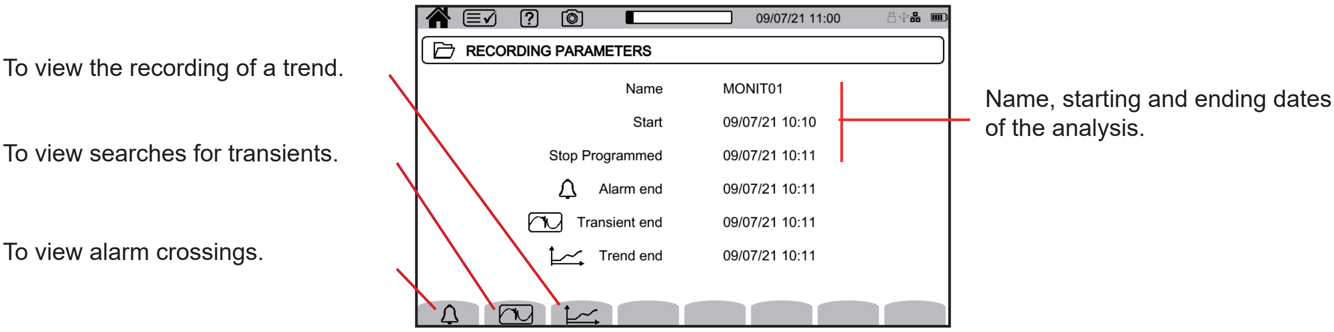


Figure 145

To read an alarm campaign, refer to § 12.3.
To read a search for transients, refer to § 10.3.
To read a trend recording, refer to § 9.3.

For slow variations, rapid changes, interruptions, voltage dips and swells, the recordings are in PAT3 in **My recorded sessions**.

14. SCREENSHOT

The key is used to make screenshots and to view the recorded screenshots.

Screenshots are recorded on the SD card in directory 8345\Photograph. They can also be read on the PC using the PAT3 software or using an SD card reader (not provided).

14.1. SCREENSHOT

You can make a screenshot in two ways:

- Long-press the key and keep it pressed.
  The symbol in the status bar turns yellow, then black. You can then release the key.
- Press the symbol in the status bar, at the top of the display unit.
  The symbol in the status bar turns yellow, then grey.

Screens that are likely to vary (curves, metering) are captured in bursts (up to five). This lets you choose the one that suits you best.

It is then necessary to wait a few seconds between screenshots, long enough for them to be recorded and for the symbol in the status bar to turn grey again.

The number of screenshots the instrument can record depends on the capacity of the SD card.
Single photographs (fixed screen) consume about 150 kB and multiple photographs (variable screen) consume approximately 8 MB. This means that the SD card provided can hold several thousand screenshots.

Then refer to § 3.5 for the procedure for total or partial erasure of the contents of the SD card.

14.2. MANAGEMENT OF SCREENSHOTS

To enter the screenshots mode, short-press the key.

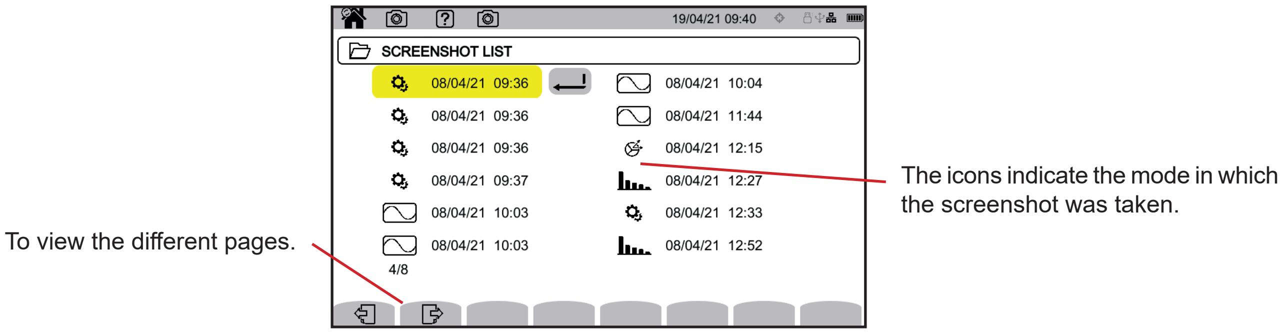


Figure 146

14.2.1. DISPLAY OF A SCREENSHOT

To display a screenshot, select it and press the confirm key ↵. The instrument displays the available photograph(s).

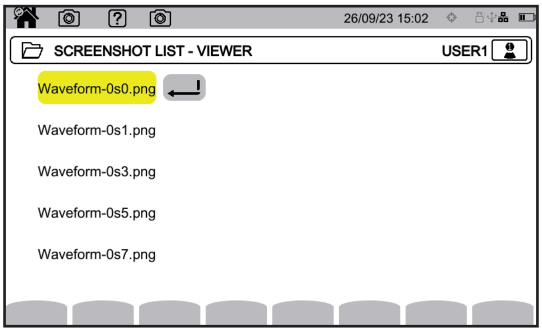
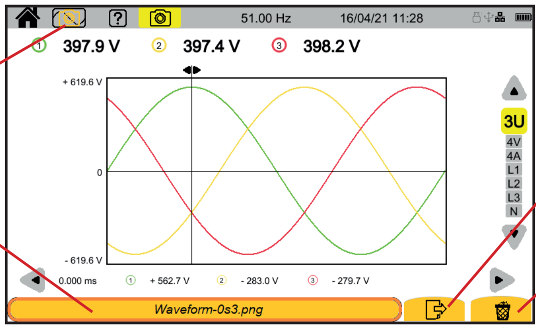


Figure 147

Select a screenshot and confirm ↵.

The mode icon blinks in alternation with 📷.

File name.



To view the different screenshots that make up the photograph.

To erase the screenshot.

Figure 148

15. HELP

The key gives you access to information about the functions of the keys and the symbols used for the display mode in progress.

Here's an example of a help screen in the power mode:

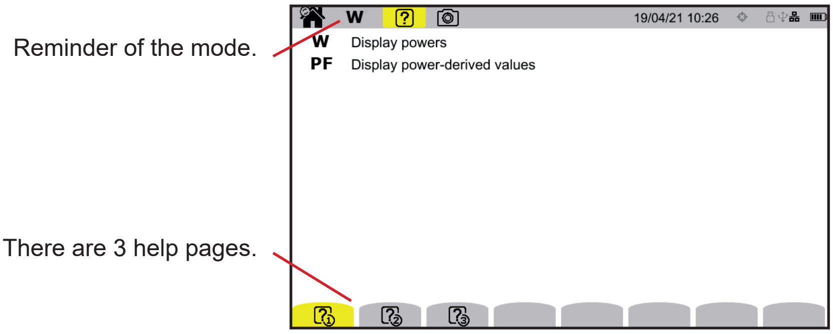


Figure 149

The first page indicates the two possible functions. The second page describes the display functions and the third defines the symbols.

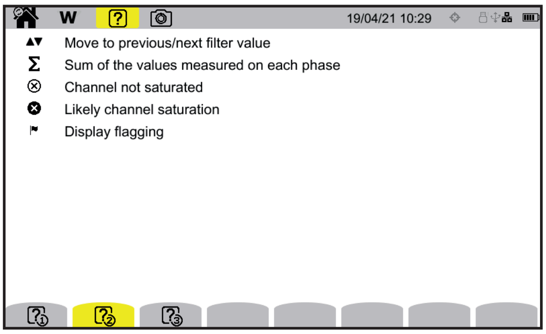


Figure 150

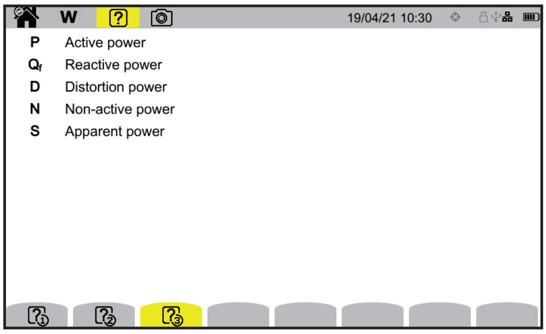


Figure 151

And an example of a waveform help screen.

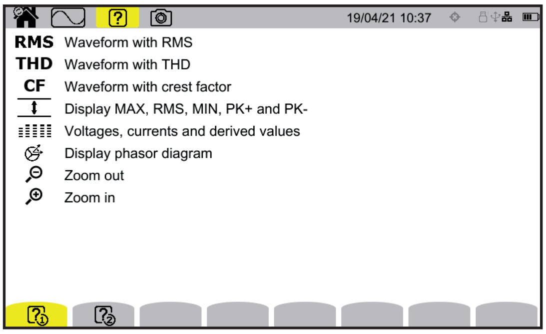


Figure 152

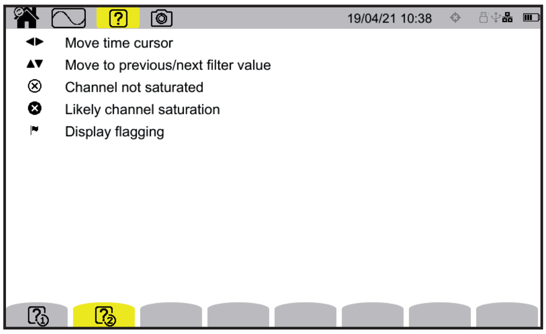


Figure 153

16. APPLICATION SOFTWARE

The PAT3 (Power Analyser Transfer 3) application software is used to:
- configure the instrument and the measurements,
- start the measurements,
- transfer the data recorded in the instrument to a PC.

PAT3 can also be used to export the configuration to a file and to import a configuration file.

16.1. OBTAIN THE PAT3 SOFTWARE

You can download the latest version from our web site:
www.chauvin-arnoux.com

Go to the **Support** tab, then **Download our software**.
Then search on the name of your instrument.
Download the software

To install it, run the **set-up.exe** file, then follow the instructions on screen.

Then connect the instrument to the PC using one of the available communication channels : Ethernet, Wi-Fi or USB (see figure below)

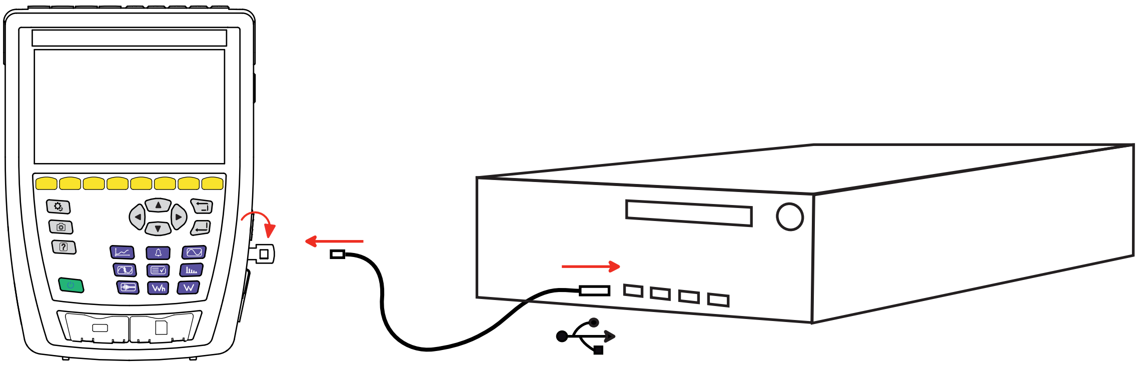


Figure 154

Switch the instrument on by pressing the ⏻ button and wait for your PC to detect it.

All measurements recorded in the instrument can be transferred to the PC. The transfer does not erase the data recorded in the SD card unless you explicitly ask it to.

The data stored in the memory card can also be read on the PC using the PAT3 software or using an SD card reader (not provided). To withdraw the memory card from the instrument, refer to § 3.5.

> ℹ To use PAT3, refer to its help menu or to its manual.

17. TECHNICAL SPECIFICATIONS

The CA 8345 has been certified to comply with IEC 61000-4-30 edition 3, Amendment 1 (2021) class A requirements.

17.1. REFERENCE CONDITIONS

Quantity of influence		Reference conditions
Environmental conditions	Ambient temperature	23 ± 3°C
	Relative humidity	40 to 75% RH
	Atmospheric pressure	860 to 1060 hPa
	Electric field	< 1 V/m from 80 to 1000 MHz ≤ 0.3 V/m from 1 to 2 GHz ≤ 0.1 V/m from 2 to 2.7 GHz
	Magnetic field	< 40 A/m DC (earth's magnetic field) < 3 A/m AC (50/60 Hz)
Specifications of the electrical system	Phases	3 phases available (for three-phase systems)
	DC components of voltage and current	No
	Waveform	Sine wave
	Frequency of the electrical network	50 ± 0.5 Hz or 60 ± 0.5 Hz
	Amplitude of the voltage	U_{din} ± 1% Phase-to-neutral voltage between 100 and 400 V Phase-to-phase voltage between 200 and 1000 V
	Flicker	P_{st} < 0,1
	Voltage unbalance	u_0 = 0 % and u_2 = 0 % Phase modulus: 100 % ± 0,5 % U_{din} Phase angles: L1 0 ± 0.05°, L2 -120 ± 0.05°, L3 120 ± 0.05°
	Harmonics	< 3% U_{din}
	Inter-harmonics	< 0.5% U_{din}
	Input voltage on the current terminals (current sensors except Flex)	30 to 1000 mVRMS without DC ■ 1 VRMS <=> A_{nom} (1) ■ 30 mVRMS <=> 3 × A_{nom} (1) / 100
	Input voltage on current terminals for AmpFlex® and MiniFlex sensors, 10 kA range	11.73 to 391 mVRMS without DC ■ 11,73 mVRMS at 50 Hz <=> 300 ARMS ■ 391 mVRMS at 50 Hz <=> 10 kARMS
	Input voltage on current terminals for AmpFlex® and MiniFlex sensors, 1000 A range	1.173 to 39.1 mVRMS without DC ■ 1,173 mVRMS at 50 Hz <=> 30 ARMS ■ 39,1 mVRMS at 50 Hz <=> 1000 ARMS
	Input voltage on current terminals for AmpFlex® and MiniFlex sensors, 100 A range	117.3 à 3910 µVRMS without DC ■ 117.3 µVRMS at 50 Hz <=> 3 ARMS ■ 3.91 mVRMS at 50 Hz <=> 100 ARMS
	Phase difference	0° (active power and energy) 90° (reactive power and energy)
Configuration of the instrument	Voltage ratio	1
	Current ratio	1
	Voltages	measured (not calculated)
	Current sensors	real (not simulated)
	Auxiliary power supply voltage	230 V ± 1% or 120 V ± 1%
	Instrument warm-up	1 h

Table 1

1: The values of A_{nom} are given in the following table.

Nominal current A_{nom} depending on the sensor

Current sensor	Nominal RMS current A_{nom} (A)	Full-scale technical RMS per class A (A) (2)	Full-scale commercial RMS per class A (A) (3)
AmpFlex® A193 and MiniFlex MA194	100 1000 10,000	14.14 to 16.97 141.42 to 169.71 1414.21 to 1697.06 (1)	30 A 300 A 3000 A (1)
J93 clamp	3500	1650 to 1980	1800
C193 clamp	1000	471 to 566	500
PAC93 clamp	1000	471 to 566	500
MN93 clamp	200	94.3 to 113	100
MINI94 clamp	200	94.3 to 113	100
MN93A clamp (100 A)	100	47.1 to 56.6	50
E94 clamp (10 mV/A)	100	47.1 to 56.6	50
E94 clamp (100 mV/A)	10	3.54 to 4.24	4
MN93A clamp (5 A)	5	1.77 to 2.12	2
Three-phase 5 A adapter	5	1.77 to 2.12	2
Essailec® 5A three-phase adapter	5	1.77 to 2.12	2

Table 2

1: Flex type current sensors do not guarantee Class A at full scale. They generate a signal proportional to the derivative of the current and the crest factor can easily reach 3, 3.5 or 4 for a non-sinusoidal signal.

