PFW03-M12
PFW03-M24

Automatic Power Factor Controller

PFW03-M12_24

Overview

- Reading for PF correction in one phase;
- Compensation for 12 and 24 steps;
- Steps can be capacitive or inductive;
- Reads and learns connection types;
- Reads and learns step types and powers;
- Records switch counts and service rate for each step;
- 6 different modes of reactive power compensation;
- Monitors the step dynamically. Checks if any step is faulty (only for 12 steps);

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Overview

- Allows testing the steps via manual actuation of the relays;
- Automatic calculation of C/k;
  - response value C/K:

    Represents the minimum step to be inserted by the controller.

$$\frac{C}{k} = \frac{Q}{\sqrt{3} \cdot U \cdot k_{tc}}$$

C = Lowest current among the steps;
K or Kct= CT ratio;
Q = Lowest power among the steps;
U = line voltage (V);

PFW03-M12_24

Overview

- Measures and calculates:
  - Current, voltage and frequency;
  - Active, reactive and apparent power;
  - Voltage and current harmonics up to the 51st order;
  - THDV, THDI;
  - Power factor and cosφ;
  - ➢All values above per phase
- Alarm configuration and saving of the last 50 alarms;
- Allows setting an alternate power factor using a digital input;

PFW03-M12_24

Overview

- Saves active and reactive energy values hourly, previous hour, daily, previous day, monthly, previous month;
- Import and export energy meter (kWh and kvarh) with the choice of setting the start counting value and saving the records in real time;
- 2 alarm output relays;
- RS485 communication port, 2000 VRMS insulation;
- Graphic LCD display and 6 keys
- 4-digit access password;
- Real time clock;

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Technical data

Supply

Voltage.....95..410V AC +_ 10%

Frequency.....45-65 Hz

Measurement Inputs

Voltage..... ……95..410V AC +_ 10% (L-N)

……95..410V AC +_ 10% (L-L)

Current..... 0.01..6 A RMS

Frequency..... 45..65 Hz

Night/Day Input. 95.. 240 VAC RMS

Relay Outputs for Compensation

12/24 pcs.,

Max. switching voltage... : 250 VAC

Max. switching current..... : 2A

Alarm Relay Outputs:

2 pcs,

Max. switching current.....: 4A

Max. switching voltage….: 250 VAC

Max. switching power..... : 1250 VA

Protection class

IP40 front, IP20 rear

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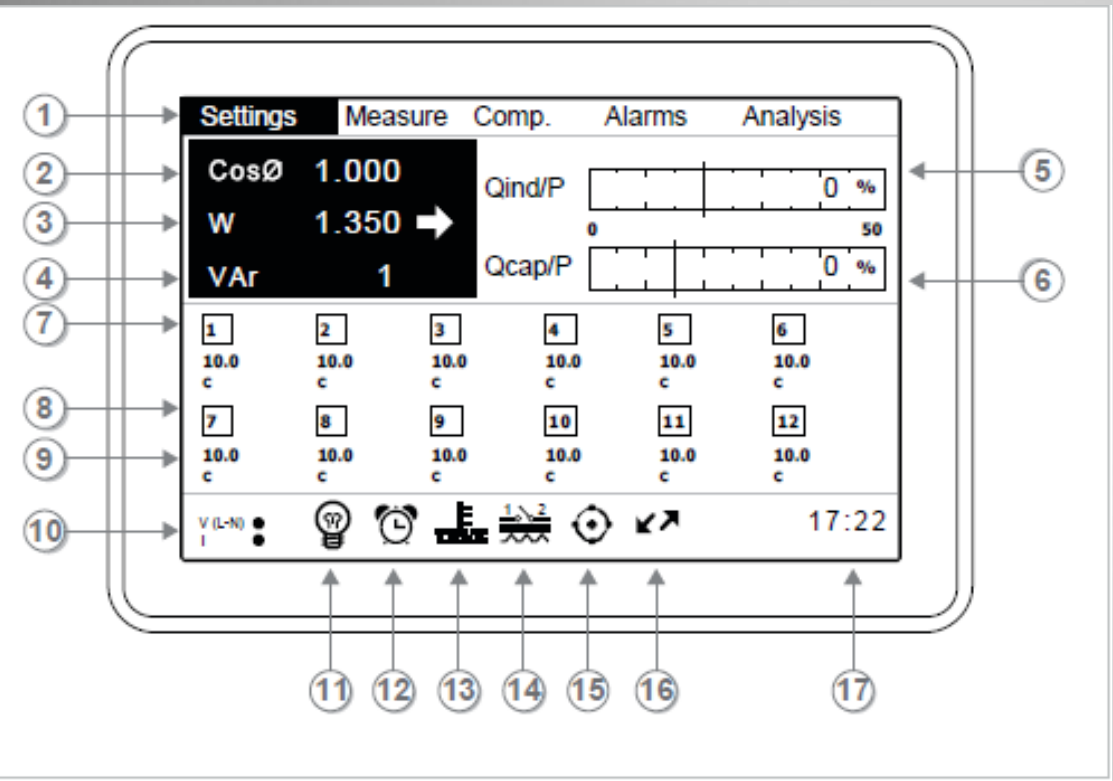
Description of the display functions



1. Menus
2. Cosφ of the system;
3. Total active power;
4. Total reactive power;
5. Monthly average inductive rate;
6. Monthly average capacitive rate;
7. Step number;
8. Step power;
9. Step type (C or I);
10. Voltage and current presence indication;
11. Compensation mode selected;
12. Alarm indication activated;
13. Indication of temperature alarm activated;

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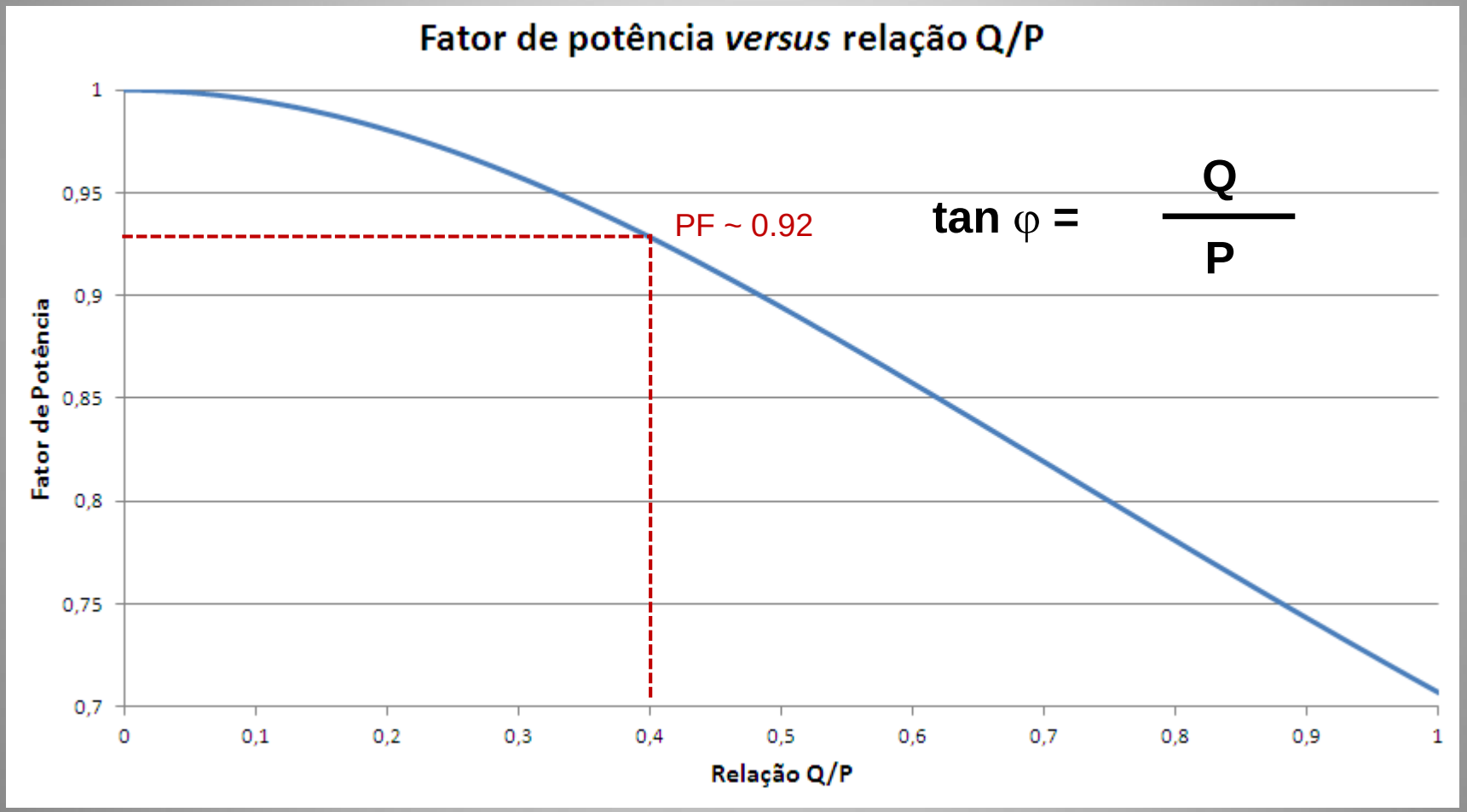
Description of the display functions



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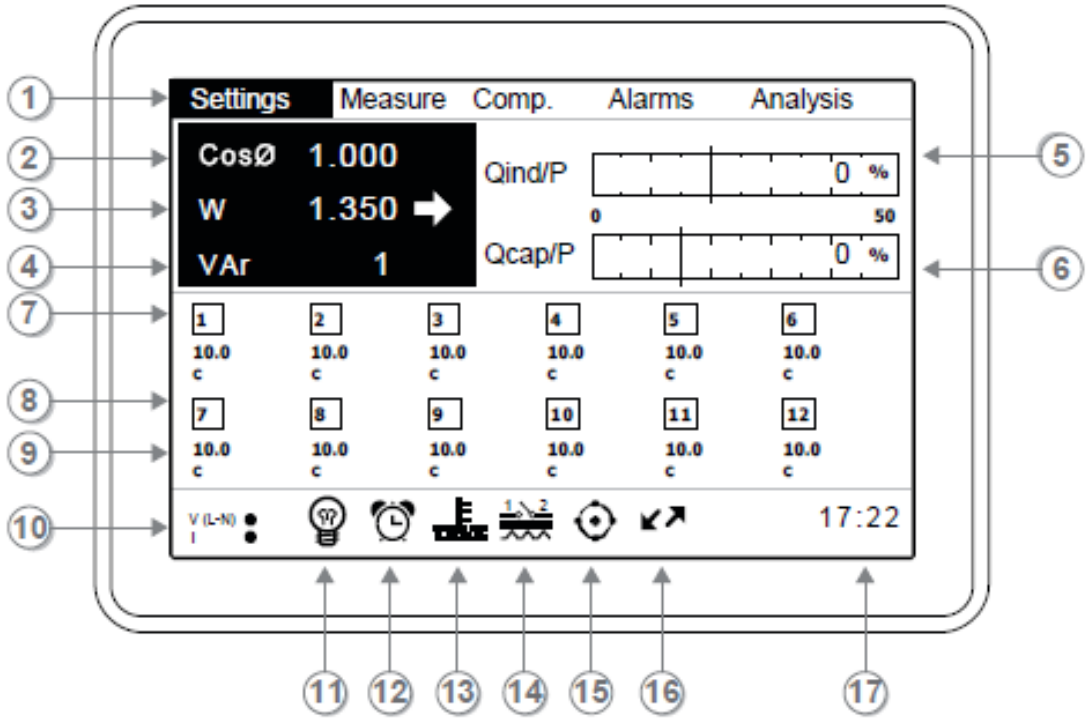
Description of the display functions



14. Alarm relay activated;
15. Dynamic step monitoring mode activated;
16. RS485 communication active;
17. Clock

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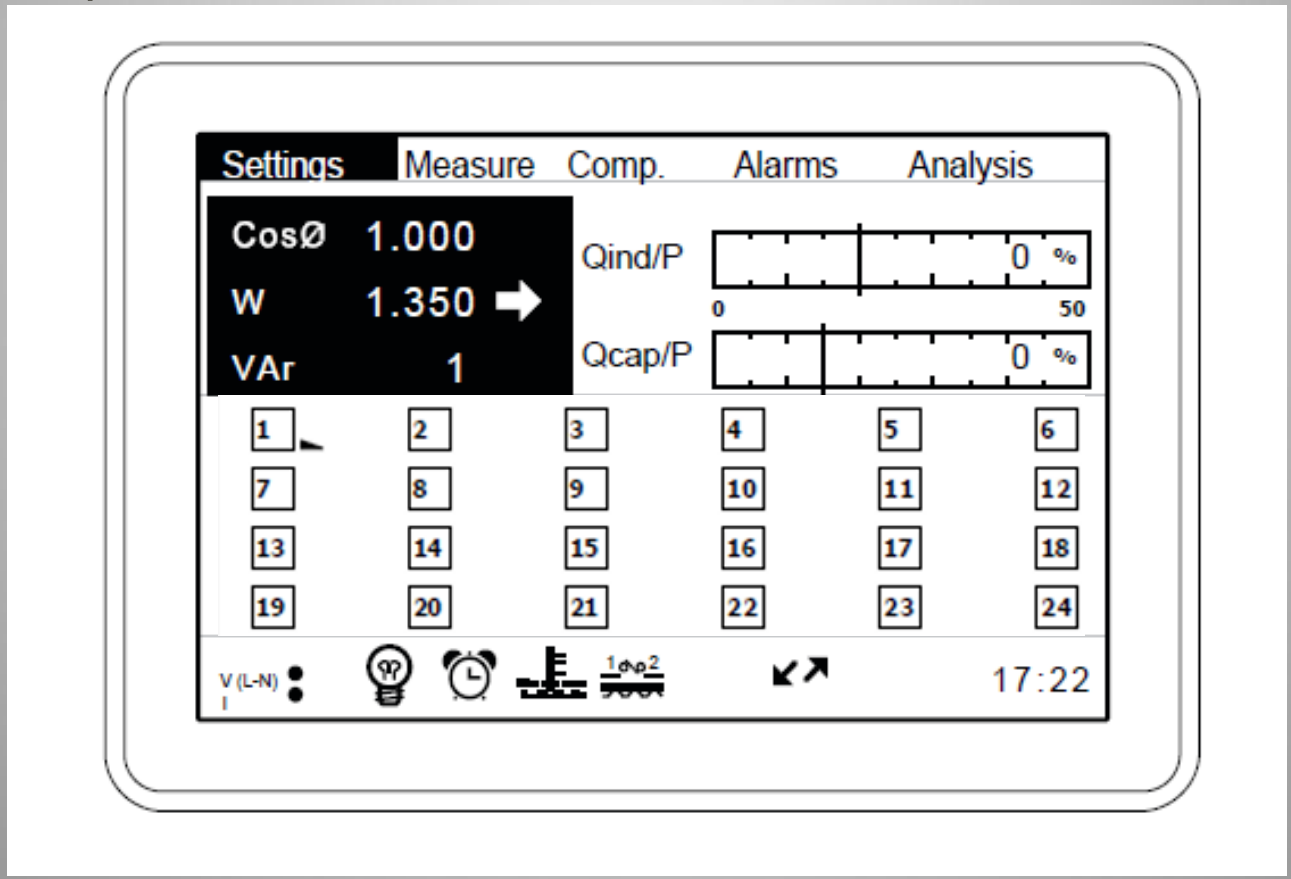
Description of the display functions - 24 steps

If the operator presses the "down" key, the reading of each step is enabled.



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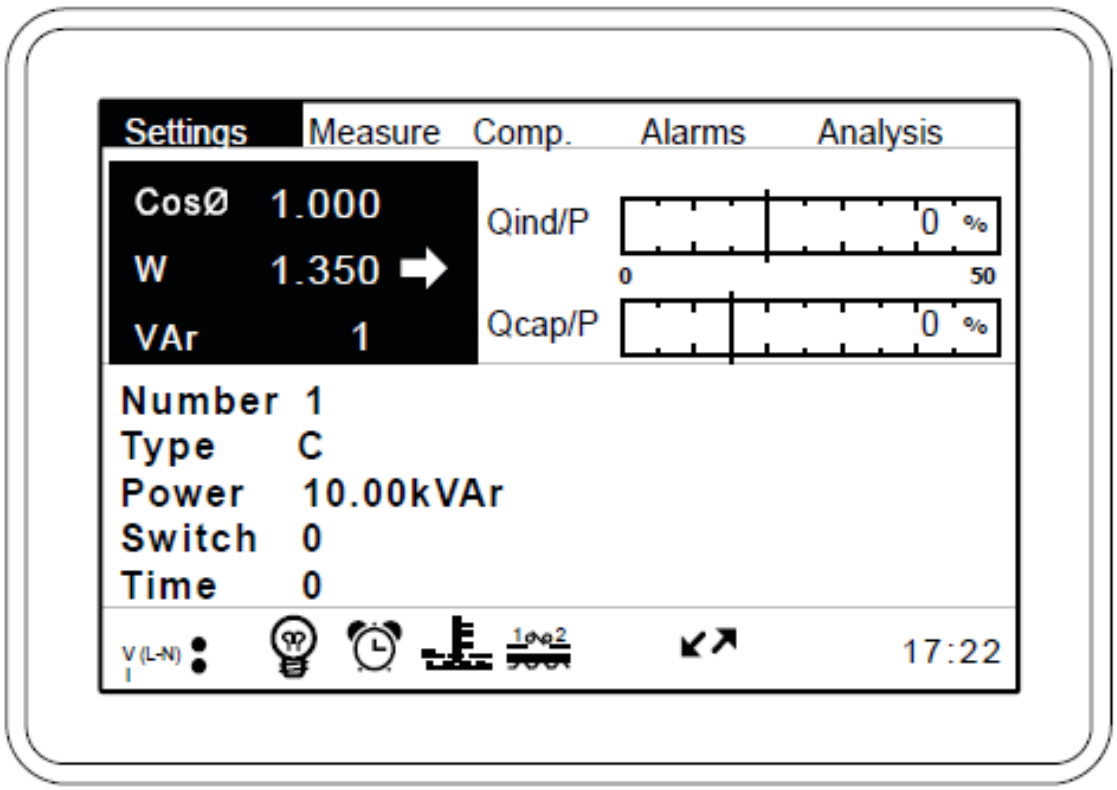
Description of the display functions - 24 steps

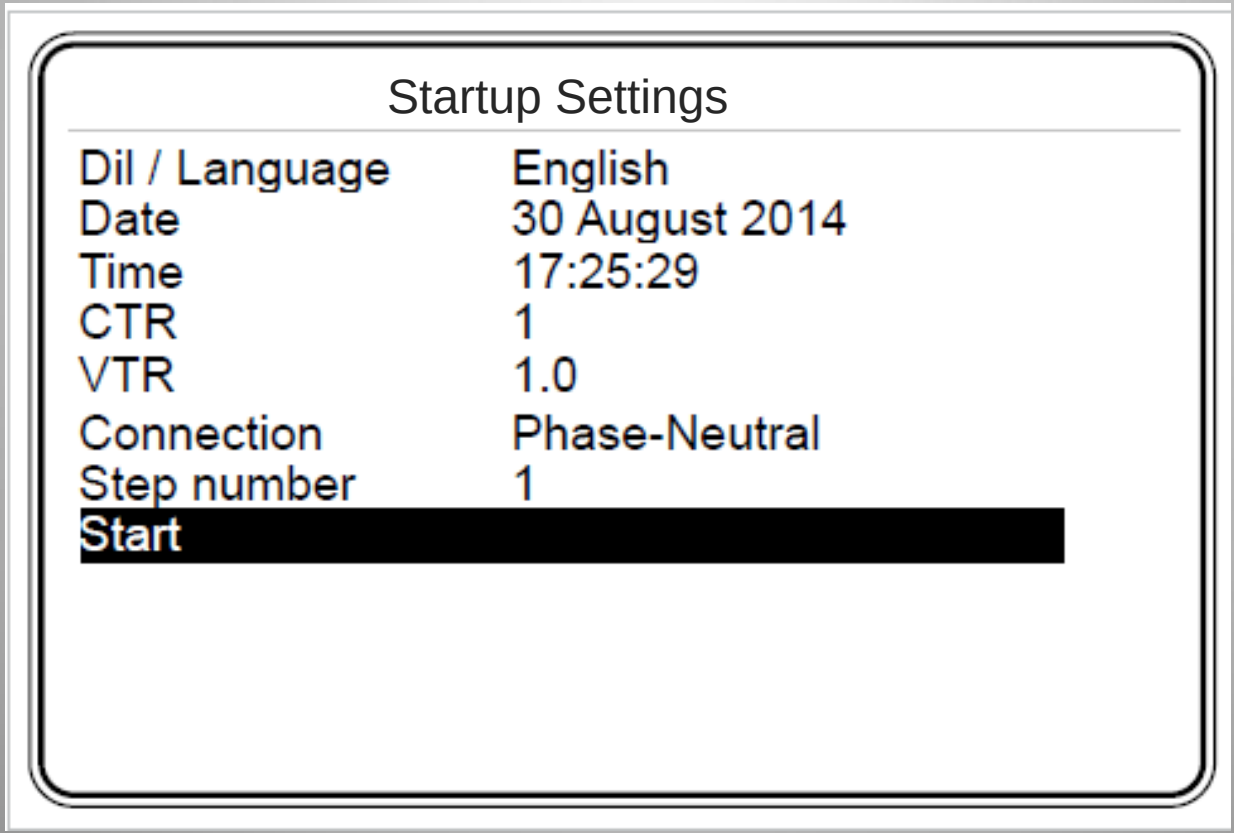
In the step menu, press the right and left keys to navigate across the menu shown below:



PFW03-M12_24

Settings - Startup - 1st power-on

When you turn on the PFW03 for the first time, the following screen will be displayed:



