

# PEL 51 PEL 52














**Power & Energy Logger**

Thank you for purchasing a **PEL51** or **PEL52 Power & Energy Logger**.

For best results from your device:

- **read** this user manual carefully, and
- **comply** with the precautions for use.

	WARNING, risk of DANGER! The operator must refer to these instructions whenever this danger symbol appears.
	Caution! Risk of electric shock. The voltage applied to parts marked with this symbol may be hazardous.
	Equipment protected by double insulation.
	Useful information or tip.
	SD card.
	Strong magnetic field.
	The product has been declared recyclable after analysis of its life cycle in accordance with the ISO 14040 standard.
	Chauvin Arnoux has adopted an Eco-Design approach in designing this appliance. Analysis of the complete lifecycle has enabled us to control and optimize the effects of the product on the environment. In particular, this appliance exceeds regulation requirements with respect to recycling and reuse.
	The CE marking indicates compliance with the European Low Voltage Directive (2014/35/EU), the Electromagnetic Compatibility Directive (2014/30/EU), the Directive on Radioelectric Equipment (2014/53/EU) and the Directive on the Restriction of Hazardous Substances (RoHS, 2011/65/EU and 2015/863/EU).
	The UKCA marking certifies that the product is compliant with the requirements that apply in the United Kingdom, in particular as regards Low-Voltage Safety, Electromagnetic Compatibility, and the Restriction of Hazardous Substances.
	The rubbish bin with a line through it indicates that, in the European Union, the product must undergo selective disposal in compliance with Directive WEEE 2012/19/EU. This equipment must not be treated as household waste.

### Definition of measurement categories

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

# PRECAUTIONS FOR USE

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This device complies with safety standard IEC/EN 61010-2-30 or BS EN 61010-2-030, the leads comply with IEC/EN 61010-031 or BS EN 61010-031 and the current sensors comply with IEC/EN 61010-2-032 or BS EN 61010-2-032 for voltages up to 600 V in category III.

Failure to observe the safety instructions may result in electric shock, fire, explosion, and/or destruction of the device 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.
- 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 device and leads (or accessories) to that of the leads (or accessories).
- 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.
- 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.
- When removing and inserting the SD card, make sure the device is disconnected and turned off.
- Use personal protection equipment systematically.
- When handling the leads and crocodile clips, keep your fingers behind the physical guard.
- If the device is wet, dry it before connecting it.
- All troubleshooting and metrological checks must be performed by competent and accredited personnel.

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# 1. GETTING STARTED

## 1.1. DELIVERY CONDITION

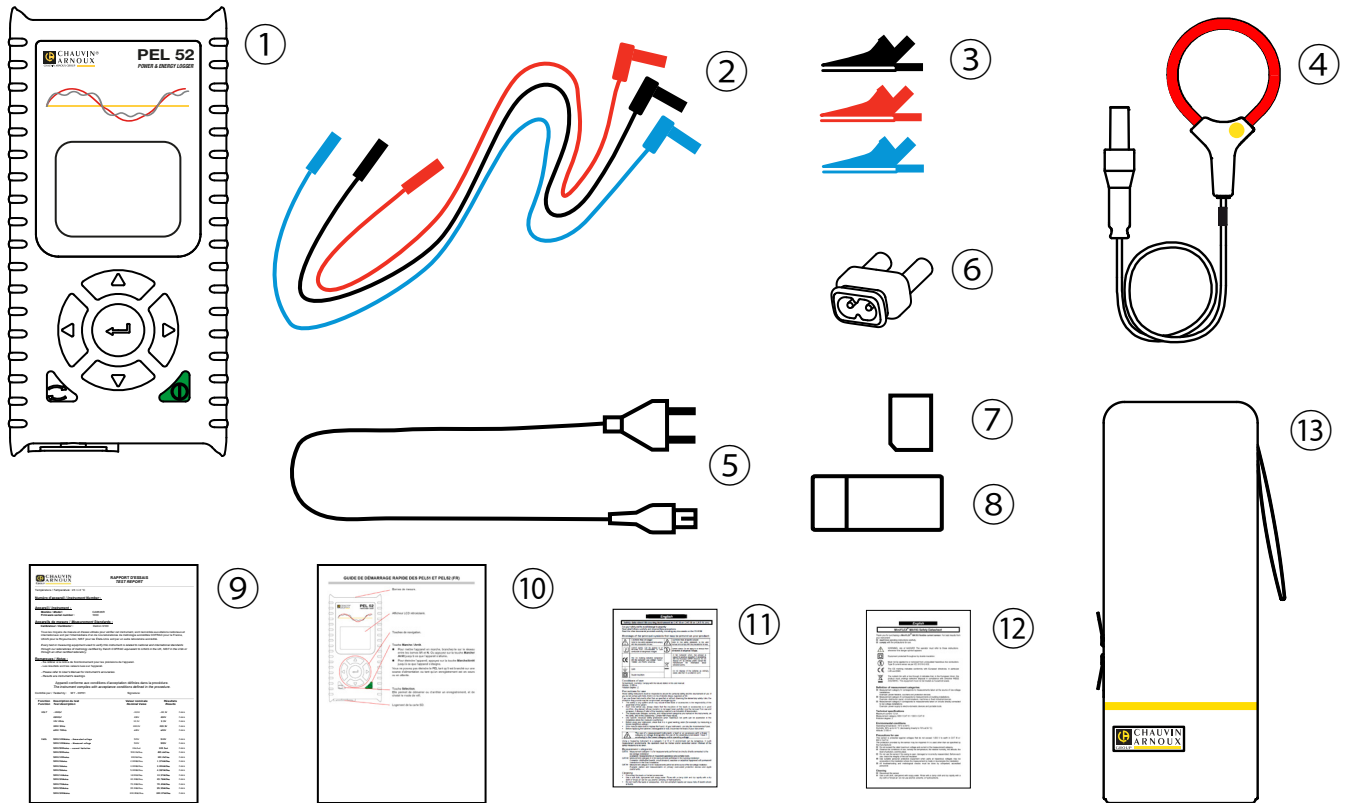


Figure 1

No.	Designation	PEL51	PEL52
①	PEL51 or PEL52	1	1
②	Safety leads, 3 m, banana-banana, straight-straight.	1 red 1 black	1 red, 1 blue, 1 black
③	Crocodile clips.	1 red 1 black	1 red, 1 blue, 1 black
④	MiniFlex MA194 250 mm current sensor.	1	0
⑤	Power cord.	1	1
⑥	C8 male / 2 banana plugs adapter	1	1
⑦	8 GB SD card (in the device).	1	1
⑧	SD card-USB adapter.	1	1
⑨	Test report.	1	1
⑩	Multilingual quick start guide.	1	1
⑪	Multilingual device safety data sheet.	1	1
⑫	Multilingual safety data sheet for current sensors and leads.	2	2
⑬	Carrying bag	1	0

Table 1

## 1.2. ACCESSORIES

- MiniFlex MA194 250 mm
- MiniFlex MA194 350 mm
- MiniFlex MA194 1000 mm
- MN93 clamp
- MN93A clamp
- C193 clamp
- MINI 94 clamp
- AmpFlex® A193 450 mm
- AmpFlex® A193 800 mm
- BNC adapter
- Dataview software

## 1.3. SPARES

- 1.8m power cord
- C8 male / 2 male banana plugs
- Set of 2 safety cables, black and red, banana-banana straight-straight and 2 crocodile clips (for the PEL51).
- Set of 3 black safety cables, banana-banana straight-straight and 3 crocodile clips (for the PEL52).

For accessories and spares, see our website:  
[www.chauvin-arnoux.com](http://www.chauvin-arnoux.com)

## 1.4. CHARGING THE BATTERY

Before first use, fully charge the battery at a temperature between 0 and 40°C.

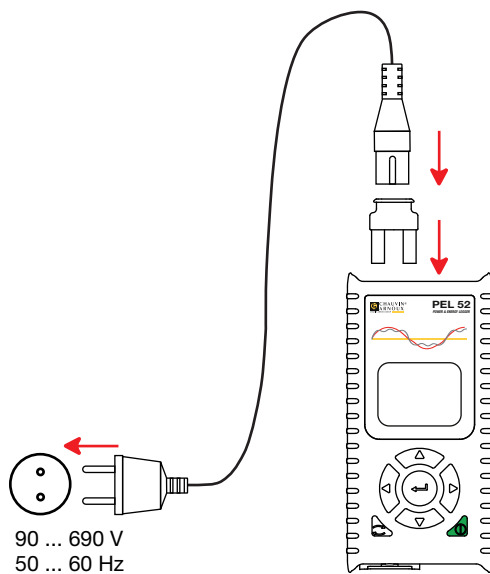



Figure 2

- Connect the C8 / banana adapter between the V1 and N terminals
  - Plug the power cord into the adapter and mains power.
- The device turns on.

The  symbol indicates that charging is in progress. When it is on and steady, the battery is charged.



It takes about 5 hours to charge a discharged battery.

## 2. PRESENTATION OF THE INSTRUMENTS

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### 2.1. DESCRIPTION

#### PEL: Power & Energy Logger

The PEL51 and PEL52 are single-phase and two-phase power and energy loggers that are easy to use. They have a large backlit LCD display and an SD card to store the measurements.

The PEL makes it possible to record voltage, current, power and energy on alternating current distribution grids (50 Hz or 60 Hz). It is designed to operate in 600 V category III or lower environments.

Compact, it fits into many distribution panels. Its housing is waterproof and shock resistant.

It operates on mains power and has a backup battery that recharges directly on the grid during measurements.

It allows the following measurements and calculations to be made:

- Phase-to-neutral and phase-to-phase voltage measurements (PEL52) up to 600 V.
- Current measurements up to 25,000 A with different current sensors.
- Automatic recognition of the different types of current sensors.
- Frequency measurements.
- Measurements of active power P (W), fundamental reactive power Qt (var) and apparent power S (VA) power.
- Measurements of fundamental active power Pf (W), non-active power N (var) and distorting power D (var) using the PEL Transfer application software.
- Measurements of active energy at source and load (Wh), reactive energy on 4 quadrants (varh) and apparent energy (VAh).
- Total energy meter.
- Calculation of  $\cos \varphi$  and power factor (PF).
- Phase angle measurement.
- Calculation of aggregations of values from 1 minute to 1 hour.
- Storage of values on SD, SDHC or SDXC card.
- Communication by wifi.
- PEL Transfer software for data recovery, configuration and communication in real time with a PC.
- Connection to an IRD server to communicate between private networks.

## 2.2. PEL51 AND PEL52

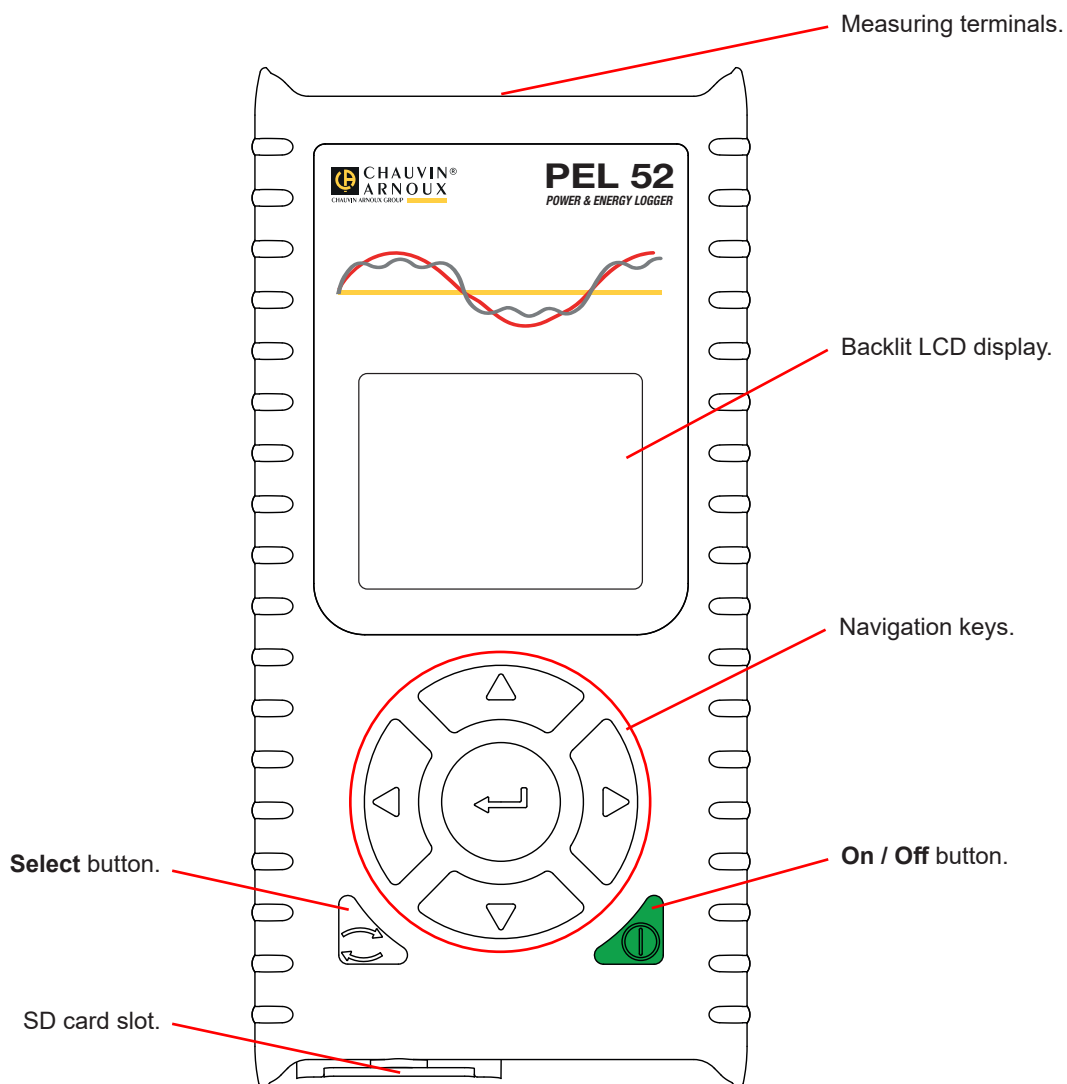


Figure 3

## 2.3. TERMINAL BLOCK

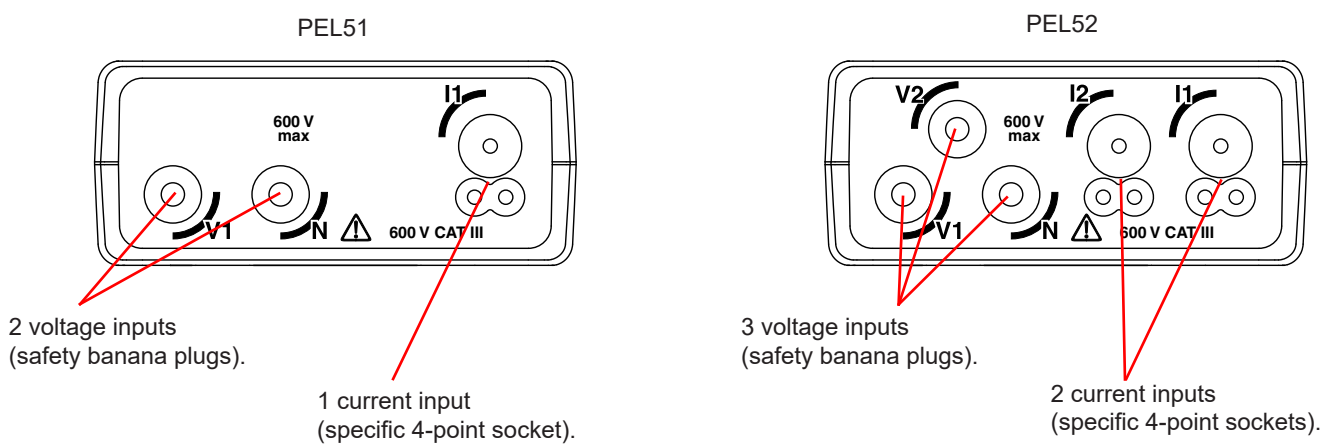


Figure 4



Before connecting a current sensor, consult its safety data sheet or its downloadable user's manual.