2: Calculation formulas

Lower value	Upper value
$\frac{\sqrt{2}}{CF_{Class\text{-}A}} \times A_{nom}$	$1.2 \times \frac{\sqrt{2}}{CF_{Class\text{-}A}} \times A_{nom}$

The factor 1.2 follows from the capacity of the current input of the instrument to accept 120% of A_{nom} with a sinusoidal signal.

$A_{nom} \leq 5$ A => $CF_{Class\text{-}A} = 4$
5 A < $A_{nom} \leq 10$ A => $CF_{Class\text{-}A} = 3.5$
10 A < A_{nom} => $CF_{Class\text{-}A} = 3$

3: The commercial full scale RMS value is chosen inside the technical full scale.

17.2. ELECTRICAL SPECIFICATIONS

17.2.1. SPECIFICATIONS OF THE INPUT VOLTAGE

Range of use	0 VRMS to 1000 VRMS phase-neutral and neutral-earth 0 VRMS to 1700 VRMS phase-phase, without exceeding 1000 VRMS with respect to earth
Input impedance	2 MΩ (between phase and neutral and between neutral and earth)
Permanent overload	1200 VRMS phase-neutral and neutral-earth
Temporary overload	12,000 VRMS phase-neutral and neutral-earth, 278 pulses per second at most

17.2.2. SPECIFICATIONS OF THE CURRENT INPUT

Range of use	0 to 1 VRMS with CF = √2 except Flex 0 to (0.391 x f_{nom} / 50) VRMS with CF = √2 for the Flex
Input impedance	1 MΩ except Flex 12.5 kΩ for the Flex
Maximum input voltage	1.2 VRMS with CF = √2
Permanent overload	1.7 VRMS with CF = √2

17.2.3. BANDWIDTH AND SAMPLING

The instrument incorporates anti-aliasing filters as required by IEC 61000-4-7 Ed.2.

S/s: samples per second
spc: samples per cycle

The bandwidth and the sampling frequency (S = sample) are:
- 88 kHz and 400 kS/s (16 bits) for the voltage channels
- 20 kHz and 200 kS/s (18 bits) for the current channels
- 200 kHz and 2 MS/s (12 bits) for fast transients

There are two streams of data used for metrology: 40 kS/s and 512 spc (samples per cycle).

- Waveform - RMS:
  - 3U, 4V, 4A filters: 512 spc stream
  - L1, L2, L3, N filters: 512 spc stream, except for the Min and Max curves: 400 kS/s for V and U, 200 kS/s for I.
- Waveform - Min- Max:
  - RMS measurements: 512 spc stream
  - Max, Min measurements: 40 kS/s stream
  - Pk+, Pk- measurements: 40 kS/s stream (10/12-cycle / 200 ms aggregation) or 512 spc stream (150/180-cycle /3 s aggregation)
- Transients:
  - 3U, 4V, 4A filters: 512 spc stream
  - L1, L2, L3, N filters: 512 spc stream, except for the Min and Max curves: 400 kS/s for V and U, 200 kS/s for I.
- Surge: 2 MS/s / 500 ns (Waveform and events), up to 12 kV
- Inrush current:
  - Curves: 512 spc stream
  - Measurements: 40 kS/s stream (RMS½ measurements)
- Harmonics: 512 spc stream
- Power and energy: 40 kS/s stream
- Trend and alarm: 512 spc or 40 kS/s, depending on the quantities:
  - RMS values, flicker, tan φ, harmonics, inter-harmonics, unbalances, harmonic distortions: 512 spc stream
  - Power frequency, power and energy measurements: 40 kS/s stream

17.2.4. SPECIFICATIONS OF THE INSTRUMENT ALONE (WITHOUT CURRENT SENSOR)

17.2.4.1. Currents and voltages

Measurement		Measurement range without ratio (with unity ratio)		Display resolution (with unity ratio)	Maximum intrinsic error
		Minimum	Maximum		
Frequency		42.50 Hz	69.00 Hz	10 mHz	±10 mHz
Voltage RMS(4)	phase-to-neutral	5.000 V	9,999 V (1)	4 digits	±(0.1% + 100 mV)
		10.00 V	600.0 V	4 digits	±(0,1 % U_{din})
		600.1 V	1,000 V	4 digits	±(0.1% + 1 V)
	phase-to-phase	5.000 V	19.99 V (1)	4 digits	±(0.1% + 100 mV)
		20.00 V	1,500 V	4 digits	±(0,1 % U_{din})
		1,501 V	2,000 V	4 digits	±(0.1% + 1 V)
DC voltage	phase-to-neutral	5.000 V	999.9 V	4 digits	±(0.5% + 500 mV)
		1,000 V	1,200 V (2)	4 digits	±(0.5% + 1 V)
	phase-to-phase	5.000 V	999.9 V	4 digits	±(0.5% + 500 mV)
		1,000 V	2,400 V (2)	4 digits	±(0.5% + 1 V)
Instantaneous sensation of flicker ($P_{inst.max}$)		0.000	12,00 (5)	4 digits	± 8%
Severity of short-term flicker (P_{st})		0.000	12,00 (5)	4 digits	Max ±(5%; 0.05)
Severity of long-term flicker (P_{lt})		0.000	12,00 (5)	4 digits	Max ±(5%; 0.05)
Crest factor (CF) (voltage and current)		1.000	9.999	4 digits	±(1% + 5 pt) CF < 4
					±(5% + 2 pt) CF ≥ 4
RMS current (4)	J93 clamp	3.000 A	164.9 A	4 digits	±(0.5% + 200 mA)
		165.0 A	1980 A	4 digits	±0.5 % (6)
		1981 A	3500 A	4 digits	±(0.5% + 1 A)
	C193 clamp PAC93 clamp	1.000 A	47.09 A	4 digits	±(0.5% + 200 mA)
		47.10 A	566.0 A	4 digits	±0.5 % (6)
		566.1 A	1,000 A	4 digits	±(0.5% + 200 mA)
	MN93 clamp	200.0 mA	9.429 A	4 digits	±(0.5% + 20 mA)
		9.430 A	113.0 A	4 digits	±0.5 % (6)
		113.1 A	200.0 A	4 digits	±(0.5% + 200 mA)
	E94 clamp (10 mV/A) MN93A clamp (100 A)	200.0 mA	4.709 A	4 digits	±(0.5% + 20 mA)
		4.710 A	56.60 A	4 digits	±0.5 % (6)
		56.61 A	100.0 A	4 digits	±(0.5% + 200 mA)
	E94 clamp (100 mV/A)	20.00 mA	353.9 mA	4 digits	±(0.5% + 2 mA)
		354.0 mA	4.240 A	4 digits	±0.5 % (6)
		4.241 A	10.00 A	4 digits	±(0.5% + 10 mA)
	MN93A clamp (5 A) 5 A adapter Essailec® adapter	5.000 mA	176.9 mA	4 digits	±(0.5% + 2 mA)
		177.0 mA	2.120 A	4 digits	±0.5 % (6)
		2.121 A	5.000 A	4 digits	±(0.5% + 2 mA)
	MINI94 clamp	50.0 mA	9.429 A	4 digits	±(0.5 % + 20 mA)
		9.430 A	113.0 A	4 digits	±0.5 % (6)
		113.1 A	200.0 A	4 digits	±(0.5 % + 200 mA)
	AmpFlex® A193 MiniFlex MA194 (10 kA)	10.00 A	299.9 A	4 digits	±(0.5% + 3 A)
		300.0 A	3,000 A	4 digits	±0.5 % (6)
		3001 A	10,000 A	4 digits	±(0.5% + 3 A)
	AmpFlex® A193 MiniFlex MA194 (1000 A)	1.000 A	29.99 A	4 digits	±(0.5% + 0.5 A)
		30.00 A	300.0 A	4 digits	±0.5 % (6)
		300.1 A	1,000 A	4 digits	±(0.5% + 0.5 A)
	AmpFlex® A193 MiniFlex MA194 (100 A)	100.0 mA	2.999 A	4 digits	±(0.5% + 100 mA)
		3.000 A	30.00 A	4 digits	±0.5 % (6)
		30.01 A	100 A	4 digits	±(0.5% + 3 A)

Measurement		Measurement range without ratio (with unity ratio)		Display resolution (with unity ratio)	Maximum intrinsic error
		Minimum	Maximum		
DC current	J93 clamp	3 A	5000 A	4 digits	±(1% + 1 A)
	PAC93 clamp	1 A	1300 A (1)	4 digits	±(1% + 1 A)
	E94 clamp (10 mV/A)	200 mA	100 A (1)	4 digits	±(1% + 100 mA)
	E94 clamp (100 mV/A)	20 mA	10 A (1)	4 digits	±(1% + 10 mA)

Table 3

1: Provided that the voltages between the individual terminals and earth do not exceed 1000 VRMS.
2: Limitation of voltage inputs.
3: 1000 x $\sqrt{2} \approx 1414$; 2000 x $\sqrt{2} \approx 2828$.
4: Total RMS value and RMS value of the fundamental.
5: The limits specified in IEC 61000-3-3 are: $P_{st} < 1{,}0$ and $P_{lt} < 0{,}65$. Values greater than 12 are unrealistic and no uncertainty is specified for them.
6: The intrinsic uncertainty of class A is ± 1%.

17.2.4.2. Power and energy

Measurement		Measurement range without ratio (with unity ratio) Minimum	Measurement range without ratio (with unity ratio) Maximum	Display resolution (with unity ratio) [11]	Maximum intrinsic error
Active power (P) [1]	Without Flex	1.000 W [3]	10.00 MW [4]	4 digits [5]	±(1% + 10 pt) |cos φ| ≥ 0,8
Active power (P) [1]	Without Flex	1.000 W [3]	10.00 MW [4]	4 digits [5]	±(1.5% + 10 pt) 0,2 ≤ |cos φ| < 0,8
Active power (P) [1]	AmpFlex® MiniFlex	1.000 W [3]	10.00 MW [4]	4 digits [5]	±(1% + 10 pt) |cos φ| ≥ 0,8
Active power (P) [1]	AmpFlex® MiniFlex	1.000 W [3]	10.00 MW [4]	4 digits [5]	±(1.5% + 10 pt) 0,5 ≤ |cos φ| < 0,8
Reactive power (Q_f) [2] and non-active power (N)	Without Flex	1.000 var [3]	10.00 Mvar [4]	4 digits [5]	±(1% + 10 pt) |sin φ| ≥ 0,5 and THD ≤ 50%
Reactive power (Q_f) [2] and non-active power (N)	Without Flex	1.000 var [3]	10.00 Mvar [4]	4 digits [5]	±(1.5% + 10 pt) 0,2 ≤ |sin φ| < 0,5 and THD ≤ 50%
Reactive power (Q_f) [2] and non-active power (N)	AmpFlex® MiniFlex	1.000 var [3]	10.00 Mvar [4]	4 digits [5]	±(1.5% + 10 pt) |sin φ| ≥ 0,5 and THD ≤ 50%
Reactive power (Q_f) [2] and non-active power (N)	AmpFlex® MiniFlex	1.000 var [3]	10.00 Mvar [4]	4 digits [5]	±(1.5% + 20 pt) 0,2 ≤ |sin φ| < 0,5 and THD ≤ 50%
Distorting power (D) [7]		1.000 var [3]	10.00 Mvar [4]	4 digits [5]	±(2 % S +(0,5 % n_{max} + 50 pt) THD_A ≤ 20 %f and |sin φ| ≥ 0,2
Distorting power (D) [7]		1.000 var [3]	10.00 Mvar [4]	4 digits [5]	±(2 % S +(0,7 % n_{max} + 10 pt) THD_A > 20 %f and |sin φ| ≥ 0,2
Apparent power (S)		1.000 VA [3]	10.00 MVA [4]	4 digits [5]	±(1% + 10 pt)
DC power (Pdc)		1.000 W [8]	6.000 MVA [9]	4 digits [5]	±(1% + 10 pt)
Power factor (PF)		-1	1	0.001	±(1.5% + 10 pt) |cos φ| ≥ 0,2
Active energy (E_P) [1]	Without Flex	1 Wh	9 999 999 MWh [6]	up to 7 digits [5]	±(1% + 10 pt) |cos φ| ≥ 0,8
Active energy (E_P) [1]	Without Flex	1 Wh	9 999 999 MWh [6]	up to 7 digits [5]	±(1.5% + 10 pt) 0,2 ≤ |cos φ| < 0,8
Active energy (E_P) [1]	AmpFlex® MiniFlex	1 Wh	9 999 999 MWh [6]	up to 7 digits [5]	±(1% + 10 pt) |cos φ| ≥ 0,8
Active energy (E_P) [1]	AmpFlex® MiniFlex	1 Wh	9 999 999 MWh [6]	up to 7 digits [5]	±(1.5% + 10 pt) 0,5 ≤ |cos φ| < 0,8
Reactive energy (E_{Qf}) [2] and non-active energy (E_N) [2]	Except Flex	1 varh	9 999 999 Mvarh [6]	up to 7 digits [5]	±(1% + 10 pt) |sin φ| ≥ 0,5 and THD ≤ 50%
Reactive energy (E_{Qf}) [2] and non-active energy (E_N) [2]	Except Flex	1 varh	9 999 999 Mvarh [6]	up to 7 digits [5]	±(1.5% + 10 pt) 0,2 ≤ |sin φ| < 0,5 and THD ≤ 50%
Reactive energy (E_{Qf}) [2] and non-active energy (E_N) [2]	AmpFlex® MiniFlex	1 varh	9 999 999 Mvarh [6]	up to 7 digits [5]	±(1.5% + 10 pt) |sin φ| ≥ 0,5 and THD ≤ 50%
Reactive energy (E_{Qf}) [2] and non-active energy (E_N) [2]	AmpFlex® MiniFlex	1 varh	9 999 999 Mvarh [6]	up to 7 digits [5]	±(1.5% + 20 pt) 0,2 ≤ |sin φ| < 0,5 and THD ≤ 50%
Distorting energy (E_D)		1 varh	9 999 999 Mvarh [6]	up to 7 digits [5]	±(2 % S +(0,5 % n_{max} + 50 pt) THD_A ≤ 20 %f and |sin φ| ≥ 0,2
Distorting energy (E_D)		1 varh	9 999 999 Mvarh [6]	up to 7 digits [5]	±(2 % S +(0,7 % n_{max} + 10 pt) THD_A ≤ 20 %f and |sin φ| ≥ 0,2
Apparent energy (E_S)		1 VAh	9 999 999 MVAh [6]	up to 7 digits [5]	±(1% + 10 pt)
DC energy (E_{PDC})		1 Wh	9 999 999 MWh [10]	up to 7 digits [5]	±(1% + 10 pt)

Table 4

1: The uncertainties on the active power and energy measurements are greatest at |cos φ| = 1 and typical for the other phase differences.
2: The uncertainties on the reactive power and energy measurements are greatest at |sin φ| = 1 and typical for the other phase differences.
3: For the MN93A clamps (5 A) or the 5 A adapters.
4: For the AmpFlex® and the MiniFlex and for a single-phase, 2-wire connection.
5: The resolution depends on the current sensor used and on the value to be displayed.
6: The energy corresponds to more than 114 years of the associated maximum power with unity ratios.
7 : n_{max} is the highest order of which the harmonic level is not zero. THD_A is the THD of the current.
8: For 100 mV/A E94 clamp.
9: For J93 clamp and a single-phase, 2-wire connection.
10: The energy corresponds to more than 190 years of the maximum power Pdc at unit ratios.
11: The display resolution is determined by the apparent power (S) or apparent energy (Es)