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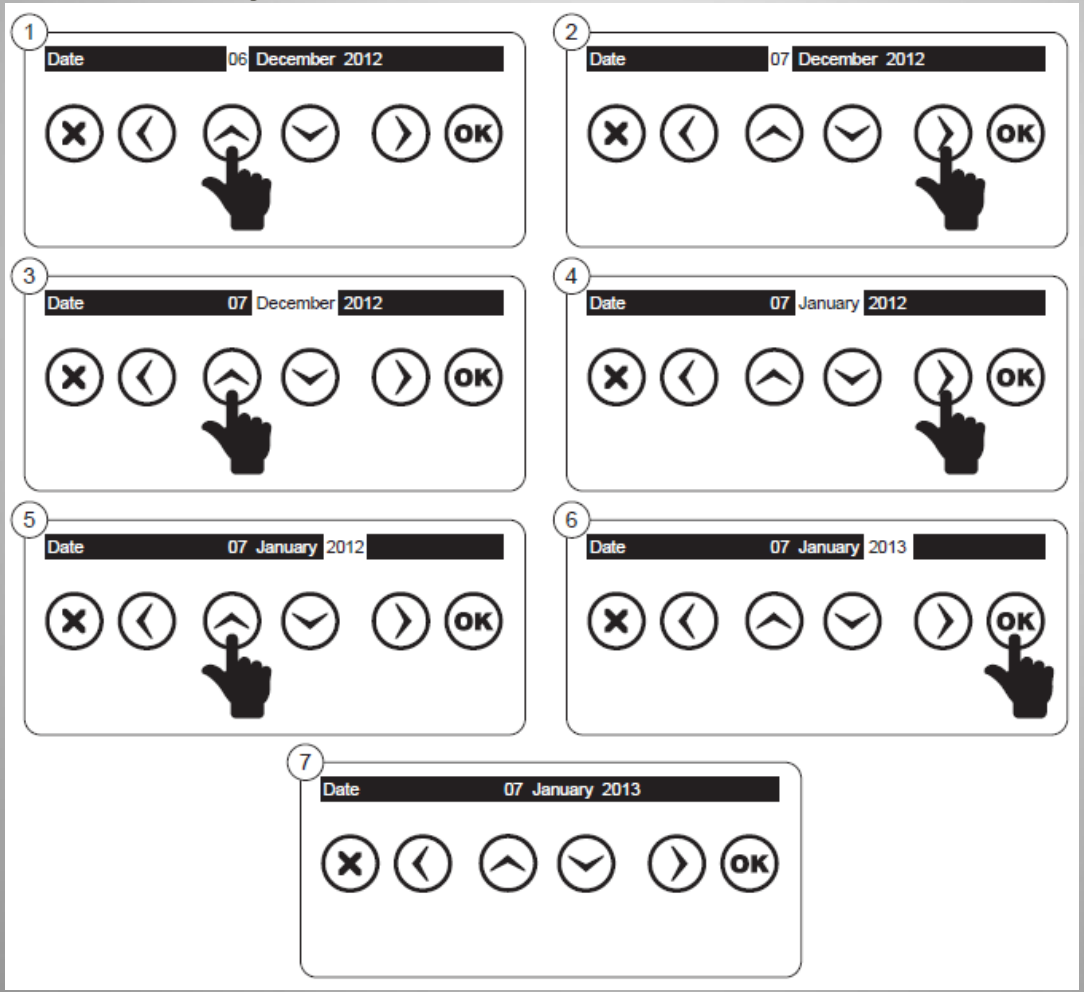
Settings - Startup - 1st power-on

Use the keys to set the date:



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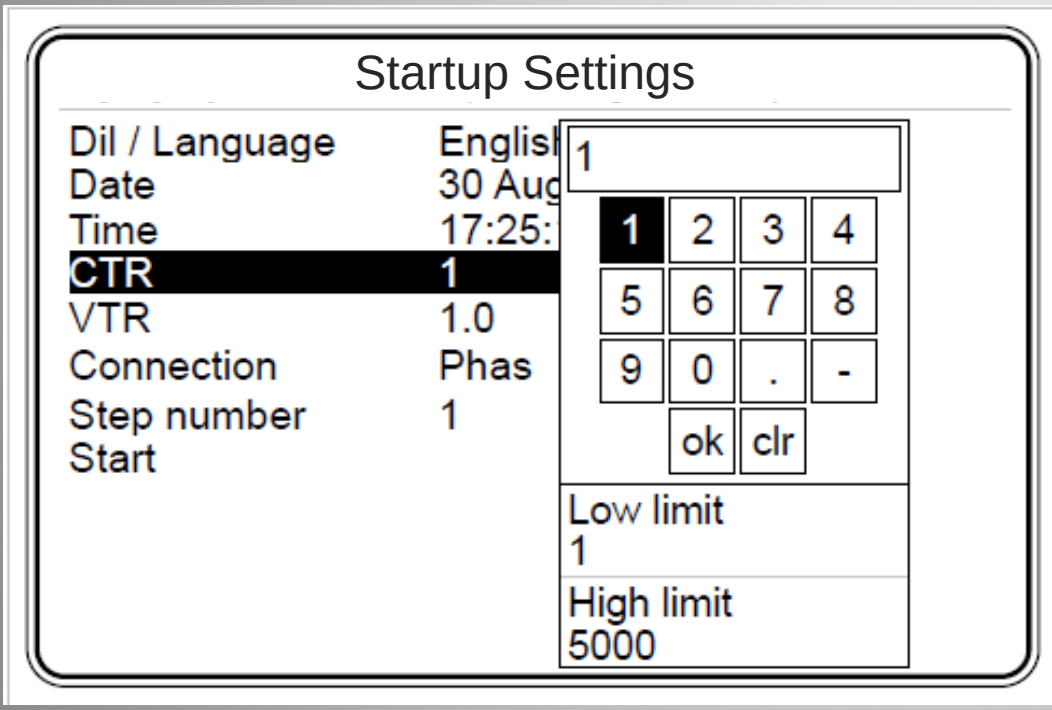
Settings - Startup - 1st power-on

Use the virtual keyboard to set the current transformer ratio - CTR:



- Press the OK key to open the virtual keyboard and enter the numbers;
- After entering the numbers, press OK on the virtual keyboard to confirm.

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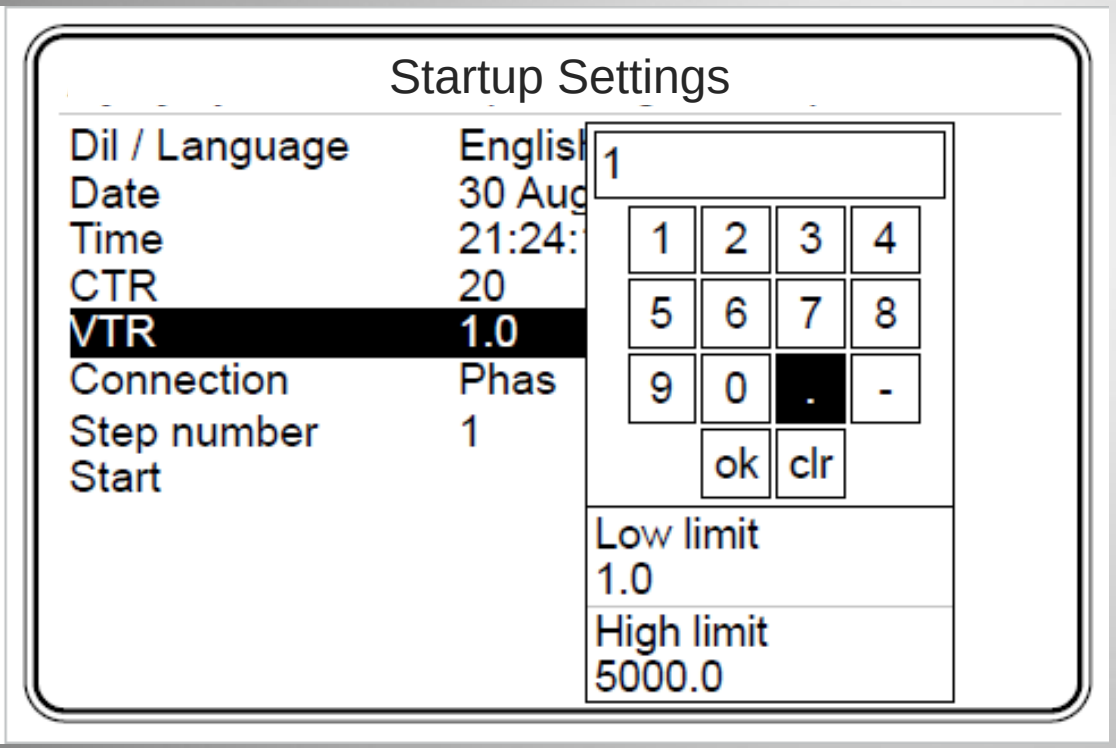
Settings - Startup - 1st power-on

Use the virtual keyboard to set the voltage transformer ratio - VTR:



- Press the OK key to open the virtual keyboard and enter the numbers;
- Use the virtual keyboard to enter the decimal point;

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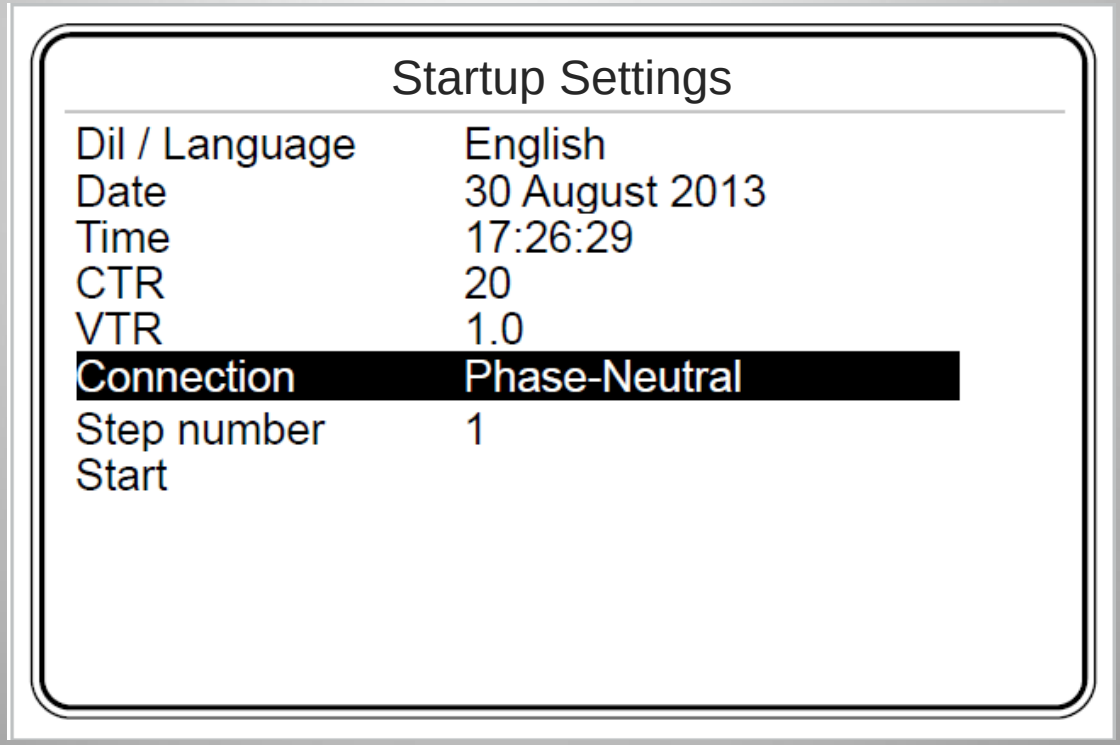
Settings - Startup - 1st power-on

In this menu, set how the PFW03 will be connected to the line. There are 2 types: phase-phase and phase-neutral.



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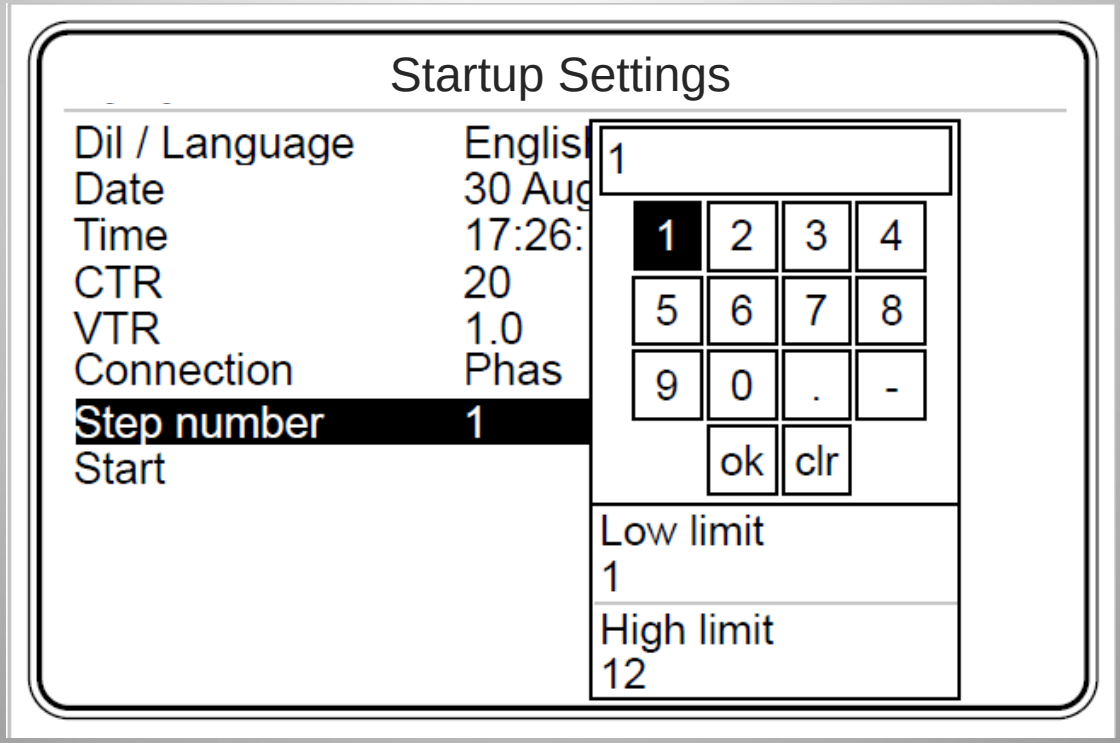
Settings - Startup - 1st power-on

In this menu, you define the number of steps to be used.
The Learning function only works for three-phase capacitors.



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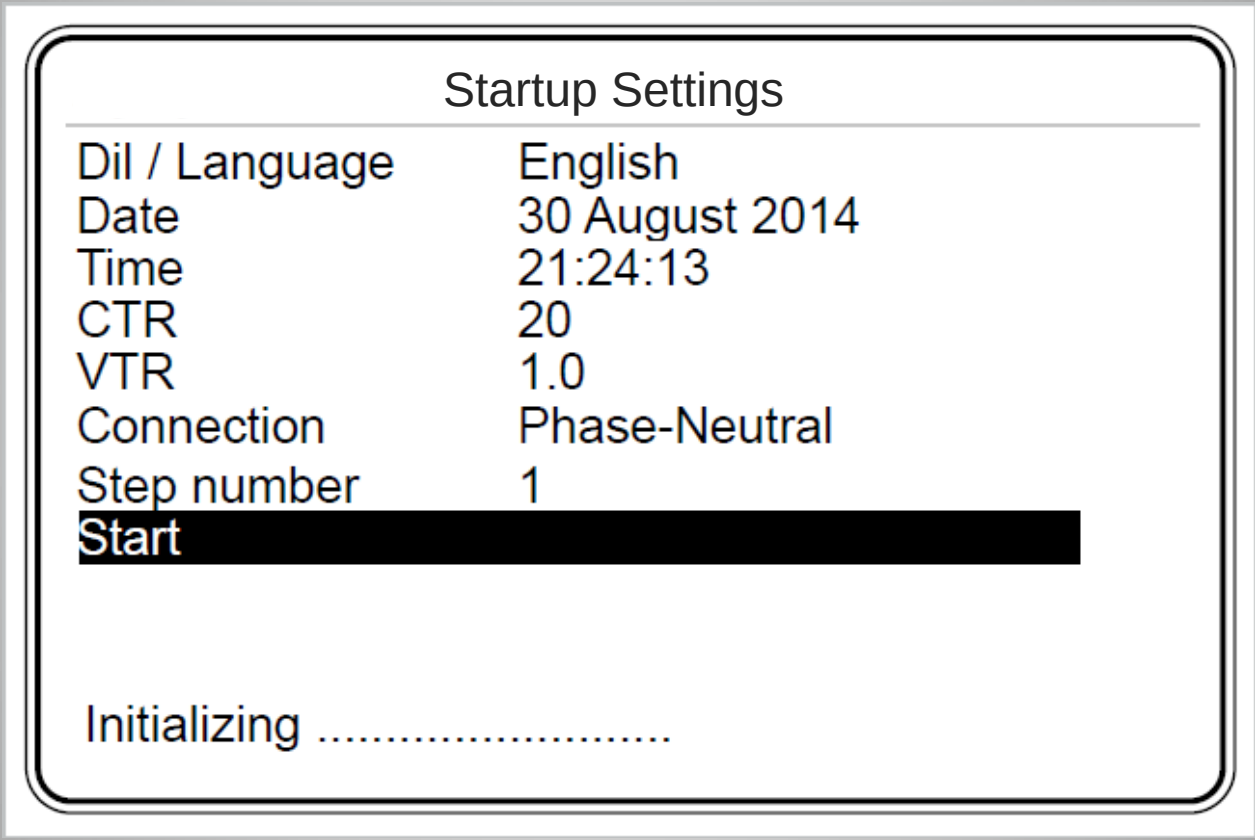
Settings - Startup - 1st power-on - End



NOTE: The startup settings page is automatically shown the first time the PFW-03 is turned on.
After that, use the available menus to access it.

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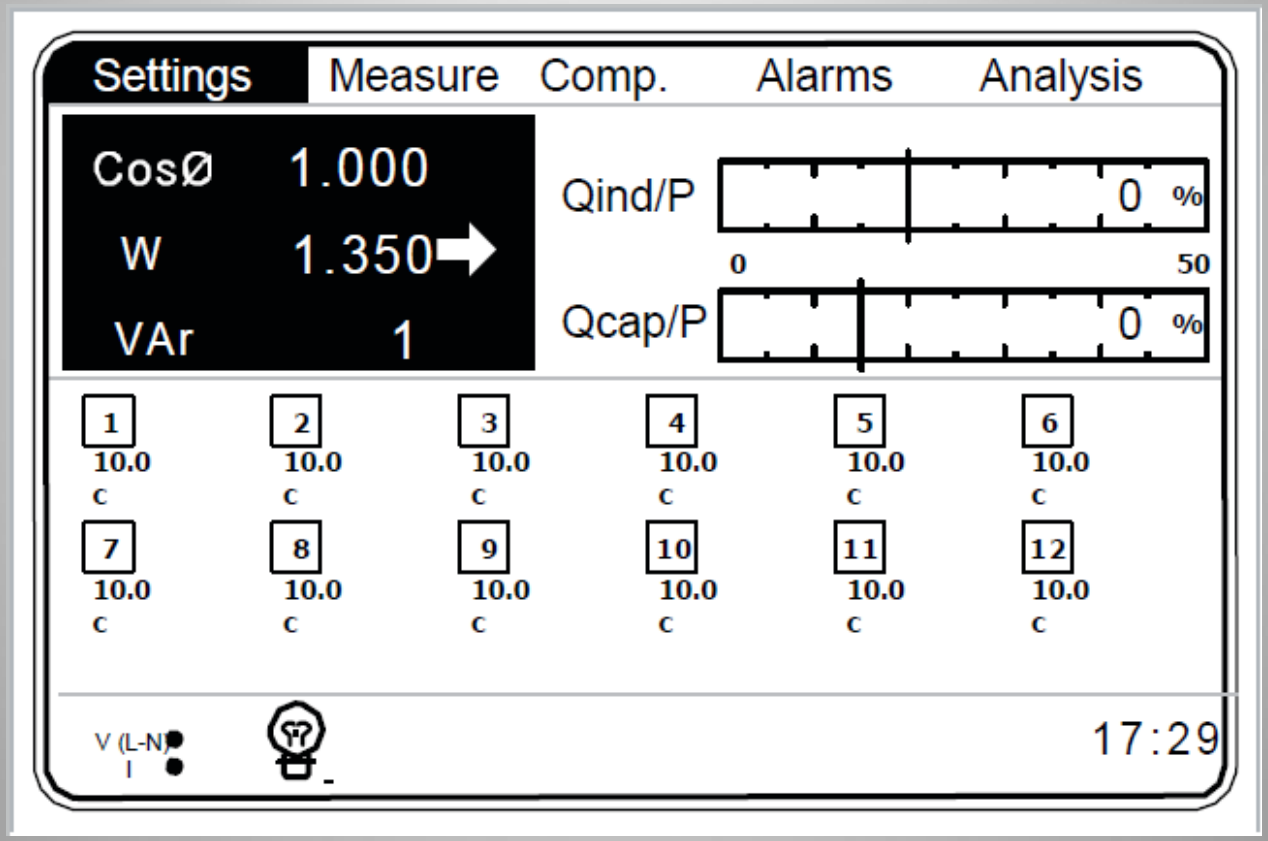
Settings Menu



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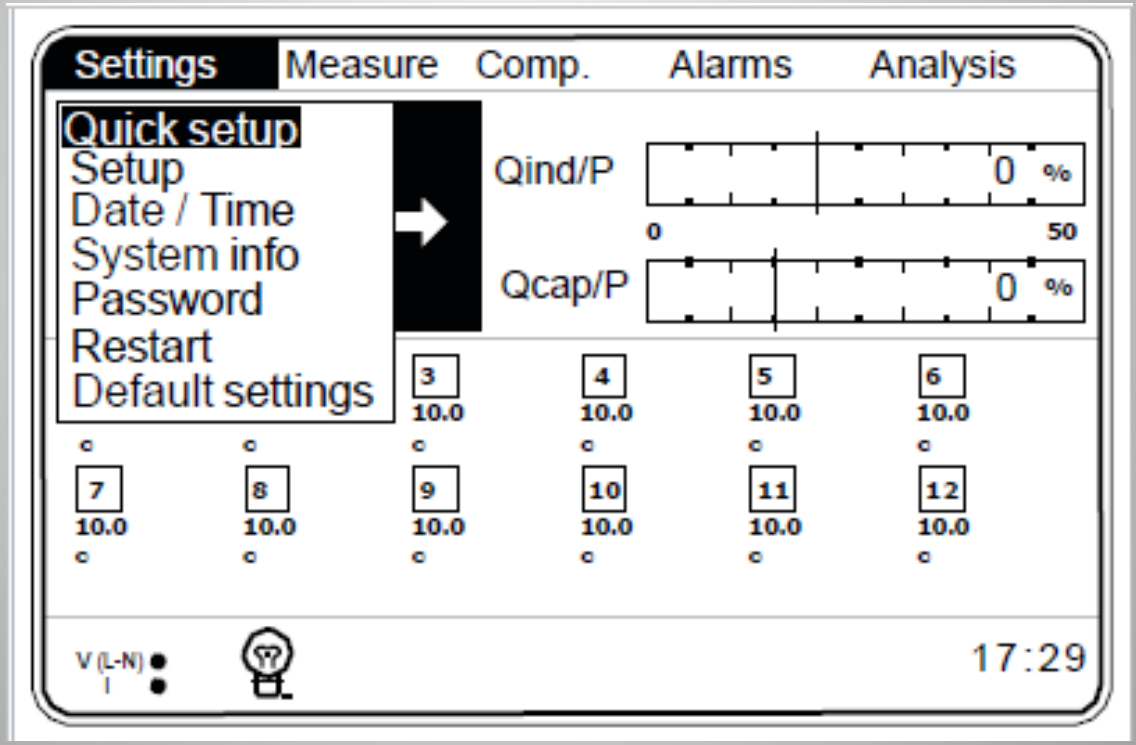
Settings Menu - Quick setup

In this menu, the PFW03 is set.