## 2.4. REAR

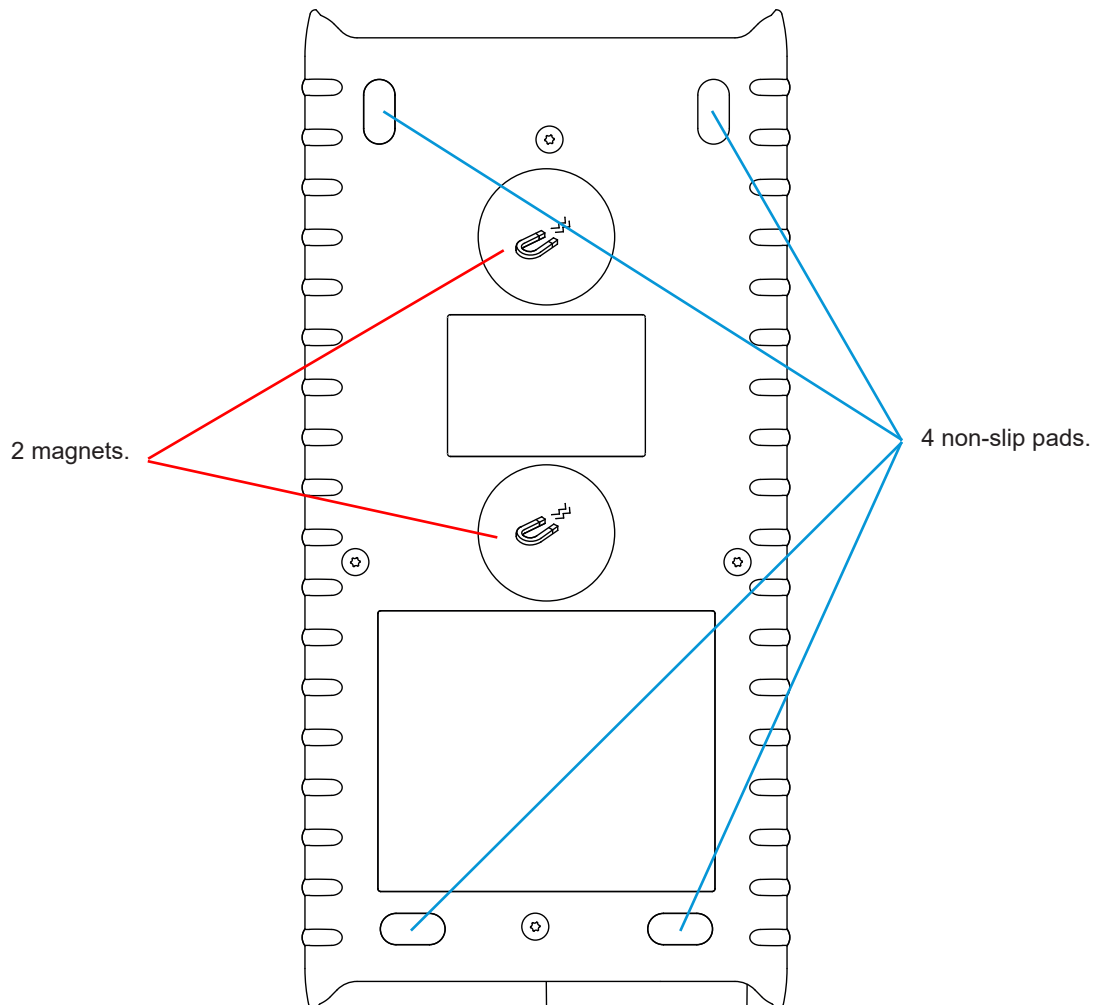



Figure 5

## 2.5. SD CARD SLOT

 The PEL must not be used when the SD card slot is open.

Before opening the SD card slot, disconnect the device and turn it off.

To unlock the protective cap, turn the screw a quarter turn.

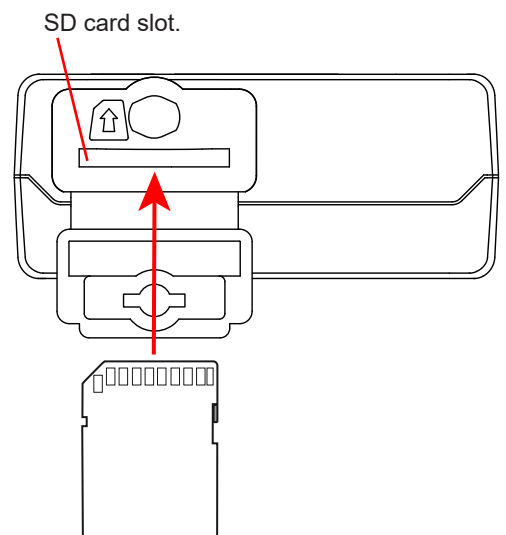
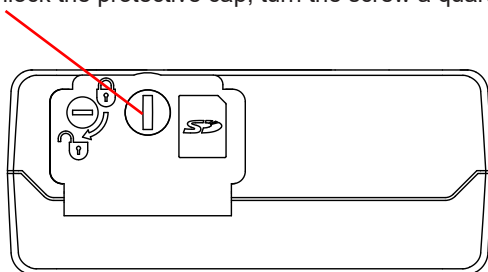


Figure 6

Open the protective cap to access the SD card.

To remove the card, press it down.

To insert the card, press it in the direction shown until you hear a "click".

## 2.6. MOUNTING

As a recorder, the PEL is intended to be installed for a fairly long period in a technical room.

The PEL must be placed in a well ventilated room whose temperature must not exceed the values specified in § 6.5.

The PEL can be mounted on a flat vertical ferromagnetic surface using the magnets incorporated in its housing.



The strong magnetic field of the magnets can damage your hard drives or medical devices.

## 2.7. KEY FUNCTIONS

Key	Description
	<p><b>On / Off button</b> A long press turns the device on or off.</p> <p>The device cannot be turned off while a recording is in progress or pending.</p>
	<p><b>Select key</b> It starts or stops a recording and allows wifi mode to be chosen.</p>
	<p><b>Navigation key</b> Used to configure the device and browse the data displayed.</p>
	<p><b>Enter key</b> In configuration mode, selects a setting to change. In measurement and power display modes, displays phase angles. In select mode, starts or stops a recording. It also allows the type of wifi to be chosen.</p>

Table 2

Pressing any key turns on the display backlighting for 3 minutes.

## 2.8. LCD DISPLAY

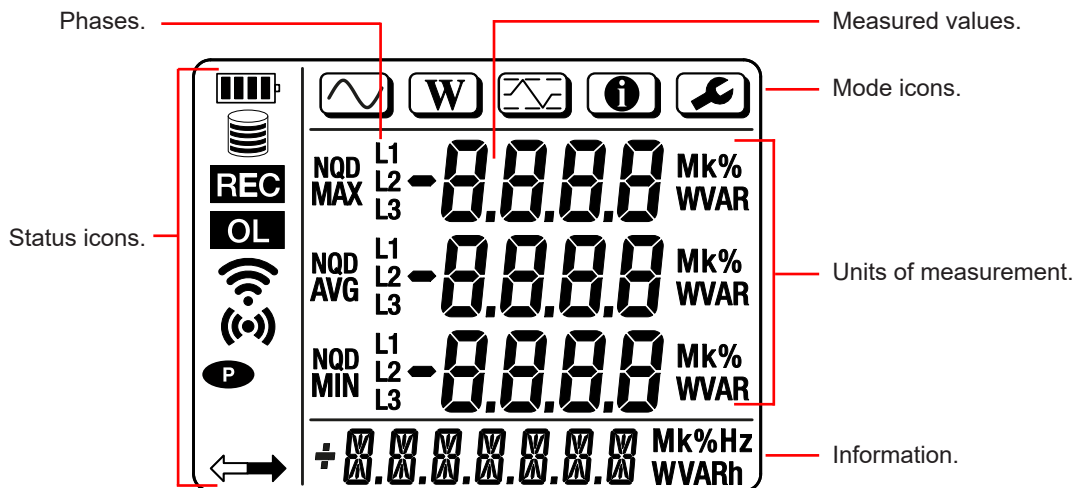


Figure 7

### 2.8.1. STATUS ICONS









Icon	Description
	Indicates battery charge status. When blinking, battery needs charging.
	Indicates memory card is full. When blinking, SD card is missing or locked.
	When blinking, a recording is scheduled. When on and steady, a recording is in progress.
	Indicates an out-of-range value that cannot be displayed. Or that the two current sensors are different (PEL52).
	Indicates active wifi at the access point. When blinking, a transmission is in progress.
	Indicates active wifi at the router. When blinking, a transmission is in progress.
	Indicates the device's automatic shutdown function is disabled. It blinks when the device is operating only on the battery, i.e., when battery charging from the measuring terminals is deactivated.
	Indicates the device is being controlled remotely (by a PC, smartphone or tablet).

Table 3

### 2.8.2. MODE ICONS







Icon	Description
	Measurement mode (instantaneous values).
	Power and energy mode.
	Maximum mode.
	Information mode.
	Configuration mode.


Table 4

## 2.9. MEMORY CARD

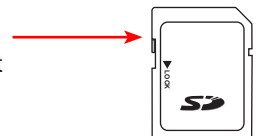
The PEL accepts SD, SDHC and SDXC cards formatted FAT32, up to 32 GB capacity. A 64 GB SDXC card must be formatted as 32 GB on a PC.

The PEL is delivered with a formatted SD card. If you want to install a new SD card:

- Open the elastomer cap marked  (see § 2.5).
- Press the SD card that is in the device and then remove it.

 Do not remove the SD card if there is a recording in progress.

- Check that the new SD card is not locked.
- It is preferable to format the SD card in the device using the PEL Transfer software, otherwise format it using a PC.
- Insert the new card and press it in all the way.
- Replace the elastomer protective cap.



## 3. OPERATION

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The PEL must be configured before any recording. Configuration involves the following steps:

- Establish a wifi connection with the PC (to use the PEL Transfer software, see § 5).
- Select the connection according to the type of distribution network.
- Connect the current sensor(s).
- Define the nominal primary current according to the current sensor used.
- Select the aggregation period.

This configuration is made in Configuration mode (see § 3.2) or with the PEL Transfer software.



In order to avoid accidental changes, the PEL cannot be configured while recording or if there is a recording pending.

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### 3.1. TURNING THE INSTRUMENT ON AND OFF

#### 3.1.1. TURNING ON

- Connect the PEL to the network between the **V1** and **N**, and it will turn on automatically. Otherwise, press the **On/Off** button until the device turns on.

The battery begins to recharge automatically when the PEL is connected to a voltage source between the **V1** and **N** terminals. Battery life is approximately one hour when fully charged. This allows the device to continue operating during brief power cuts.

#### 3.1.2. AUTO OFF

By default, the device operates in continuous mode ( symbol displayed).

When the device is running on battery power, you can choose to have it turn off automatically after a period with no keyboard activity and no recording in progress. This time will be defined in PEL Transfer (see § 5). This saves the battery life.

#### 3.1.3. TURNING OFF

You cannot turn the PEL off while it is connected to a power source or while a recording is in progress or pending. This is a precaution intended to prevent a recording being unintentionally stopped by the user.

To turn the PEL off:

- Disconnect the PEL.
- Press the **On/Off** button until the device turns off.


#### 3.1.4. BATTERY OPERATION

In certain applications, such as measurements on low fan-out generators, powering the device from the network can disturb the measurement.

To operate on the battery alone, press  and  keys simultaneously. The  symbol blinks.

### 3.2. CONFIGURING THE INSTRUMENT

Several main functions can be configured directly on the device. For full configuration, use the PEL Transfer software (see § 5) once wifi communication has been established.

To enter Configuration mode from the device, press the ◀ or ▶ keys until the  symbol is selected.

The following screen is displayed:

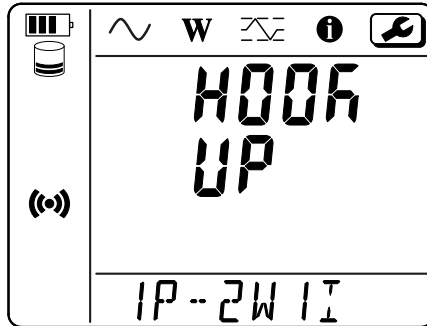



Figure 8

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 If the PEL is already being configured from the PEL Transfer software, it is not possible to enter Configuration mode on the device. In this case, when an attempt is made to configure it, the screen displays **LOCK**.

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#### 3.2.1. NETWORK TYPE (PEL52)

To change the network, press the ◀ key.

- 1P-2W1I: Single-phase 2-wire with a current sensor
- 1P-3W2I: Single-phase 3-wire (2 voltages in phase) with two current sensors
- 2P-3W2I: Two-phase 3-wires (2 voltages in opposite phases) with two current sensors

#### 3.2.2. WIFI

Press the ▼ key to go to the following screen.

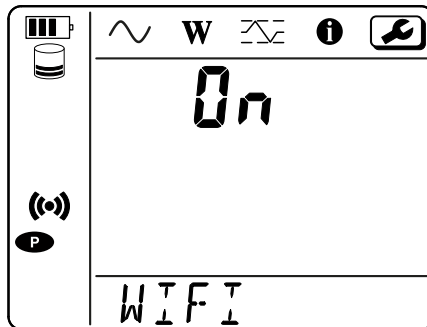





Figure 9



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 For the wifi to operate, the battery must be sufficiently charged ( or .

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Press the ◀ key to activate or deactivate the wifi. If the battery is too low, the device indicates it and activation is not possible.

#### To establish a wifi connection

- Enable wifi.
- This connection then lets you connect your PC to any other device such as a smartphone or a tablet. The connection procedure is detailed below.

### 1) Wifi access point connection procedure

The first connection must be made in wifi access point mode.

- Press the **Select**  first. The device displays **START REC. PUSH ENTER TO START RECORDING.**
- Press the  key a second time and the device displays **(W) WIFI ST. PUSH ENTER FOR WIFI ST, (W) WIFI OFF. PUSH ENTER FOR WIFI OFF or WIFI AP. PUSH ENTER FOR WIFI AP.**

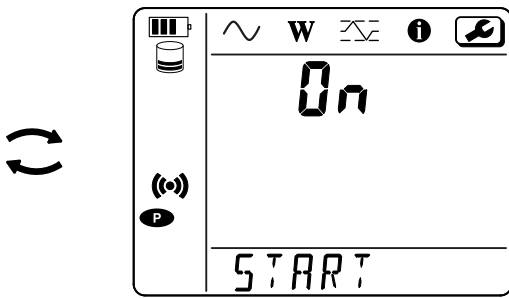


Figure 10

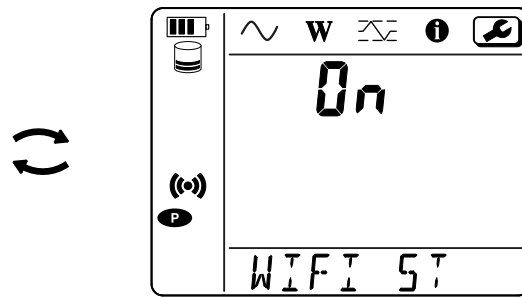


Figure 11

Change with the  key to have **(W) WIFI AP.**

Your device's IP address, shown in the information menu, is 192.168.2.1 3041 UDP.