17.2.4.3. Quantities associated with power values

Measurement	Measurement range		Display resolution	Maximum intrinsic error
	Minimum	Maximum		
Fundamental phase differences	-179°	180°	0.1°	±2°
cos φ (DPF, PF_1)	-1	1	4 digits	±5 pt
tan φ	-32.77 (1)	32.77 (1)	4 digits	±1° if THD < 50%
Voltage unbalance ratio (u_0,u_2)	0%	100%	0,001 %	±0.15% if u_0 or u_2 ≤ 10% ±0.5% if u_0 or u_2 > 10%
Current unbalance ratio (a_0,a_2)	0%	100%	0,001 %	±0.15% if a_0 or a_2 ≤ 10% ±0.5% if a_0 or a_2 > 10%

Table 5

1: |tan φ| = 32.767 corresponds to φ = ±88.25° + k × 180° (with k a natural integer)

17.2.4.4. Harmonics

Measurement	Measurement range		Display resolution	Maximum intrinsic error
	Minimum	Maximum		
Harmonic level of voltage (τ_n)	0%	1500%f 100%r	0.1% τ_n < 1000 %	±(2.5% + 5 pt)
			1% $\tau_n \geq$ 1000 %	
Harmonic level of current (τ_n) (except Flex)	0%	1500%f 100%r	0.1% τ_n < 1000 %	±(2 % + (n × 0.2 %) + 10 pt) n ≤ 25
			1% $\tau_n \geq$ 1000 %	±(2 % + (n × 0.6 %) + 5 pt) n > 25
Harmonic level of current (τ_n) (AmpFlex® and MiniFlex)	0%	1500%f 100%r	0.1% τ_n < 1000 %	±(2 % + (n × 0.3 %) + 5 pt) n ≤ 25
			1% $\tau_n \geq$ 1000 %	±(2 % + (n × 0.6 %) + 5 pt) n > 25
Total harmonic distortion (THD) of voltage (with respect to the fundamental) of the voltage	0%	999.9%	0.1%	±(2.5% + 5 pt)
Total harmonic distortion (THD) (with respect to the fundamental) of the current (except Flex)	0%	999.9%	0.1%	±(2.5% + 5 pt) if ∀ n ≥ 1, $t_n \leq (100 \div n)$ [%]
				or
				±(2 % + (n_{max} × 0.2 %) + 5 pt) $n_{max} \leq 25$
				±(2 % + (n_{max} × 0.5 %) + 5 pt) $n_{max} > 25$
Total harmonic distortion (THD) (with respect to the fundamental) of the current (AmpFlex® and MiniFlex)	0%	999.9%	0.1%	±(2.5% + 5 pt) if ∀ n ≥ 1, $t_n \leq (100 \div n^2)$ [%]
				or
				±(2 % + (n_{max} × 0.3 %) + 5 pt) $n_{max} \leq 25$
				±(2 % + (n_{max} × 0.6 %) + 5 pt) $n_{max} > 25$
Total harmonic distortion (THD) of voltage (with respect to the signal without DC)	0%	100%	0.1%	±(2.5% + 5 pt)
Total harmonic distortion (THD) of the current (with respect to the signal without DC) (except Flex)	0%	100%	0.1%	±(2.5% + 5 pt) if ∀ n ≥ 1, $t_n \leq (100 \div n)$ [%]
				or
				±(2 % + (n_{max} × 0.2 %) + 5 pt) $n_{max} \leq 25$
				±(2 % + (n_{max} × 0.5 %) + 5 pt) $n_{max} > 25$
Total harmonic distortion (THD) of the current (with respect to the signal without DC) (AmpFlex® and MiniFlex)	0%	100%	0.1%	±(2.5% + 5 pt) if ∀ n ≥ 1, $t_n \leq (100 \div n^2)$ [%]
				or
				±(2 % + (n_{max} × 0.3 %) + 5 pt) $n_{max} \leq 25$
				±(2 % + (n_{max} × 0.6 %) + 5 pt) $n_{max} > 25$
Harmonic loss factor (FHL)	1	99.99	0.01	±(5 % + (n_{max} × 0.4 %) + 5 pt) $n_{max} \leq 25$
				±(10 % + (n_{max} × 0.7 %) + 5 pt) $n_{max} > 25$
K factor (FK)	1	99.99	0.01	±(5 % + (n_{max} × 0.4 %) + 5 pt) $n_{max} \leq 25$
				±(10 % + (n_{max} × 0.7 %) + 5 pt) $n_{max} > 25$
Phase differences of harmonics (order ≥ 2)	-179°	180°	1°	±(1.5° + 1° x (n ÷ 12.5)

$Nmax_{max}$ is the highest order of which the harmonic level is not zero.

Measurement		Measurement range (with unity ratio)		Display resolution (with unity ratio)	Maximum intrinsic error
		Minimum	Maximum		
RMS voltage of harmonic (order n ≥ 2)	phase-to-neutral	2 V	1000 V [1]	4 digits	±(2.5% + 1 V)
				4 digits	
	phase-to-phase	2 V	2000 V [1]	4 digits	±(2.5% + 1 V)
				4 digits	
Distorting voltage (RMS)	phase-to-neutral (Vd)	2 V	1000 V [1]	4 digits	±(2.5% + 1 V)
				4 digits	
	phase-to-phase (Ud)	2 V	2000 V [1]	4 digits	±(2.5% + 1 V)
				4 digits	
RMS current of harmonic RMS [3] (order n ≥ 2)	J93 clamp	1 A	3500 A	4 digits	n ≤ 25: ±(2 % + (n x 0.2%) + 1 A)
				4 digits	n > 25: ±(2 % + (n x 0.5%) + 1 A)
	C193 clamp PAC93 clamp	1 A	1000 A	4 digits	n ≤ 25: ±(2 % + (n x 0.2%) + 1 A)
				4 digits	n > 25: ±(2 % + (n x 0.5%) + 1 A)
	MN93 clamp	200 mA	200 A	4 digits	n ≤ 25: ±(2 % + (n x 0.2%) + 1 A)
				4 digits	n > 25: ±(2 % + (n x 0.5%) + 1 A)
	E94 clamp (10 mV/A) MN93A clamp (100 A)	200 mA	100 A	4 digits	n ≤ 25: ±(2 % + (n x 0.2%) + 100 mA)
				4 digits	n > 25: ±(2 % + (n x 0.5%) + 100 mA)
	E94 clamp (100 mV/A)	20 mA	10 A	4 digits	n ≤ 25: ±(2 % + (n x 0.2%) + 10 mA)
				4 digits	n > 25: ±(2 % + (n x 0.5%) + 10 mA)
	MN93A clamp (5 A) 5 A adapter Essailec® adapter	5 mA	5 A	4 digits	n ≤ 25: ±(2 % + (n x 0.2%) + 10 mA)
				4 digits	n > 25: ±(2 % + (n x 0.5%) + 10 mA)
	MINI94 clamp	5 mA	5 A	4 digits	n ≤ 25 : ±(2 % + (n x 0.2%) + 10 mA)
				4 digits	n > 25 : ±(2 % + (n x 0.5%) + 10 mA)
	AmpFlex® A193 MiniFlex MA194 (10 kA)	10 A	10 kA	4 digits	n ≤ 25: ±(2 % + (n x 0.3%) + 1 A + (Af_{RMS}[2] x 0.1%))
				4 digits	n > 25: ±(2 % + (n x 0.6%) + 1 A + (Af_{RMS}[2] x 0.1%))
	AmpFlex® A193 MiniFlex MA194 (6500 A)	10 A	6500 A	4 digits	n ≤ 25: ±(2 % + (n x 0.3%) + 1 A + (Af_{RMS}[2] x 0.1%))
				4 digits	n > 25: ±(2 % + (n x 0.6%) + 1 A + (Af_{RMS}[2] x 0.1%))
	AmpFlex® A193 MiniFlex MA194 (100 A)	100 mA	100 A	4 digits	n ≤ 25: ±(2 % + (n x 0.2%) + 30 pt)
				4 digits	n > 25: ±(2 % + (n x 0.5%) + 30 pt)
Distorting current (RMS) (Ad) [3]	J93 clamp	1 A	3500 A	4 digits	±((n_{max} x 0.4%) + 1 A)
	C193 clamp PAC93 clamp	1 A	1000 A	4 digits	±((n_{max} x 0.4%) + 1 A)
				4 digits	
	MN93 clamp	200 mA	200 A	4 digits	±((n_{max} x 0.4%) + 1 A)
	E94 clamp (10 mV/A) MN93A clamp (100 A)	200 mA	100 A	4 digits	±((n_{max} x 0.4%) + 100 mA)
				4 digits	
	E94 clamp (100 mV/A)	20 mA	10 A	4 digits	±((n_{max} x 0.4%) + 10 mA)
				4 digits	
	MN93A clamp (5 A) 5 A adapter Essailec® adapter	5 mA	5 A	4 digits	±((n_{max} x 0.4%) + 10 mA)
	MINI94 clamp	50 mA	200 A	4 digits	±((n_{max} x 0.4%) + 1 A)
	AmpFlex® A193 MiniFlex MA194 (10 kA)	10 A	10 kA	4 digits	±((n_{max} x 0.4%) + 1 A)
				4 digits	
	AmpFlex® A193 MiniFlex MA194 (6500 A)	10 A	6500 A	4 digits	±((n_{max} x 0.4%) + 1 A)
				4 digits	
	AmpFlex® A193 MiniFlex MA194 (100 A)	100 mA	100 A	4 digits	±(n_{max} x 0.5%) + 30 pt)
				4 digits	

Table 6

1: Provided that the voltages between the individual terminals and earth do not exceed 1000 VRMS.
2: RMS value of the fundamental.

3: n_{max} is the highest order of which the harmonic level is not zero.

17.2.4.5. Current and voltage ratios

Ratio	Minimum	Maximum
Voltage	$\frac{100}{1000 \times \sqrt{3}}$	$\frac{9999900 \times \sqrt{3}}{0.1}$
Current [1]	1/5	60,000 / 1

Table 7

1: Only for the 5 A MN93A clamps and the 5 A adapters.

17.2.5. SPECIFICATIONS OF THE CURRENT SENSORS

The measurement error on the RMS current and the phase error must be added to the errors of the instrument in the case of measurements that use the current measurements: powers, energies, power factors, tangents, etc.

Type of sensor	RMS current at 50/60 Hz (ARMS)	Maximum error at 50/60 Hz	Maximum error on φ at 50/60 Hz
AmpFlex® A193	[1 000 A ... 12 000 A]	±(1,2% + 1 A)	± 0,5°
	[100 A ... 1 000 A]	±(1,2% + 0,5 A)	
	[5 A ... 100 A]	±(1,2% + 0,2 A)	
	[0,1 A ... 5 A]	±(1,2% + 0,2 A)	-
MiniFlex MA194	[1 000 A ... 12 000 A]	±(1% + 1 A)	± 0,5°
	[100 A ... 1 000 A]	±(1% + 0,5 A)	
	[5 A ... 100 A]	±(1% + 0,2 A)	
	[0,1 A ... 5A]	±(1% + 0,2 A)	-
J93 clamp 3,500 A	[50 A ... 100 A]	±(2% + 2.5 A)	± 4°
	[100 A ... 500 A]	±(1.5% + 2.5 A)	± 2°
	[500 A ... 2,000 A]	± 1%	± 1°
	[2,000 A ... 3,500 A]	± 1%	± 1.5°
C193 clamp 1,000 A	[1 A ... 50 A]	± 1%	-
	[50 A ... 100 A]	± 0.5%	± 1°
	[100 A ... 1,200 A]	± 0.3%	± 0.7°
PAC93 clamp 1,000 A	[0.5 A ... 100 A]	±(1.5% + 1 A)	± 2.5°
	[100 A ... 800 A]	± 2.5%	± 2°
	[800 A ... 1,000 A]	± 4%	± 2°
MN93 clamp 200 A	[0.5 A ... 5 A]	±(3% + 1 A)	-
	[5 A ... 40 A]	±(2.5% + 1 A)	± 5°
	[40 A ... 100 A]	±(2% + 1 A)	± 3°
	[100 A ... 240 A]	±(1% + 1 A)	± 2.5°
MN93A clamp 100 A	[0.2 A ... 5 A]	±(1% + 2 mA)	± 4°
	[5 A ... 120 A]	± 1%	± 2.5°
MN93A clamp 5 A	[0.005 A ... 0.25 A]	±(1.5% + 0.1 mA)	-
	[0.25 A ... 6 A]	± 1%	± 5°
E94 clamp (BNC) 100 A	[0.5 A ... 40 A]	±(4% + 50 mA)	± 1°
	[40 A ... 70 A]	±15%	± 1°
E94 clamp (BNC) 10 A	[0.1 A ... 7 A]	±(3% + 50 mA)	± 1.5°
MINI94 clamp 200 A	[0.05 A ... 10 A]	± (0.2% + 20mA)	± 1°
	[10 A ... 200 A]		± 0.2°
Three-phase 5 A adapter	[5 mA ... 50 mA[	±(1% + 1.5 mA)	± 1°
	[50 mA ... 1 A[	±(0.5% + 1 mA)	± 0°
	[1 A ... 5 A]	±0.5%	± 0°

Table 8

This table does not take into account possible distortion of the measured signal (THD) because of the physical limitations of the current sensor (saturation of the magnetic circuit or of the Hall effect sensor).

Limitation of the AmpFlex® and of the MiniFlex
As is true of all Rogowski sensors, the output voltage of the AmpFlex® and of the MiniFlex is proportional to the frequency. A high current at high frequency can saturate the current input of the instruments.

To avoid saturation, it is necessary to satisfy the following condition:

$$\sum_{n=1}^{n=\infty} [n.\ I_n] < I_{nom}$$

With I_{nom} being the range of the current sensor
n the order of the harmonic
I_n the current of the harmonic of order n

For example, the input current range of a dimmer must be one fifth of the current range selected on the instrument. Wave-train dimmers having a non-integer number of periods are not compatible with Flex type sensors.

This requirement does not take into account the limitation of the bandwidth of the instrument, which can lead to other errors.

17.2.6. UNCERTAINTY OF THE TIME-REAL CLOCK

The uncertainty of the real-time clock is at most 80 ppm (instrument 3 years old used at an ambient temperature of 50°C).

With a new instrument used at 25°C, this uncertainty is no more than 30 ppm.

17.3. MEMORY CARD

The CA 8345 is delivered with a 16GB SD card.
Depending on their capacities, SD cards can store:

	2 GB	4 GB	16 GB
Various functions	■ 50 screenshots ■ 16,362 alarms ■ 210 searches for transients and 5 searches for surges ■ 1 inrush current capture, RMS+PEAK – 10 min ■ 1 trend recording of all parameters for 20 hours with a 3s sampling period	■ 50 screenshots ■ 16,362 alarms ■ 210 searches for transients and 5 searches for surges ■ 1 inrush current capture, RMS+PEAK – 10 min ■ 1 trend recording of all parameters for 6 days with a 3s sampling period	■ 50 screenshots ■ 16,362 alarms ■ 210 searches for transients and 5 searches for surges ■ 1 inrush current capture, RMS+PEAK – 10 min ■ 1 trend recording of all parameters for 40 days with a 3s sampling period
or a single trend recording of all parameters per EN 50160.	■ 1.9 day with a sampling period of 1 s. ■ 5.6 days with a sampling period of 3 s.	■ 3.75 days with a sampling period of 1 s. ■ 11.25 days with a sampling period of 3 s.	■ 15 days with a sampling period of 1 s. ■ 45 days with a sampling period of 3 s.