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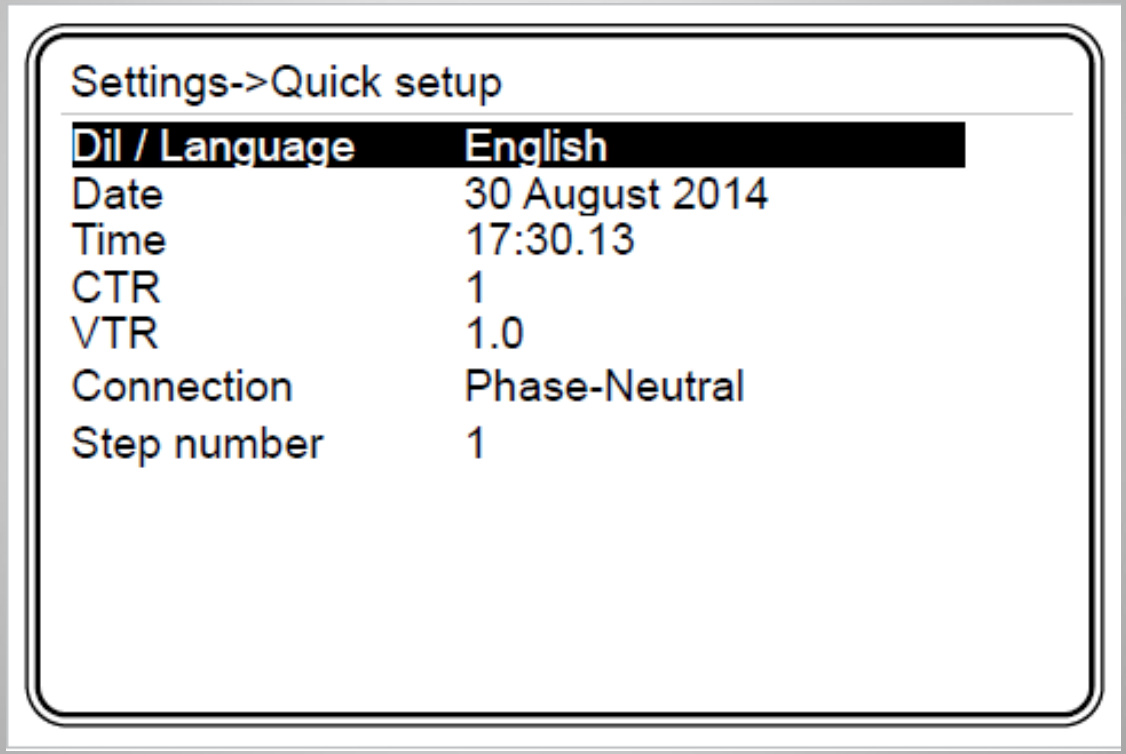
Settings Menu - Quick setup

The Quick setup has the following submenus:



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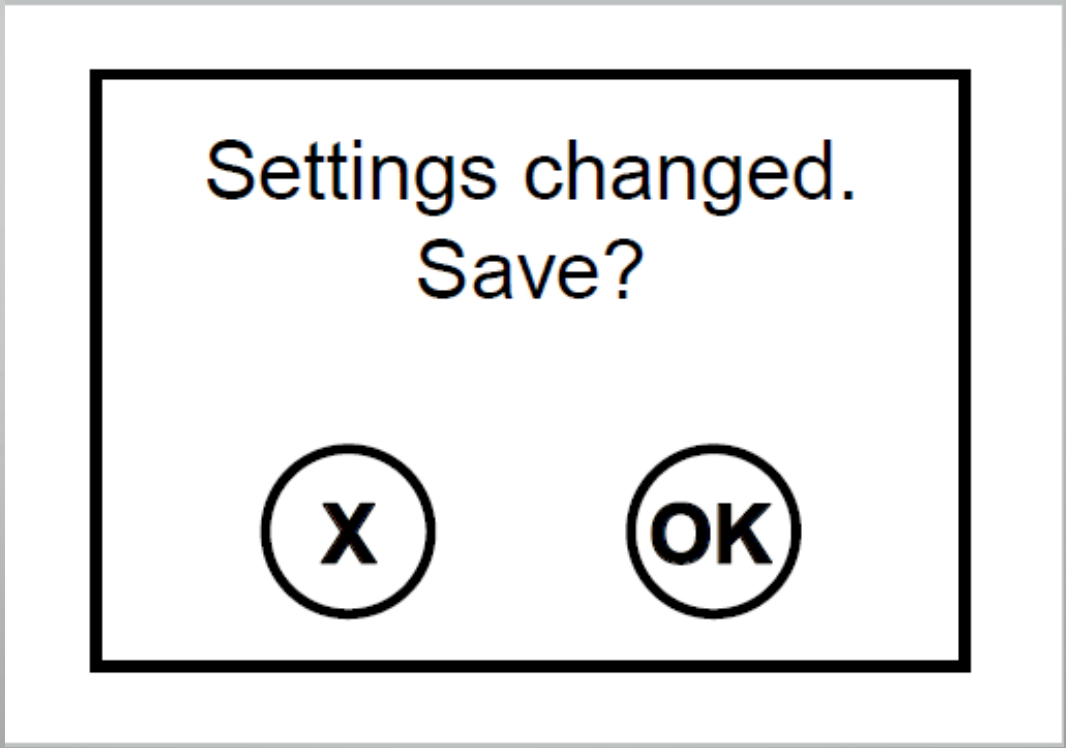
Settings Menu - Saving the settings

After setting the menus and submenus, confirm the changes by pressing the OK key when exiting the Settings menu.



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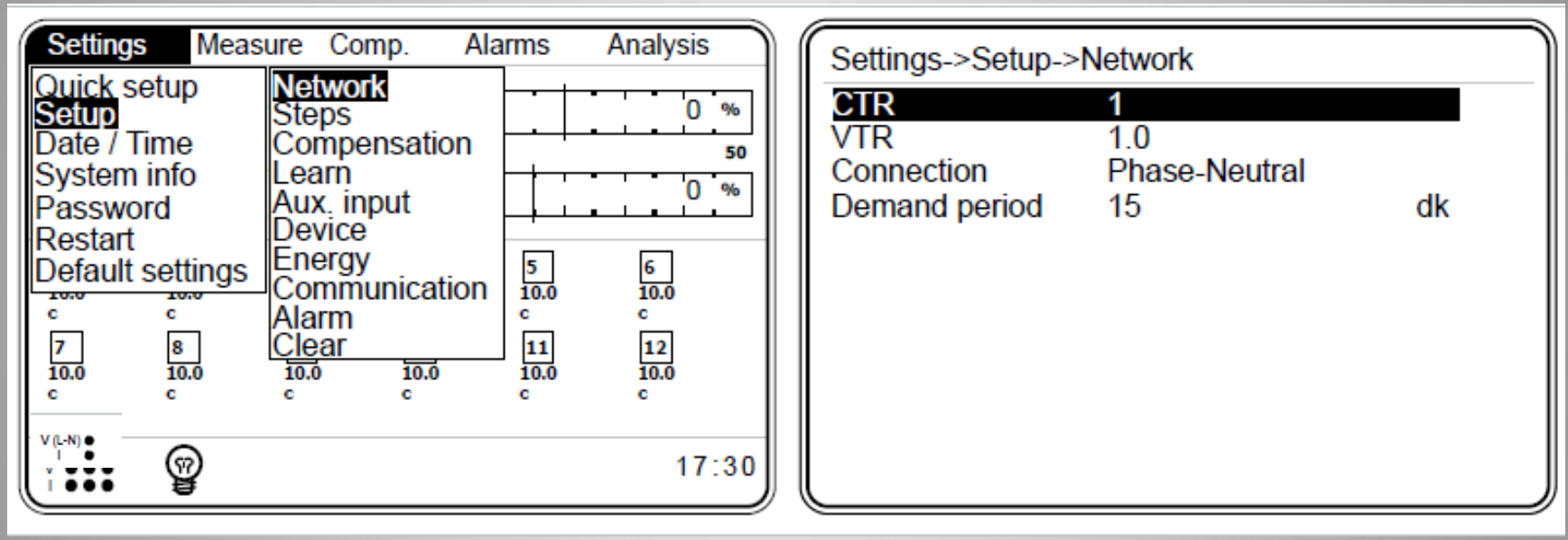
Settings Menu - Setup - Network

In Setup, the following submenus will be available:



- CTR - CT turn ratio - Select between 1 and 5000.
- VTR - PT turn ratio - Select between 1.0 and 5000.0.
- Demand - Definition of the demand calculation time - 1 to 60 min.

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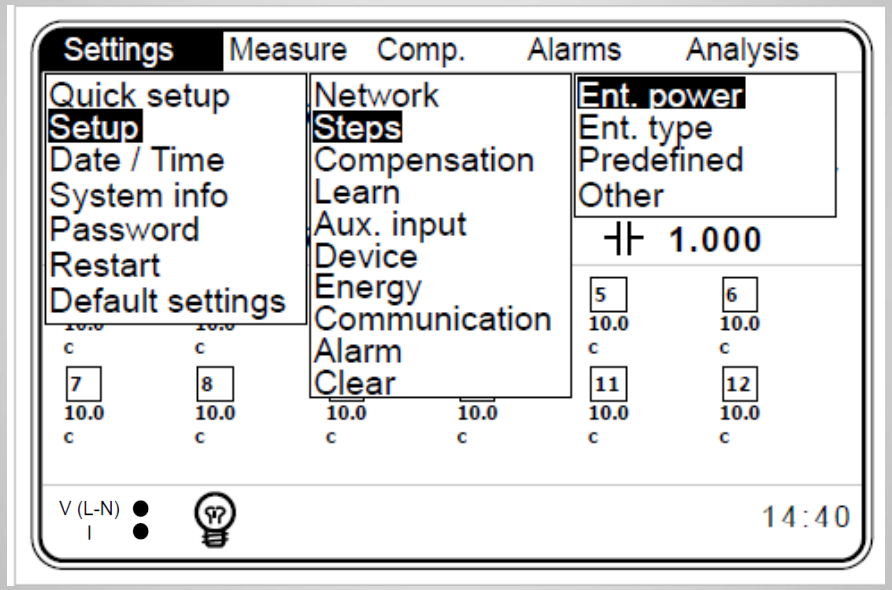
Settings Menu - Setup - Steps - Ent. power

In this menu we have the following submenus:



- Note: The PFW03-M24 has 2 power inputs. In the "Ent. Power 1" submenu, the operator enters the powers into the 1st, 2nd... and 12th steps, and in the second Submenu "Power 2", into the 13th, 14th… and 24th steps.

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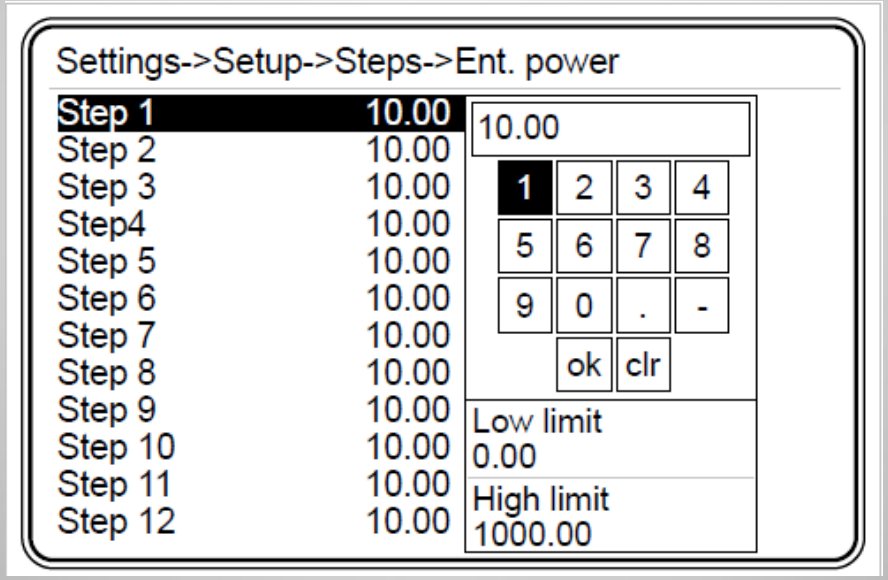
Settings Menu - Setup - Steps - Ent. power

For steps learned in the Learning mode, the powers are shown as below. The user can also change them manually in this menu.



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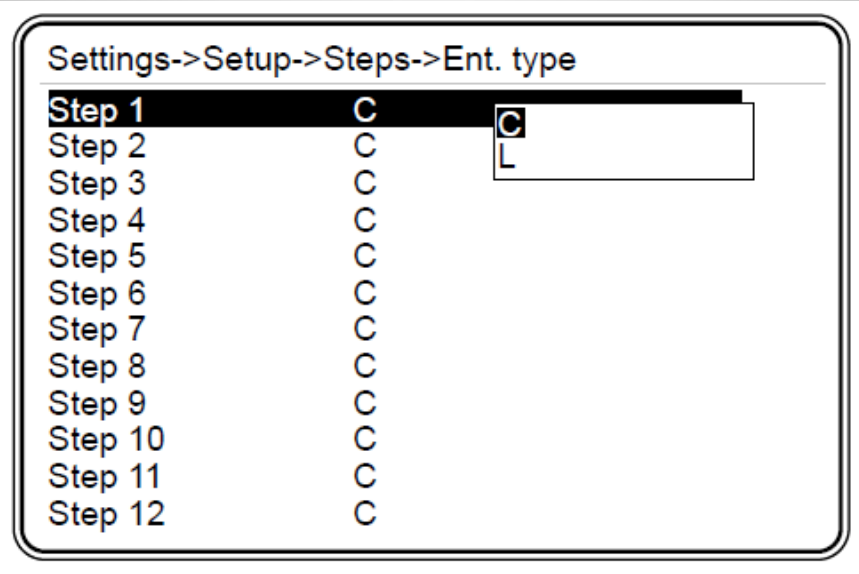
Settings Menu - Setup - Steps - Ent. Type

For steps learned in the Learning mode, the types of reactive powers are shown as below. The user can also change them manually in this menu.



Note: The user must always check that the PFW03 has read and recorded the values of the steps correctly. If not, follow one of the procedures below:

- Start the LEARN function again;
- Manually redo the stage values;

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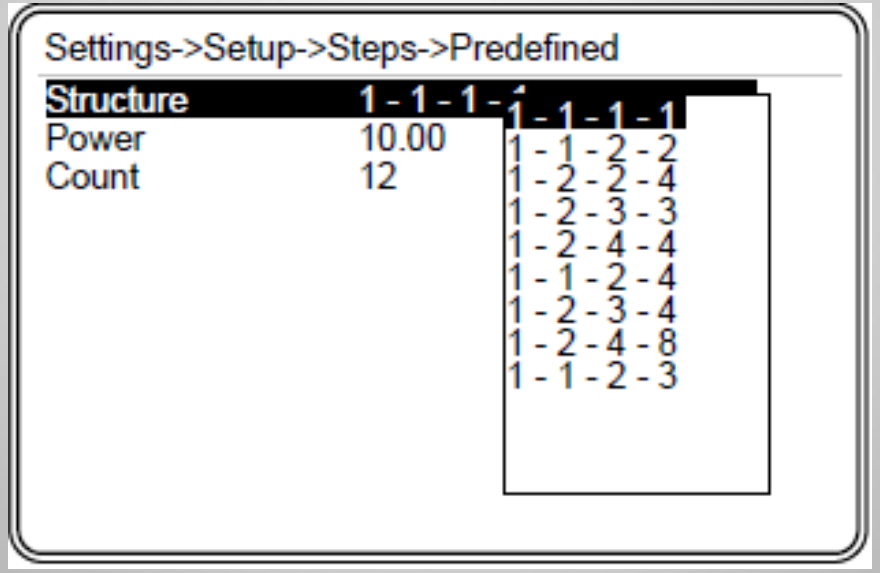
Settings Menu - Setup - Steps - Predefined

The stages can be configured by a predefined structure according to the submenus below:



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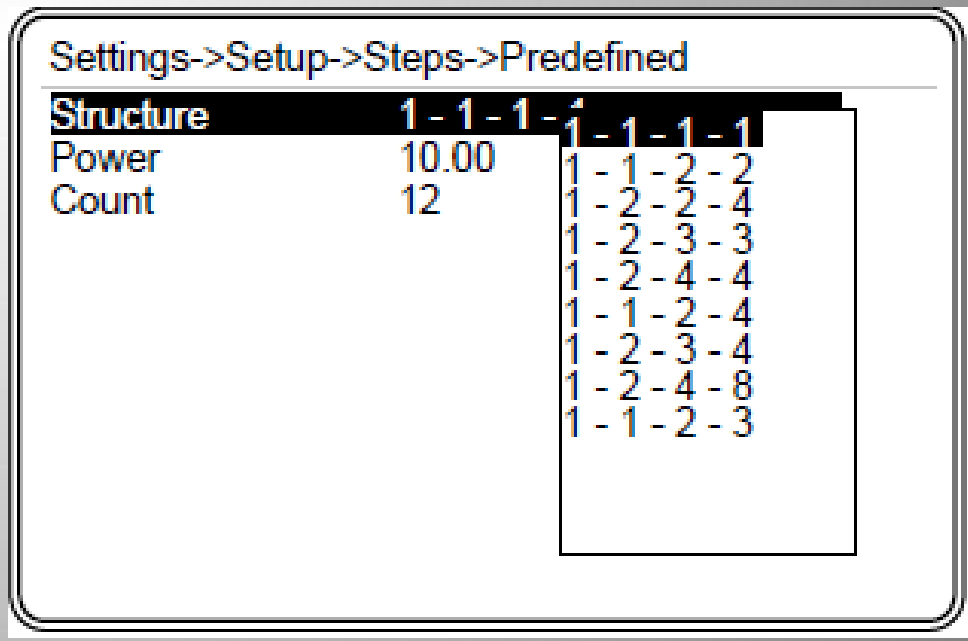
Settings Menu - Setup - Steps - Predefined

- **Example:**

  Consider that structure 1.2.4.8 was selected, 10 kVAR is the power set and 8 is the number of steps.

  Therefore, the steps will be:

  - 1st step: 10 kVAR
  - 2nd step: 20 kVAR
  - 3rd step: 40 kVAR
  - 4th step: 80 kVAR
  - 5th step: 80 kVAR
  - 6th step: 80 kVAR
  - 7th step: 80 kVAR
  - 8th step: 80 kVAR



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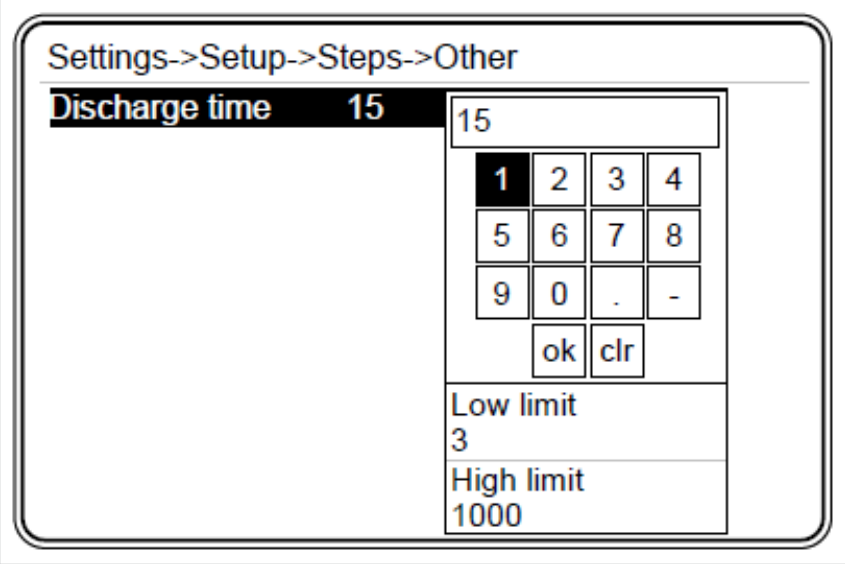
Settings Menu – Setup – Steps – Other

The discharge time is set in this menu.
The PFW03 waits for the discharge time to reactivate a step. It varies from 3 to 1000 sec.