- Connect your PC to the device's wifi.  
In the Windows status bar, click the connection symbol.  
Select your device from the list.

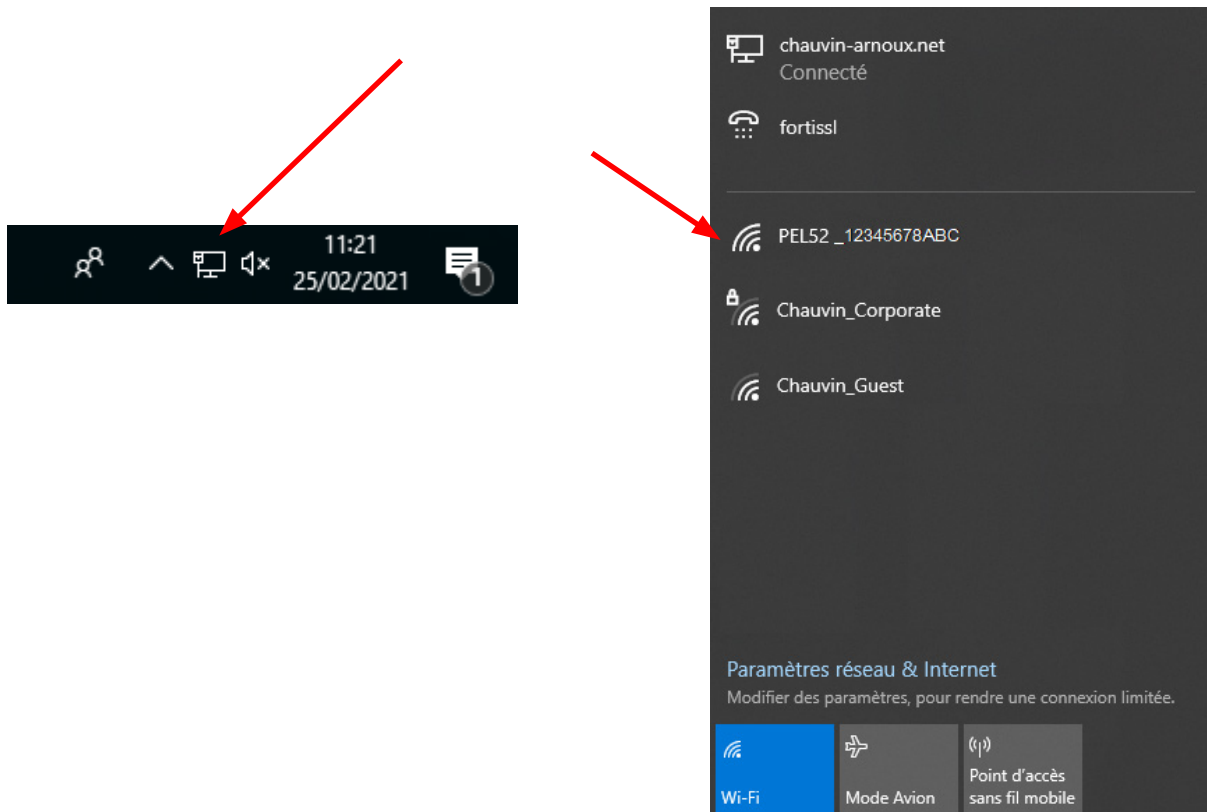


Figure 12

- Start the PEL Transfer application software (see § 5).
- Go to **Device, Add a device, PEL51 or PEL52, to Wifi access point.**

This connection to the PEL Transfer software lets you:


- Configure the device,
- Access real-time measurements,
- Upload the recordings,
- Change the access point SSID name and secure it with a password,
- Enter the SSID and password for a wifi network to which the device can connect,
- Enter the IRD server password, allowing the device to access separate private networks.

If the username and password are lost, you can reset to factory configuration (see § 3.2.5)

## 2) Wifi connection procedure (continued)

Once your device is connected to a wifi access point, you can connect it to a wifi router. This will allow you to access your device from a smartphone or tablet, or even from an IRD network through a public or private network.

### Configuration of the wifi router connection

- In PEL Transfer, go to the Configuration menu , **Communication** tab, and enter the network name (SSID) and password in the box **Wifi router connection**, port 3041, UDP protocol. The SSID is the name of the network you want to connect to. It can be the network of your smartphone or tablet in access point mode.

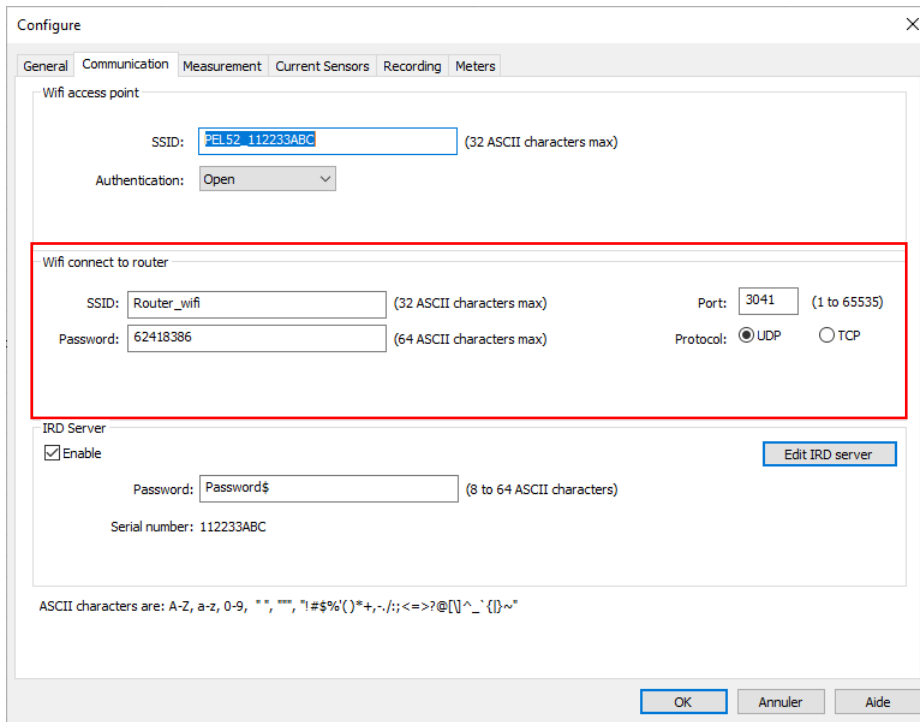







Figure 13

- Click **OK** to load the configuration into the device.
- Press twice on the **Select**  button on the device, then twice on the  key to switch to  **WIFI ST**. Your device connects to this wifi network. The wifi access point connection is lost.

Once the PEL is connected to the network, you can find its IP address in information mode .

- In PEL Transfer, change the connection  to **Ethernet (LAN or wifi)** and enter the IP address of your device, port 3041, UDP protocol.  
This lets you connect several PELs on the same network.

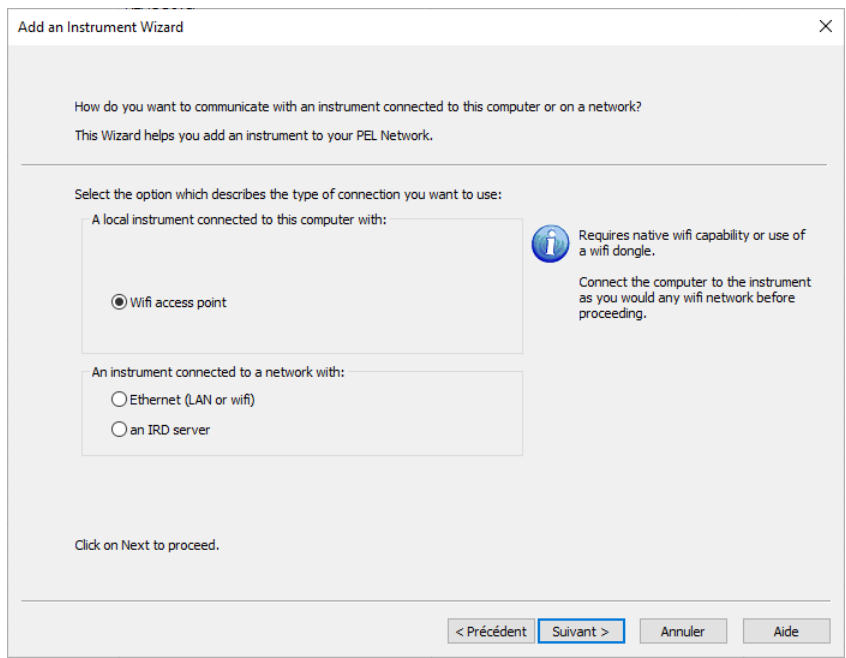




Figure 14

**Configuration of the IRD server connection**

- To connect the PEL to the IRD server, it must be in  **WIFI ST** and the network to which it is connected must have internet access to be able to access the IRD server.
- Go to PEL Transfer, then to the Configuration menu , **Communication** tab. Enable the IRD server and enter the password that will be used to connect afterwards.

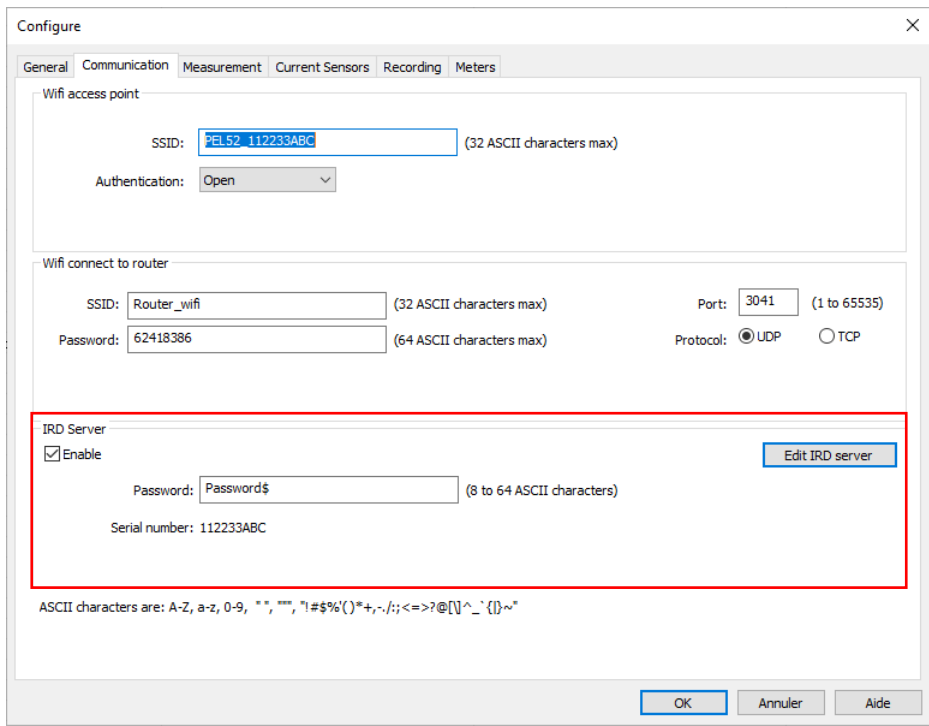


Figure 15



### 3.2.3. NOMINAL PRIMARY CURRENT

Press the ▼ key to go to the following screen.

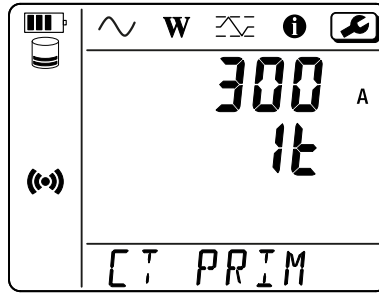


Figure 16

Connect the current sensor(s).

The current sensor is automatically detected by the device.

For the PEL52, if two current sensors are connected, they must be identical.

For AmpFlex® or MiniFlex sensors, press the ← key to select 300 or 3000 A.

The nominal currents of current sensors are as follows:

Sensor	Nominal current	Choice of gain	Number of turns
C193 clamp	1,000 A	✘	✘
AmpFlex® A193 MiniFlex MA194	300 or 3,000 A	✔	1, 2 or 3 to be configured in PEL Transfer
MN93A clamp 5 A calibre	5 A	to be configured in PEL Transfer	✘
MN93A clamp 100 A calibre	100 A	✘	✘
MN93 clamp	200 A	✘	✘
MINI 94 clamp	200 A	✘	✘
BNC adapter	1,000 A	to be configured in PEL Transfer	✘

Table 5

### 3.2.4. AGGREGATION PERIOD

Press the ▼ key to go to the following screen.

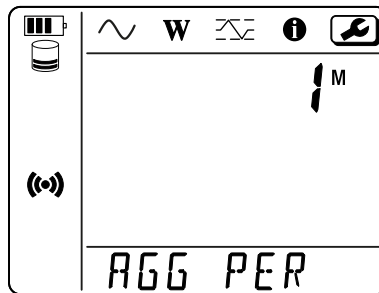


Figure 17

To change the aggregation period, press the ← key: 1, 2, 3, 4, 5 à 6, 10, 12, 15, 20, 30 or 60 minutes.

### 3.2.5. RESET

Press the ▼ key to go to the following screen.

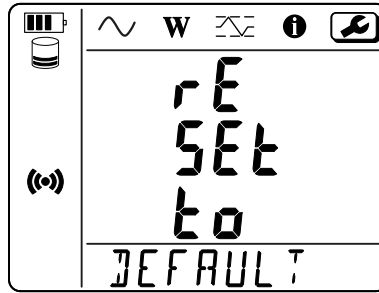


Figure 18

To reset the device to the default wifi configuration (direct wifi, password deleted), press the ← key. The device asks for confirmation before performing the reset. Press the ← key to confirm and any other key to cancel.

### 3.3. REMOTE USER INTERFACE

The remote user interface runs on a PC, tablet or smartphone. It allows you to view device information.

- Enable wifi on the PEL. The remote user interface can work with an access point wifi ((•)) link or a router wifi (•••) link but not an IRD server link.
- On a PC, connect as indicated in §3.2.2.  
On a tablet or smartphone, share a wifi connection.
- In an Internet browser, enter `http://device_IP_address`.  
For a wifi access point ((•)) connection, enter <http://192.168.2.1>  
For a wifi router (•••) connection, this address is indicated in the information menu (see §3.4).

The following screen will be displayed:

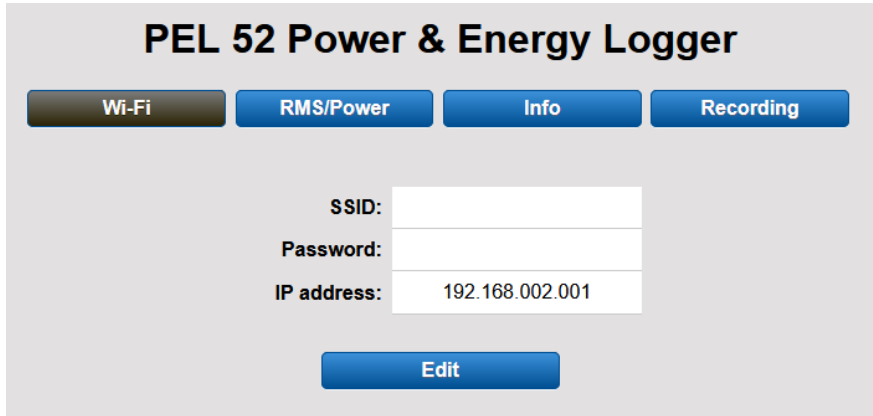


Figure 19



Refreshing the display is not automatic. You need to do this regularly.