	32 GB	64 GB
Various functions	■ 50 screenshots ■ 16,362 alarms ■ 210 searches for transients and 5 searches for surges ■ 1 inrush current capture, RMS+PEAK – 10 min ■ 1 trend recording of all parameters for 84 days with a 3s sampling period	■ 50 screenshots ■ 16,362 alarms ■ 210 searches for transients and 5 searches for surges ■ 1 inrush current capture, RMS+PEAK – 10 min ■ 1 trend recording of all parameters for 174 days with a 3s sampling period
or a single trend recording of all parameters per EN 50160.	■ 30 days with a sampling period of 1 s. ■ 90 days with a sampling period of 3 s.	■ 90 days with a sampling period of 1 s. ■ 180 days with a sampling period of 3 s.

The shorter the recording interval and the longer the duration of a recording, the larger the file will be.

17.4. POWER SUPPLY

17.4.1. BATTERY

The power supply unit of the instrument is a 10.9 V, 5700 mAh, Li-ion battery pack.
Battery mass: approximately 375 g including 5.04 g of lithium.

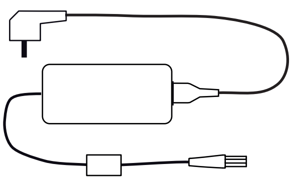
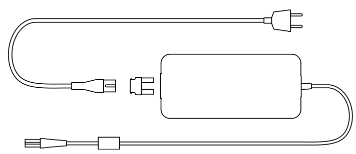
Voltage	10.86 V	
Nominal capacity	5700 mAh	
Minimum capacity	5500 mAh	
Loss of capacity	11% after 200 charge-discharge cycles 16% after 400 charge-discharge cycles	
The charging current and duration depend on the power supply unit (PA40W-2 or PA32ER)	10°C < T < 40°C	PA40W-2: 1.5 A and 3h50 PA32ER: 1 A and 5h50
	0°C < T < 10°C	PA40W-2: 0.75 A and 7h30 PA32ER: 0.5 A and 11h30
	-20°C < T < 0°C	PA40W-2: 0 A PA32ER: 0 A
T° of use	-20 to +60°C	
Recharging T°	0 to 40°C	
Storage T°	-20 to +60 °C for one month -20 to +45°C for 3 months -20 to +20°C for one year	

If the instrument will be left unused for an extended period, remove the battery (see § 18.3).

17.4.2. EXTERNAL POWER SUPPLY:

The CA 8345 can be connected to an external supply to save or recharge the battery. It can operate while being charged.

There are two chargers.

	PA 40W-2 	PA32ER 
Nominal voltage and overvoltage category	600 V category III	1000 V category IV
Input voltage	100 to 260 V from 0 to 440 Hz	100 to 1000 VAC 150 to 1000 VDC
Input frequency	0 to 440 Hz	DC, 40 to 70 Hz, 340 to 440 Hz
Maximum input current	0.8 A	2 A
Maximum input power	50 W	30 W
Output voltage	15 V ± 4%	15 V ± 7%
Output power	40 W max	30 W
Dimensions	160 x 80 x 57 mm	220 x 112 x 53 mm
Mass	Approximately 460 g	Approximately 930 g
Temperature of use	0 to +50°C, from 30 to 95%RH without condensation	-20 to +50°C, from 30 to 95%RH without condensation
Storage temperature	-25 to +85°C, from 10 to 90%RH without condensation	-25 to +70°C, from 10 to 90%RH without condensation

i To use these power supplies, please refer to their manuals.

17.4.3. BATTERY LIFE

The typical consumption of the instrument is 750 mA. This includes the display, the SD card, GPS, the Ethernet link, Wi-Fi, and supplying the current sensors when necessary.

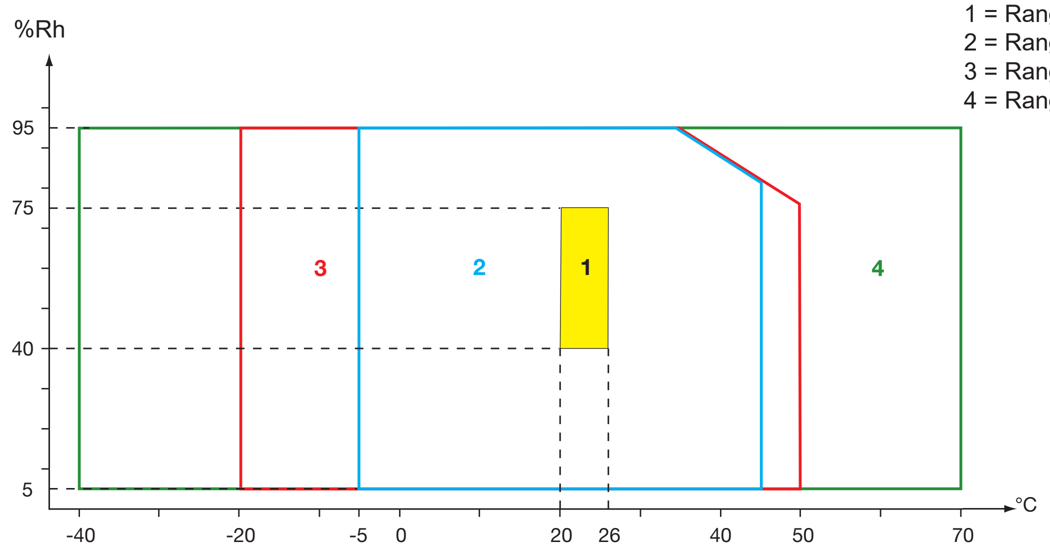
Battery life between charges is approximately 6 hours when the battery is fully charged and the screen is on. If the screen is off, battery life between charges is approximately 10 hours.

17.5. DISPLAY UNIT

The display unit is an active matrix LCD (TFT) having the following specifications:

- diagonal 18 cm or 7"
- resolution 800 x 480 pixels (WVGA)
- 262,144 colours
- LED backlighting
- angle of view 85° in all directions

17.6. ENVIRONMENTAL CONDITIONS



1 = Range of reference.
2 = Range of use:
3 = Range of storage with battery.
4 = Range of storage without battery.

Figure 155

Indoor use.

Altitude:
Use < 2,000 m
Storage < 10,000 m

Degree of pollution: 3.

17.7. MECHANICAL SPECIFICATIONS

Dimensions (L x D x H)	200 mm x 285 mm x 55 mm
Mass	approximately 2 kg
Display unit	152 mm x 91 mm (diagonal 7”)

Index of protection

- IP54 per IEC 60529 when the 5 elastomer caps are closed and there are no leads on the 9 terminals.
- IP20 on the measurement terminals when the instrument is in service.
- IK06 per IEC 62262, without screen.

Drop test 1 m per IEC 60068-2-31.

17.8. COMPLIANCE WITH INTERNATIONAL STANDARDS

17.8.1. ELECTRICAL SAFETY

The instrument is compliant with IEC/EN 61010-2-030 and BS EN 61010-2-030:

- Measurement inputs and enclosure: 1,000 V cat. IV, degree of pollution 3.
- Power supply input: 1,000 V cat. IV, degree of pollution 3.

The current sensors are compliant with standard IEC/EN 61010-2-032 and BS EN 61010-2-032 600 V cat. IV or 1000 V cat. III, degree of pollution 2.
The measurement leads and crocodile clips are compliant with standard IEC/EN 61010-031 and BS EN 61010-031, 1,000 V cat. IV, degree of pollution 2.

Association with current sensors:

- using the AmpFlex®, the MiniFlex, and C193 clamps creates an "instrument + current sensor" assembly rated at 600 V, category IV or 1000 V, category III.
- using PAC93, J93, MN93, MN93A, MINI94, E94 clamps creates an "instrument + clamp" assembly rated at 300 V, category IV or 600 V, category III.
- using a 5 A adapter housing creates an "instrument + adapter" assembly rated at 150 V, category IV or 300 V, category III.

In order to protect the user, the instrument has protection impedances between the input terminals and the electronic circuit. As a consequence, if the user connects a USB lead to the instrument and touches the other end of the lead, the voltage and the current will not endanger them.

The devices comply with BS EN 62749 for EMF. Product intended for professional use.

17.8.2. STANDARD IEC 61000-4-30, CLASS A

All of the measurement methods, the measurement uncertainties, the measurement ranges, the aggregations of measurements, the flagging, and the markings are compliant with the requirements of IEC 61000-4-30, edition 3.0, Amendment 1 (2021) for instruments of class A.

The CA 8345 therefore performs the following measurements:

- Measurement of power frequency over 10 s,
- Measurement of the amplitude of the voltage for 10/12 cycles, 150/180 cycles, 10 minutes, and 2 hours,
- Calculation of the voltage unbalance for 10/12 cycles, 150/180 cycles, 10 minutes, and 2 hours,
- Measurement of the harmonics of voltages for 10/12 cycles, 150/180 cycles, 10 minutes, and 2 hours,
- Measurement of the inter-harmonics of voltages for 10/12 cycles, 150/180 cycles, 10 minutes, and 2 hours,
- Minimum and maximum values of the voltage (Under/Over deviation),
- Calculation of flicker over 10 minutes and 2 hours,
- Detection of voltage dips, swells and interruptions, in amplitude and duration,
- Mains signalling voltages (MSV),
- Rapid voltage changes (RVC),
- Measurement of the amplitude of the current for 10/12 cycles, 150/180 cycles, 10 minutes, and 2 hours,
- Calculation of the current unbalance for 10/12 cycles, 150/180 cycles, 10 minutes, and 2 hours,
- Measurement of the harmonics of currents for 10/12 cycles, 150/180 cycles, 10 minutes, and 2 hours,
- Measurement of the inter-harmonics of currents for 10/12 cycles, 150/180 cycles, 10 minutes, and 2 hours,

All measurements are made for 10/12 cycles and synchronised with UTC time every 10 minutes.
They are then aggregated to 150/180 cycles, 10 minutes, and 2 hours.

Class A certification has been carried out in accordance with standard IEC 62586-2 edition 2 Amendment 1 (2021).

17.8.3. MEASUREMENT UNCERTAINTIES AND RANGES

Parameter		Measurement range	Uncertainty	Range of quantity of influence
Power frequency	50 Hz network	42.5 to 57.5 Hz	± 10 mHz	U_{din} ∈[100 V; 400 V] (V) U_{din} ∈[200 V; 1000 V] (U)
	60 Hz network	51 to 69 Hz		
Amplitude of the supply voltage		[10%; 150 %] U_{din}	± 0.1 % U_{din}	U_{din} ∈[100 V; 400 V] (V) U_{din} ∈[200 V; 1000 V] (U)
Flicker	$P_{inst,max}$	0.2 to 12	± 8%	U_{din} ∈[100 V; 400 V] (V) U_{din} ∈[200 V; 1000 V] (U)
	P_{st}, P_{lt}	0.2 to 12	Max (± 5%; 0.05)	
Voltage dips	Amplitude	[10%; 90 %] U_{din}	± 0.2 % U_{din}	U_{din} ∈[100 V; 400 V] (V) U_{din} ∈[200 V; 1000 V] (U)
	Beginning	-	½ cycle	
	Duration	≥ ½ cycle x 1 cycle	1 cycle	
Voltage swells	Amplitude	[110%; 200 %] U_{din}	± 0.2 % U_{din}	U_{din} ∈[100 V; 400 V] (V) U_{din} ∈[200 V; 1000 V] (U)
	Beginning	-	½ cycle	
	Duration	≥ ½ cycle	1 cycle	
Interruptions of the voltage	Beginning	-	½ cycle	U_{din} ∈[100 V; 400 V] (V) U_{din} ∈[200 V; 1000 V] (U)
	Duration	≥ ½ cycle x 1 cycle	1 cycle	
Voltage unbalance (u_0,u_2)		0.5 to 5% (absolute)	± 0.15% (absolute)	U_{din} ∈[100 V; 400 V] (V) U_{din} ∈[200 V; 1000 V] (U)
Voltage harmonics (V_{sgh}/U_{sgh})	h∈[0 ; 50]	[0.1% ; 16%] of V_1/U_1 and V_{sgh}/U_{sgh} ≥ 1% U_{din}	± 5%	U_{din} ∈[100 V; 400 V] (V) U_{din} ∈[200 V; 1000 V] (U)
		[0.1% ; 16%] of V_1/U_1 and V_{sgh}/U_{sgh} < 1% U_{din}	± 0,05 % U_{din}	
Interharmonics of voltage (V_{isgh}/U_{isgh})	h∈[0 ; 49]	[0.1% ; 10%] of V_1/U_1 and V_{isgh}/U_{isgh} ≥ 1% U_{din}	± 5%	U_{din} ∈[100 V; 400 V] (V) U_{din} ∈[200 V; 1000 V] (U)
		[0.1% ; 10%] of V_1/U_1 and V_{isgh}/U_{isgh} < 1% U_{din}	± 0.05 % U_{din}	
Mains signalling voltages (MSV)		[3% ; 15%] U_{din} [0 Hz; 3 kHz]	± 5%	U_{din} ∈[100 V; 400 V] (V) U_{din} ∈[200 V; 1000 V] (U)
		[1% ; 3%] U_{din} [0 Hz; 3 kHz]	± 0.15 % U_{din}	
Rapid voltage changes (RVC) VRMS½/URMS½	Beginning	-	½ cycle	U_{din} ∈[100 V; 400 V] (V) U_{din} ∈[200 V; 1000 V] (U)
	Duration	-	1 cycle	
	ΔU_{max}	[1% ; 6%] U_{din}	± 0.2 % U_{din}	
	ΔU_{ss}	[1% ; 6%] U_{din}	± 0.2 % U_{din}	
Amplitude of current		[10%; 100%] of the full-scale technical class-A RMS value of the current	± 1%	See Table 2
Current harmonics (I_{sgh})	h∈[0 ; 50]	I_{sgh} ≥ 3% I_{nom}	± 5%	I_{nom}
		I_{sgh} < 3% I_{nom}	± 0.15 % I_{nom}	
Interharmonics of currents (I_{isgh})	h∈[0 ; 49]	I_{isgh} ≥ 3% I_{nom}	± 5%	I_{nom}
		I_{isgh} < 3% I_{nom}	± 0.15 % I_{nom}	
Current unbalance (a_0,a_2)		0.5 to 5% (absolute)	± 0.15% (absolute)	I_{nom}

Table 9

17.8.4. MARKINGS PER IEC 62586-1

The marking PQI-A-PI means:

- PQI-A: class A power quality instrument
- P: portable measuring instrument
- I: Indoor use

17.9. ELECTROMAGNETIC COMPATIBILITY (EMC)

The instrument is in compliance with the requirements of standard IEC/ EN 61326-1 or BS EN 61326-1.

- The instrument is intended for use in an industrial environment.
- The instrument is a class A product.
- This instrument is not intended for use in residential environments and may not ensure adequate protection of radio reception in this type of environment.

For AmpFlex® and MiniFlex sensors:

- An (absolute) influence of 2% may be observed on the current THD measurement in the presence of a radiated electric field.
- An influence of 0.5 A may be observed on the RMS current measurement in the presence of conducted radio frequencies.
- An influence of 1 A may be observed on the RMS current measurement in the presence of a magnetic field.

17.10. RADIO EMISSIONS

The instruments are in compliance with directive RED 2014/53/EU and with FCC regulations.

The Wi-Fi module is certified in compliance with the FCC regulations under number XF6-RS9113SB.