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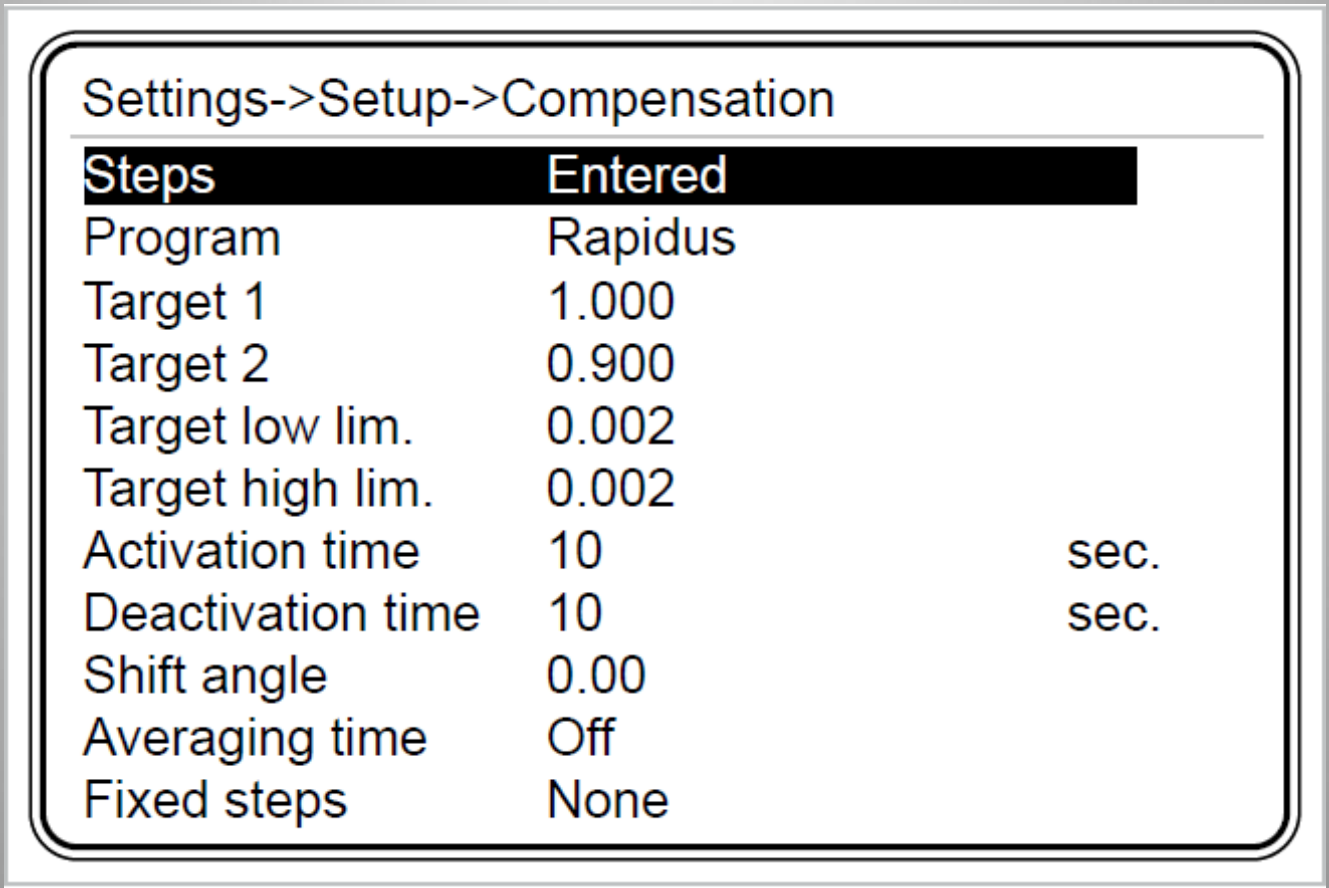
Settings Menu – Setup – Compensation

The Compensation menu is composed of the following menus:



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Settings Menu – Setup – Compensation – Steps

- There are 3 methods for defining the types and powers of the steps:
  - **Entered:** The values are manually entered;
  - **Predefined:** The values are entered as previously explained.
  - **DCM (Dynamic Capacitor Monitoring):**

    - The PFW03 dynamically monitors the values of the steps.

    Thus, the correction of reactive powers will be done using the effectively available powers in the steps.

    - **NOTE:** DCM (Dynamic Capacitor Monitoring) is only available on the PFW03-M12.

Settings->Setup->Compensation

Steps	Entered	
Program	Rapidus	
Target 1	1.000	
Target 2	0.900	
Target low lim.	0.002	
Target high lim.	0.002	
Activation time	10	sec.
Deactivation time	10	sec.
Shift angle	0.00	
Averaging time	Off	
Fixed steps	None	

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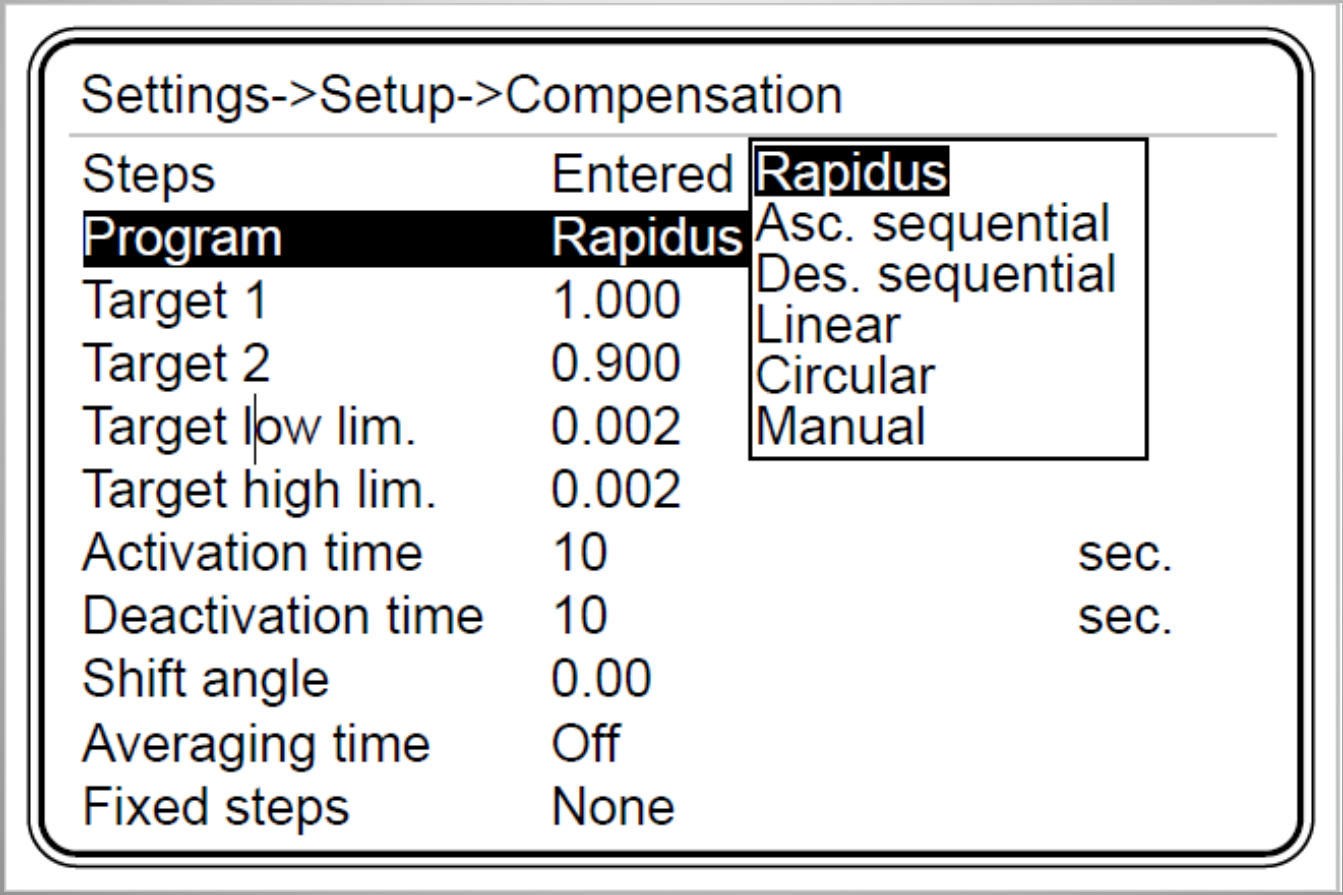
Settings Menu – Setup – Compensation – Program

The reactive power compensation can be done by six different programs according to the submenu below:



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Settings Menu – Setup – Compensation – Program

Smart Mode:

- This mode activates the closest step to the measured reactive power demand.

Ascending Sequential:

- The activation and deactivation of the steps is done starting from the lowest step.

Descending Sequential:

- Activation and deactivation of the steps start with the closest step to the demand.

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Settings Menu – Setup – Compensation - Program

Linear Mode:

- The first activated step is the last to be disabled (FILO);

Note: This program only applies to the 1.1.1.1 step structure.

Circular Mode:

- The first activated step is the first to be disabled (FIFO);

Note: This program only applies to the 1.1.1.1 step structure.

Manual Mode:

- The steps are activated and deactivated manually;

When this program is active, a "Hand" is displayed in the lower left corner of the main page.

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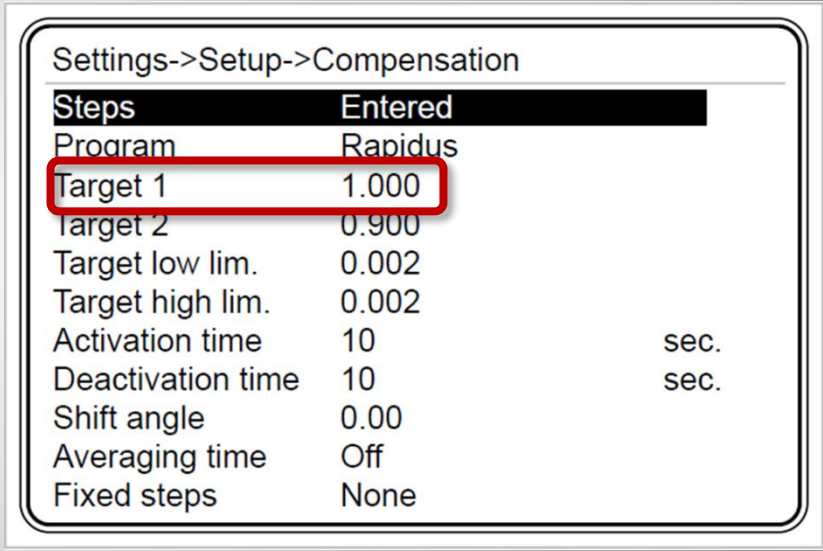
Settings Menu – Setup – Compensation – Target 1

- The Target 1 CosΦ value is set in this menu. It may range from -0.8 (capacitive) to 0.8 (inductive).



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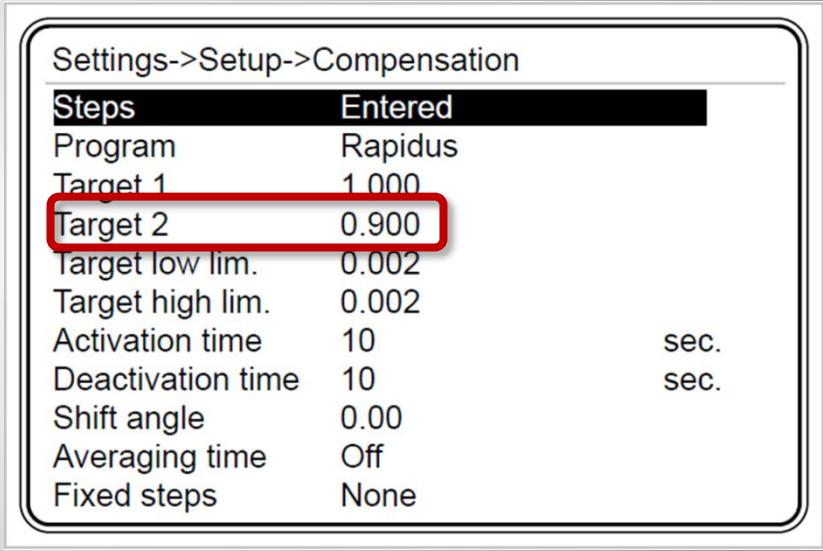
Settings Menu – Setup – Compensation – Target 2

- The Target 2 CosΦ value is set in this menu. It may range from 0.800 (inductive) to 1.000.
- This feature can be enabled by functions:
  - Night/day
  - Generator
  - GEN input activated by a voltage signal between 85 and 265 VAC.



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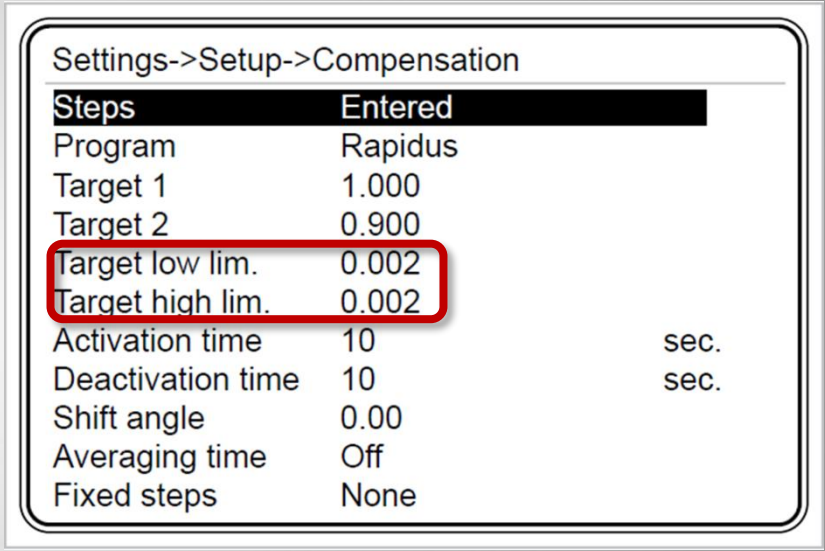
Settings Menu – Setup – Compensation – Low/High lim.

- Target low limit: Lower tolerance for target 1 and target 2. Adjustable from 0.000 to 0.200.
- Target high limit: Higher tolerance for target 1 and target 2. Adjustable from 0.000 to 0.200.



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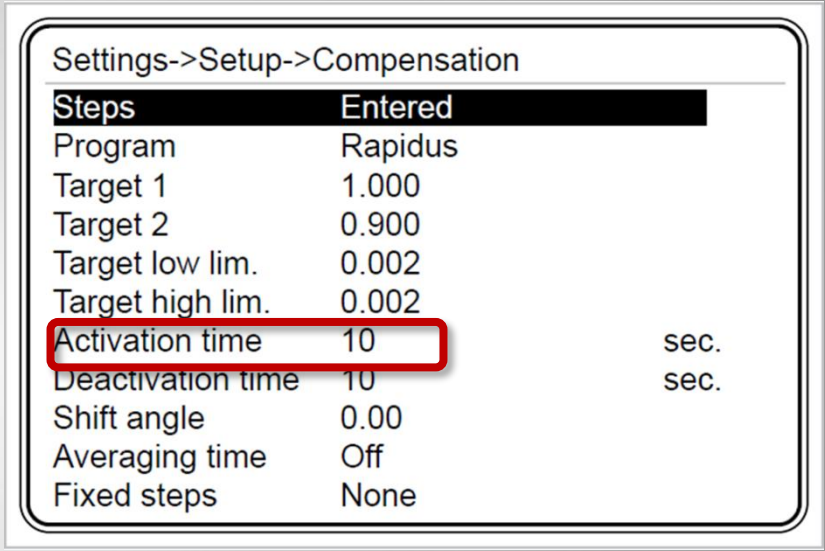
Settings Menu – Setup – Compensation – Activation time

- Activation Time: Delay to activate the step. Adjustable from 1 to 600 seconds.



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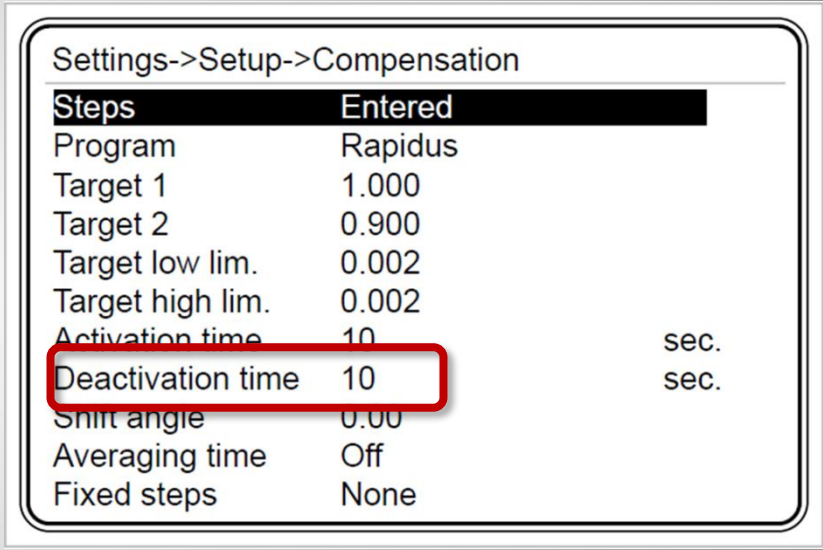
Settings Menu – Setup – Compensation – Deactivation time

- Deactivation Time: Delay to deactivate the step. Adjustable from 1 to 600 seconds.



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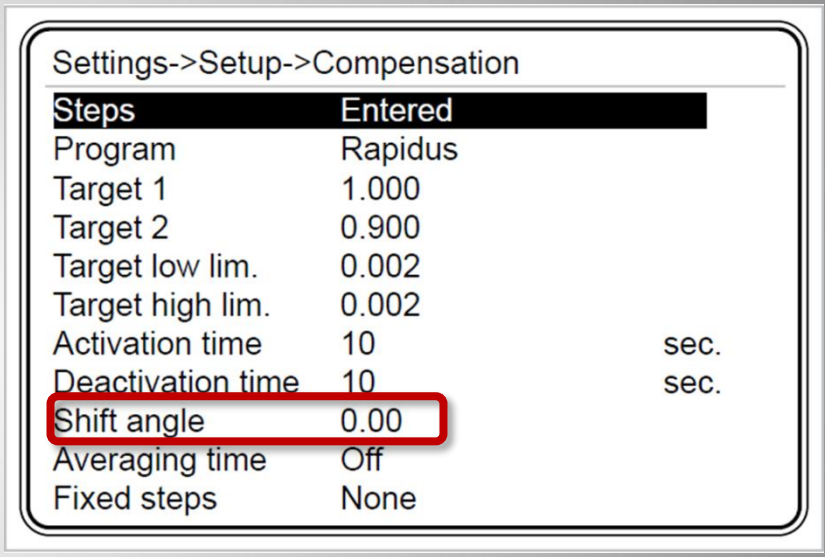
Settings Menu – Setup – Compensation – Shift angle

- Shift Angle: Inclusion of transformer losses, which are not measured, in the compensation of reactive powers.
- **E.g.:**

➢ Considering the CosØ value is 1,000.

➢ If the user enters 20° as the shift angle, the PFW03 will calculate the value of CosØ as 0.940 inductive.

➢ If you use -30° as the shift angle, the value of CosØ will be 0.866 capacitive



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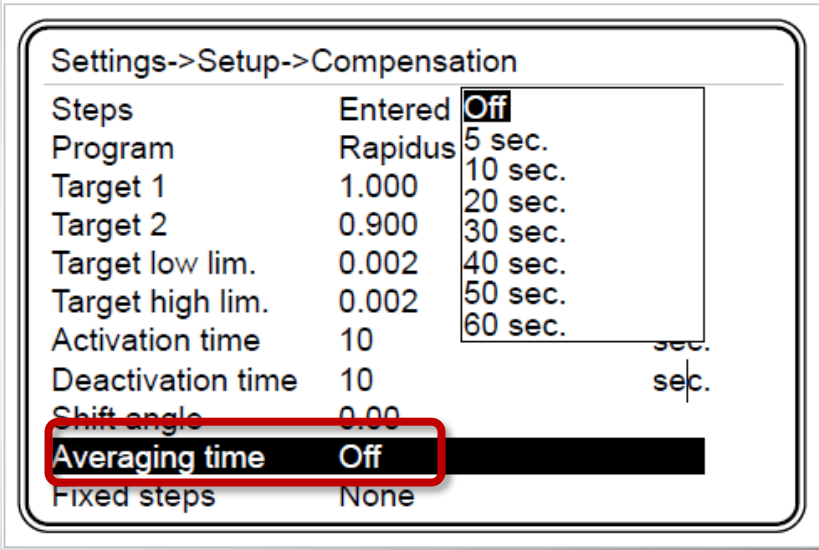
Settings Menu – Setup – Compensation – Averaging time

- Averaging Time: If the operator does not need a quick response from the PFW03, use this menu to adjust the equipment.

- The PFW03 uses the calculated average power related to the interval set (5 sec - 60 sec). Immediately after the time set has elapsed, the reactive power compensation will be done according to the calculated average power.