On the second tab, you can view the measurements:

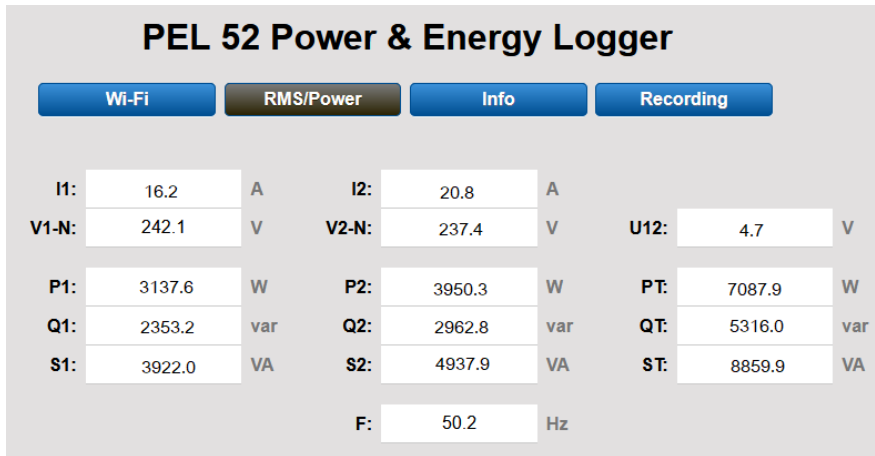


Figure 20

On the third tab, you can view the device information:

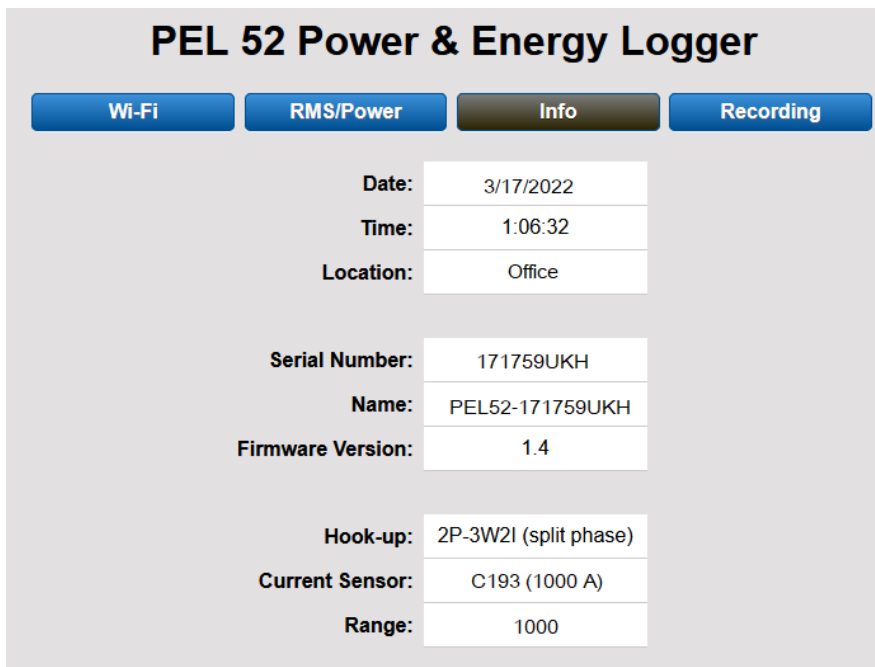


Figure 21

On the fourth tab, you can view information about the current recording or the last recording made.

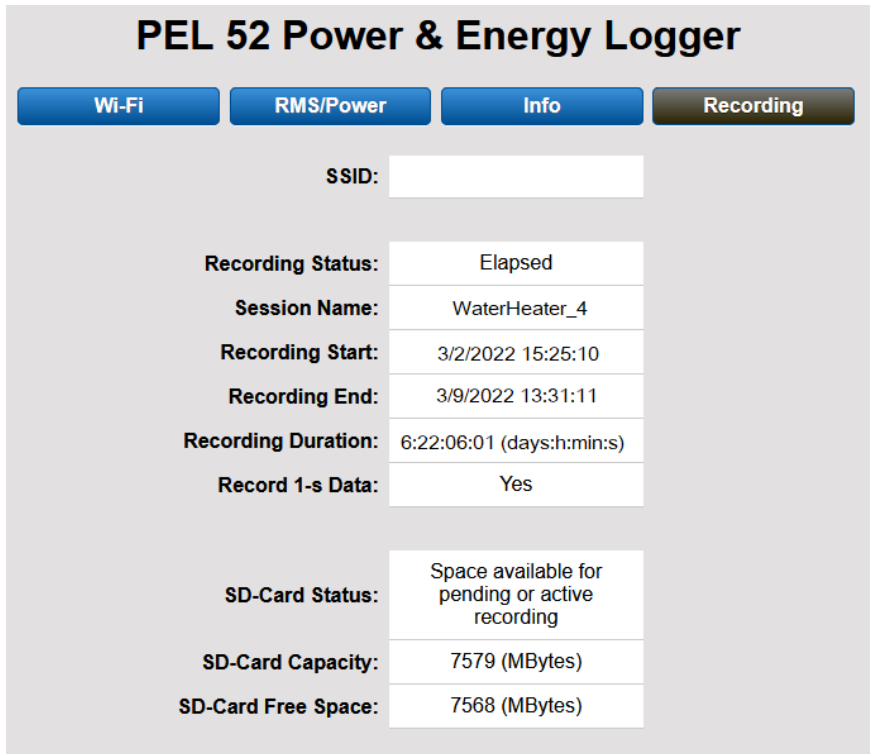


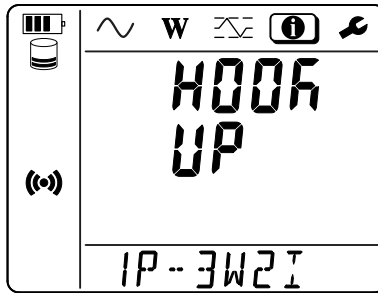
Figure 22

### 3.4. INFORMATION

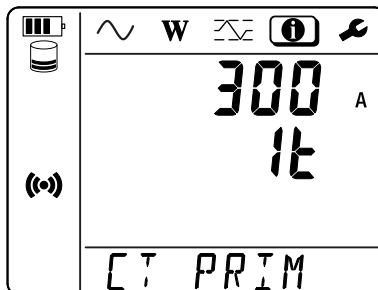
To enter Information mode, press the ◀ or ▶ keys until the  symbol is selected.

Using the ▲ and ▼ keys, scroll through the device information:

- Type of network

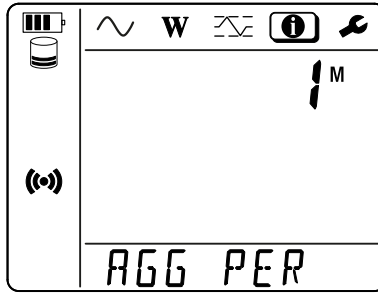


- Nominal primary current and number of turns: 1t, 2t or 3t (to be defined via PEL Transfer for Flex type current sensors)

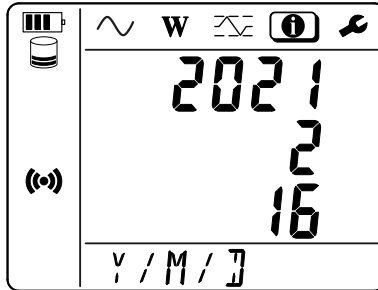


- C193 clamp: 1,000 A
- AmpFlex® or MiniFlex: 300 or 3,000 A
- MN93A clamp 5 A calibre: 5 A modifiable
- MN93A clamp 100 A calibre: 100 A
- MN93 clamp: 200 A
- Mini 94 clamp: 200 A
- BNC adapter: 1,000 A modifiable

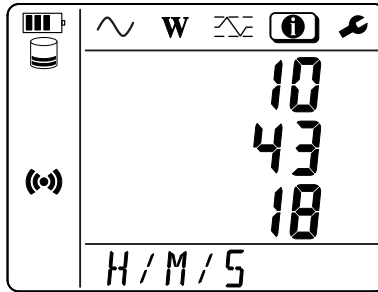
- Aggregation period



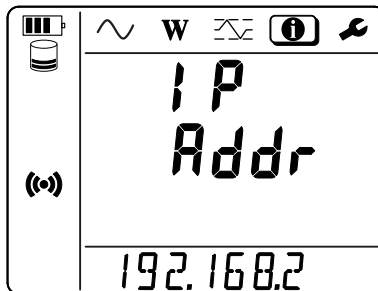
- Date  
Year, month, day



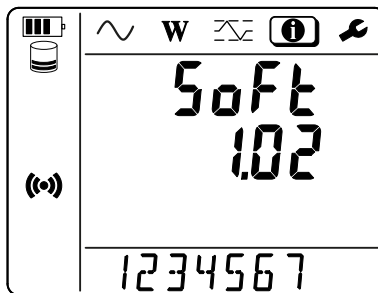
- Time  
Hour, minute, second



- IP address (scrolling)



- Software version and scrolling  
serial number,

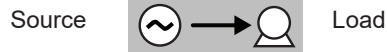


## 4. USE

Once the device has been configured, it is ready for use.

### 4.1. DISTRIBUTION NETWORKS AND CONNECTIONS OF THE PEL

Connect the current sensors and voltage measurement leads on your installation according to the type of distribution network.



Always check that the arrow on the current sensor is pointing towards the load. In this way the phase angle will be correct for power measurements and other phase dependent measurements. Otherwise, the PEL Transfer software allows the phase of a current sensor to be reversed under certain conditions.

#### 4.1.1. SINGLE-PHASE 2-WIRE: 1P-2W1I

For single-phase 2-wire measurements:

- Connect the N measuring lead to the neutral conductor.
- Connect the V1 measuring lead to the L1 phase conductor.
- Connect the I1 current sensor to the L1 phase conductor.

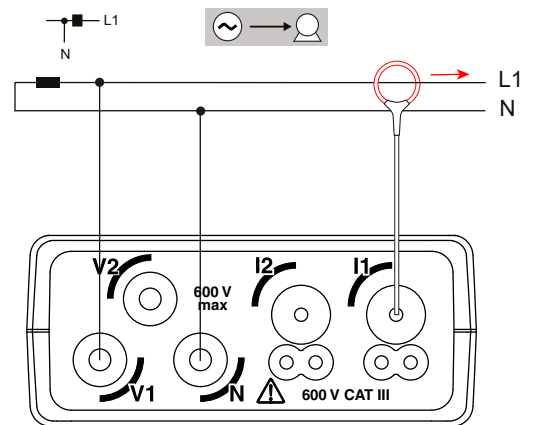


Figure 23

#### 4.1.2. SINGLE-PHASE 3-WIRE 2-CURRENTS: 1P-3W2I (PEL52)

For single-phase 3-wire measurements with 2 current sensors:

- Connect the N measuring lead to the neutral conductor.
- Connect the V1 measuring lead to the L1-I1 phase conductor.
- Connect the V2 measuring lead to the L1-I2 phase conductor.
- Connect the I1 current sensor to the L1 phase conductor.
- Connect the I2 current sensor to the L2 phase conductor.

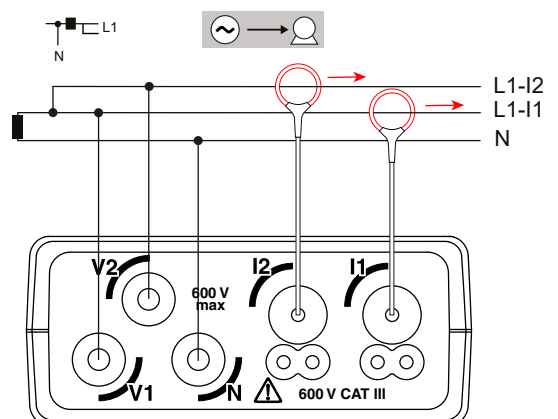


Figure 24

### 4.1.3. TWO-PHASE 3-WIRE (TWO-PHASE FROM A MID-TAP TRANSFORMER): 2P-3W2I (PEL52)

For two-phase 3-wire measurements with 2 current sensors:

- Connect the N measuring lead to the neutral conductor.
- Connect the V1 measuring lead to the L1 phase conductor.
- Connect the V2 measuring lead to the L2 phase conductor.
- Connect the I1 current sensor to the L1 phase conductor.
- Connect the I2 current sensor to the L2 phase conductor.

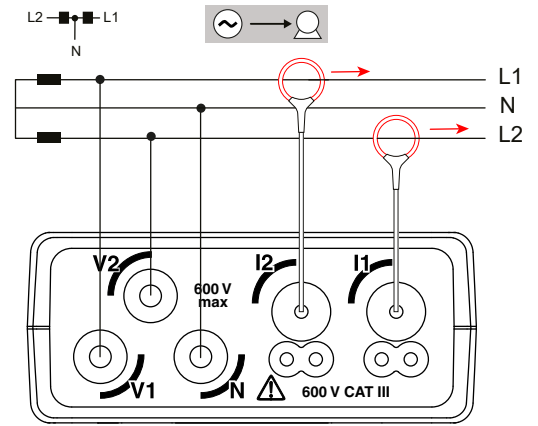


Figure 25

## 4.2. RECORDING

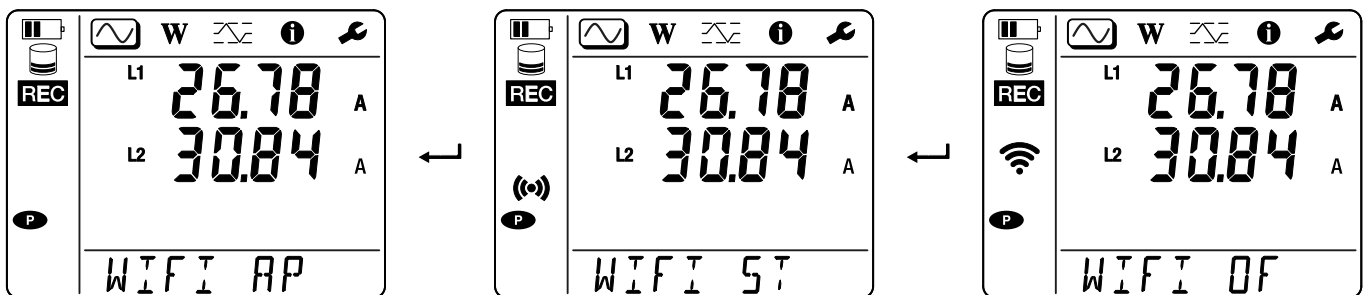
To start a recording:

- Check that there is an SD card in the PEL (not locked and with sufficient space).
- Press the **Select** key first. The device displays **START**. If it displays **INSERT SD CARD**, there is no SD card in the device. If it displays **SD CARD WRITE PROTECT**, it is locked. In either case, recordings cannot be made.
- Confirm with the **←** key. The **REC** symbol blinks.

To stop recording, repeat in exactly the same way. The **REC** symbol disappears.

Recordings can be managed from PEL Transfer (see § 5).