17.11. GPL CODE

The source codes of the software under GNU GPL (General Public License) are available
https://update.chauvin-arnoux.com/ca/CA8345/OpenSource/CA834x_licenses_list.zip

18. MAINTENANCE

⚠ Except for the batteries, the instrument contains no parts that can be replaced by personnel who have not been specially trained and accredited. Any unapproved work or replacement of any part by equivalents may gravely compromise safety.

⚠ The servicing and maintenance instructions must be provided to the responsible authority.

18.1. CLEANING THE HOUSING

Disconnect anything connected to the instrument and switch it off.

Use a soft cloth, moistened with soapy water. Rinse with a damp cloth and dry rapidly with a dry cloth or forced air. Do not use alcohol, solvents, or hydrocarbons.

18.2. MAINTENANCE OF THE SENSORS

The current sensors must be regularly maintained:

- Use a soft cloth, moistened with soapy water. Rinse with a damp cloth and dry rapidly with a dry cloth or forced air. Do not use alcohol, solvents, or hydrocarbons.
- Keep the air gaps of the clamps perfectly clean. Lightly oil visible metal parts to prevent rust.

18.3. REPLACEMENT OF THE BATTERY

The battery of this instrument is specific: it has precisely adapted protective and safety elements. Replacing the battery by a model other than the one specified may cause material damage or bodily injury by explosion or fire.

⚠ To ensure unbroken safety, replace the battery only by the original model. Do not use a battery of which the housing is damaged.

Do not throw the battery into a fire.

Do not expose the battery to a temperature in excess of 100°C.

Do not short-circuit the terminals of the battery pack.

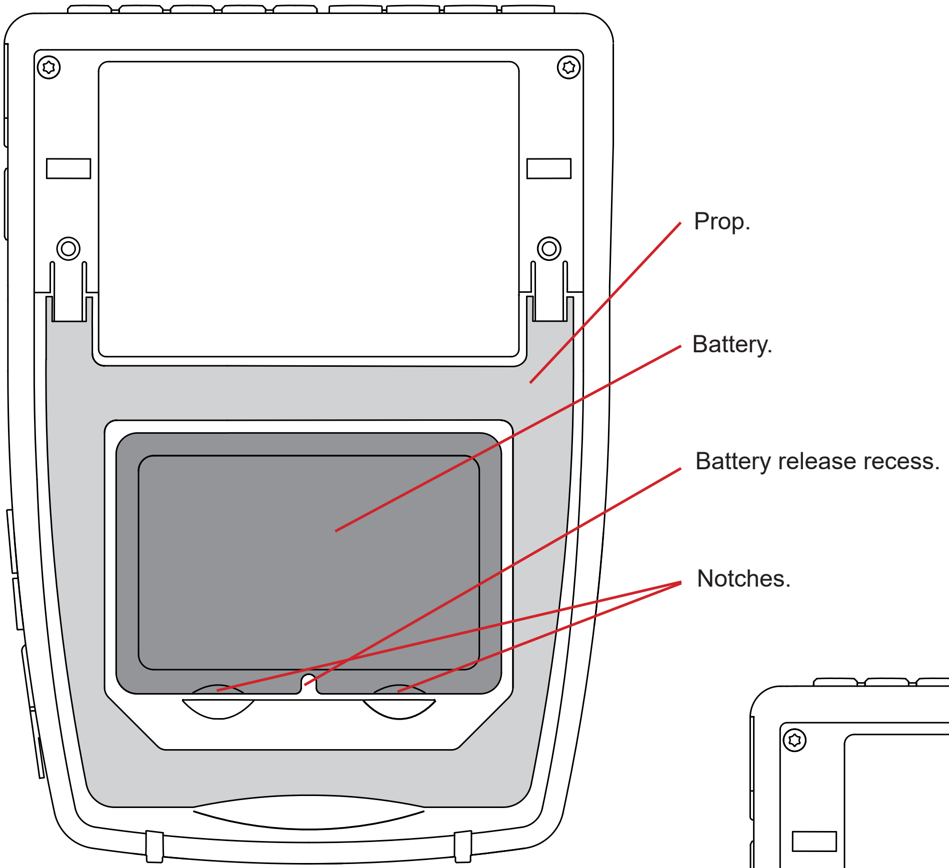


Figure 156

1. Disconnect anything connected to the instrument.
2. Turn the instrument over and insert a flat-head screwdriver in the battery release recess.
3. Push down on the screwdriver to release the battery.

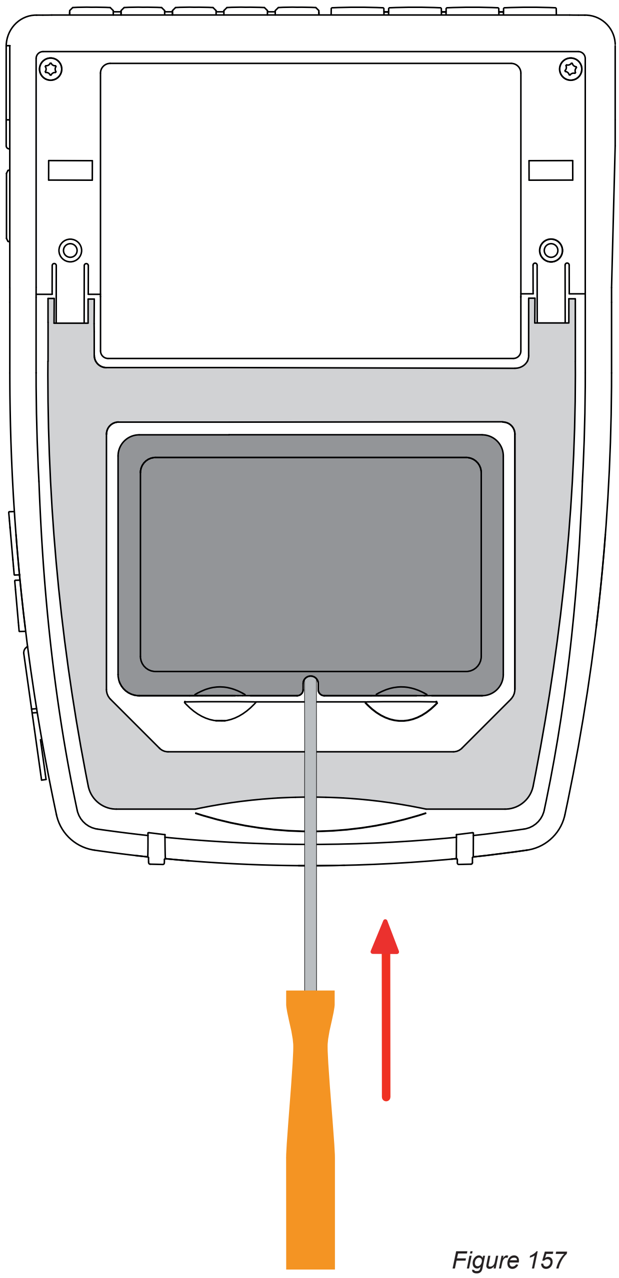


Figure 157

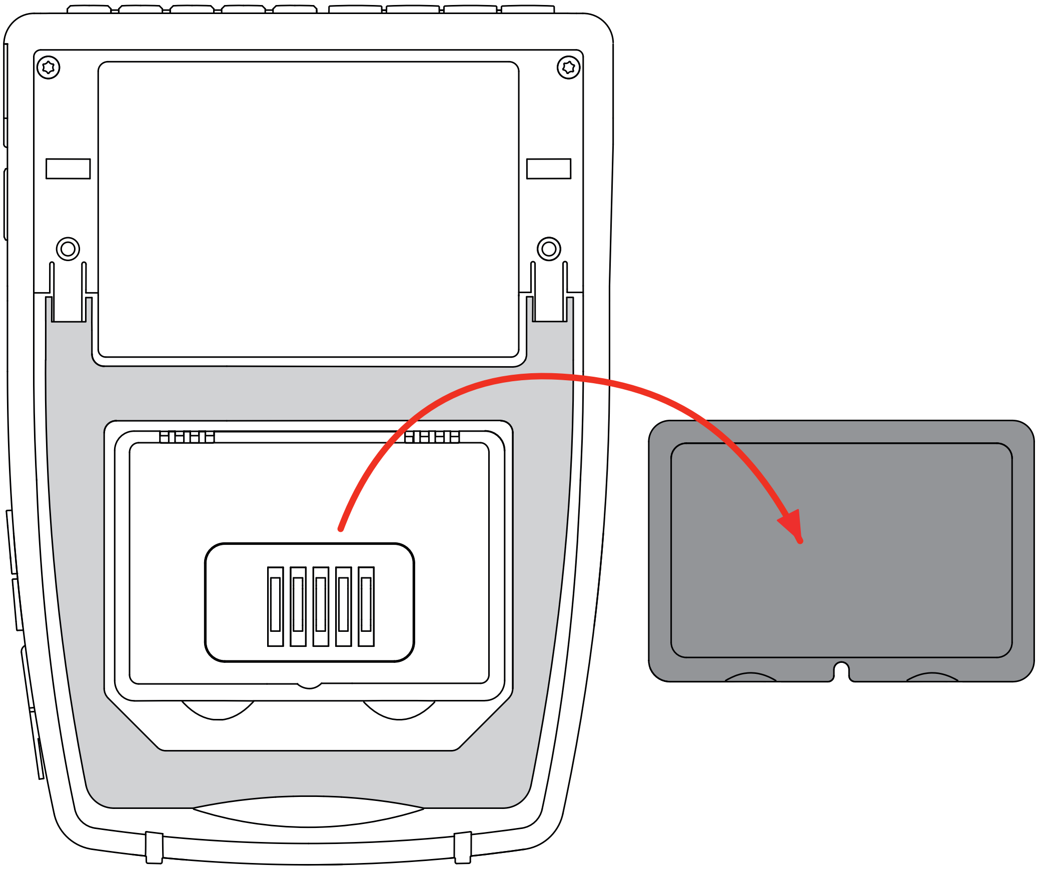


Figure 158

4. Use the notches to extract the battery from its compartment.

Old batteries must not be treated as household wastes. Take them to the appropriate collection point for recycling.

In the absence of a battery, the internal clock of the instrument continues to operate for at least 17 hours.

5. Place the new battery in its compartment and press down until you hear the click of the locking mechanism.

Whenever the battery has been disconnected, even if it has not been replaced, it must be fully recharged. This is so that the instrument will know the charge status of the battery (this information is lost when it is disconnected).

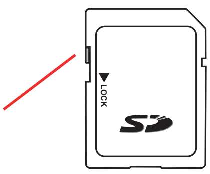
18.4. MEMORY CARD

The instrument accepts type SD (SDSC), SDHC, and SDXC memory cards.

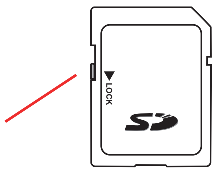
To remove an SD card from the instrument, refer to § 3.5.

Write-protect the memory card when you remove it from the instrument. Remove the write protection before putting the card back in its slot in the instrument.

Unprotected memory card



Protected memory card



To remove the memory card from its slot, open the elastomer cap.
Eject the card as described in § 3.5 (, , ,).
Press on the memory card to remove it from its slot.

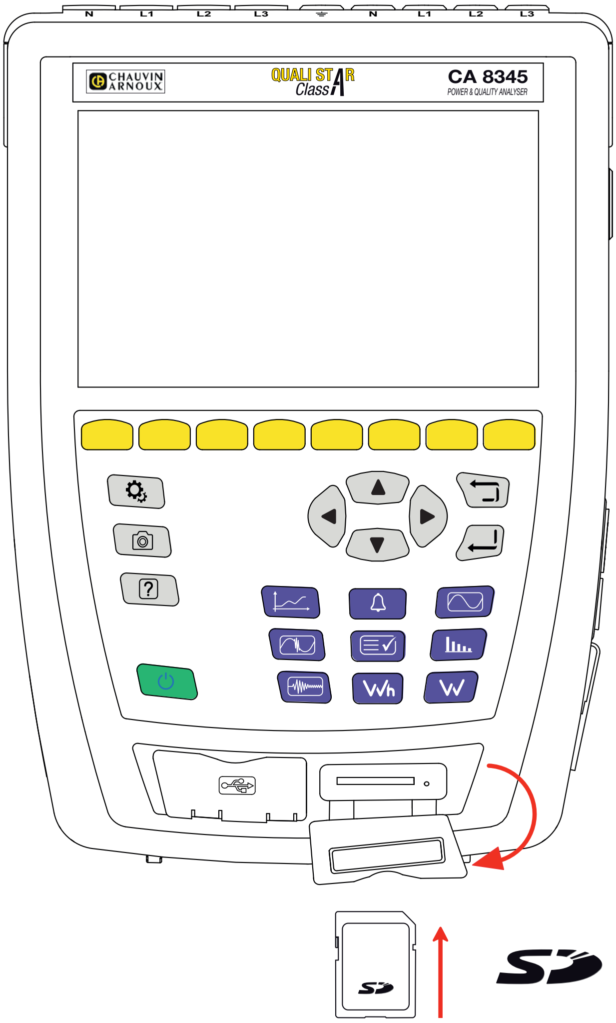


Figure 159

To put the card back in place, slip it into its slot until it is all the way home. The red indicator lights.
Then put the elastomer cap back in place.

18.5. UPDATING THE FIRMWARE

With a view to providing the best possible service in terms of performance and technical upgrades, Chauvin Arnoux enables you to update the software incorporated in this instrument by a free download of the new version, available on our web site.

Our site:
www.chauvin-arnoux.com
In the «Support» item, click on “Download our software” and enter the name of the instrument, "CA 8345".

You can perform the update in several ways:

- Connect the instrument to your PC to an Ethernet network having access to Internet using an Ethernet cord.
- Copy the update file to a USB key, then insert the drive in its port in the instrument.
- Copy the update file to the SD card and insert the card in its slot in the instrument.

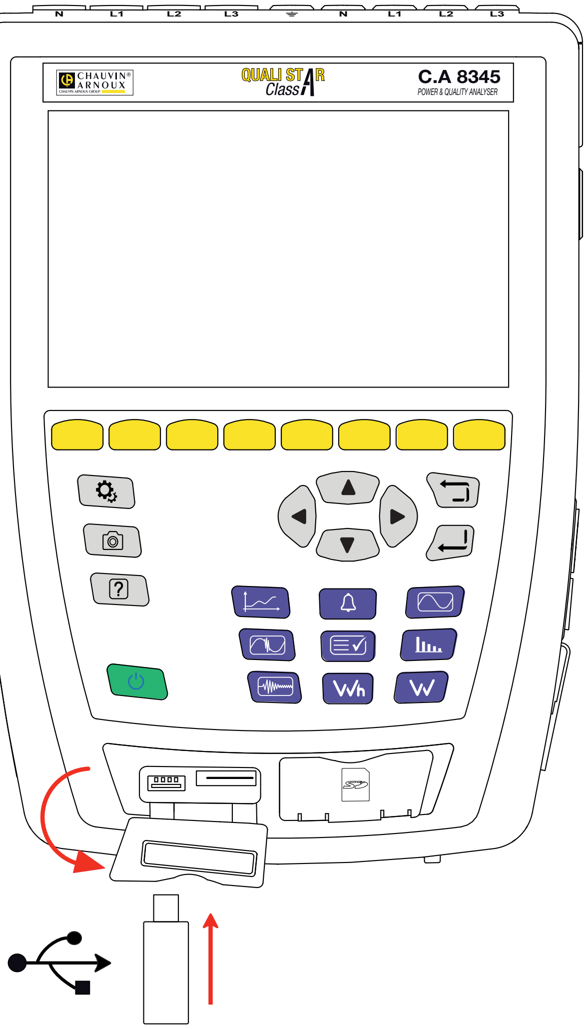


Figure 160

To install the update, refer to § 3.8.