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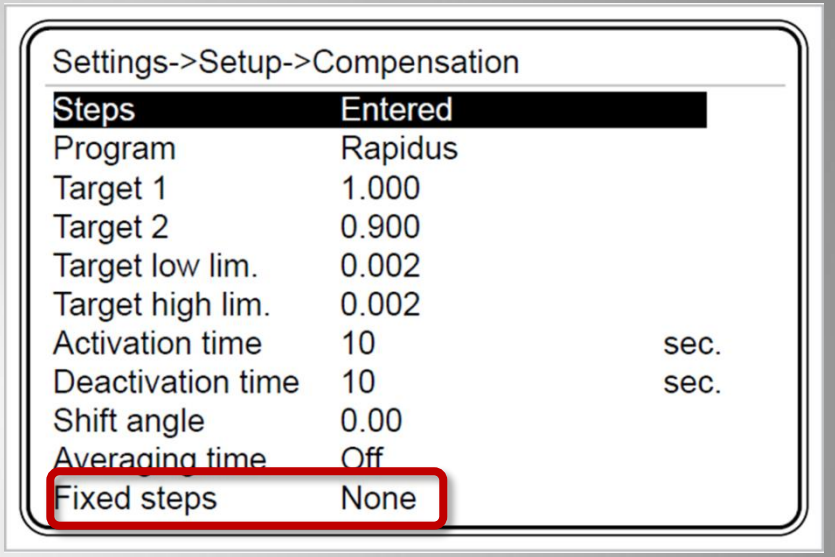
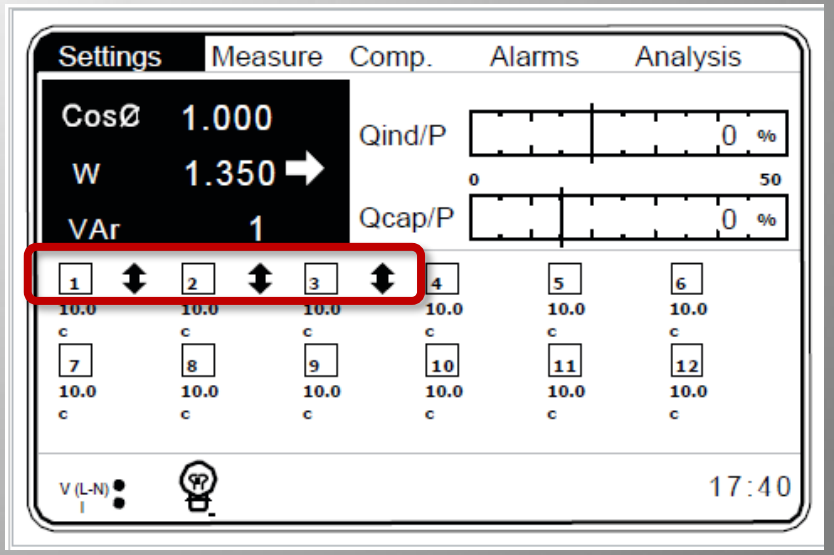
Settings Menu – Setup – Compensation – Fixed steps

- Fixed steps: The first three steps of the PFW03 can be fixed.
- In the main menu, the symbol "↕" will be displayed next to the steps defined as fixed.





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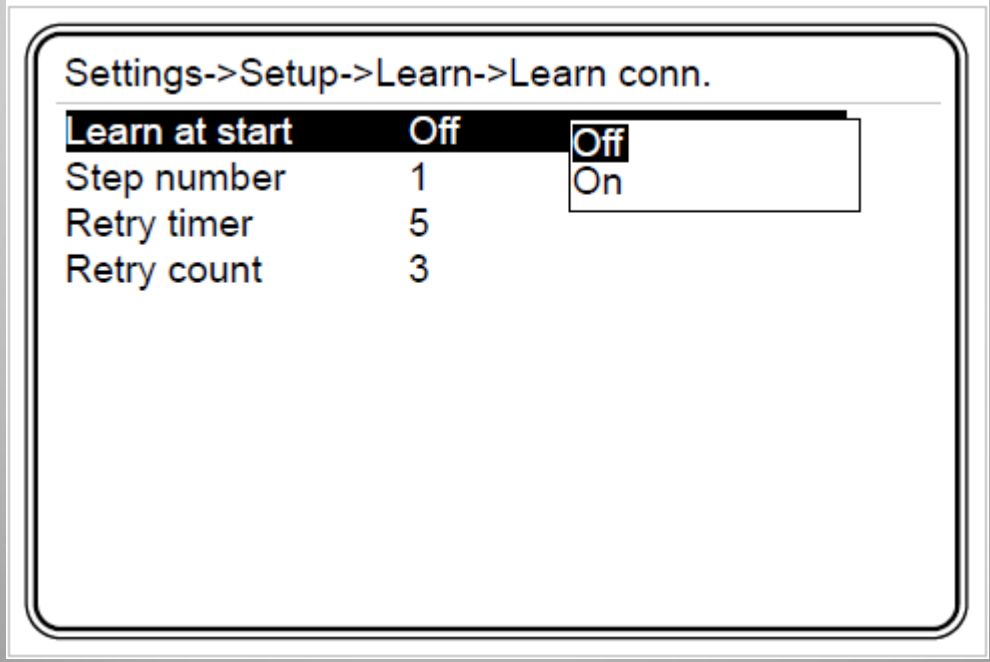
Settings Menu – Setup – Learn – Learn connection

- Learn connection:
  - On => The PFW03 automatically "learns" the executed connections when turned on or restarted;
  - Off => The PFW03 does not automatically "learn" the executed connections when turned on or restarted;



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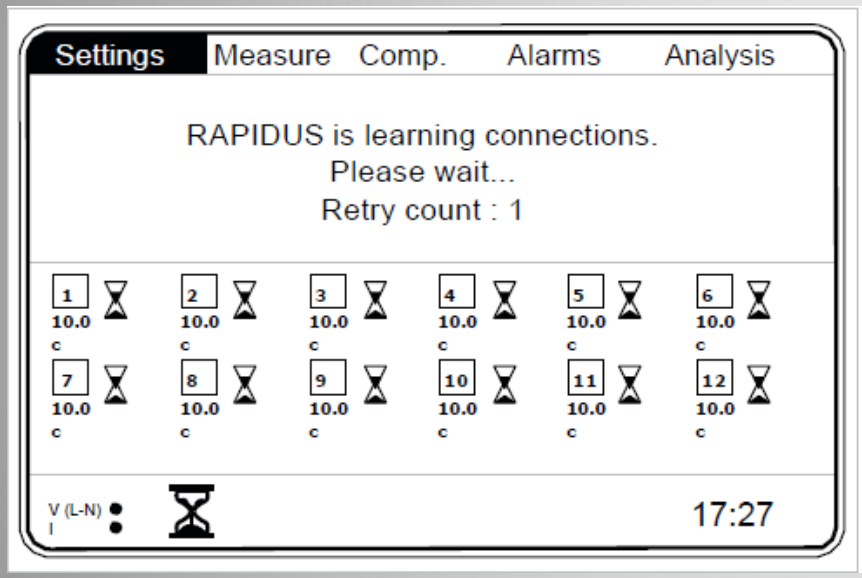
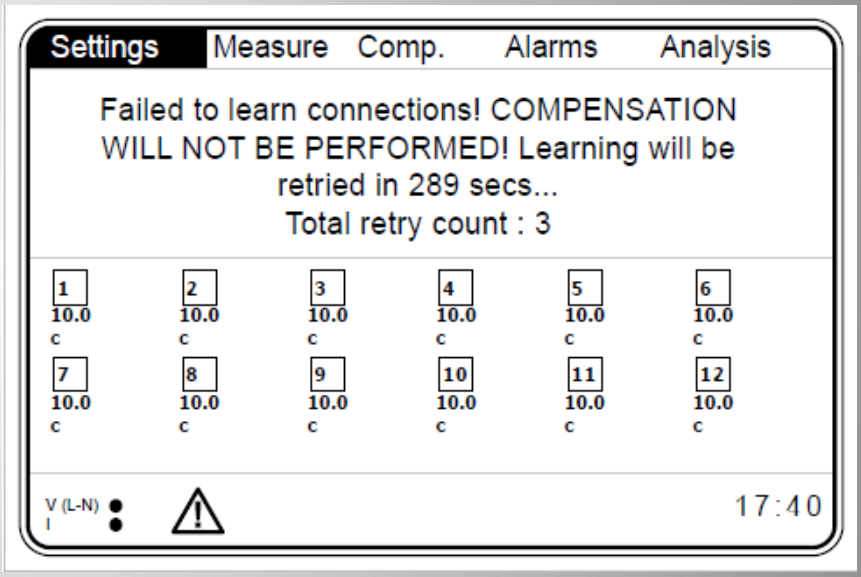
Settings Menu – Setup – Learn – Learn connection

Learning Connections



Learning connection not performed



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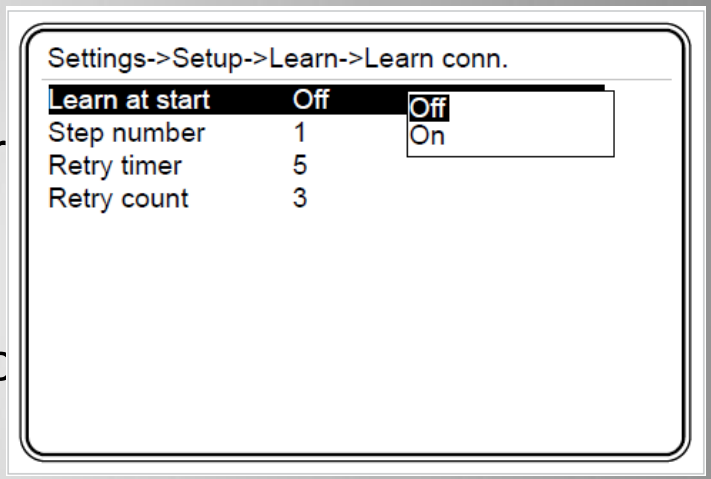
Settings Menu – Setup – Learn – Learn connection

- Step Number: This function is valid for three-phase capacitors

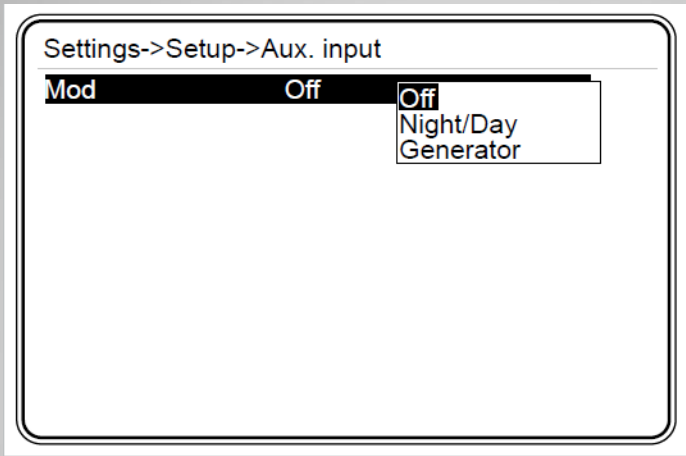
NOTE: It is advisable to enter the number of the step that has the highest installed power;

- Retry Timer: In case the PFW does nc "learn" the connection, it will retry it after the time set in this menu;
- Retry count: When the PFW does not "learn", it will retry it according to the number set in this menu;



PFW03-M12_24

Settings Menu – Setup – Aux. input



- The auxiliary input is used to activate the second option target 2 cosØ and allow the use of the functions:
  - Night/Day: In this function, when the input is activated, compensation is done as defined in TARGET 2. The energy meters remain counting.
  - Generator: In this function, when the input is activated, compensation is done as defined in TARGET 2. The energy meters do not count while the input is activated.

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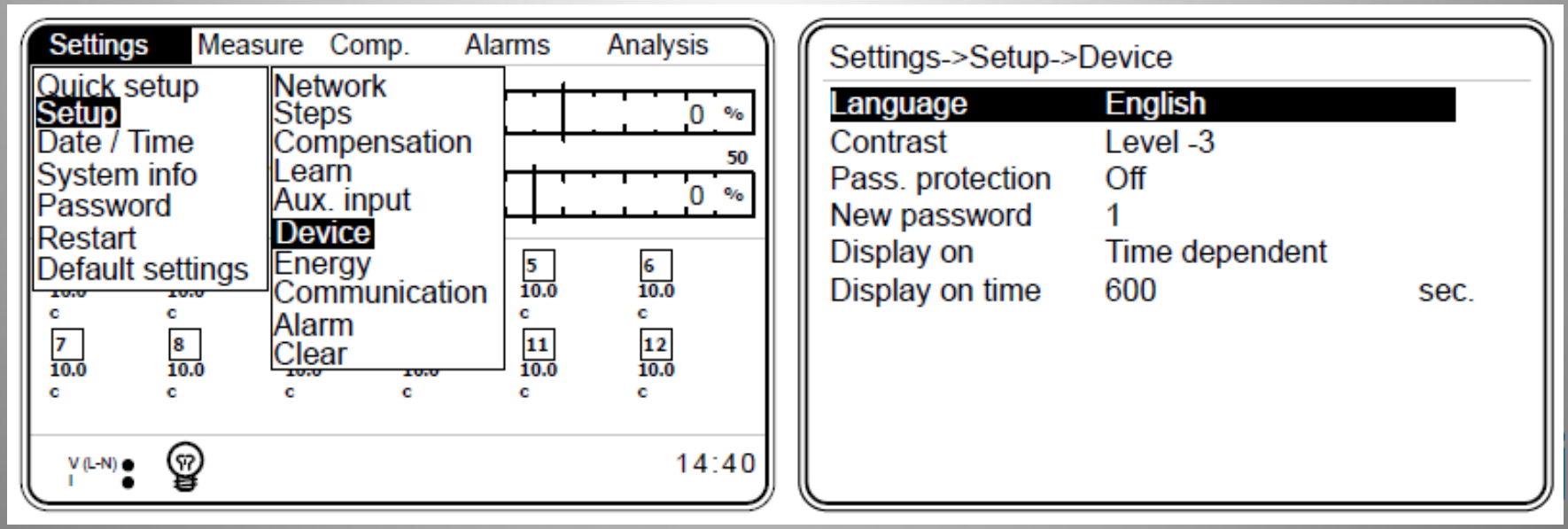
Settings Menu – Setup – Device

In this menu you set:

- Language
- Contrast
- Password protection
- New password
- Display on
- Display on time



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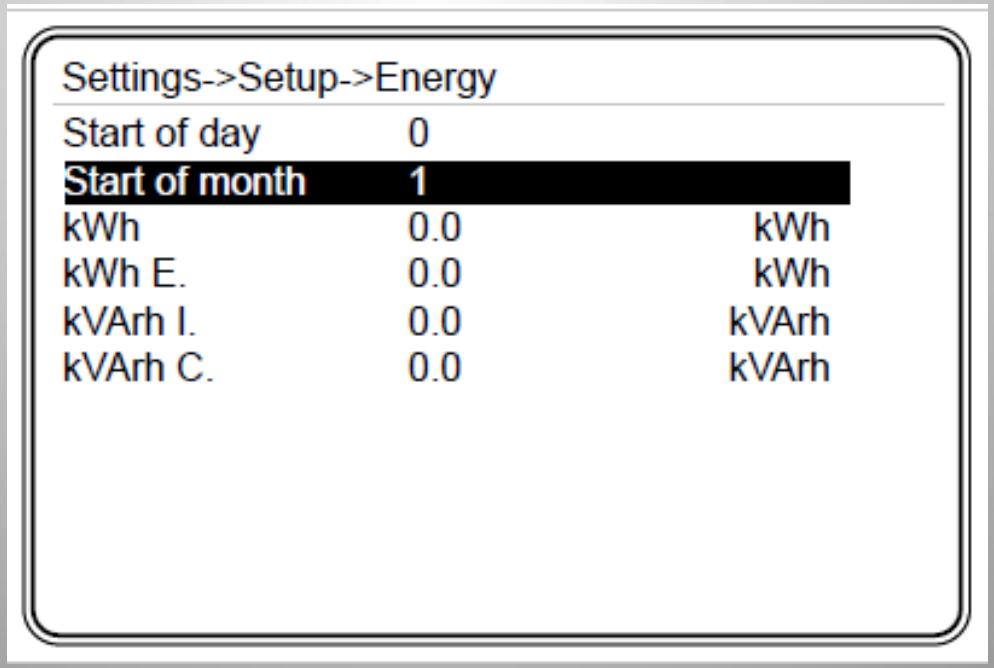
Settings Menu – Setup – Energy

In this menu you define the criteria for using the energy meters.

- Star of day: setting of the time to start the energy meters;
- Star of month: setting of the day of the month to start the energy meters;
- kWh; kwh E (export); kVArh I; kVArh C: implementation of start values of the meters;



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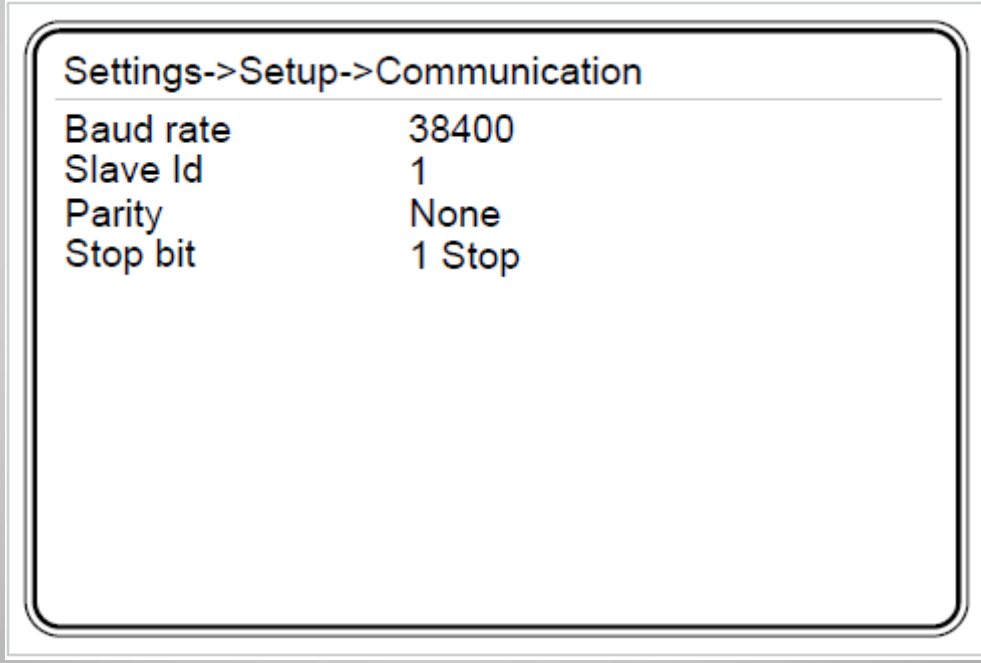
Settings Menu – Setup – Communication

Communication parameters are set in this menu.



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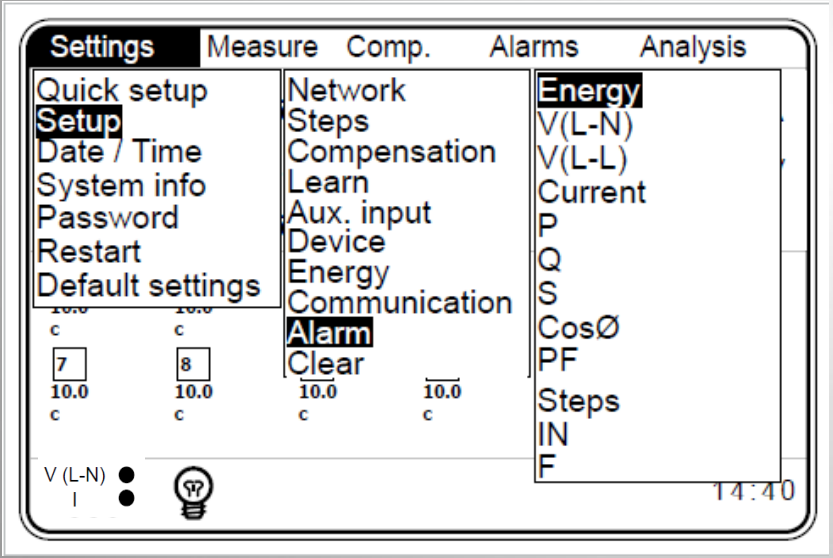
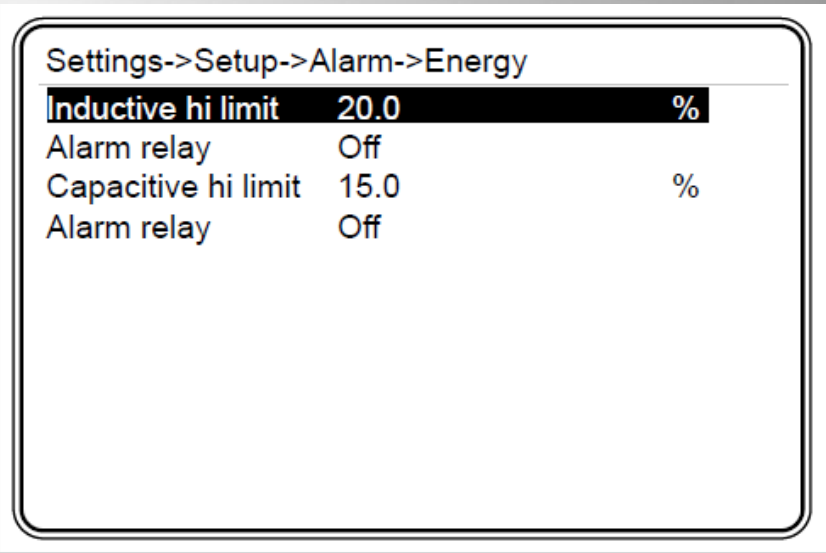
Settings Menu – Setup – Alarm – Energy

This menu is used to set the high limit alarm of the Inductive/Active and Capacitive/Active energy rates.