While recording, the device configuration cannot be modified. To enable or disable wifi, press the **Select** key twice, then the **←** key to choose **WIFI AP**, **WIFI ST** or no wifi.



## 4.3. MEASURED VALUE DISPLAY MODES

The PEL has 3 measurement display modes, **W** and **V**, represented by the icons at the top of the display. To switch from one mode to another, use the **◀** or **▶** keys.

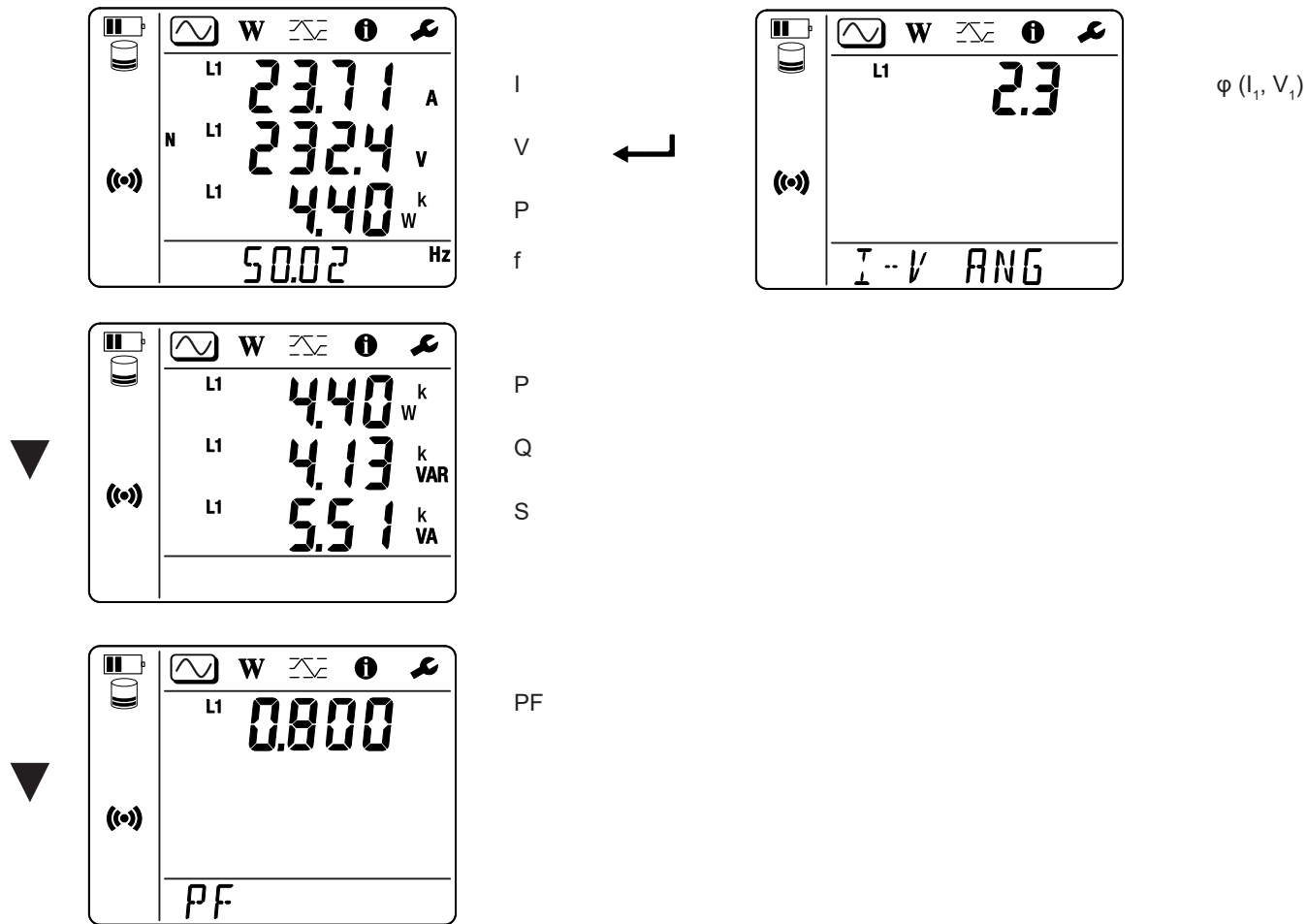
The displays can be accessed as soon as the PEL is turned on but the values are at zero. As soon as voltage or current is present at the inputs, the values are updated.

### 4.3.1. MEASUREMENT MODE

This mode displays the instantaneous values: voltage (V), current (I), active power (P), reactive power (Q), apparent power (S), frequency (f), power factor (PF), phase shift ( $\phi$ ).

The display depends on the configured network. Press the  $\blacktriangledown$  key to switch from one screen to the next.

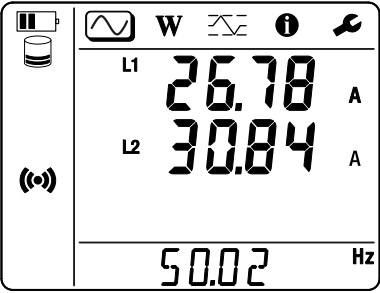

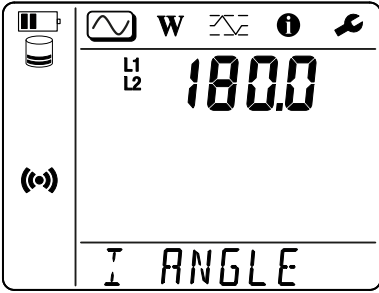
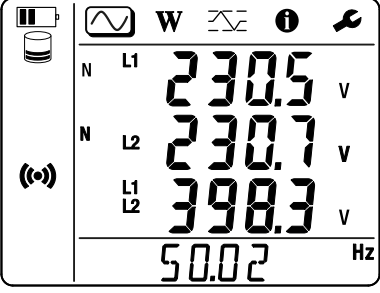

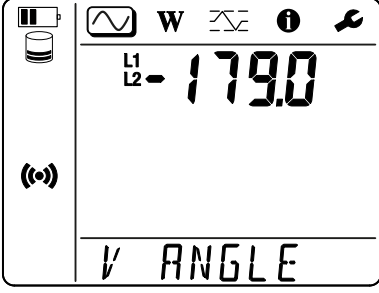
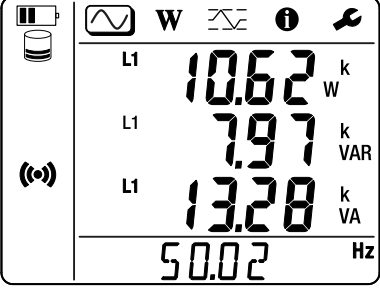

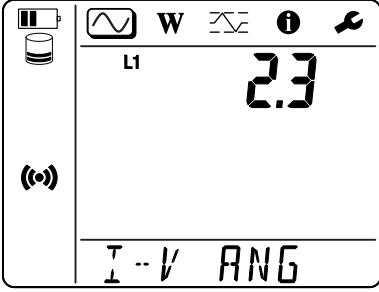
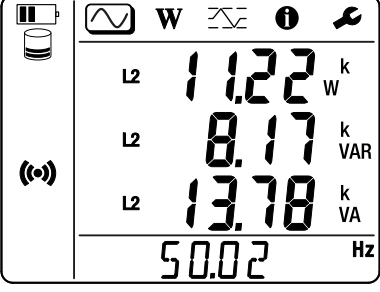

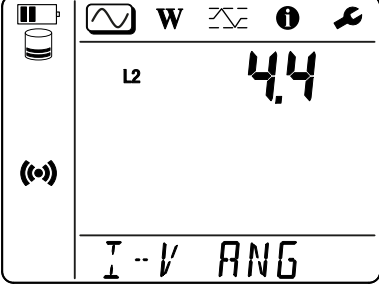
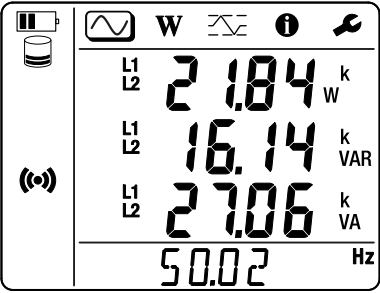

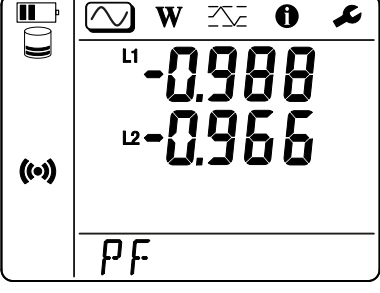
#### Single-phase 2-wire (1P-2W1I)



If the current sensor is not detected, all the quantities that depend on the current (current, angle, powers, PF) are undefined (displays - - - -).



Single-phase 3-wire 2-currents (1P-3W2I) and two-phase 3-wire (2P-3W2I) (PEL52)

▼		$I_1$ $I_2$ $f$			$\varphi (I_2, I_1)$
▼		$V_1$ $V_2$ $U_{12}$ $f$			$\varphi (V_2, V_1)$
▼		$P$ $Q$ $S$ $f$			$\varphi (I_1, V_1)$
▼		$P$ $Q$ $S$ $f$			$\varphi (I_2, V_2)$
▼		$P$ $Q$ $S$		<p>Sum of powers on L1 and L2.</p>	
▼		$PF_1$ $PF_2$			<p>If a current sensor is not detected, all the quantities that depend on this current (current, angle, powers, PF) are undefined (displays - - - -).</p>

### 4.3.2. ENERGY MODE

This mode displays the energy: active energy (Wh), reactive energy (varh), apparent energy (VAh).

The energies displayed are the total energies, of the source or of the load. The energy depends on the duration.

Press the  $\blacktriangledown$  key to switch from one screen to the next. You will scroll successively:

- Ep+: Total active energy consumed (by the load) in Wh
- Ep-: Total active energy supplied (by the source) in Wh
- Eq1: Reactive energy consumed (by the load) in the inductive quadrant (quadrant 1) in varh.
- Eq2: Reactive energy supplied (by the source) in the capacitive quadrant (quadrant 2) in varh.
- Eq3: Reactive energy supplied (by the source) in the inductive quadrant (quadrant 3) in varh.
- Eq4: Reactive energy consumed (by the load) in the capacitive quadrant (quadrant 4) in varh.
- Es+: Total apparent energy consumed (by the load) in VAh
- Es-: Total apparent energy supplied (by the source) in VAh

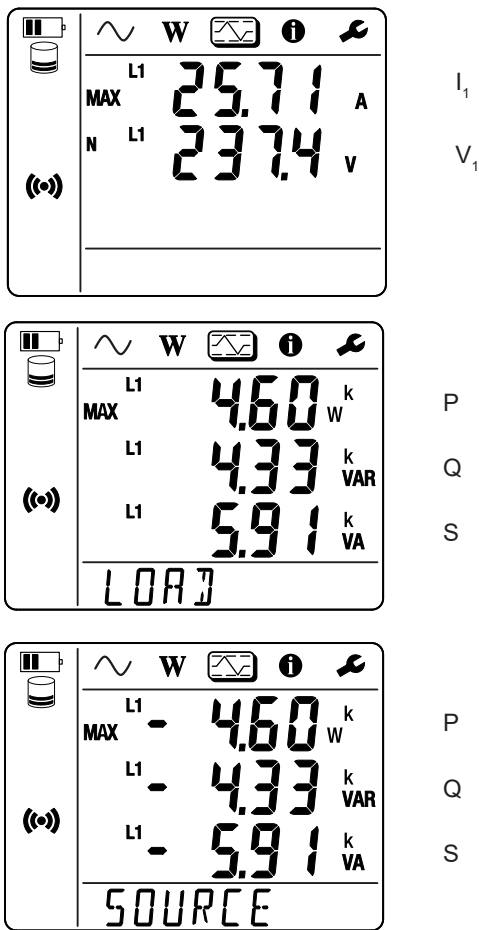
The device does not display the "h" symbol. Therefore you will see "W" for "Wh".

### 4.3.3. MAXIMUM MODE

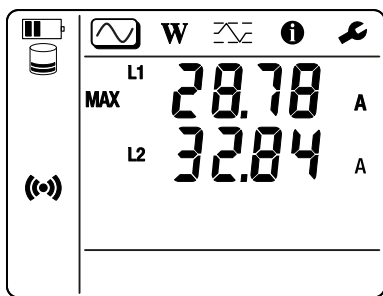
This mode displays the maximum values: maximum aggregated values of measurements and energy.

Depending on the option selected in PEL Transfer, these may be the maximum aggregated values for the recording in progress or the maximum aggregated values of the last recording, or the maximum aggregated values since the last reset to zero.

#### Single-phase 2-wire (1P-2W1I)

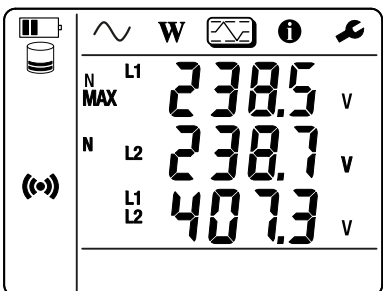


Single-phase 3-wire 2-currents (1P-3W2I) and two-phase 3-wire (2P-3W2I) (PEL52)



$I_1$

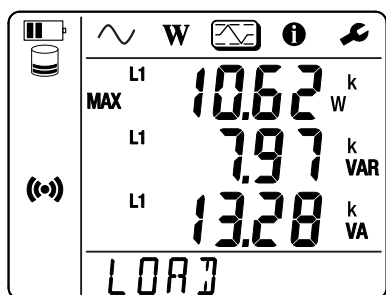
$I_2$



$V_1$

$V_2$

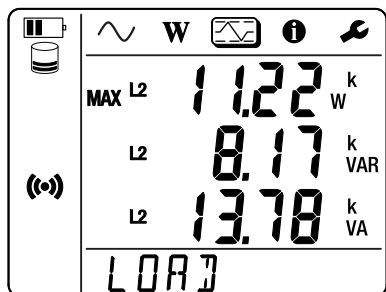
$U_{12}$



P

Q

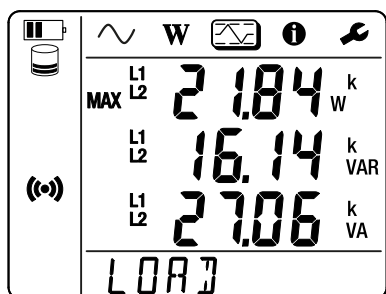
S



P

Q

S

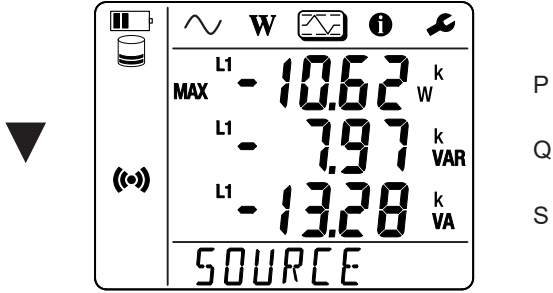


P

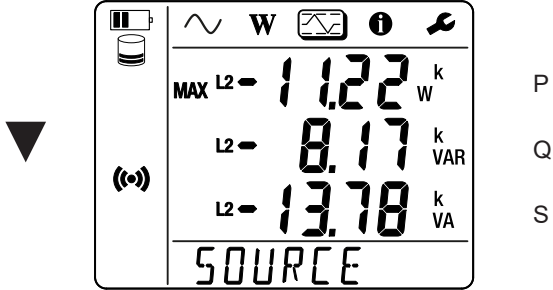
Q

S

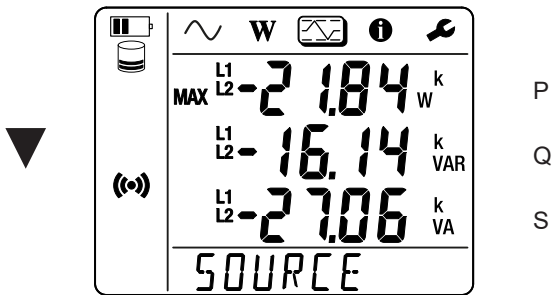
Sum of powers on the load on L1 and L2.