The update of the firmware depends on its compatibility with the hardware version of the instrument. This version is indicated in the instrument configuration; see § 3.6.

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i Updating the embedded software may result in the deletion of all configuration data such as user profiles or recording campaigns scheduled for the future. Do not update if there are pending recordings and, after updating, check that the configuration data is still correct.

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19. WARRANTY

Except as otherwise stated, our warranty is valid for 36 months starting from the date on which the equipment was sold. The extract from our General Conditions of Sale is available on our website.
www.group.chauvin-arnoux.com/en/general-terms-of-sale

The warranty does not apply in the following cases:

- inappropriate use of the equipment or use with incompatible equipment;
- modifications made to the equipment without the explicit permission of the manufacturer's technical staff
- work done on the device by a person not approved by the manufacturer;
- adaptation to a particular application not anticipated in the definition of the equipment or by the user manual
- damage caused by shocks, falls, or floods.

20. APPENDICES

This section presents the formulas used for the calculation of the different parameters.

The formulas are compliant with standard IEC 61000-4-30, edition 3.0, Amendment 1 (2021) for class A instruments and with IEEE 1459, 2010 edition, for the power formulas.

20.1. NOTATION

Notation	Description
Y	Represents V, U or I.
L	Number of the phase or of the channel.
n	Instantaneous sample index.
h	Subgroup order of the harmonic or of the interharmonic.
M	Total number of samples in the duration considered.
N	Number of cycles.
$Y_L(n)$	Instantaneous value of the channel L sample having index n.
$Y_{sghL}(h)$	RMS value of the sub-group harmonic of order h on channel L, Voltage/Current. = square root of the sum of the squares of the RMS values of a harmonic and of the two spectral components directly adjacent to it.
$Y_{isghL}(h)$	RMS value of the centred interharmonic subgroup of order h on channel L, Voltage/Current. = RMS value of all spectral components between two consecutive harmonic frequencies, not including the spectral components directly adjacent to the harmonic frequencies.
$I_{hL}(h)$	RMS current of the harmonic of order h on channel L.

Most of the quantities measured can be calculated on aggregations of different durations:
- 1 cycle (= 1 period = 1/frequency),
- 10/12 cycles (10 cycles for 50 Hz, 12 cycles for 60 Hz),
- 150/180 cycles (150 cycles for 50 Hz, 180 cycles for 60 Hz),
- 10 minutes,
- other.

20.2. AGGREGATIONS IN TREND MODE

Measurements recorded in trend mode come from sources sampled in 2 distinct ways, which are re-aggregated into a common flow intended for trend recordings. The source flows of measurements are:

- The 40 kS/s flow (fixed sampling at 40 kHz) includes the measurements:
  - Network frequency
  - Power
  - DC values

  with S/s (samples per second)

- The 512 spc flow (adaptive sampling at 512 samples per cycle of the measured voltage, which is used for measurements (including Class A measurements) of:
  - RMS Voltages and Currents
  - Peak Voltages and Currents
  - Flicker
  - Imbalances
  - Distortions
  - Harmonics and Inter-harmonics

  with spc (samples per cycle)

From these 2 flows, measurements are produced every 200 ms for the quantities coming from the 40 kS/s flow and every 10 cycles (50 Hz network) or 12 cycles (60 Hz network) for the quantities coming from the 512 spc flow.

These metrics are recombined, aggregated, and timestamped based on the selected aggregation period:

- 10/12c / 200ms
  - 10/12 cycles measurements: aggregation of 10/12 cycles over 10 seconds, 10 minutes, 15 minutes, 2 hours
  - 200 ms measurements: quantities 40 kS/s over 10 seconds, 10 minutes, 15 minutes, 2 hours
- 150/180c / 3s
  - 10/12 cycles measurements: aggregation of 15 measurements 10/12 cycles. For trend recordings, following the shift between 3 s intervals and 150/180 cycle intervals, an occasional aggregation may include a 10/12 cycles plus or minus. This only concerns the trend mode, the measurements displayed in real time always include 15 aggregations.
  - 200 ms measurements: aggregation of quantities 40 kS/s over 10 seconds, 10 minutes, 15 minutes, 2 hours

All measurements subject to Class A are aggregated from 10/12 cycle values (square root of the arithmetic mean of the square of the input values), regardless of the aggregation period.

Furthermore, complying with Class A, every 10 minutes round, the intervals of 10/12 cycles and 150/180 cycles are resynchronised, with overlap of the 10/12 cycle interval which ends with the new one (overlap 1) and with overlap of the 150/180 cycle interval which ends with the new one (overlap 2).

Synchronisation of aggregation intervals for class A (IEC 61000-4-30)

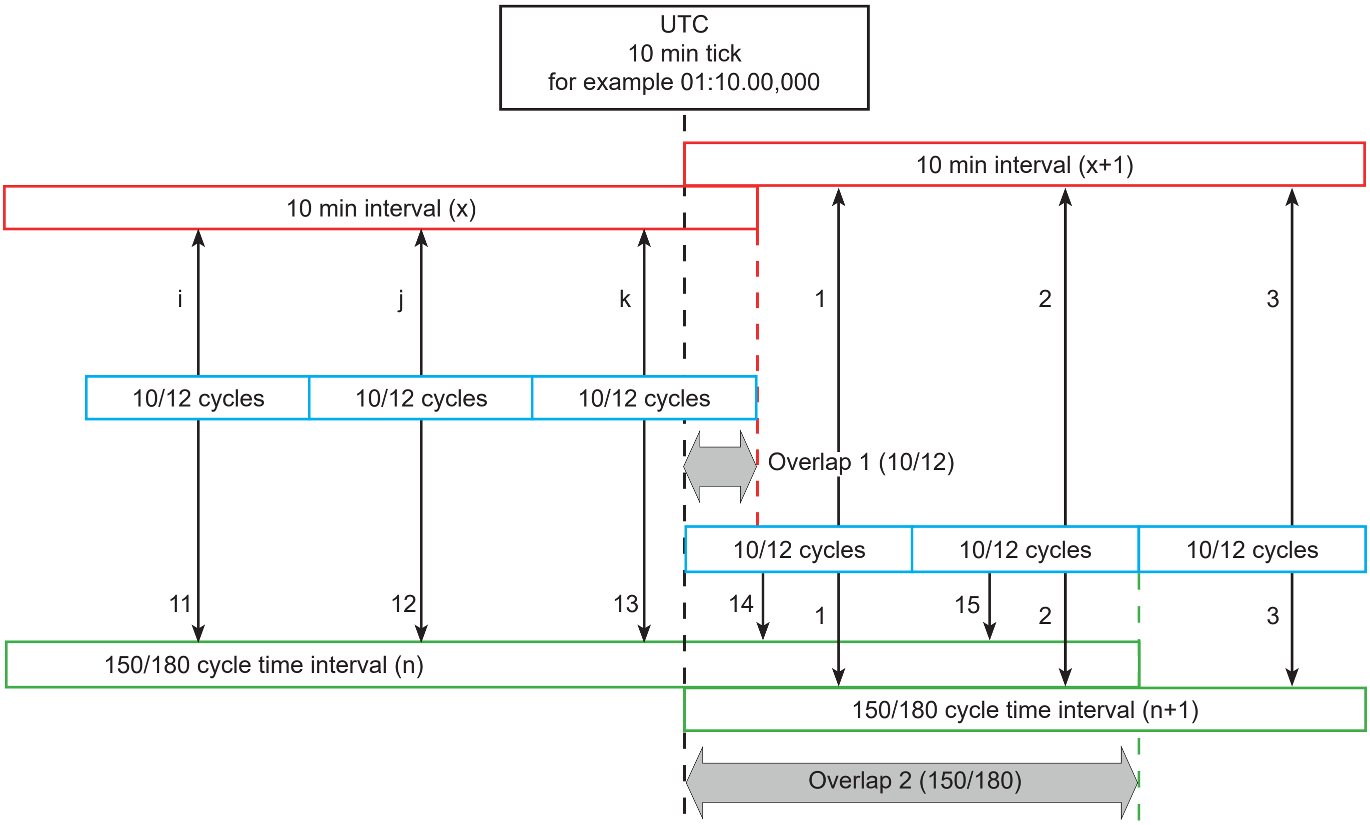

Figure 161

20.3. FORMULAS

20.3.1. RMS VALUES

The quantities are calculated in accordance with standard IEC 61000-4-30 edition 3.0 Amendment 1 (2021), § 5.2.1.
The RMS value includes the DC component.

$$Y_{RMSL} = \sqrt{\frac{\sum_{n=1}^{M} Y_L^2(n)}{M}}$$

20.3.2. PEAK VALUES

$$Y_{pk+L} = \max_M(Y_L(n))$$

$$Y_{pk-L} = \min_M(Y_L(n))$$

20.3.3. CREST FACTOR

$$Y_{CFL} = \frac{Y_{pkL}}{Y_{RMSL}}$$

With $Y_{pkL} = \max(|Y_{pk+L}|,|Y_{pk-L}|)$

20.3.4. DEFINITIONS RELATING TO HARMONICS

Rank of a harmonic, h

Ratio (integer) of a harmonic frequency to the fundamental frequency of the power supply network. In relation to the analysis carried out using a Fourier Transform and a synchronisation between $f_{H,1}$ and f_s (sampling frequency), the rank h of a harmonic corresponds to the spectral component:

k = h × N

where k = number of the spectral component,
N = 10 = number of periods at the fundamental frequency in the time window TN.

Effective value of a spectral component of rank k, $Y_{c,k}$

In analysis of a waveform, the RMS value of a component whose frequency is a multiple (rank k) of the reciprocal of the duration of the time window.

20.3.5. EFFECTIVE VALUE OF A HARMONIC AND INTER-HARMONIC SUBGROUP

The quantities are calculated in accordance with standard IEC 61000-4-7 edition 2.0 Amendment 1, § 5.6.

Effective value of a harmonic subgroup h:

The RMS value of a harmonic subgroup is the root of the sum of the squares of the effective values over N = 10 periods of the harmonic considered and the 2 closest inter-harmonic lines (the inter-harmonic lines harmonics resulting from the Fourrier Transform are spaced by f/10).

$$Y_{sghL}(h) = \sqrt{Y^2_{(h\times 10)-1,L,N} + Y^2_{(h\times 10),L,N} + Y^2_{(h\times 10)+1,L,N}}$$

Where $Y_{k,L,N}$ = spectral component of rank k on channel L calculated over N = 10 periods.

Effective value of an inter-harmonic subgroup centred h:

Effective value of all spectral components between two consecutive harmonic frequencies, not including the spectral components directly adjacent to the harmonic frequencies.

By convention, the RMS value of the centred subgroup located between harmonic ranks h and h + 1 is designated by $Y_{isg,h}$, for example, the centred subgroup located between h = 5 and h = 6 is denoted by Y**isg,5**.

$$Y_{isghL}(h) = \sqrt{Y^2_{(h\times 10)+2,L,N} + Y^2_{(h\times 10)+3,L,N} + Y^2_{(h\times 10)+4,L,N} + Y^2_{(h\times 10)+5,L,N} + Y^2_{(h\times 10)+6,L,N} + Y^2_{(h\times 10)+7,L,N} + Y^2_{(h\times 10)+8,L,N}}$$

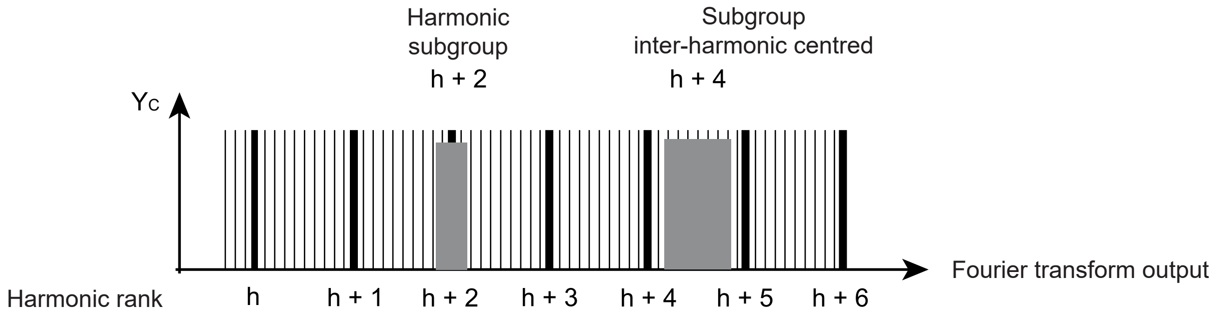

Figure 162

20.3.6. LEVELS OF HARMONICS AND INTERHARMONICS

The quantities are calculated in accordance with standard IEC 61000-4-7, edition 2.0 Amendment 1, § 5.6.

Level of harmonics referred to the RMS value of the fundamental (%f):

$$Y_{h\%fL}(h) = \frac{Y_{sghL}(h)}{Y_{sghL}(1)}$$

Level of harmonics referred to the RMS value without DC (%r):

$$Y_{h\%rL}(h) = \frac{Y_{sghL}(h)}{Y_{Lrms}}$$

Level of interharmonics referred to the RMS value of the fundamental (%f):

$$Y_{ih\%fL}(h) = \frac{Y_{isghL}(h)}{Y_{sgL}(1)}$$

Level of interharmonics referred to the RMS value without DC (%r):

$$Y_{ih\%rL}(h) = \frac{Y_{isghL}(h)}{Y_{Lrms}}$$

Where:
h : subgroup order of the harmonic or of the inter-harmonic.
L : channel number (L1, L2, L3, LN, 12, 23, 31)
Y_{sghL}(h) : RMS value of the sub-group harmonic of rank h of voltage/current
= square root of the sum of the squares of the RMS values of a harmonic and of the two spectral components directly adjacent to it.
Y_{isghL}(h): RMS value of the centred inter-harmonic sub-group of rank h of voltage/current.
= RMS value of all spectral components between two consecutive harmonic frequencies, not including the spectral components directly adjacent to the harmonic frequencies.

20.3.7. LEVEL OF UNBALANCES

The quantities are calculated in accordance with standard IEC 61000-4-30 edition 3.0, Amendment 1 (2021), § 5.7.1.

The unbalance of the supply voltage is evaluated by the method of symmetrical components. In addition to direct component U1, an unbalance adds at least one of the following components: inverse component U2 and/or zero sequence component U0.

Inverse voltage component:

$$u_2 = \frac{U_2}{U_1} x100\%$$

Zero sequence voltage component:

$$u_0 = \frac{U_0}{U_1} x100\%$$

Inverse current component:

$$a_2 = \frac{I_2}{I_1} x100\%$$

Zero sequence current component:

$$a_0 = \frac{I_0}{I_1} x100\%$$

With

U_0	Voltage zero (or homopolar) sequence unbalance	I_0	Current zero (or homopolar) sequence unbalance
U_1	Voltage positive (or direct) sequence unbalance	I_1	Current positive (or direct) sequence unbalance
U_2	Voltage negative (or inverse) sequence unbalance	I_2	Current negative (or inverse) sequence unbalance
u_0	Voltage zero (or homopolar) sequence unbalance ratio	a_0	Current zero (or homopolar) sequence unbalance ratio
u_2	Voltage negative (or inverse) sequence unbalance ratio	a_2	Current negative (or inverse) sequence unbalance ratio

20.3.8. MAINS SIGNALLING VOLTAGES (MSV)

The quantities are calculated in accordance with standard IEC 61000-4-30 edition 3.0, Amendment 1 (2021), § 5.10.

The voltage amplitude of the signal for a specified carrier frequency is obtained by calculating the square root of the sum of the squares of the RMS values, for 10/12 periods, of the four closest interharmonic spikes.