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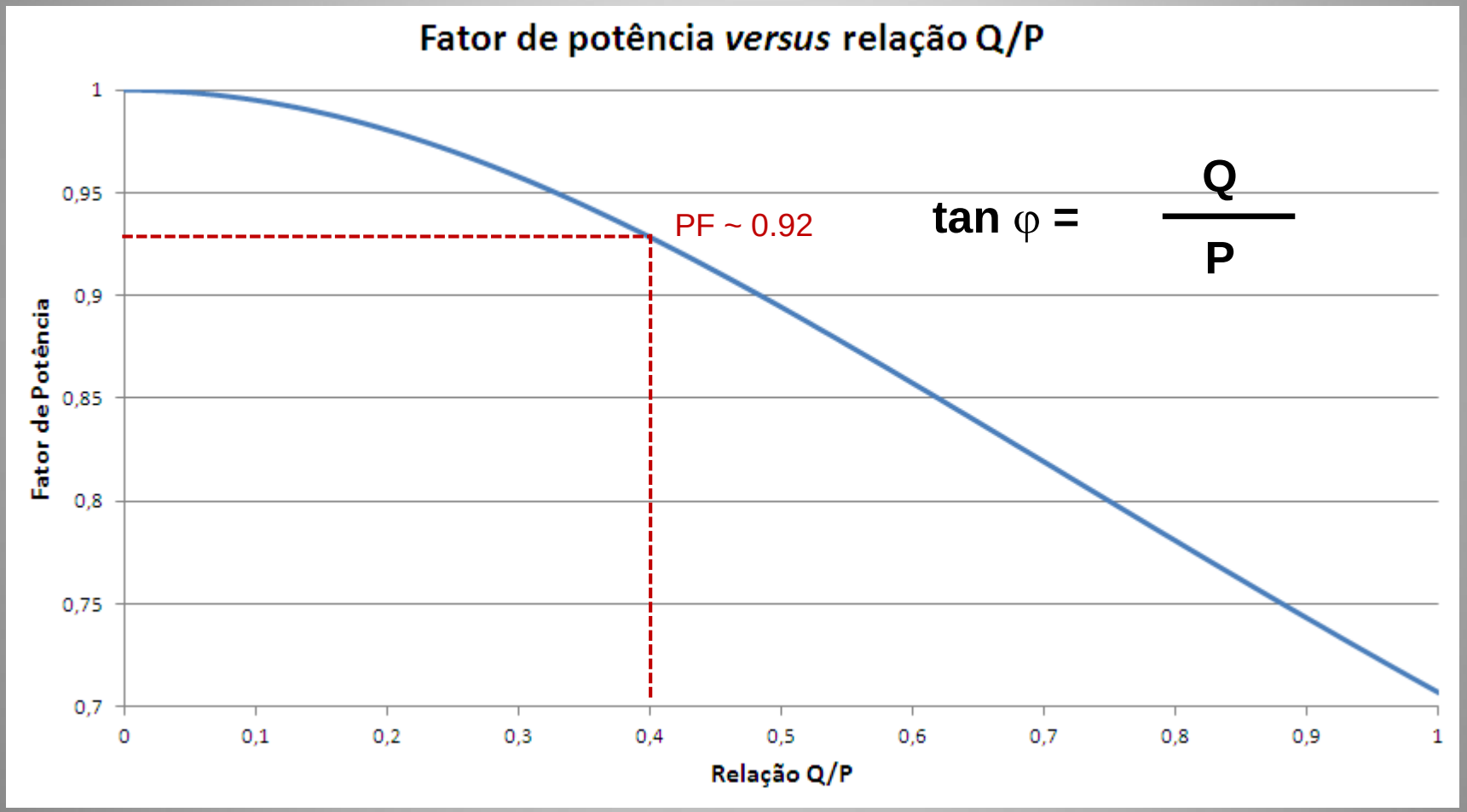
Description of the display functions



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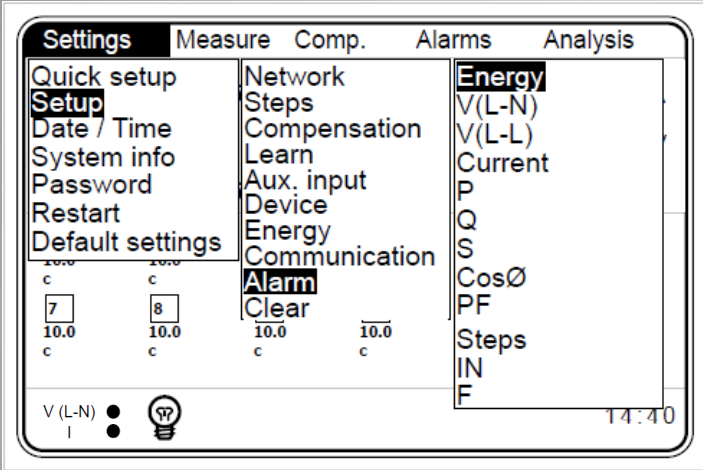
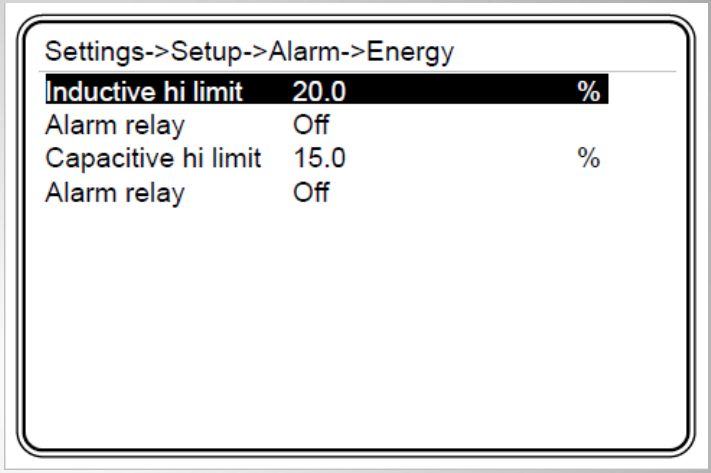
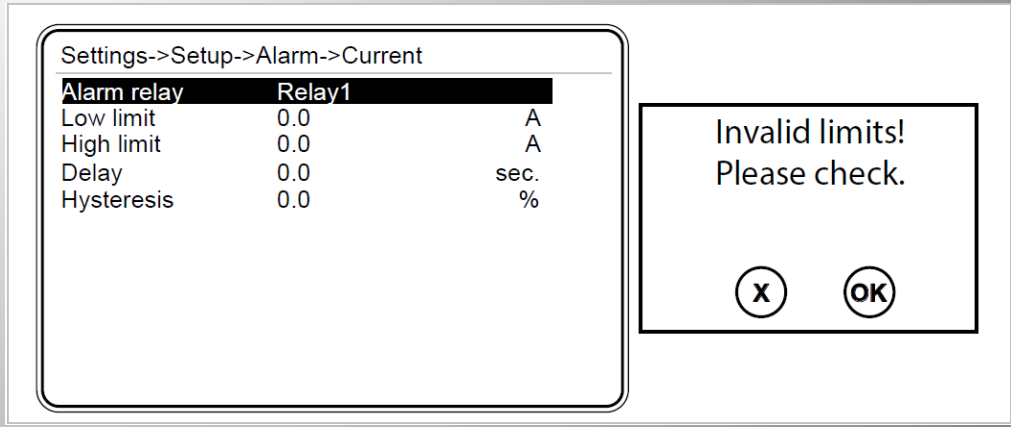
Settings Menu – Setup – Alarm – Energy





NOTE:

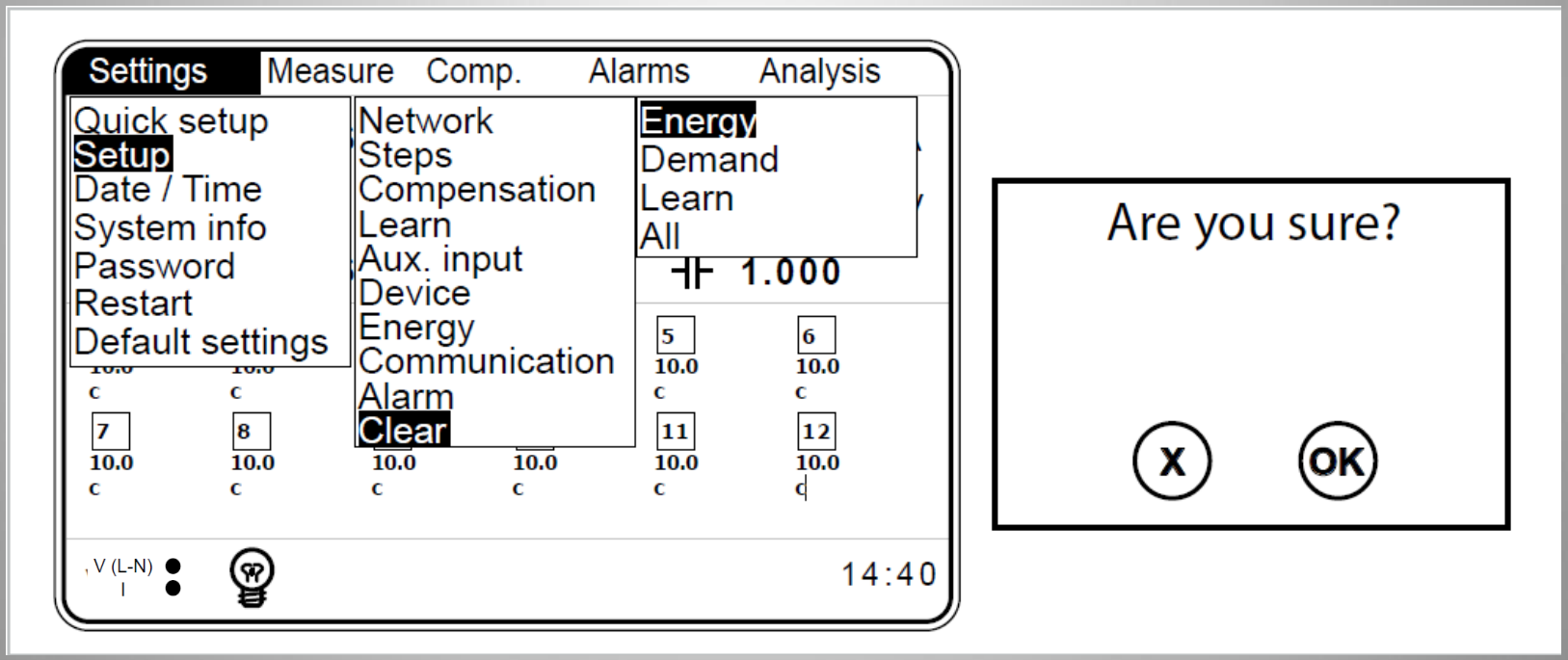
- If the high and low limits are the same, the alarm will not be activated;
- If the low limit is greater than the high limit, the PFW will display "Invalid limits! Please check."



PFW03-M12_24

Settings Menu – Setup – Clear

In this menu, energy and demand values can be cleared;
"Learned" connections return to the factory settings;



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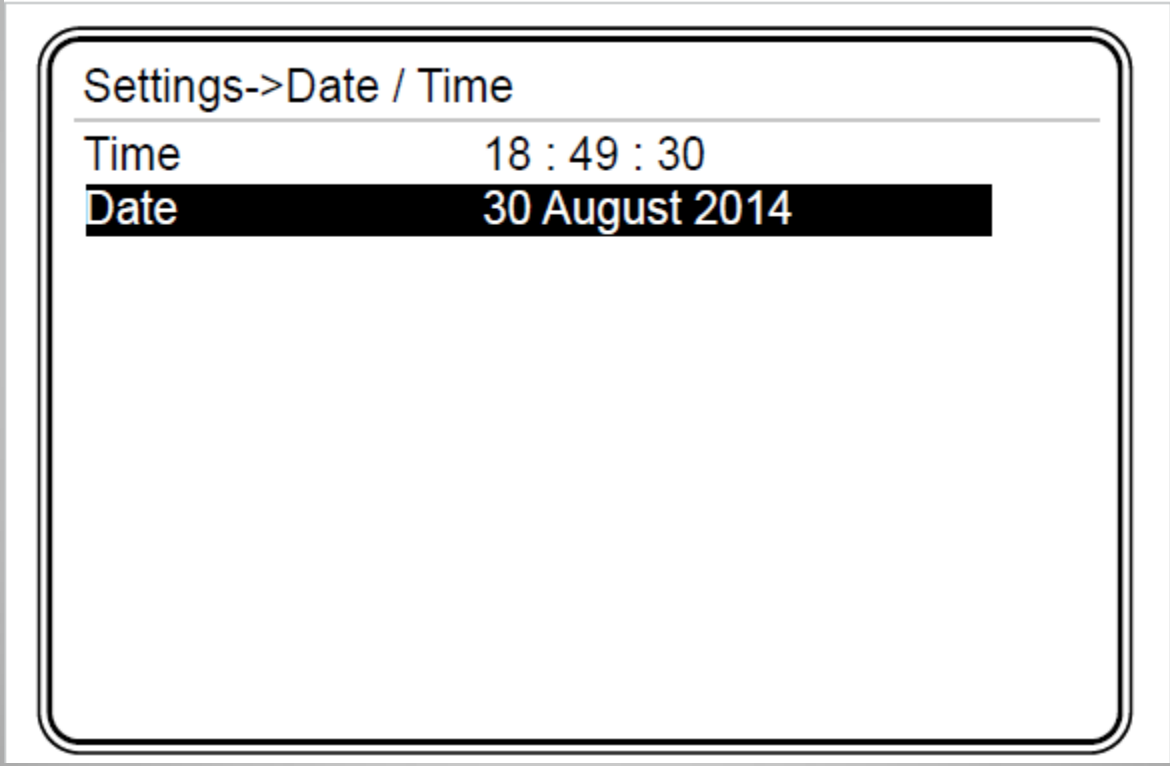
Settings Menu – Date / Time



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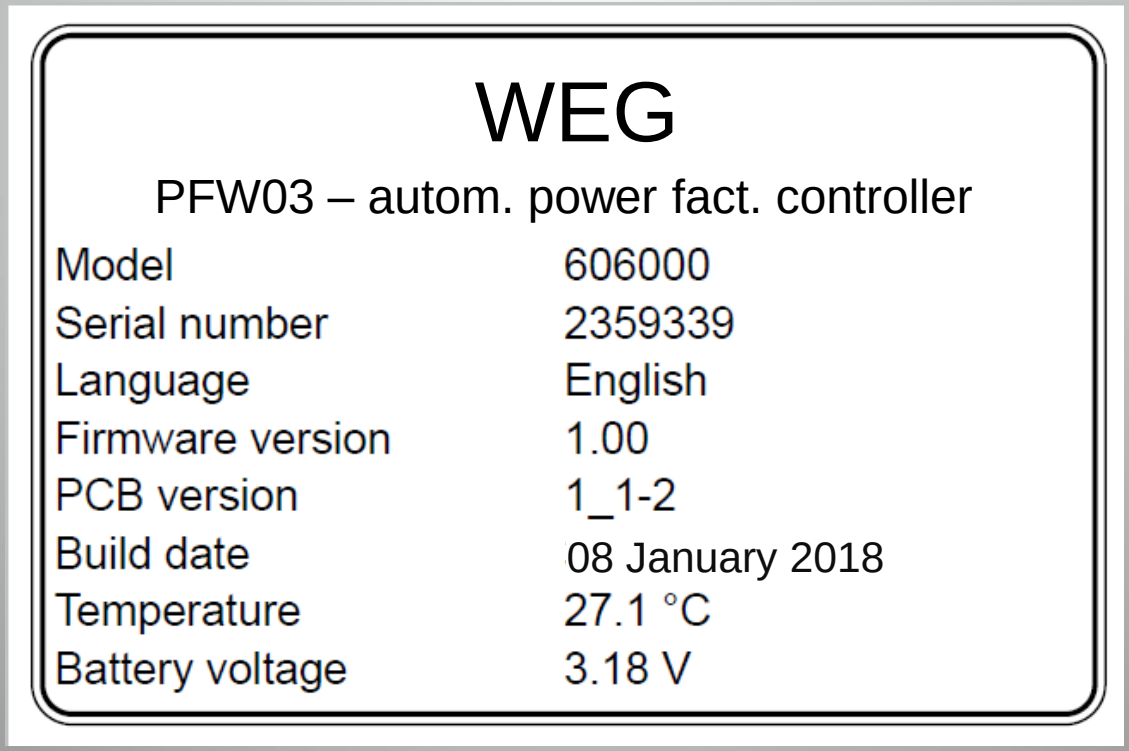
Settings Menu – System info

- There is no setting in this menu. Only product information.
- Battery voltage and temperature can be read via RS485.



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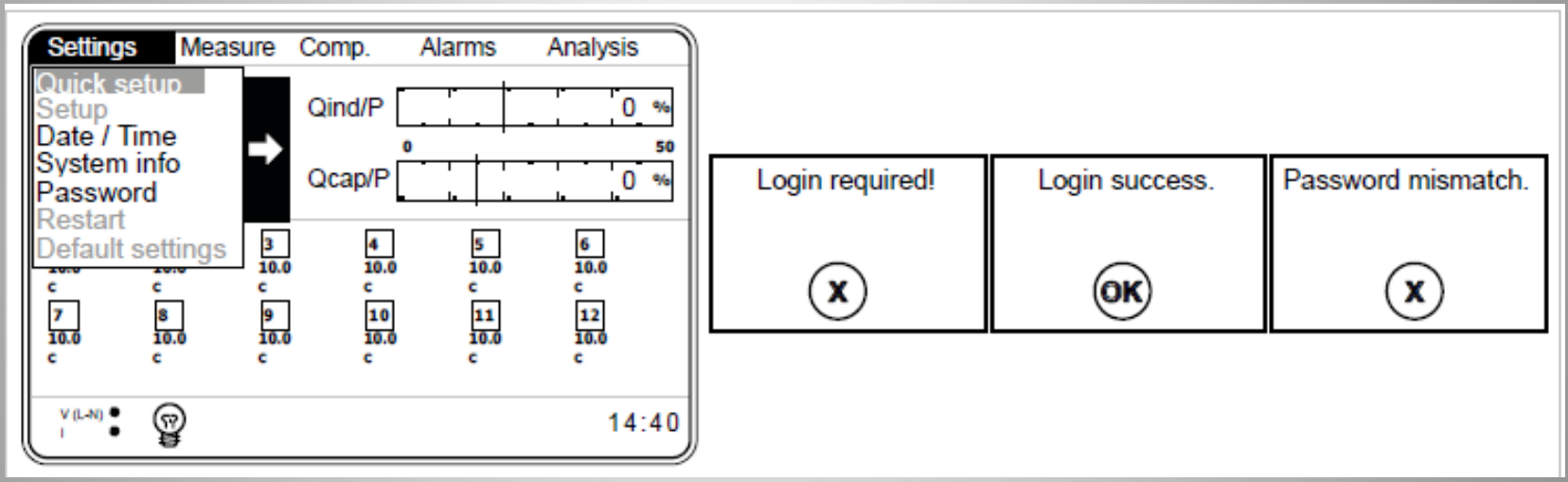
Settings Menu – Password

If the password is not entered, only "Date / Time"; "System info" and "Password" are active.
To activate the other menus, enter the password. (Default password = 1)



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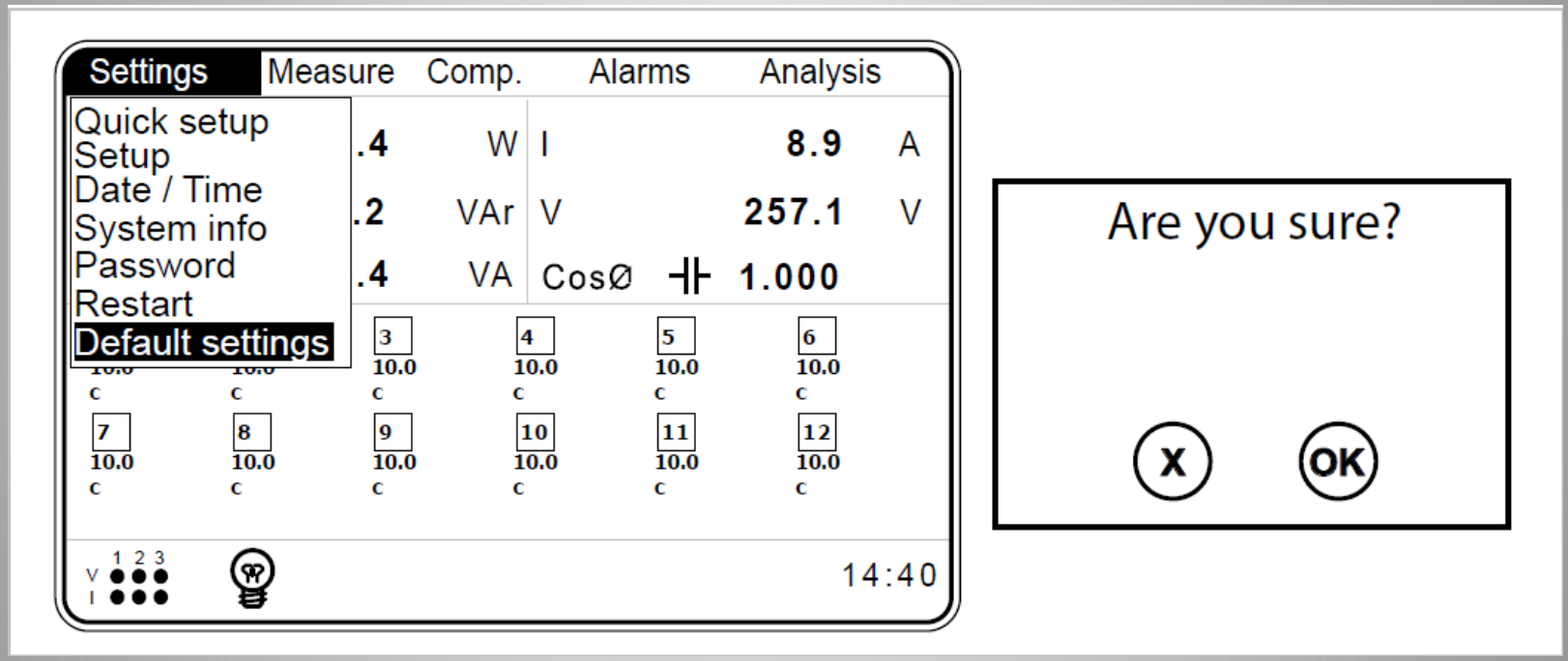
Settings Menu – Default Settings

This menu returns the equipment to the factory settings



NOTE: Indexed values and date / time are not reset in this operation.