P  
Q  
S



P  
Q  
S




P  
Q  
S

Sum of powers on the source on L1 and L2.

# 5. PEL TRANSFER SOFTWARE

## 5.1. FUNCTIONS

The PEL Transfer software lets you:

- Connect the device to the PC by wifi.
- Configure the device: give the device a name, set the automatic power-off delay, choose the refresh rate for the maximum values, lock the device's **Select key** , prevent battery charging during measurement, set a device configuration password, set date and time, format the SD card, etc.
- Configure communication between the device, PC and network.
- Configure measurement: choose the distribution network.
- Configure the current sensors: the transformation ratio and number of turns, if necessary.
- Configure recordings: choose their names, duration, start and end date, aggregation period.
- Reset the energy meters to zero.

PEL Transfer also allows recordings to be opened, uploaded to the PC and exported to a spreadsheet, as well displaying the corresponding curves and creating and printing reports.

It also allows the firmware of the device to be updated when a new update is available.

## 5.2. INSTALLING PEL TRANSFER

1. Download the latest version of PEL Transfer from our website.  
[www.chauvin-arnoux.com](http://www.chauvin-arnoux.com)

Go to the **Support** section and search for **PEL Transfer**.

Download the software to your PC.

Launch **setup.exe**. Then follow the installation instructions.



You must have administrator rights on your PC to install the PEL Transfer software.

---

2. A warning message similar to the one below appears. Click **OK**.  
There is no USB connection on the PEL 51 and 52, so ignore this automatic message which applies to other devices in the PEL range.

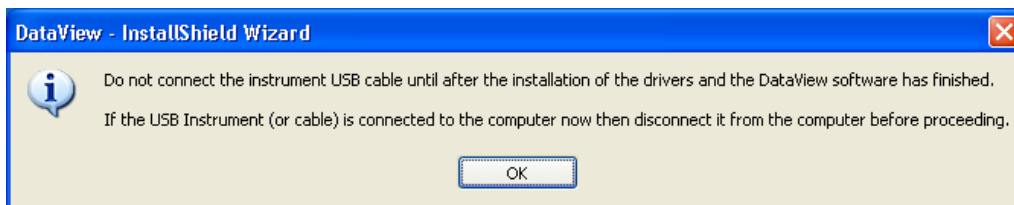



Figure 26



Installing the drivers may take some time. Windows may even indicate that the program is not responding, although it is still running. Wait until it is finished.

---

3. When driver installation is finished, the dialogue box **Installation successful** is displayed. Click **OK**.
4. The **Install Shield Wizard completed** window then displays. Click **Finish**.
5. If necessary, restart the computer.

A shortcut has been added to your desktop  or in the Dataview directory.

You can now open PEL Transfer and connect your PEL to the computer.



For background information on using PEL Transfer, see the software Help.

---

## 6. TECHNICAL SPECIFICATIONS

### 6.1. REFERENCE CONDITIONS

Parameter	Reference conditions
Ambient temperature	23 ± 2 °C
Relative humidity	45 to 75% RH
Voltage	No DC component
Current	No DC component
Phase voltage	[100 VRMS; 600 VRMS] without DC (< 0.5%)
Input voltage of current inputs (except AmpFlex® / MiniFlex)	[50 mV; 1.2 V] without DC (< 0.5%)
Network frequency	50 Hz ± 0.1 Hz and 60 Hz ± 0.1 Hz
Harmonics	< 0.1%
Preheating	The device must have been powered up for at least one hour.
Common mode	The neutral input and the casing are grounded.
	The device is powered by the battery.
Magnetic field	0 A/m AC
Electrical field	0 V/m AC

Table 6

### 6.2. ELECTRICAL PROPERTIES

Uncertainties are expressed in % of reading (R) and an offset:  
± (a % R + b)

#### 6.2.1. VOLTAGE INPUTS

**Operating range** up to 600 VRMS for phase-neutral voltages and 1200 VRMS for phase-phase voltages from 45 to 65 Hz.



Phase-to-neutral voltages less than 2 V and phase-to-phase voltages less than 3.4 V are set to zero.

**Input impedance** 903 kΩ when the device is running on battery.  
When the device is powered by the voltage at the terminals, the impedance on L1 is dynamic and the current source must be able to deliver up to 100 mA at 100 V and 500 mA at 600 V.

**Sustained overload** 660 V.

Above 690 V, the device displays the **OL** symbol.

#### 6.2.2. CURRENT INPUTS



The outputs from current sensors are voltages.

**Operating range** 0.5 mV to 1.7 V<sub>peak</sub>

**Peak factor**  $\sqrt{2}$  except AmpFlex® / MiniFlex current sensors see Table 16.

**Input impedance** 1 MΩ (except AmpFlex® / MiniFlex current sensors)  
12.4 kΩ (AmpFlex® / MiniFlex current sensors)

**Maximum overload** 1.7 V

### 6.2.3. INTRINSIC UNCERTAINTY (EXCLUDING CURRENT SENSORS)

With:

- R: displayed value.
- $I_{nom}$ : nominal current of the current sensor for an output of 1 V, see Table 15 and Table 16.
- $P_{nom}$  and  $S_{nom}$ : active and apparent power for  $V = 230$  V,  $I = I_{nom}$  and  $PF = 1$ .
- $Q_{nom}$ : reactive power for  $V = 230$  V,  $I = I_{nom}$  and  $\sin \varphi = 0.5$ .

#### 6.2.3.1. Specifications of the PEL

$I_{nom}$  see Table 15 and Table 16.

Quantities	Measurement range	Intrinsic uncertainty
Frequency (f)	[45 Hz; 65 Hz]	$\pm 0.1$ Hz
Phase-neutral voltage ( $V_1, V_2$ )	[10 V; 600 V]	$\pm 0.2\%$ R $\pm 0.2$ V
Phase-phase voltage ( $U_{12}$ )	[20 V; 1200 V]	$\pm 0.2\%$ R $\pm 0.4$ V
Current ( $I_1, I_2$ )	$[0.2\% I_{nom}; 120\% I_{nom}]$	$\pm 0.2\%$ R $\pm 0.02\%$ $I_{nom}$
Active power ( $P_1, P_2, P_T$ ) kW	PF = 1 V = [100 V; 600 V] I = $[5\% I_{nom}; 120\% I_{nom}]$	$\pm 0.3\%$ R $\pm 0.003\%$ $P_{nom}$
	PF = [0.5 inductive; 0.8 capacitive] V = [100 V; 600 V] I = $[5\% I_{nom}; 120\% I_{nom}]$	$\pm 0.7\%$ R $\pm 0.007\%$ $P_{nom}$
Reactive power ( $Q_1, Q_2, Q_T$ ) kvar	Sin $\varphi$ = [0.8 inductive; 0.6 capacitive] V = [100 V; 600 V] I = $[5\% I_{nom}; 10\% I_{nom}]$	$\pm 2\%$ R $\pm 0.02\%$ $Q_{nom}$
	Sin $\varphi$ = [0.8 inductive; 0.6 capacitive] V = [100 V; 600 V] I = $[10\% I_{nom}; 120\% I_{nom}]$	$\pm 1\%$ R $\pm 0.01\%$ $Q_{nom}$
Apparent power ( $S_1, S_2, S_T$ ) kVA	V = [100 V; 600 V] I = $[5\% I_{nom}; 120\% I_{nom}]$	$\pm 0.3\%$ R $\pm 0.003\%$ $S_{nom}$
Power factor (PF <sub>1</sub> , PF <sub>2</sub> , PF <sub>T</sub> )	PF = [0.5 inductive; 0.5 capacitive] V = [100 V; 600 V] I = $[5\% I_{nom}; 120\% I_{nom}]$	$\pm 0.02$
	PF = [0.2 inductive; 0.2 capacitive] V = [100 V; 600 V] I = $[5\% I_{nom}; 120\% I_{nom}]$	$\pm 0.05$
Cos $\varphi$ (Cos $\varphi_1, \text{Cos } \varphi_2, \text{Cos } \varphi_T$ )	Cos $\varphi$ = [0.5 inductive; 0.5 capacitive] V = [100 V; 600 V] I = $[5\% I_{nom}; 120\% I_{nom}]$	$\pm 0.05$
	Cos $\varphi$ = [0.2 inductive; 0.2 capacitive] V = [100 V; 600 V] I = $[5\% I_{nom}; 120\% I_{nom}]$	$\pm 0.1$
Active energy (Ep <sub>1</sub> , Ep <sub>2</sub> , Ep <sub>T</sub> ) kWh	PF = 1 V = [100 V; 600 V] I = $[5\% I_{nom}; 120\% I_{nom}]$	$\pm 0.5\%$ R
	PF = [0.5 inductive; 0.8 capacitive] V = [100 V; 600 V] I = $[5\% I_{nom}; 120\% I_{nom}]$	$\pm 0.6\%$ R
Reactive energy (Eq <sub>1</sub> , Eq <sub>2</sub> , Eq <sub>T</sub> ) kvarh	Sin $\varphi$ = [0.8 inductive; 0.6 capacitive] V = [100 V; 600 V] I = $[5\% I_{nom}; 10\% I_{nom}]$	$\pm 2.5\%$ R
	Sin $\varphi$ = [0.8 inductive; 0.6 capacitive] V = [100 V; 600 V] I = $[10\% I_{nom}; 120\% I_{nom}]$	$\pm 1.5\%$ R
Apparent energy (Es) kVAh	V = [100 V; 600 V] I = $[5\% I_{nom}; 120\% I_{nom}]$	$\pm 0.5\%$ R

Table 7



Internal clock: ± 20 ppm

## 6.2.4. CURRENT SENSORS

### 6.2.4.1. Precautions for use



Refer to the safety data sheet provided or the downloadable user manual.

Current clamps and flexible current sensors are used to measure the current flowing in a cable without opening the circuit. They also isolate the user from dangerous voltages present in the circuit.

The choice of the current sensor to use depends on the current to be measured and the diameter of the cables. When installing current sensors, point the arrow on the sensor towards the load.

When a current sensor is not connected, the device displays - - - -.

### 6.2.4.2. Characteristics

The measurement ranges are those of the current sensors. Sometimes they may differ from the ranges measurable by the PEL.

#### a) MiniFlex MA194

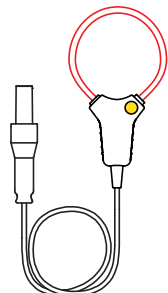
MiniFlex MA194		
Nominal range	300 / 3,000 AAC	
Measurement range	0.5 to 360 AAC for the 300 A range 1 to 3,600 AAC for the 3,000 A range	
Maximum clamping diameter	Length = 250 mm; Ø = 70 mm Length = 350 mm; Ø = 100 mm Length = 1000 mm; Ø = 320 mm	
Influence of the conductor's position in the sensor	≤ 2.5 %	
Influence of an adjacent conductor carrying an AC current	> 40 dB typical at 50/60 Hz for a conductor in contact with the sensor and > 33 dB near the latching mechanism	
Safety	IEC/EN 61010-2-032 or BS EN 61010-2-032, pollution degree 2, 600 V category IV, 1000 V category III	

Table 8

**Remark:** Currents < 0.5 A for the 300 A range and < 1 A for the 3,000 A range are set to zero.

#### b) AmpFlex® A193

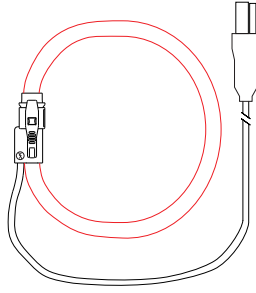
AmpFlex® A193		
Nominal range	300 / 3,000 AAC	
Measurement range	0.5 to 360 AAC for the 300 A range 1 to 3,600 AAC for the 3,000 A range	
Maximum clamping diameter (depending on the model)	Length = 450 mm; Ø = 120 mm Length = 800 mm; Ø = 235 mm	
Influence of the conductor's position in the sensor	≤ 2 % everywhere and ≤ 4 % near the latching mechanism	
Influence of an adjacent conductor carrying an AC current	> 40 dB typical at 50/60 Hz everywhere and > 33 dB near the latching mechanism	
Safety	IEC/EN 61010-2-032 or BS EN 61010-2-032, pollution degree 2, 600 V category IV, 1000 V category III	

Table 9

**Remark:** Currents < 0.5 A for the 300 A range and < 1 A for the 3,000 A range are set to zero.

**c) C193 clamp**

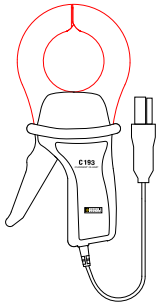
C193 clamp		
Nominal range	1000 AAC	
Measurement range	1 to 1200 AAC (I >1000 A for 5 minutes maximum)	
Maximum clamping diameter	52 mm	
Influence of the conductor's position in the clamp	< 0.1% from DC to 440 Hz	
Influence of an adjacent conductor carrying an AC current	> 40 dB typical at 50/60 Hz	
Safety	IEC/EN 61010-2-032 or BS EN 61010-2-032, pollution degree 2, 600 V category IV, 1000 V category III	

Table 10

**Remark:** Currents < 1 A are set to zero.

**d) MN93 clamp**

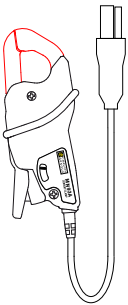
MN93 clamp		
Nominal range	200 AAC for $f \leq 1$ kHz	
Measurement range	0.5 to 240 AAC max (I >200 A non-continuous)	
Maximum clamping diameter	20 mm	
Influence of the conductor's position in the clamp	< 0.5%, at 50/60 Hz	
Influence of an adjacent conductor carrying an AC current	> 35 dB typical at 50/60 Hz	
Safety	IEC/EN 61010-2-032 or BS EN 61010-2-032, pollution degree 2, 300 V category IV, 600 V category III	

Table 11

**Remark:** Currents < 0.5 A are set to zero.

**e) MN93A clamp**

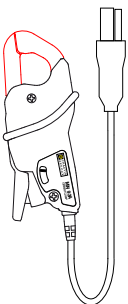
MN93A clamp		
Nominal range	5 A and 100 AAC	
Measurement range	5 mA to 6 AAC for the 5 A range 0.2 to 120 AAC for the 100 A range	
Maximum clamping diameter	20 mm	
Influence of the conductor's position in the clamp	< 0.5%, at 50/60 Hz	
Influence of an adjacent conductor carrying an AC current	> 35 dB typical at 50/60 Hz	
Safety	IEC/EN 61010-2-032 or BS EN 61010-2-032, pollution degree 2, 300 V category IV, 600 V category III	

Table 12

The 5 A range of MN93A clamps is suitable for measuring the secondary currents of current transformers.