20.3.9. LEVEL OF HARMONIC GROUP DISTORTION

The quantities are calculated in accordance with standard IEC 61000-4-7, edition 2.0, Amendment 1, § 3.3.2.

$$THDG_L\%f = \sqrt{\frac{\sum_{h=2}^{127} Y_{sghL}(h)^2}{Y_{sghL}(1)^2}}$$

$$THDG_L\%r = \sqrt{\frac{\sum_{h=2}^{127} Y_{sghL}(h)^2}{(Y_{sghL}(1)^2+\sum_{n=2}^{127} Y_{sghL}(h)^2)}}$$

20.3.10. DISTORTION

$$Y_{dL} = \sqrt{\sum_{h=2}^{127} Y_{sghL}(h)^2}$$

20.3.11. K FACTOR AND HARMONIC LOSS FACTOR

These quantities concern only the current and are calculated in accordance with standard IEEE C57.110, 2004 edition, § B.1 and § B.2.

The factor K (KF) is a nominal value applied to a transformer to indicate its ability to be used with loads that consume non-sinusoidal currents:

$$KF_L = \sum_{h=1}^{h_{max}} \frac{I_{HL}^2(h)}{I_R^2} x h^2$$

With I_R: nominal current of the transformer

Harmonic loss factor (HLF):

$$FHL_L = \frac{\sum_{h=1}^{h_{max}} h^2 \times I_{HL}^2(h)}{\sum_{h=1}^{h_{max}} I_{HL}^2(h)}$$

K factor (FK)
Derating of the transformer as a function of the harmonics:

$$FK_L = \sqrt{1 + \frac{e}{1+e}\left(\frac{\sum_{h=2}^{h_{max}} h^q \times I_{HL}^2(h)}{\sum_{h=1}^{h_{max}} I_{HL}^2(h)}\right)}$$

With: $e \in [0.05 ; 0.1]$ and $q \in [1.5 ; 1.7]$

20.3.12. POWER FREQUENCY

Quantity calculated in accordance with standard IEC 61000-4-30, edition 3.0, Amendment 1 (2021), § 5.1.1.

The zero crossings method is used. The duration of the aggregation depends on the configuration of the instrument (10 seconds in Class A mode).

20.3.13. DC COMPONENT

Mean of the M samples Y_L.

$$Y_{DCL} = \frac{\sum_{n=0}^{M-1} Y_L(n)}{M}$$

20.3.14. ACTIVE POWER (P)

Quantity calculated in accordance with standard IEEE 1459, 2010 edition, § 3.1.2.3.
Active power, per phase:

$$P_L = \frac{\sum_{n=0}^{M-1} V_L(n).I_L(n)}{M}$$

With $V_L(n)$ and $I_L(n)$ = instantaneous values of the V or I sample having index n in channel L.

Total active power:

$$P_\Sigma = P_1 + P_2 + P_3$$

20.3.15. FUNDAMENTAL ACTIVE POWER (P_F)

Quantity calculated in accordance with standard IEEE 1459, 2010 edition, § 3.1.2.4.

Active power of fundamental, per phase:

$$P_{fL} = \frac{\sum_{n=0}^{M-1} V_{fL}(n).I_{fL}(n)}{M}$$

With $V_{fL}(n)$ and $I_{fL}(n)$ = instantaneous fundamental voltage and current of the sample having index n in channel L.

Total active power of fundamental:

$$P_{f\Sigma} = P_{fL1} + P_{fL2} + P_{fL3}$$

Notes: these quantities, which are used to calculate other quantities, are not displayed.

20.3.16. FUNDAMENTAL REACTIVE POWER (Q_F)

Quantity calculated in accordance with standard IEEE 1459, 2010 edition, § 3.1.2.6.

Fundamental reactive power, per phase:

$$Q_{fL} = V_{fL}\ x\ I_{fL}\ x\ \sin(\varphi_{V_{fL}I_{fL}})$$

with $\varphi_{VfL\ IfL}$ = angle between V_{fL} and I_{fL}, V and I of the fundamental in channel L.

Total fundamental reactive power

$$Q_f = Q_{fL1} + Q_{fL2} + Q_{fL3}$$

20.3.17. HARMONIC ACTIVE POWER (P_H)

Quantity calculated in accordance with standard IEEE 1459, 2010 edition, § 3.1.2.5.

The harmonic active power includes the DC component.

Harmonic active power, per phase:

$$P_{HL} = P_L - P_{fL}$$

Total harmonic active power:

$$P_{H\Sigma} = P_{HL1} + P_{HL2} + P_{HL3}$$

20.3.18. DC POWER (P_{DC})

DC power, per phase:

$$P_{DCL} = V_{DCL}\ x\ I_{DCL}$$

With V_{DCL} and $_{IDCL}$: DC voltage and current in channel L.

Total DC power:

$$P_{DC\Sigma} = P_{DCL1} + P_{DCL2} + P_{DCL3}$$

20.3.19. APPARENT POWER (S)

Quantity calculated in accordance with standard IEEE 1459, 2010 edition, § 3.1.2.7.

Apparent power, per phase:

$$S_L = V_L \ x \ I_L$$

With V_L and I_L: RMS voltage and current of channel L.

Total apparent power:

$$S_\Sigma = S_{L1} + S_{L2} + S_{L3}$$

20.3.20. NON-ACTIVE POWER (N)

Quantity calculated in accordance with standard IEEE 1459, 2010 edition, § 3.1.2.14.

Non-active power, per phase:

$$N_L = \sqrt{S_L^2 - P_L^2}$$

Total non-active power:

$$N_\Sigma = \sqrt{S_\Sigma^2 - P_\Sigma^2}$$

20.3.21. DISTORTING POWER (D)

Distorting power, per phase:

$$D_L = \sqrt{S_L^2 - P_L^2 - Q_{fL}^2} = \sqrt{N_L^2 - Q_{fL}^2}$$

Total distorting power:

$$D_\Sigma = \sqrt{S_\Sigma^2 - P_\Sigma^2 - Q_f^2} = \sqrt{N_\Sigma^2 - Q_f^2}$$

20.3.22. POWER FACTOR (PF), POWER FACTOR OF FUNDAMENTAL (PF1)

Quantities calculated in accordance with standard IEEE 1459, 2010 edition, § 3.1.2.16 and § 3.1.2.15.

Power factor (PF), per phase:

$$PF_L = \frac{P_L}{S_L}$$

total power factor (PF):

$$PF_\Sigma = \frac{P_\Sigma}{S_\Sigma}$$

Displacement Factor (DPF) or cos φ or Fundamental power factor (PF1), per phase:

$$DPF_L = PF_{1L} = cos(\varphi)_L = \frac{P_{fL}}{S_{fL}}$$

Total Displacement Factor (DPF) or cos φ or Fundamental power factor (PF1):

$$DPF_\Sigma = PF_{1\Sigma} = \frac{P_{f\Sigma}}{S_{f\Sigma}}$$

20.3.23. TANGENT

Tangent of the difference between the angle of the fundamental voltage and the angle of the fundamental current.

Tangent, per phase:

$$\tan(\varphi)_L = \frac{Q_{fL}}{P_{fL}}$$

Total tangent:

$$\tan(\varphi)_\Sigma = \frac{Q_{f\Sigma}}{P_{f\Sigma}}$$

20.4. FLICKER

The quantities are calculated in accordance with class F3 of standard IEC 61000-4-15, edition 2.0, § 4.7.3, § 4.7.4, and § 4.7.5.

Flicker measures the human perception of the effects of fluctuations in the amplitude of the voltage supplying a lamp.

These variations are caused mainly by fluctuations of the reactive power in the network, themselves caused by the connection and disconnection of devices.

To accurately reflect the effects on vision, the measurement must be made over a long enough time (10 minutes or 2 hours). That said, flicker can vary considerably in a short time, since it depends on connections and disconnections to the network.

The CA 8345 therefore measures:

- instantaneous flicker Pinst,
  The value displayed is max(Pinst) on a 150/180-cycle aggregation. The max(Pinst) recorded in Trend mode is calculated on the selected aggregation.

- short-term flicker P_{st},
  This is calculated over 10 minutes. This interval is long enough to minimise the transient effects of connections and disconnections, but also long enough to take into account the deterioration of a user's vision.

- long-term flicker P_{lt}.
  This is calculated over 2 hours. It is used to take into account devices having a long cycle.
  For P_{lt}, the instrument lets you choose the calculation method (see § 3.9.1): fixed or sliding window. Long-term flicker based on a 2-hour observation period.

The perceived discomfort is a function of the square of the amplitude of the fluctuation multiplied by the duration of the fluctuation. The average observer's sensitivity to lighting fluctuations is greatest around 10 Hz.

20.5. SOURCES OF DISTRIBUTION SUPPORTED BY THE INSTRUMENT

See the connections § 4.4.

20.6. HYSTERESIS

Hysteresis is a filtering principle used in alarm mode (see § 12) and in inrush current mode (see § 11). Careful adjustment of the hysteresis avoids a repeated change of state when the measurement oscillates around the threshold.

20.6.1. VOLTAGE SWELL DETECTION

At a hysteresis of 2% for example, the reset point for an Voltage swell detection will be (100% - 2%), or 98 % of the threshold voltage.

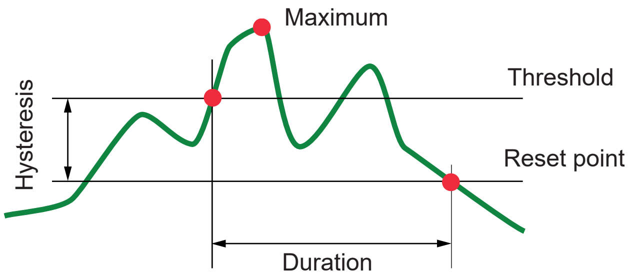

Figure 163

20.6.2. VOLTAGE DIP AND VOLTAGE INTERRUPTION DETECTION

For a hysteresis of 2% for example, the reset point in the context of dip detection will be (100% + 2%), or 102% of the threshold voltage.

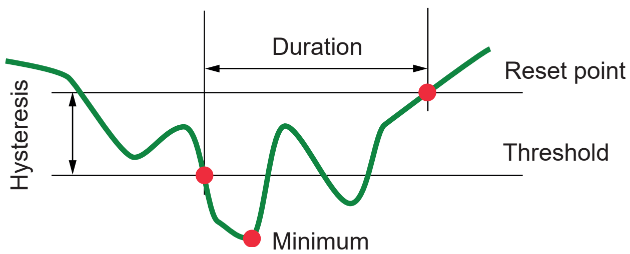

Figure 164

20.7. MINIMUM SCALE VALUES OF WAVEFORMS AND MINIMUM RMS VALUES

	Minimum scale value (waveform mode)	Minimum RMS values
Phase-to-earth and phase-to-phase voltages	8 V	2 V
AmpFlex® A193, MiniFlex MA194 (10 kA)	80 A	8 A
AmpFlex® A193, MiniFlex MA194 (1 kA)	8 A	800 mA
AmpFlex® A193, MiniFlex MA194 (100 A)	800 mA	80 mA
J93 clamp	24 A	2 A
C193 clamp	8 A	800 mA
PAC93 clamp	8 A	800 mA
MN93 clamp	2 A	150 mA
MN93A clamp (100 A)	800 mA	80 mA
E94 clamp (10 mV/A)	800 mA	100 mA
E94 clamp (100 mV/A)	80 mA	10 mA
MN93A clamp (5 A)	40 mA	4 mA
MINI94 clamp	400 mA	40 mA
5 A and Essailec® adapters	40 mA	4 mA

Value to be multiplied by the ratio in effect (if not unity).
Scale value = (dynamic full scale) / 2 = (Max - Min) / 2

20.8. FOUR-QUADRANT DIAGRAM

This diagram is used for power and energy measurements (see § 7 and 8).

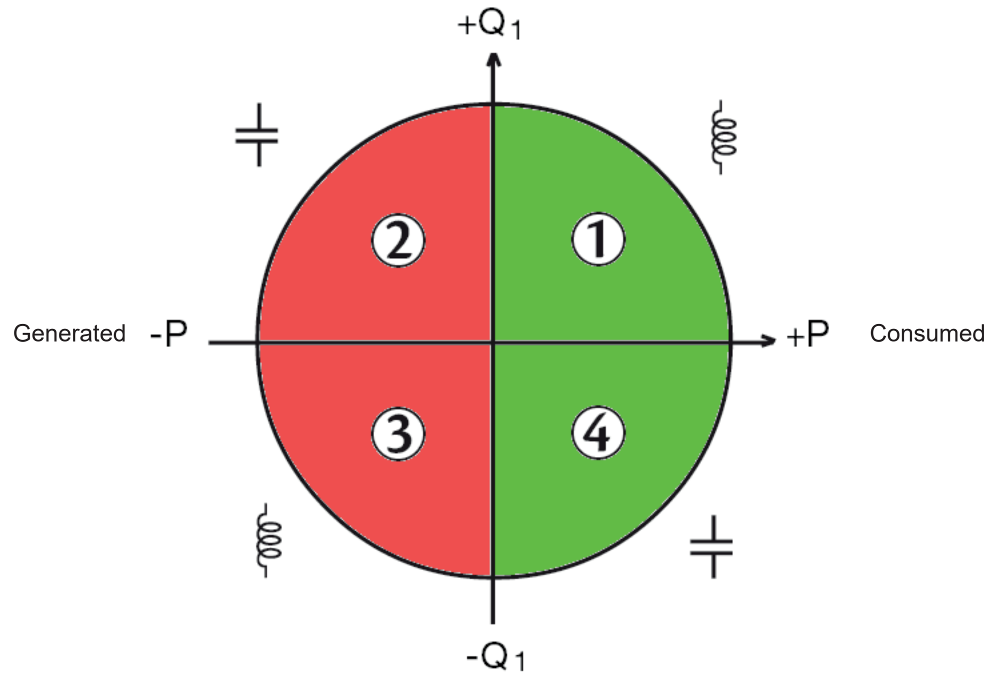

Figure 165

20.9. TRANSIENT CAPTURE TRIGGERING MECHANISM

When a search for transients is started, each sample is compared to the sample from the previous cycle. In standard IEC 61000-4-30, this monitoring method is called the "sliding window method". The previous cycle corresponds to the middle of a virtual tube; it is used as reference. For voltage and current, the half-width of the virtual tube is equal to the threshold programmed “Level configuration” in the transient mode configuration (see 3.10.3).

When a sample deviates from the tube, it is considered a triggering event. The representation of the transient is then captured by the instrument. The instrument records 10 periods (50 Hz) or 12 periods (60 Hz), with the trigger point being positioned between 1 and 4 periods after the start of recording, depending on the programming of the “Number of cycles before trigger” parameter.