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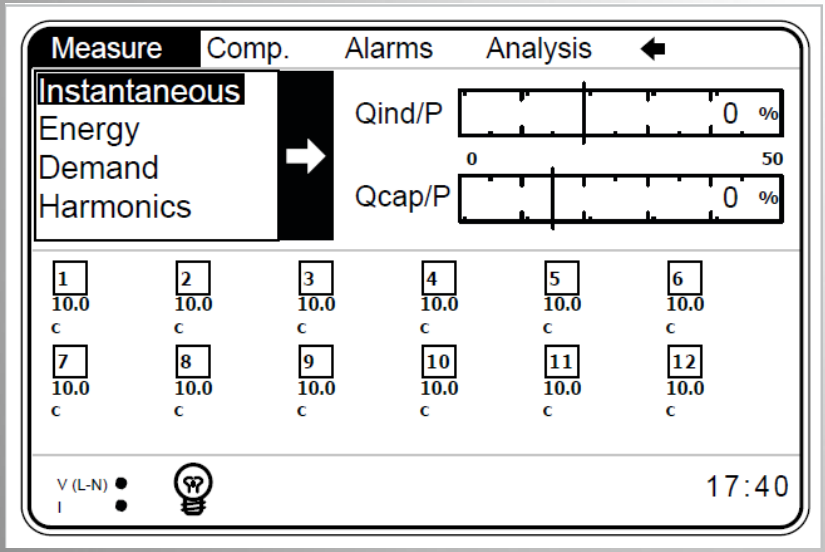
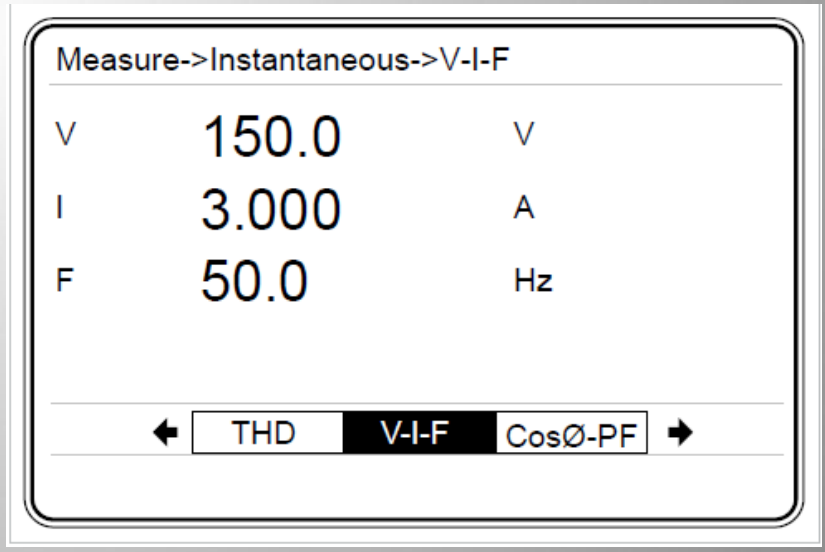
Measure Menu – Instantaneous

This menu shows the reading of the values: V(L-N), V(L-L), (I), (IN), CosØ, (PF), (P), (Q), (S), (F), THDV, THDI





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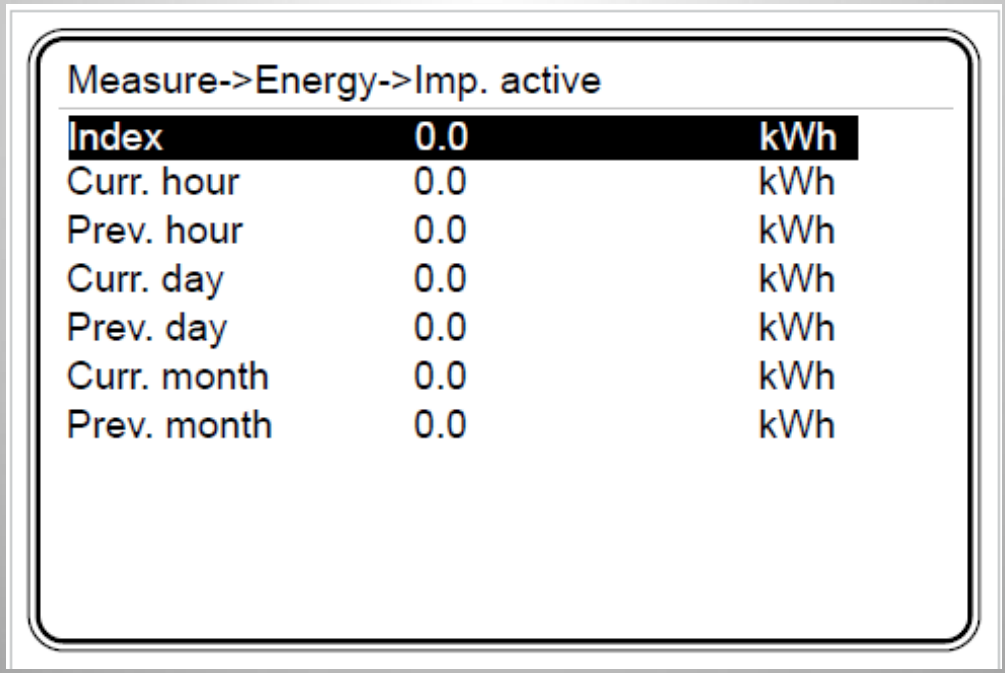
Measure Menu – Energy

The energy measure menu includes Imp. active (import active energy); Exp. Active (export active energy); Ind. Reactive (inductive reactive energy); Cap. reactive (capacitive reactive energy)



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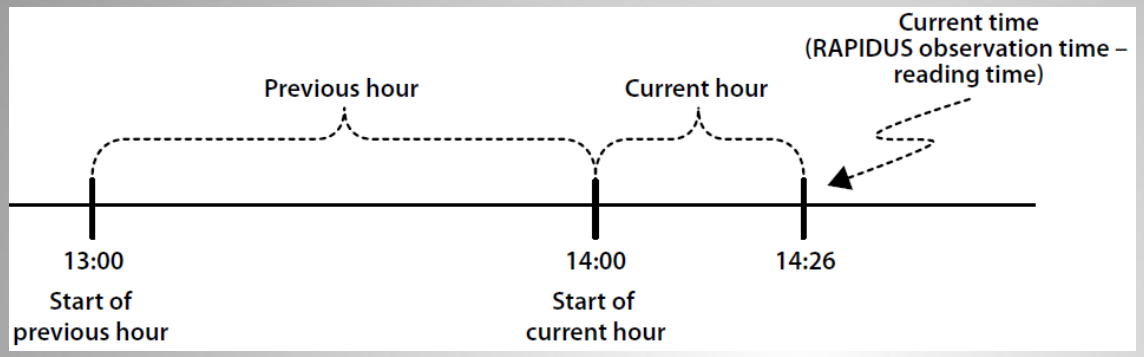
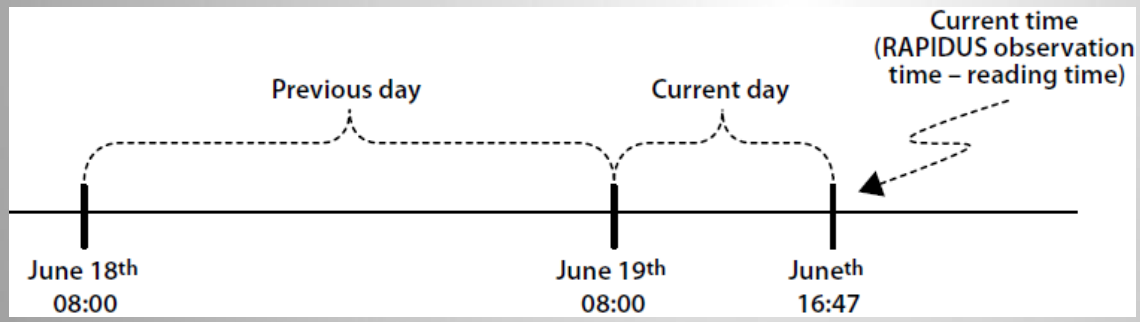
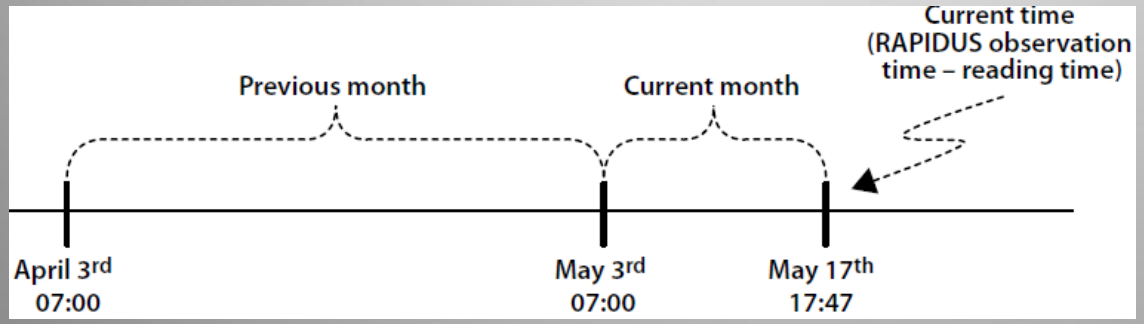
Measure Menu – Energy



Current / Previous Hour



Current / Previous Day



Current / Previous Month

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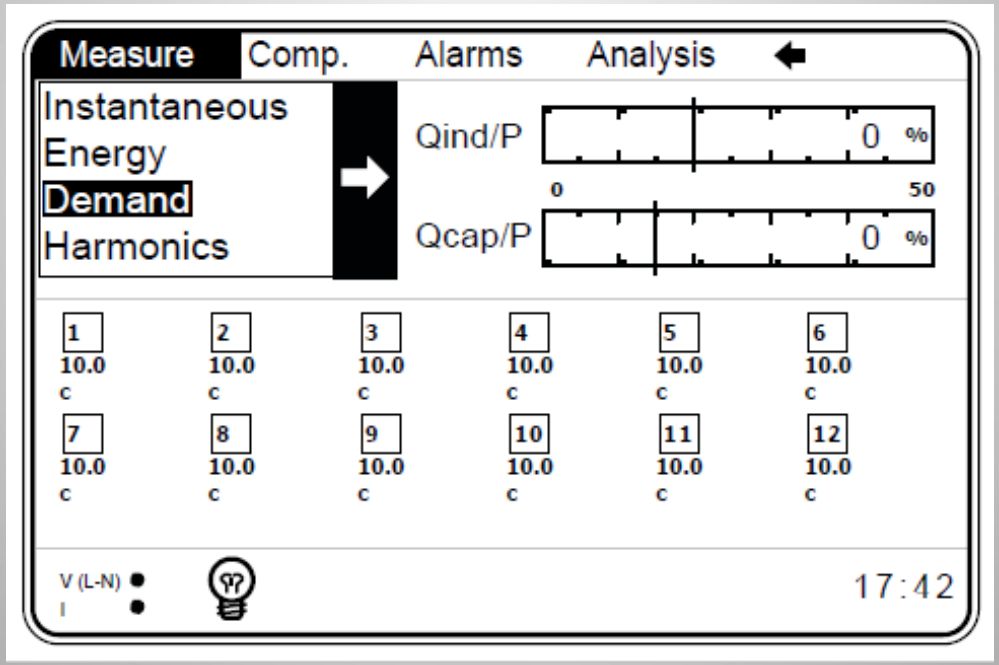
Measure Menu – Demand

The demand value is saved with date and time tag.
The demand menu has submenus with current and energy values saved by phase and total.



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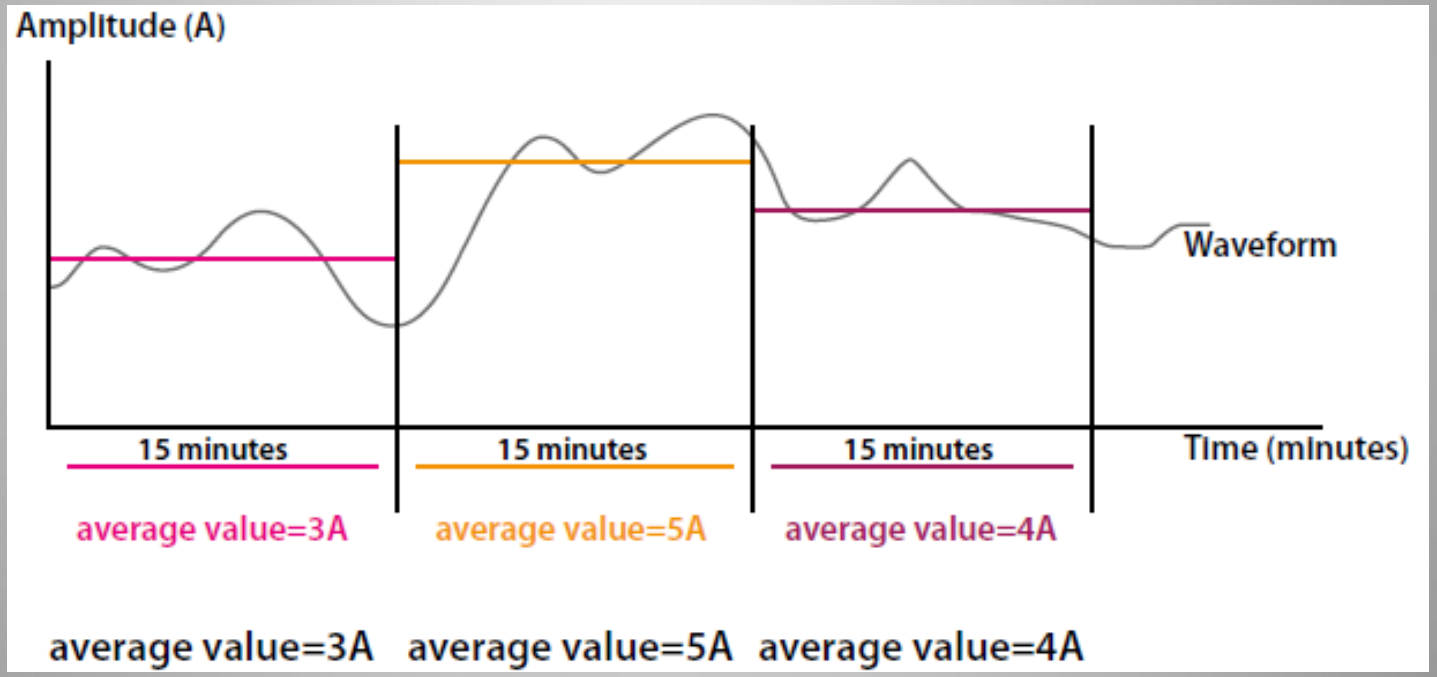
Measure Menu – Demand

The highest averages of current and power are recorded according to the time defined for such calculation.



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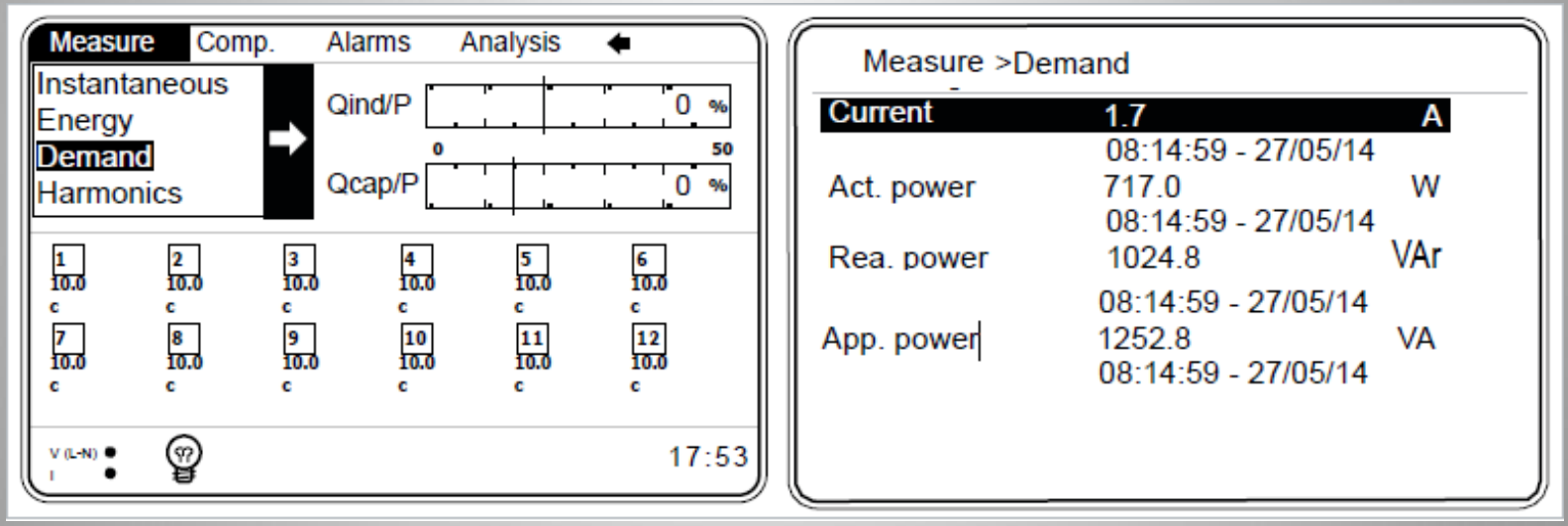
Measure Menu – Demand

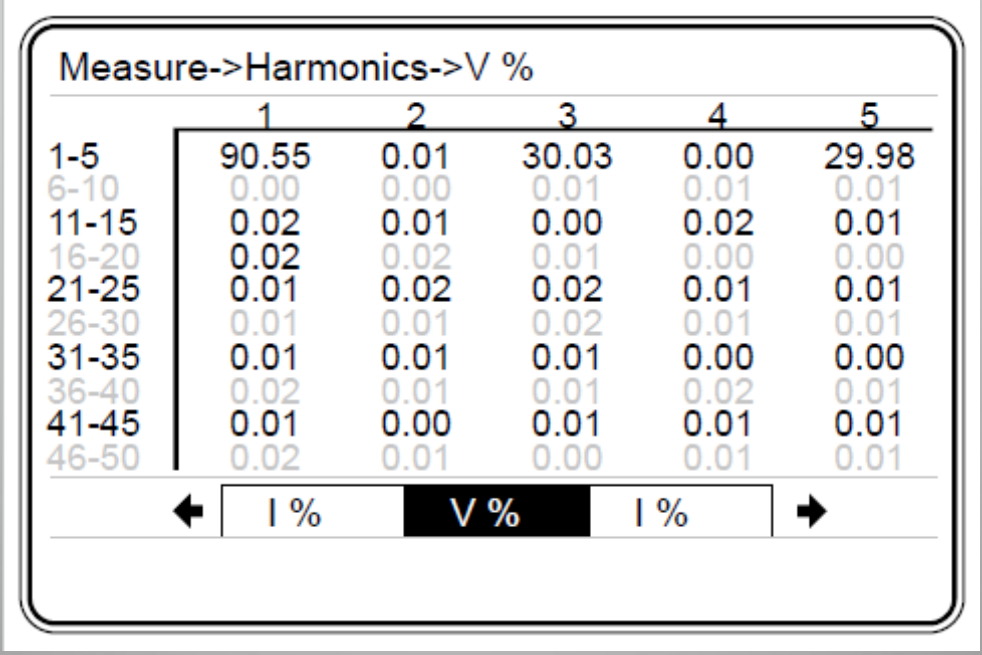
In the demand submenus, present and total power values are shown for the measured phase.



PFW03-M12_24

Measure Menu – Harmonics – Table

The PFW measures/calculates harmonics up to the 51st order.
Voltage and current are shown in separate tables as is the image below.



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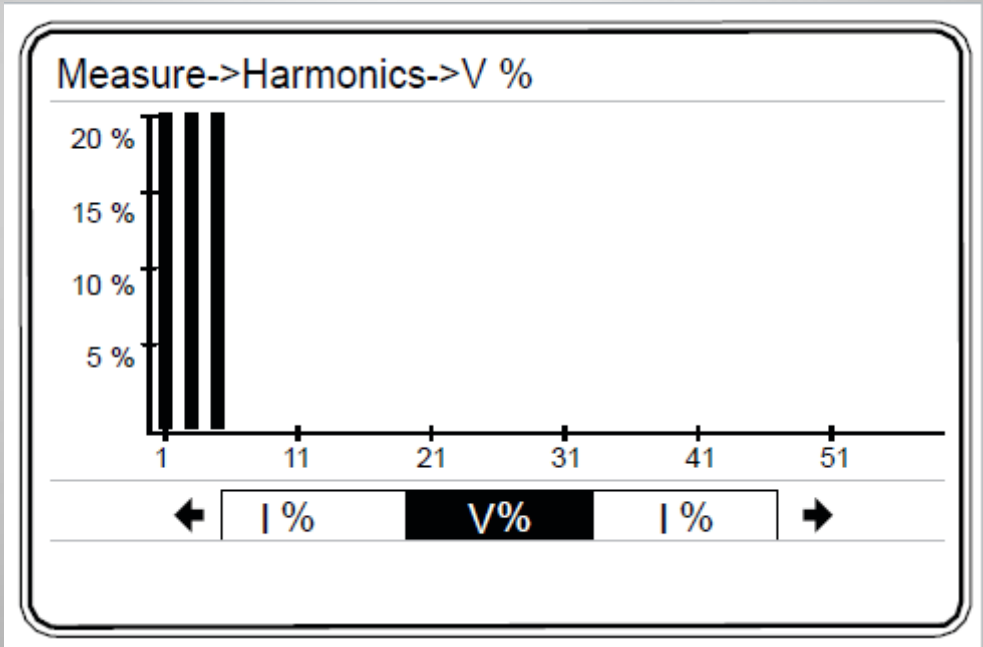
Measure Menu – Harmonics – Graph

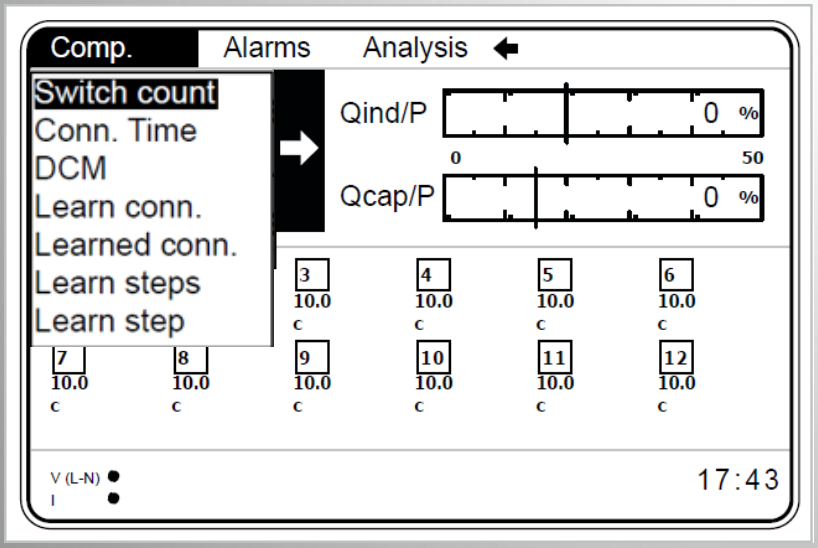
There are 2 bar graphs. One for voltage and one for current.