**Remark:** Currents < 5 mA for the 5 A range and < 200 mA for the 100 A range are set to zero.

f) MINI 94 clamp

MINI 94 clamp	
Nominal range	200 Aac
Measurement range	50 A to 240 Aac
Maximum clamping diameter	16 mm
Influence of the conductor's position in the clamp	< 0.08%, at 50/60 Hz
Influence of an adjacent conductor carrying an AC current	> 45 dB typical at 50/60 Hz
Safety	IEC/EN 61010-2-032 or BS EN 61010-2-032, pollution degree 2, 300 V category IV, 600 V category III

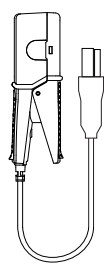


Table 13

**Remark:** Currents < 50 A are set to zero.

g) Current sensor thresholds

Sensor	Nominal current	Number of turns	Display threshold
C193 clamp	1000 A		0.50 A
AmpFlex® A193 MiniFlex MA194	300 A	1 turn	0.40 A
		2 turns	0.21 A
		3 turns	0.15 A
	3,000 A	1 turn	2 A
		2 turns	1 A
		3 turns	0.7 A
MN93A clamp	5 A		2.5 mA
	100 A		50 mA
MN93 clamp	200 A		0.1 A
MINI 94 clamp	200 A		50 mA
BNC adapter	1000 A (1 mV/A calibre)		0 A (no threshold)

Table 14

### 6.2.4.3. Intrinsic uncertainty



The intrinsic uncertainties of the current and phase measurements must be added to the intrinsic uncertainties of the instrument for the quantity concerned: power, energies, power factors, etc.

The following characteristics are given for the reference conditions of the current sensors.

#### Characteristics of current sensors which have an output of 1 V at $I_{nom}$

Current sensor	I nominal	Current (RMS or DC)	Intrinsic uncertainty at 50/60 Hz	Intrinsic uncertainty on $\varphi$ at 50/60 Hz	Typical uncertainty on $\varphi$ at 50/60 Hz	Resolution
<b>C193 clamp</b>	1000 AAC	[1 A; 50 A]	$\pm 1\% R$	-	-	10 mA
		[50 A; 100 A]	$\pm 0.5\% R$	$\pm 1^\circ$	+ 0.25°	
		[100 A; 1200 A]	$\pm 0.3\% R$	$\pm 0.7^\circ$	+ 0.2°	
<b>MN93 clamp</b>	200 AAC	[0.5 A; 5 A]	$\pm 3\% R \pm 1 A$	-	-	1 mA
		[5 A; 40 A]	$\pm 2.5\% R \pm 1 A$	$\pm 5^\circ$	+ 2°	
		[40 A; 100 A]	$\pm 2\% R \pm 1 A$	$\pm 3^\circ$	+ 1.2°	
		[100 A; 240 A]	$\pm 1\% R + 1 A$	$\pm 2.5^\circ$	$\pm 0.8^\circ$	
<b>MN93A clamp</b>	100 AAC	[200 mA; 5 A]	$\pm 1\% R \pm 2 mA$	$\pm 4^\circ$	-	1 mA
		[5 A; 120 A]	$\pm 1\% R$	$\pm 2.5^\circ$	+ 0.75°	
	5 AAC	[5 mA; 250 mA]	$\pm 1.5\% R \pm 0.1 mA$	-	-	1 mA
		[250 mA; 6 A]	$\pm 1\% R$	$\pm 5^\circ$	+ 1.7°	
<b>MINI 94 clamp</b>	200 AAC	[0.05 A; 10 A]	$\pm 0.2\% R \pm 20 mA$	$\pm 1^\circ$	$\pm 0.2^\circ$	1 mA
		[10 A; 240 A]		$\pm 0.2^\circ$	$\pm 0.1^\circ$	
<b>BNC adapter</b>	The nominal range of the input voltage of the BNC adaptor is 1 V. Refer to the specifications of the current sensors.					

Table 15

#### AmpFlex® and MiniFlex characteristics

Current sensor	I nominal	Current (RMS or DC)	Intrinsic uncertainty at 50/60 Hz	Intrinsic uncertainty on $\varphi$ at 50/60 Hz	Typical uncertainty on $\varphi$ at 50/60 Hz	Resolution
<b>AmpFlex® A193</b>	300 AAC	[0.5 A; 10 A]	$\pm 1.2\% R \pm 0.2 A$	-	-	10 mA
		[10 A; 360 A]		$\pm 0.5^\circ$	0°	
	3,000 AAC	[1 A; 100 A]	$\pm 1.2\% R \pm 1 A$	-	-	100 mA
		[100 A; 3,600 A]		$\pm 0.5^\circ$	0°	
<b>MiniFlex MA194</b>	300 AAC	[0.5 A; 10 A]	$\pm 1\% R \pm 0.2 A$	-	-	10 mA
		[10 A; 360 A]		$\pm 0.5^\circ$	0°	
	3,000 AAC	[1 A; 100 A]	$\pm 1\% R \pm 1 A$	-	-	100 mA
		[100 A; 3,600 A]		$\pm 0.5^\circ$	0°	

Table 16

Crest factor:

- 2.8 to 360 A on the 300 A calibre.
- 1.7 to 3,600 A on the 3,000 A calibre.

### AmpFlex® and MiniFlex limitation

Like all Rogowski sensors, the output voltage of AmpFlex® and MiniFlex is proportionate to the frequency. High current at high frequency can saturate the current input of devices.

To avoid saturation, the following condition must be respected:

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

Where  $I_{nom}$  is the range of the current sensor  
 $n$  is the harmonic order  
 $I_n$  is the current value for the harmonic of order  $n$

For example, the input current range of a potentiometer should be 5 times less than the current range selected on the device.

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

## 6.3. VARIATION IN THE FIELD OF USE

### 6.3.1. GENERAL

Internal clock drift:  $\pm 5$  ppm/year at  $25 \pm 3^\circ\text{C}$

### 6.3.2. TEMPERATURE

$V_1, V_2$ : 50 ppm/ $^\circ\text{C}$  typical  
 $I_1, I_2$ : 150 ppm/ $^\circ\text{C}$  typical, for  $5\% I_{nom} < I < 120\% I_{nom}$   
Internal clock: 10 ppm/ $^\circ\text{C}$

### 6.3.3. HUMIDITY

Range of influence: 30 to 75 %RH / 85 %RH at  $23^\circ\text{C}$  excluding condensation  
 $V_1, V_2$ :  $\pm 0.05\%$  typical  
 $I_1, I_2$  ( $1\% I_{nom} \leq I \leq 10\% I_{nom}$ ): 0.1% typical  
( $10\% I_{nom} < I \leq 120\% I_{nom}$ ): 0.05% typical

### 6.3.4. CONTINUOUS COMPONENT

Range of influence:  $\pm 100$  VDC  
Quantities influenced:  $V_1, V_2$   
Rejection:  $> 60$  dB

### 6.3.5. FREQUENCY

Range of influence: 45 Hz to 65 Hz,  $-60^\circ \leq \varphi \leq +60^\circ$   
Quantities influenced:  $V_1, V_2, I_1, I_2, P_1, P_2$   
Influence: 0.1 %/Hz

### 6.3.6. BANDWIDTH

Range of influence: 100 Hz to 5 kHz (harmonics)  
Presence of the fundamental at 50/60 Hz (THD = 50%)  
 $V_1, V_2$ : 0.5% @ 2.1 kHz / -3 dB @ 5 kHz  
 $I_1, I_2$  (direct input): 0.5% @ 1.75 kHz / -3 dB @ 5 kHz  
 $P_1, P_2$ : 0.5% @ 1.25 kHz / -3 dB

### 6.3.7. DISTURBED SIGNALS

The following signal bandwidth is 6 kHz,  $5\% I_{nom} < I \leq 50\% I_{nom}$ .

Signal type	Sensor	Typical influence
Phase cut-off potentiometer	MN93A clamp	< 1%
	MiniFlex MA194	< 3%
Square	MN93A clamp	< 1%
	MiniFlex MA194	< 3%

Bridge rectifiers have a waveform that is not supported by the PEL51/52.

## 6.4. POWER SUPPLY

### Mains power supply (between terminals V1 and N)

- Operating range: 100 V - 600 V  
DC voltage of 100 V or more will prevent the operation of the mains power supply.
- Power: 3 to 5 W depending on input voltage.
- Current: at 100 V<sub>ac</sub>, 100 mA<sub>peak</sub> and 17 mA<sub>RMS</sub>. Inrush current: 1.9 A<sub>peak</sub>  
at 600 V<sub>ac</sub>, 500 mA<sub>peak</sub> and 0.026 mA<sub>RMS</sub>. Inrush current: 5.3 A<sub>peak</sub>

### Battery

- 2 NiMH rechargeable elements type AAA 750 mAh
- Battery mass: about 25 g
- Lifespan: at least 500 charge / discharge cycles or 2 years
- Charging time: approx. 5 hours
- Charging temperature: 10 to 40 °C
- Battery life with active wifi: 1 hr minimum, 3 hrs typical



When power is off, the real time clock is retained for more than 20 days.

## 6.5. ENVIRONMENTAL CHARACTERISTICS

### ■ Temperature and relative humidity

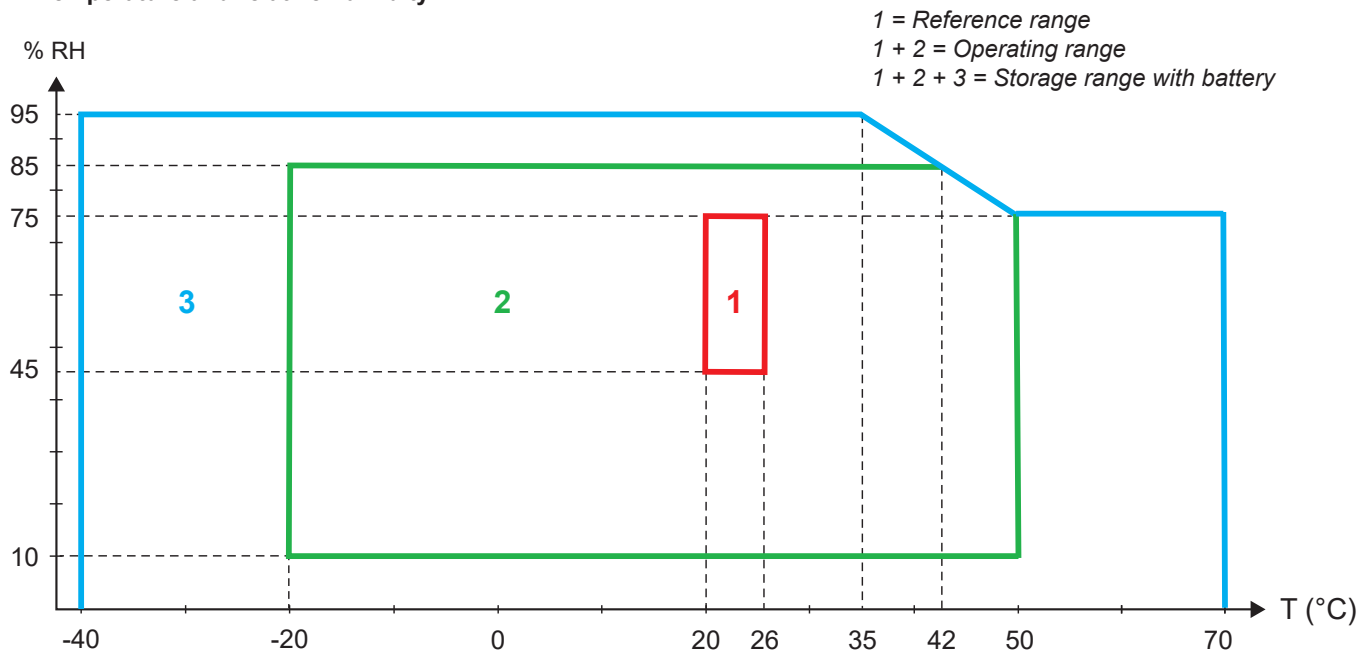


Figure 27

- For indoor use.
- **Altitude**
  - Operating: 0 to 2,000 m;
  - Storage: 0 to 10,000 m

## 6.6. WIFI

2.4 GHz IEEE 802.11 b/g band  
Tx (b) power: +17.3 dBm  
Tx (g) power: +14 dBm  
Rx sensitivity: -98 dBm  
Security: open / WPA2

## 6.7. MECHANICAL CHARACTERISTICS

- **Dimensions:** 180 × 88 × 37 mm
- **Mass:** Approx. 400 gr
- **Degree of protection:** provided by the enclosure according to IEC 60529,  
IP 54 when the device is not connected  
IP 20 when the device is connected

## 6.8. ELECTRICAL SAFETY

The devices comply with IEC/EN 61010-2-030 or BS EN 61010-2-030 for a voltage of 600 V measurement category III pollution degree 2.

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

Battery load between terminals **V1** and **N**: 600 V surge category III, pollution degree 2.  
The test leads and crocodile clips comply with standard IEC/EN 61010-031 or BS EN 61010-031.

## 6.9. ELECTROMAGNETIC COMPATIBILITY

Emissions and immunity in industrial environment compatible with IEC/EN 61326-1 or BS EN 61326-1.

With the AmpFlex® and MiniFlex, the typical influence on the measurement is 0.5% of full scale with a maximum of 5 A.

## 6.10. RADIO EMISSION

The devices comply with the RED Directive 2014/53/EU and FCC regulations.  
FCC certification number for the wifi: FCC QOQWF121

## 6.11. MEMORY CARD

Transferring a large amount of data from the SD card to a PC can take a long time. In addition, some computers can have difficulty processing such amounts of information and spreadsheets only accept a limited amount of data.

To transfer data faster, use the SD/USB card adapter.

Do not exceed 32 recordings on the SD card. Beyond that, the SD card may become full.

The maximum size of a recording is 4 GB and its duration is unlimited (> 100 years).

# 7. MAINTENANCE

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Except for the batteries, the device contains no parts that can be replaced by personnel who have not been specially trained and accredited. Any unauthorized work or any part replacement with equivalents may seriously compromise safety.

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## 7.1. CLEANING

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Disconnect all connections from the device.

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

Do not use the device if the terminals or the keyboard are wet. Dry it first.

For the current sensors:

- Ensure that no foreign body interferes with the current sensor latching mechanism.
- Keep the air gaps of the clamp completely clean. Do not spray water directly on the clamps.

## 7.2. BATTERY

The device is equipped with a NiMH battery. This technology has several advantages:

- Long battery life for a limited volume and weight;
- Significantly reduced memory effect. You can recharge the battery even if it is not completely discharged;
- Environmentally friendly. No polluting material such as lead or cadmium, in accordance with applicable regulations.

The battery may be completely discharged after prolonged storage. In this case, it must be fully recharged. The device may not work during part of the charging. Recharging a completely discharged battery may take several hours.

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In this case, at least 5 charge/discharge cycles will be necessary for the battery to regain 95% of its capacity. Refer to the battery data sheet delivered with the device.

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To optimise the use of your battery and extend its effective life:

- Charge the device only at temperatures between 10 °C and 40 °C.
- Comply with the conditions for use.
- Comply with the conditions for storage.

## 7.3. UPDATING FIRMWARE

In a constant concern to provide the best possible service in terms of performance and technical developments, Chauvin Arnoux offers the opportunity to update the firmware.

When your device is connected to PEL Transfer via wifi, you will be informed when a new firmware version is available. Start the update via PEL Transfer.

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Updating firmware may reset the configuration and cause loss of recorded data. As a precaution, back up the data in memory on a PC before updating the firmware.

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## 8. WARRANTY

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Except as otherwise stated, our warranty is valid for **24 months** starting from the date on which the equipment was sold. The extract from our General Terms of Sale is available on our website.