Here is a graphic representation of the transient capture triggering mechanism :

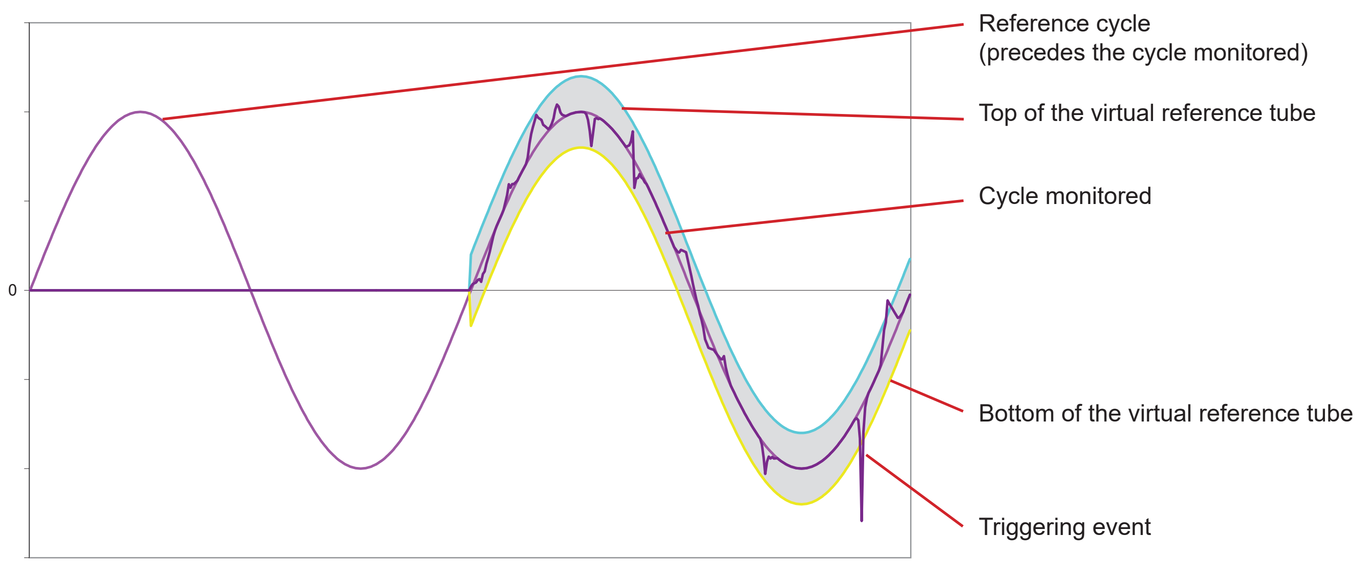

Figure 166

20.10. TRIGGERING MECHANISM FOR SHOCK-WAVE CAPTURES

Unlike all other modes, where the voltages are referenced to neutral, the voltages are referenced here to earth. It is therefore not possible to record fast transients with an unearthed connection.

32 samples form a moving average to smooth the signal (i.e. a duration of 32 x 500 ns = 16 µs). A new sample is compared with the moving average. If the difference exceeds the programmed threshold, the sample is considered a trigger event. The representation of the surge is then captured by the instrument.

The programmed threshold is not an absolute value reached by the signal, but a voltage variation with a steep slope (< 10 µs). The 4 voltage channels (V1E, V2E, V3,E and VNE) are recorded over a period of 1024 µs. The trigger point is always positioned at the first quarter of the recording, i.e. 256 µs after the start of the recording.

The other information recorded is as follows:

- The channel on which the trigger occurred,
- The trigger date and time,
- The peak value reached,
- The date and time of this peak value.

20.11. CONDITIONS OF CAPTURE IN INRUSH CURRENT MODE

The capture is determined by a triggering event and a stop event. A capture stops automatically in one of the following cases:

- the stop threshold is crossed in the downward direction,
- the recording memory is full,
- the recording duration exceeds 10 minutes in RMS+WAVE mode,
- the recording duration exceeds 30 minutes in RMS mode.

The capture stop threshold is calculated by the following formula:

[Stop threshold [A]] = [Triggering threshold [A]] x (100 - [stop hysteresis [%]]) ÷ 100

Here are the triggering and stop conditions of captures:

Triggering filter	Triggering and stop conditions
A1	Triggering condition <=> [half-cycle RMS value of A1] > [Triggering threshold] Stop condition <=> [half-cycle RMS value of A1] < [Stop; threshold]
A2	Triggering condition <=> [half-cycle RMS value of A2] > [Triggering threshold] Stop condition <=> [half-cycle RMS value of A2] < [Stop; threshold]
A3	Triggering condition <=> [half-cycle RMS value of A3] > [Triggering threshold] Stop condition <=> [half-cycle RMS value of A3] < [Stop; threshold]
3 A	Triggering condition <=> [the half-cycle RMS value in **one** of the current] channels > [Triggering threshold] Stop condition <=> [the half-cycle RMS value in **all** of the current channels] < [Stop threshold]

20.12. POSSIBLE CAUSES FOR A STOPPED RECORD

When displaying a list of recordings (trend, transient, inrush current, alarm or monitoring), if the end date is in red, it means that the recording could not be completed to the scheduled end date. An error code is then displayed next to the red date. To find out what the error number is, use the help button [?].

For trend, transient, inrush current or monitoring records:

- Code 1: The recording stopped at the programmed end time.
- Code 2: Recording stopped manually.
- Code 3: Memory full.
- Code 4: Other recording error.
- Code 5: Recording stopped due to the instrument being switched off (battery level too low and no mains power).
- Code 6: The maximum number of events (transient, inrush current) has been reached.

In case of alarm records:

- Code 2: Manual stop of the recording.
- Code 4: Other recording error.
- Code 5: Memory full.
- Code 6: Recording stopped at the programmed end time.
- Code 7: Recording stopped due to the instrument being switched off (battery level too low and no mains power supply).
- Code 8: The maximum number of events has been reached.

20.13. GLOSSARY

≃	AC and DC components.
~	AC component only.
═	DC component only.
(inductor symbol)	Inductive phase shift.
(capacitor symbol)	Capacitive phase shift.
°	Degree.
| |	Absolute values.
φ_{VA}	Phase difference of the phase-to-earth voltage (phase voltage) with respect to the phase-to-earth current (line current).
φ_{UA}	Phase difference of the phase-to-phase voltage (line voltage) with respect to the phase-to-earth current (line current). Two-phase 2-wire mode only.
Σ	System value.
%	Percentage.
%f	Value of fundamental as reference (percentage of the fundamental value).
%r	Total value as reference (percentage of the total value).
A	Line current or ampere as unit.
a_0	Current zero (or homopolar) sequence unbalance ratio.
a_2	Current negative (or inverse) sequence unbalance ratio.
A1	Current of phase 1.
A2	Current of phase 2.
A3	Current of phase 3.
A-h	Current harmonic.
AC	AC component (current or voltage).
ACF	Crest factor of the current.
Ad	Distorting RMS current.
ADC	DC current.
A_{nom}	Nominal current of the current sensors.
APK+	Maximum peak current.
APK-	Minimum peak current.
ARMS	RMS current.
ATHD	Total harmonic distortion of the current.
ATHDF	Harmonic distortion of the current referred to the RMS value of the fundamental.
ATHDR	Harmonic distortion of the current referred to the total RMS value without DC .
AVG	Average value (arithmetic mean).

Bandwidth: frequency range within which the response of an instrument is greater than some minimum.

BTU	British Thermal Unit.
CF	Crest Factor for current or voltage**:** ratio of peak current to RMS current.

Channel and phase: a measurement channel corresponds to a difference of potential between two conductors. A phase corresponds to a single conductor. In polyphase systems, a measurement channel can be between two phases, between a phase and the neutral, between a phase and the earth, or between the neutral and the earth.

cos φ	Cosine of the phase difference of the voltage with respect to the current (displacement factor – DPF).
D	Distorting power.
DC	DC component (current or voltage).
DHCP	Dynamic Host Configuration Protocol.

Dip threshold: voltage specified for detection of the beginning and end of a voltage dip.

DPF	Displacement factor (cos φ).
E	Exa (10^{18})
E_D	Distorting energy.
E_{PDC}	DC energy.
E_{Qf}	Reactive energy.
E_P	Active energy.
E_N	Non-active energy.
E_S	Apparent energy.

FK Factor K. Downgrading of the transformer as a function of harmonics..

FHL Harmonic loss factor (FHL) This is used to quantify losses due to harmonics in transformers.

Flicker visual effect produced by voltage variations.

Frequency number of complete voltage or current cycles produced in one second.

Fundamental component : component of which the frequency is the fundamental frequency.

G Giga (10^9)

GPS Satellite-based (Global Positioning System).

Harmonics Voltages or currents found in electrical installations at frequencies that are integral multiples of the fundamental frequency.

Hysteresis difference of amplitude between the forward and reset points of thresholds.

Hz unit in which network frequency is stated.

Interruption reduction of the voltage at a point in the electrical network to below the interruption threshold.

IRD Internet Relay Device: proprietary protocol allowing the interconnection, via a centralised server, of two devices located in different subnetworks.

J Joule

k kilo (10^3)

KF K factor calculated per IEEE C57.110. Indicates the ability of a transformer to be used with loads that consume non-sinusoidal currents.

L Channel (Line).

m milli (10^{-3})

M Mega (10^6)

MAX Maximum value, calculated over 10 or 12 cycles depending on whether the frequency is 50 or 60 Hz.

MIN Minimum value, calculated over 10 or 12 cycles depending on whether the frequency is 50 or 60 Hz.

ms millisecond.

MSV Mains Signalling Voltage.

N Non-active power.

Nominal voltage: voltage by which a network is designated or identified.

NTP Network Time Protocol, enables time synchronisation via a time server

Order of a harmonic: integer equal to the ratio of the frequency of the harmonic to the frequency of the fundamental.

P Active power.

P Peta (10^{15})

P_{DC} DC power.

PF Power Factor: ratio of active power to apparent power.

PF_1 Fundamental power factor.

Phase Time relation between current and voltage in AC circuits.

PK or PEAK**.** Maximum (+) or minimum (-) peak value of the signal over 10/12 cycles.

P_{lt} Severity of long-term flicker (Long term severity), calculated over 2 hours.

P_{st} Severity of short-term flicker (Short term severity), calculated over 10 minutes.

Q_f Reactive power.

RMS RMS value of current or voltage (Root Mean Square). Square root of the arithmetic mean of the square of the instantaneous values of a quantity during a specified interval of time (200 ms, 1 s, or 3 s) .

RVC Rapid Voltage Changes.

S Apparent power.

S-h Harmonics in power.

T Relative date of the time cursor.

T Tera (10^{12})

tan φ Tangent of the phase difference of the voltage with respect to the current.

Toe Tonnes oil equivalent (nuclear or non-nuclear).

THD Total Harmonic Distortion. Total harmonic distortion is the percentage of harmonics in a signal, referred to the RMS value of the fundamental (%f) or to the total RMS value without DC (%r).

U Phase-to-phase voltage or voltage between phases.

u_0 Voltage zero (or homopolar) sequence unbalance ratio.

u_2 Voltage negative (or inverse) sequence unbalance ratio if the neutral is connected, otherwise phase-to-phase voltage.

U1 = U_{12} Phase-to-phase voltage between phases 1 and 2.

U2 = U_{23}	Phase-to-phase voltage between phases 2 and 3.
U3 = U_{31}	Phase-to-phase voltage between phases 3 and 1.
U-h	Harmonics in phase-to-phase voltage.
Uc	Declared supply voltage, normally Uc = Un.
UCF	Crest factor of the phase-to-phase voltage (line voltage).
Ud	Distorting phase-to-phase RMS voltage.
UDC	Phase-to-phase DC voltage.
Udin	Declared input voltage, Udin = Uc x transducer ratio.
Uh	Harmonic of the phase-to-phase voltage.
UPK+	Maximum peak phase-to-phase voltage.
UPK-	Minimum peak phase-to-phase voltage.
Un	Nominal network voltage.

Nominal network voltage.

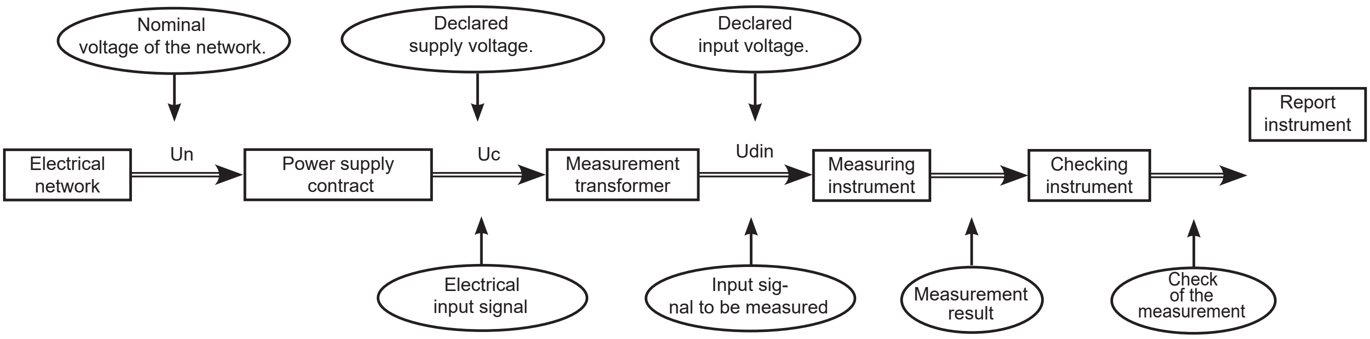

Figure 167

Networks that have a nominal voltage 100 V <Un > 1000 V have standard voltages of:
- Phase-to-earth voltages: 120, 230, 347, 400 V
- Phase-to-phase voltages: 208, 230, 240, 400, 480, 600, 690, 1000 V

In some countries there are also:
- Phase-to-earth voltages: 100, 220, 240, 380 V
- Phase-to-phase voltages: 200, 220, 380, 415, 600, 660 V

URMS	Phase-to-phase RMS voltage.
UTC	Coordinated Universal Time.
UTHD	Total harmonic distortion of the phase-to-phase voltage.
UTHDF	Harmonic distortion of the phase-to-phase voltage referred to the RMS value of the fundamental.
UTHDR	Harmonic distortion of the phase-to-phase voltage referred to the total RMS value without DC.
V	Phase-to-earth voltage or phase-neutral voltage or unit = volt.
V1	Phase-to-earth voltage on phase 1.
V2	Phase-to-earth voltage on phase 2.
V3	Phase-to-earth voltage on phase 3.
V-h	Harmonics in phase-to-earth voltage.
VA	Unit = voltampere.
VAh	Unit = voltampere hour.
var	Unit = reactive voltampere.
varh	Unit reactive voltampere hour.
VCF	Crest factor of the phase-to-earth voltage.
Vd	Distorting phase-to-earth RMS voltage.
VDC	Phase-to-earth DC voltage.
VPK+	Maximum peak value of phase-to-earth voltage.
VPK-	Minimum peak value of phase-to-earth voltage.
Vh	Harmonic of the phase-to-earth voltage.
VN	Phase-to-earth voltage on the neutral.

Voltage balance in a polyphase electrical network: state in which the RMS values of the voltages between conductors (fundamental component), and/or the phase differences between successive conductors, are not all equal.

Voltage dip: temporary lowering of the amplitude of the voltage at a point in the electrical network to below some specified threshold.

Voltage swell: temporary increase of the voltage magnitude at a point in the electrical system above a threshold.

VRMS Phase-to-earth RMS voltage.

VTHD Total harmonic distortion of the phase-to-earth voltage.

VTHDF Harmonic distortion of the phase-to-earth voltage referred to the RMS value of the fundamental.

VTHDR Harmonic distortion of the phase-to-earth voltage referred to the total RMS value without DC.

W Unit = watt.

Wh Unit = watt-hour.

20.14. ABBREVIATIONS

Prefixes (of units) of the International System (S.I.)

Prefix	Symbol:	Multiplies by
milli	m	10^{-3}
kilo	k	10^{3}
Mega	M	10^{6}
Giga	G	10^{9}
Tera	T	10^{12}
Peta	P	10^{15}
Exa	E	10^{18}

FRANCE
Chauvin Arnoux
12-16 rue Sarah Bernhardt
92600 Asnières-sur-Seine
Tél : +33 1 44 85 44 85
Fax : +33 1 46 27 73 89
info@chauvin-arnoux.com
www.chauvin-arnoux.com

INTERNATIONAL
Chauvin Arnoux
Tél : +33 1 44 85 44 38
Fax : +33 1 46 27 95 69

Our international contacts
www.chauvin-arnoux.com/contacts

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