[www.chauvin-arnoux.com/en/general-terms-of-sale](http://www.chauvin-arnoux.com/en/general-terms-of-sale)

The warranty does not apply in the following cases:

- Improper use of the device or use with incompatible equipment;
- Modifications to the device without the explicit authorisation of the manufacturer's technical department;
- Work performed on the device by a person not approved by the manufacturer;
- Adaptation to a particular application not anticipated in the definition of the device or not indicated in the user manual;
- Damage caused by shocks, falls or floods.

## 9. APPENDIX

### 9.1. MEASUREMENTS

#### 9.1.1. DEFINITION

Geometric representation of active and reactive powers:

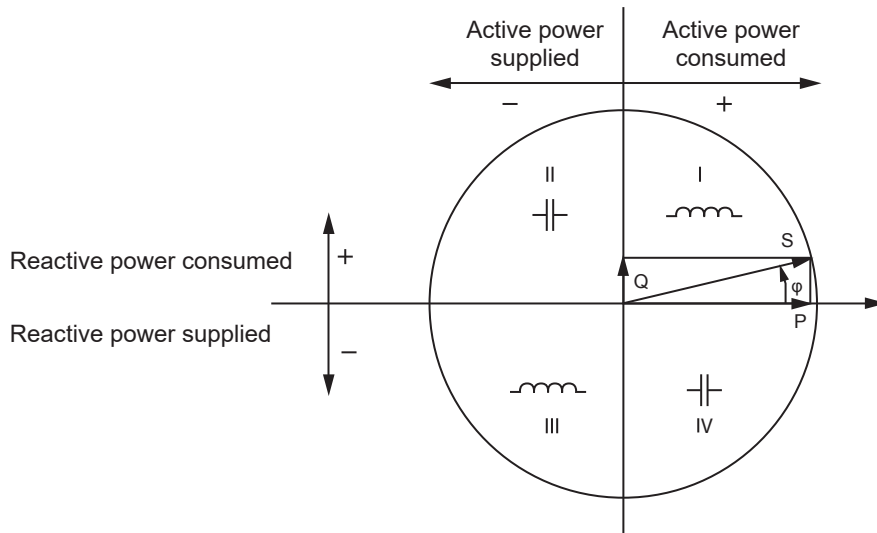


Figure 28

The reference of this diagram is the current vector (fixed on the right-hand part of the axis).

The voltage vector  $V$  varies in its direction as a function of the phase angle  $\varphi$ .

The phase angle  $\varphi$ , between voltage  $V$  and current  $I$ , is considered positive in the mathematical sense of the term (counterclockwise).

#### 9.1.2. SAMPLING

##### 9.1.2.1. "1 s" (one second) quantities

The device calculates the following quantities every second on the basis of measurements over a cycle, according to § 9.2. "1 s" quantities are used for:

- real-time values
- trends over 1 second
- aggregation of values for "aggregated" trends
- determination of minimum and maximum values for the values of "aggregated" trends

All "1 s" quantities can be recorded on the SD card during the recording session.

##### 9.1.2.2. Aggregation

An aggregated quantity is a value calculated over a period defined according to the formulas indicated in Table 18.

The aggregation period always begins at the start of an hour or a minute. The aggregation period is the same for all quantities. The following periods are possible: 1, 2, 3, 4, 5, 6, 10, 12, 15, 20, 30 and 60 min.

All aggregated quantities are recorded on the SD card during the recording session. They can be displayed in PEL Transfer.

##### 9.1.2.3. Minimum and maximum

Min and Max are the minimum and maximum values of the "1 s" quantities for the aggregation period considered. They are recorded with their dates and times. The Max values of certain aggregated values are displayed directly on the device.

### 9.1.2.4. Calculation of energies

Energies are calculated every second.  
Total energies are available with the data of the recorded session.

## 9.2. MEASUREMENT FORMULAS

Quantities	Formulas	Comments
AC RMS phase-neutral voltage ( $V_L$ )	$V_L[1s] = \sqrt{\frac{1}{N} \times \sum_1^N v_L^2}$	$v_L = v_1$ or $v_2$ incremental sample $N =$ number of samples
AC RMS phase-phase voltage ( $U_L$ )	$U_{ab}[1s] = \sqrt{\frac{1}{N} \times \sum_1^N u_{ab}^2}$	$ab = u_{12}$ incremental sample $N =$ number of samples
AC RMS current ( $I_L$ )	$I_L[1s] = \sqrt{\frac{1}{N} \times \sum_1^N i_L^2}$	$i_L = i_1, i_2$ or $i_3$ incremental sample $N =$ number of samples
Active power ( $P_L$ )	$P_L[1s] = \frac{1}{N} \times \sum_1^N (v_L \times i_L)$	$L = I1$ or $I2$ incremental sample $N =$ number of samples $P_T[1s] = P_1[1s] + P_2[1s]$

Table 17

## 9.3. AGGREGATION

Aggregated quantities are calculated for a defined period according to the following formulas based on "1 s" values. Aggregation can be calculated by arithmetic average, quadratic average or other methods.

Quantities	Formula
Phase-neutral voltage ( $V_L$ ) (RMS)	$V_L[agg] = \sqrt{\frac{1}{N} \times \sum_{x=0}^{N-1} V_{Lx}^2[1s]}$
Phase-phase voltage ( $U_{ab}$ ) (RMS)	$U_{ab}[agg] = \sqrt{\frac{1}{N} \times \sum_{x=0}^{N-1} U_{abx}^2[1s]}$ $ab = 12$
Current ( $I_L$ ) (RMS)	$I_L[agg] = \sqrt{\frac{1}{N} \times \sum_{x=0}^{N-1} I_{Lx}^2[1s]}$
Frequency ( $F_L$ )	$F[agg] = \frac{1}{N} \times \sum_{x=0}^{N-1} F_x[1s]$
Active power ( $P_L$ )	$P_L[agg] = \frac{1}{N} \times \sum_{x=0}^{N-1} P_{Lx}[1s]$
Reactive power ( $Q_L$ )	$Q_L[agg] = \frac{1}{N} \times \sum_{x=0}^{N-1} Q_{Lx}[1s]$
Apparent power ( $S_L$ )	$S_L[agg] = \frac{1}{N} \times \sum_{x=0}^{N-1} S_{Lx}[1s]$
Source power factor with the associated quadrant ( $PF_{SL}$ )	$PF_{SL}[agg] = \frac{1}{N} \times \sum_{x=0}^{N-1} PF_{SLx}[1s]$
Load power factor with the associated quadrant ( $PF_{LL}$ )	$PF_{LL}[agg] = \frac{1}{N} \times \sum_{x=0}^{N-1} PF_{LLx}[1s]$
Cos ( $\varphi$ ) <sub>s</sub> of the source with the associated quadrant	$\text{Cos}(\varphi_L)_s[agg] = \frac{1}{N} \times \sum_{x=0}^{N-1} \text{Cos}(\varphi_L)_{sx}[1s]$

Quantities	Formula
Cos ( $\varphi$ ) <sub>L</sub> of the load with the associated quadrant	$\text{Cos}(\varphi_L)_{L[\text{agg}]} = \frac{1}{N} \times \sum_{x=0}^{N-1} \text{Cos}(\varphi_L)_{L,x}[\text{Is}]$

Table 18

N is the number of "1 s" values for the aggregation period considered (1, 2, 3, 4, 5, 6, 10, 12, 15, 20, 30 or 60 minutes).

## 9.4. SUPPORTED ELECTRICAL NETWORKS

The following types of distribution networks are supported:


- V1, V2 are the phase-neutral voltages of the installation measured. [V1=VL1-N; V2=VL2-N].
- The lower case letters v1, v2, v3 denote the sampled values.
- U12 is the voltage between phases of the installation measured.
- Lower case letters denote the sampled values [u12 = v1-v2].
- I1, I2 are the currents flowing in the phase conductors of the installation measured.
- The lower case letters i1, i2, i3 denote the sampled values.

Distribution network	Abbreviation	Comments	Reference diagram
<b>PEL51</b> Single phase (single phase 2-wire 1 current)	1P- 2W1I	Voltage is measured between L1 and N. Current is measured on conductor L1.	see § 4.1.1
<b>PEL51 and PEL52</b> Single phase (single phase 3-wire 2 currents)	1P- 3W2I	Voltage is measured between L1 and N. Current is measured on conductors L1 and L2.	see § 4.1.2
<b>PEL51 and PEL52</b> Two-phase (split-phase single phase 3-wire)	2P-3W2I	Voltage is measured between L1, L2 and N. Current is measured on conductors L1 and L2.	see § 4.1.3

Table 19

## 9.5. VALUES AVAILABLE

●	available on the instrument and in PEL Transfer
○	available in PEL Transfer
	not available

Quantities	Symbol	Real-time value 1s	Trend value 1s	Max value 	Trend value aggregated	Min/Max 1s aggregated
Phase-neutral voltage	$V_1, V_2$	●	○	●	○	○
Phase-phase voltage	$U_{12}$	●	○	●	○	○
Current	$I_1, I_2$	●	○	●	○	○
Frequency	$f$	●	○		○	○
Active power	$P_1, P_2, P_T$	●	○		○	
Active power on the source	$P_1, P_2, P_T$			●	○	○ (1)
Active power on the load	$P_1, P_2, P_T$			●	○	○ (1)
Fundamental active power	$Pf_1, Pf_2, Pf_T$	○	○		○	
Fundamental active power on the source	$Pf_1, Pf_2, Pf_T$				○	
Fundamental active power on the load	$Pf_1, Pf_2, Pf_T$				○	
Reactive power	$Q_1, Q_2, Q_T$	●	○		○	
Reactive power on the source	$Q_1, Q_2, Q_T$			●	○	○ (1)
Reactive power on the load	$Q_1, Q_2, Q_T$			●	○	○ (1)
Apparent power	$S_1, S_2, S_T$	●	○		○	○ (1)
Apparent power on the source	$S_1, S_2, S_T$			●	○	
Apparent power on the load	$S_1, S_2, S_T$			●	○	
Non-active power	$N_1, N_2, N_T$	○	○		○	
Distorting power	$D_1, D_2, D_T$	○	○		○	
Power factor	$PF_1, PF_2, PF_T$	●	○			
Power factor on the source	$PF_1, PF_2, PF_T$				○	
Power factor on the load	$PF_1, PF_2, PF_T$				○	
Cos $\varphi$	$\text{Cos } \varphi_1, \text{Cos } \varphi_2, \text{Cos } \varphi_T$	○	○			
Cos $\varphi$ on the source	$\text{Cos } \varphi_1, \text{Cos } \varphi_2, \text{Cos } \varphi_T$				○	
Cos $\varphi$ on the load	$\text{Cos } \varphi_1, \text{Cos } \varphi_2, \text{Cos } \varphi_T$				○	
Total active energy on the source	$Ep_T$	●	○			
Total active energy on the load	$Ep_T$	●	○			
Reactive energy on quadrant 1	$Eq_T$	●	○			
Reactive energy on quadrant 2	$Eq_T$	●	○			
Reactive energy on quadrant 3	$Eq_T$	●	○			
Reactive energy on quadrant 4	$Eq_T$	●	○			


Quantities	Symbol	Real-time value 1s	Trend value 1s	Max value 	Trend value aggregated	Min/Max 1s aggregated
Apparent energy on the source	$Es_T$	•	○			
Apparent energy on the load	$Es_T$	•	○			
$\Phi (I_1, I_2)$		•				
$\Phi (V_1, V_2)$		•				
$\Phi (I_1, V_1)$		•				
$\Phi (I_2, V_2)$		•				

Table 20

(1) No minimum value for  $P_1, P_2, P_T, Q_1, Q_2, Q_T$

## 9.6. VALUES AVAILABLE

The following quantities are available in the instrument or in PEL Transfer.

Quantities	PEL51 and PEL52 1P-2W1I	PEL52 1P-3W2I and 2P-3W2I
$V_1$	•	•
$V_2$		•
$U_{12}$		•
$I_1$	•	•
$I_2$		•
$f$	•	•
$P_1$	•	•
$P_2$		•
$P_T$	• <sup>(1)</sup>	•
$Pf_1$	•	•
$Pf_2$		•
$Pf_T$	• <sup>(1)</sup>	•
$Q_1$	•	•
$Q_2$		•
$Q_T$	• <sup>(1)</sup>	•
$S_1$	•	•
$S_2$		•
$S_T$	• <sup>(1)</sup>	•
$N_1$	•	•
$N_2$		•
$N_T$	• <sup>(1)</sup>	•
$D_1$	•	•
$D_2$		•
$D_T$	• <sup>(1)</sup>	•
$PF_1$	•	•
$PF_2$		•
$PF_T$	• <sup>(1)</sup>	•
$\text{Cos } \phi_1$	•	•
$\text{Cos } \phi_2$		•
$\text{Cos } \phi_T$	• <sup>(1)</sup>	•
$Ep_T$ source	•	•
$Ep_T$ load	•	•
$Eq_T$ quadrant 1	•	•
$Eq_T$ quadrant 2	•	•
$Eq_T$ quadrant 3	•	•
$Eq_T$ quadrant 4	•	•
$Es_T$ source	•	•
$Es_T$ load	•	•
$\Phi (I_1, I_2)$		•
$\Phi (V_1, V_2)$		•
$\Phi (I_1, V_1)$	•	•
$\Phi (I_2, V_2)$		•

Table 21

(1)  $P_1 = P_T$   $Pf_1 = Pf_T$   $Q_1 = Q_T$   $N_1 = N_T$   $D_1 = D_T$   $S_1 = S_T$   $PF_1 = PF_T$   $\text{Cos } \phi_1 = \text{Cos } \phi_T$

## 9.7. GLOSSARY

$\phi$	Phase offset of the voltage relative to the current.
°	Degree.
%	Percentage.
<b>A</b>	Ampere (current unit).
<b>AC</b>	Alternative component (current or voltage).
<b>Aggregation</b>	Different averages defined at § 9.3.
<b>CF</b>	Current or voltage peak factor: ratio of the peak value of a signal to the effective value.
<b>cos <math>\phi</math></b>	Cosine of the phase shift of the voltage with respect to the current.
<b>DC</b>	DC component (current or voltage).
<b>Ep</b>	Active energy.
<b>Eq</b>	Reactive energy.
<b>Es</b>	Apparent energy.
<b>Frequency</b>	Number of full cycles of voltage or current per second.
<b>Hz</b>	Hertz (unit of frequency).
<b>I</b>	Symbol for current.
<b>L</b>	Phase of a multiphase network.
<b>MAX</b>	Maximum value.
<b>MIN</b>	Minimum value.
<b>P</b>	Active power.
<b>PF</b>	Power Factor: Ratio of active power to apparent power.
<b>Phase</b>	Temporal relationship between current and voltage in alternating current circuits.
<b>Q</b>	Reactive power.
<b>RMS</b>	RMS (Root Mean Square) average quadratic value of the current or voltage. Square root of the average of the squares of instantaneous values of a quantity during a specified interval.
<b>S</b>	Apparent power.
<b>IRD Server</b>	Internet Relay Device server. Server that relays data between the recorder and a PC.
<b>Nominal voltage:</b>	Nominal voltage of a network.
<b>U</b>	Voltage between two phases.
<b>V</b>	Phase-neutral voltage or Volt (unit of voltage).
<b>VA</b>	Unit of apparent power (Volt x Ampere).
<b>var</b>	Unit of reactive power.
<b>varh</b>	Unit of reactive energy.
<b>W</b>	Unit of active power (Watt).
<b>Wh</b>	Unit of active energy (Watt x hours).

Prefixes of units of the International System (SI)

Prefix	Symbol	Multiplied 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	$10^{18}$

Table 22





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