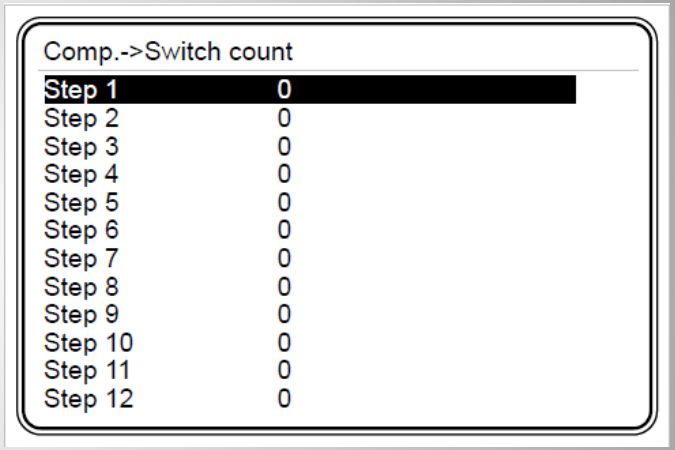


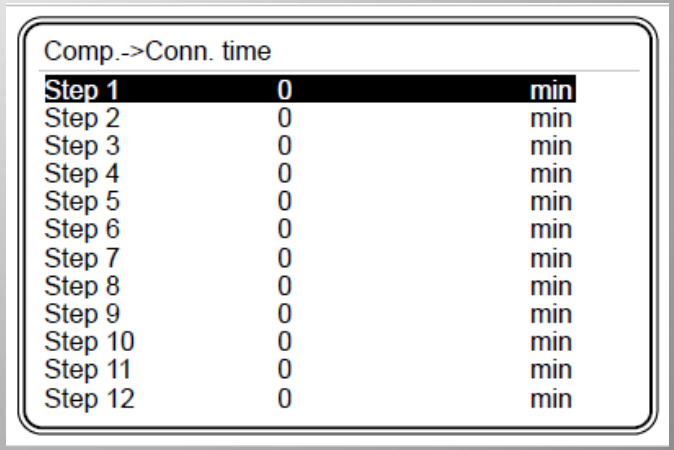
PFW03-M12_24

Comp. Menu

In the compensation menu, the number of operations and the connection time of each step are shown.







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Comp. Menu – DCM (only in the PFW03-M12)

Dynamic Capacitor Monitoring:

The first results of the step power verification require at least 128x8 step switches.
The following power values will be updated every 128 operations.
The previous estimated power will be the step reference value for the new estimate/calculation cycle.
DCM works in any of the selected compensation programs.

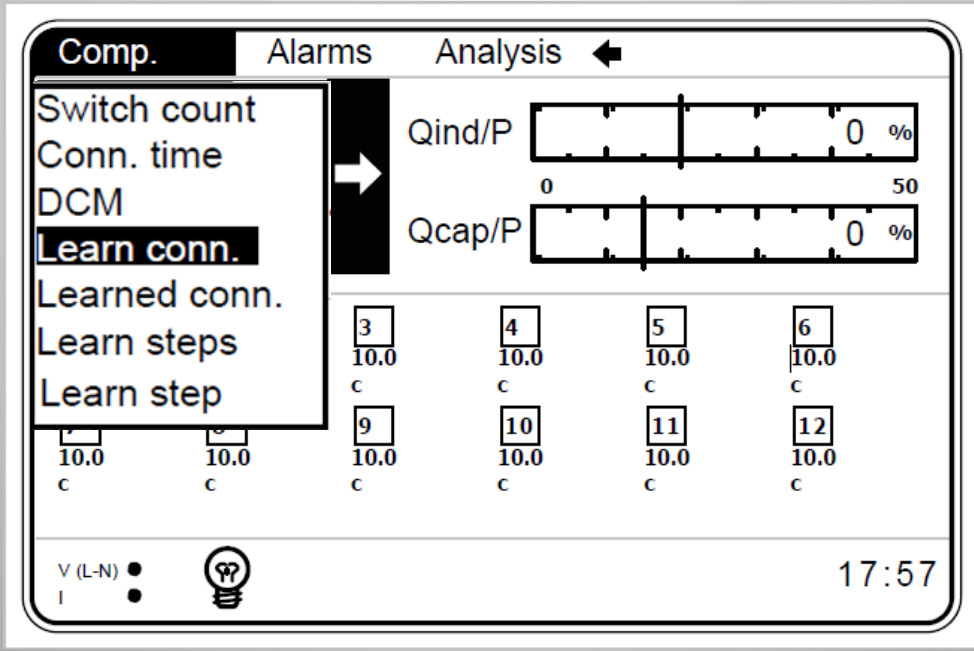
If one of the step power values defined by the DCM algorithm is less than 20% of the previous value or greater than 180% of the previous value, the related step will not be used as compensation.
In this situation, the step and its connection must be checked. An alarm can be set for this situation.

NOTE: DCM is not available on the PFW03-M24.

PFW03-M12_24

Comp. Menu – Learn connection

This function can "learn" the connection only for three-phase capacitors. The appropriate capacitor can be set in the "Step number" submenu of the "Quick Setup" menu or in the "Settings-> Setup-> Learn-> Learn Conn." menu.

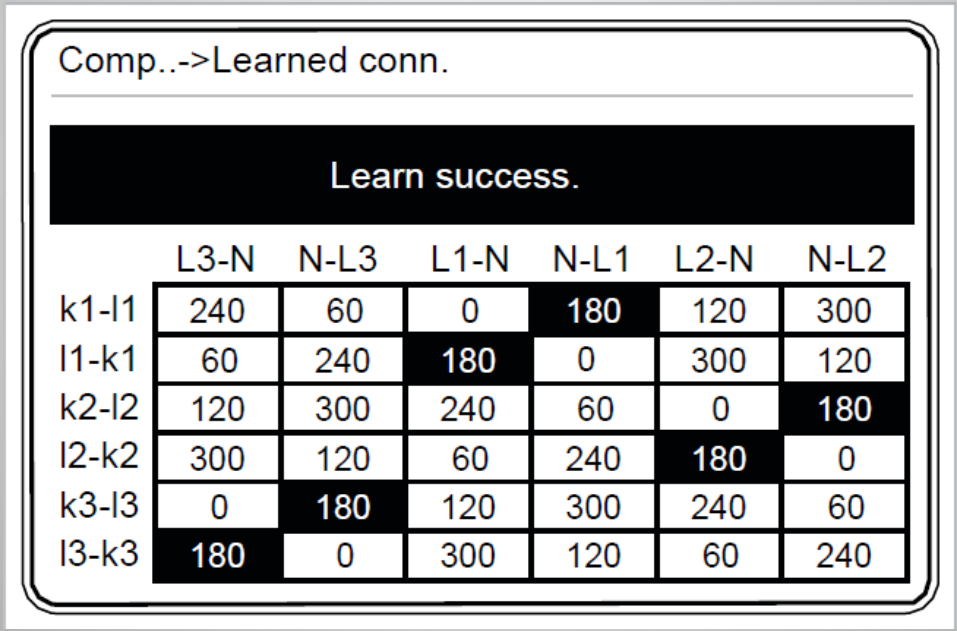


NOTE: In the "Step number" setting, the number of the step to be entered is the step with the highest installed power.

PFW03-M12_24

Comp. Menu – Learn connection

Learned connections are shown on the display.



	L3-N	N-L3	L1-N	N-L1	L2-N	N-L2
k1-l1	240	60	0	**180**	120	300
l1-k1	60	240	**180**	0	300	120
k2-l2	120	300	240	60	0	**180**
l2-k2	300	120	60	240	**180**	0
k3-l3	0	**180**	120	300	240	60
l3-k3	**180**	0	300	120	60	240

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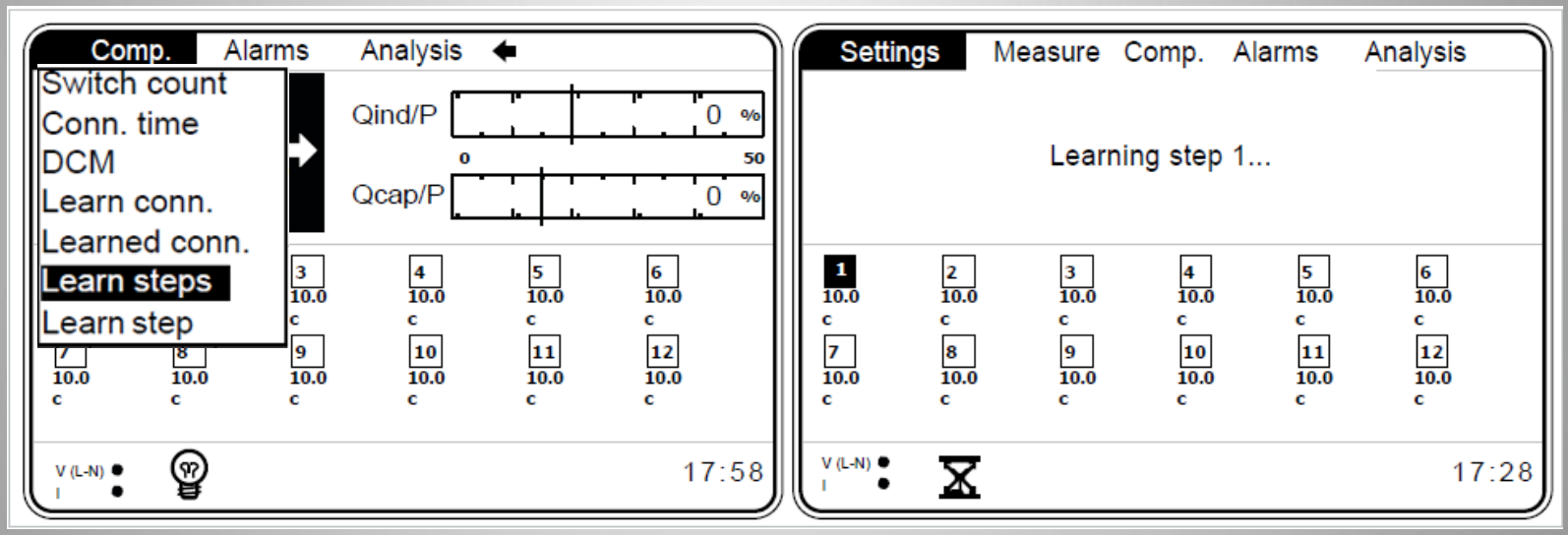
Comp. Menu – Learn steps

The PFW03 learns the power and the correction type (capacitor or reactor) of each step.

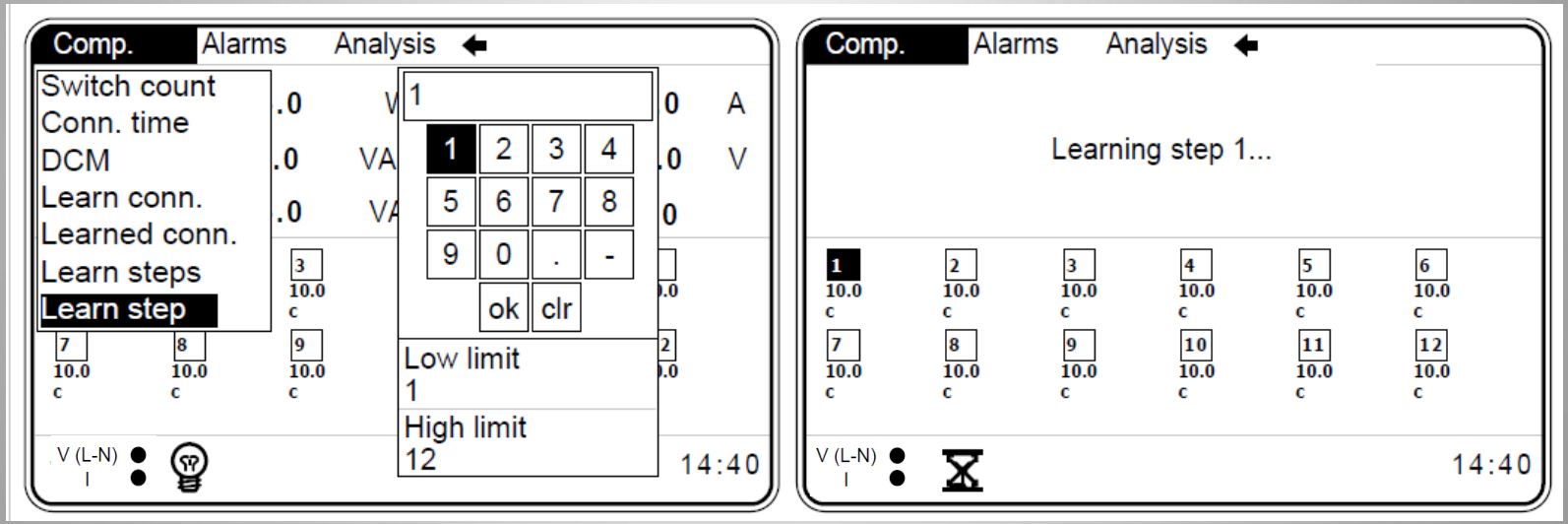


NOTE: No load (current and amplitude) must present changes in the system to ensure that the step powers are learned correctly. Otherwise, the PFW03 may learn the step powers incorrectly.

PFW03-M12_24

Comp. Menu – Learn steps

Through this menu, the PFW03 learns the step power and its type.



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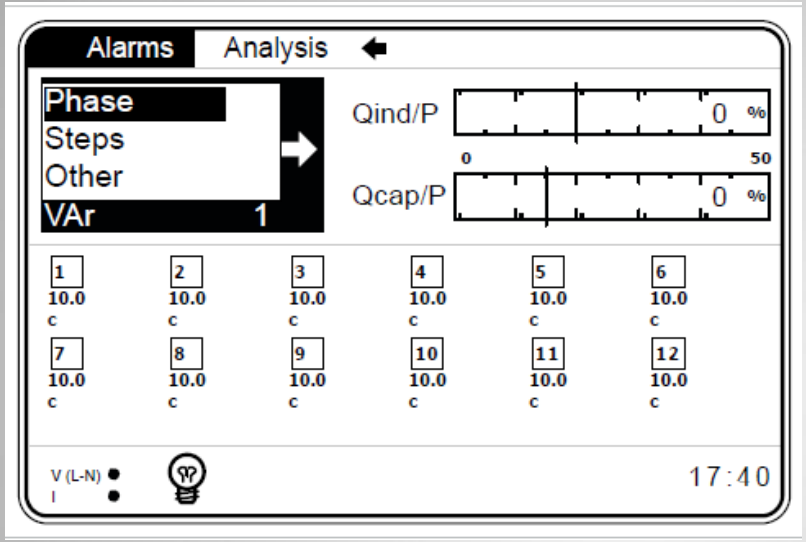
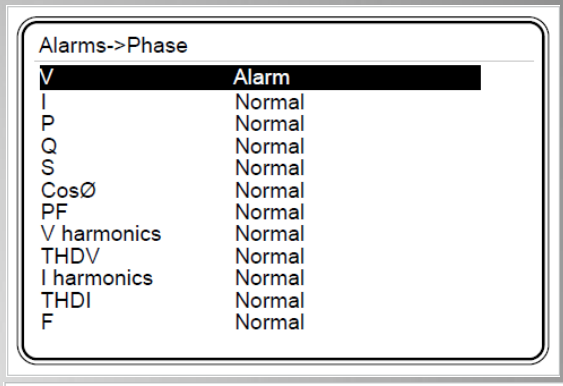
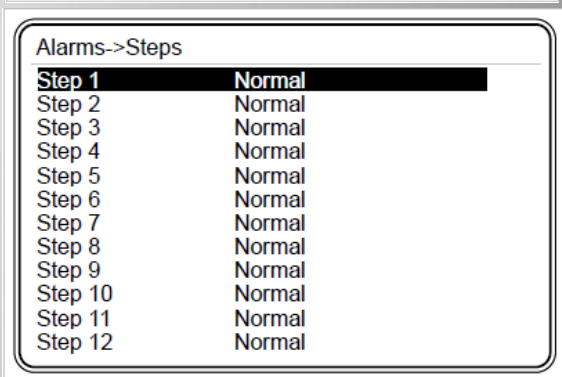
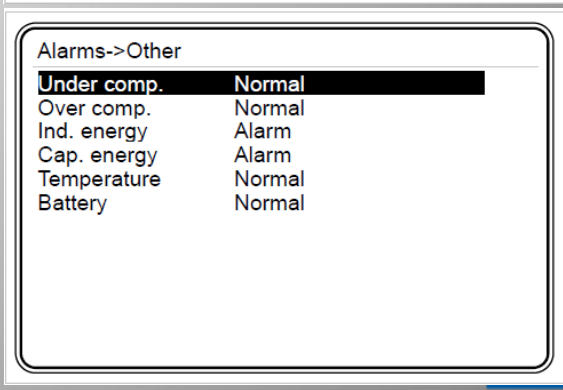
Alarms Menu









Steps: An alarm is activated when the value set in Settings-Setup-Alarm-Steps-Low limit is reached;

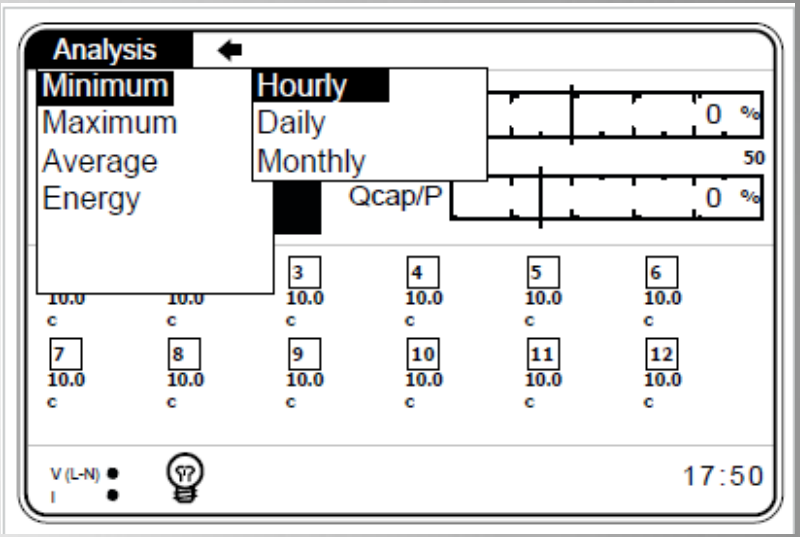
Other:
Battery = if the voltage drops below 1.9 V, the alarm is activated; in this case, contact your dealer. Do not open the device.

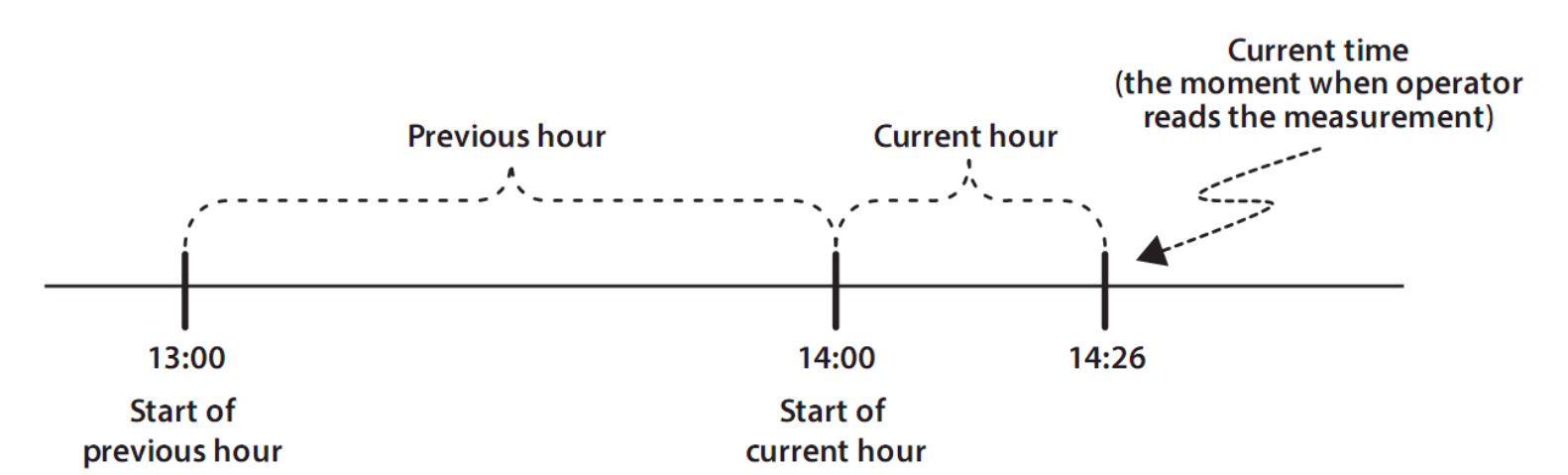
PFW03-M12_24

Analysis Menu (minimum; maximum; average; energy)

In this menu, you can read the maximum, minimum and average values of voltage (V), current (I), active power (P), reactive power (Q), apparent power (S), cosO, power factor (PF) and frequency (F);

Hourly: value measured from the beginning of the hour to the current time.

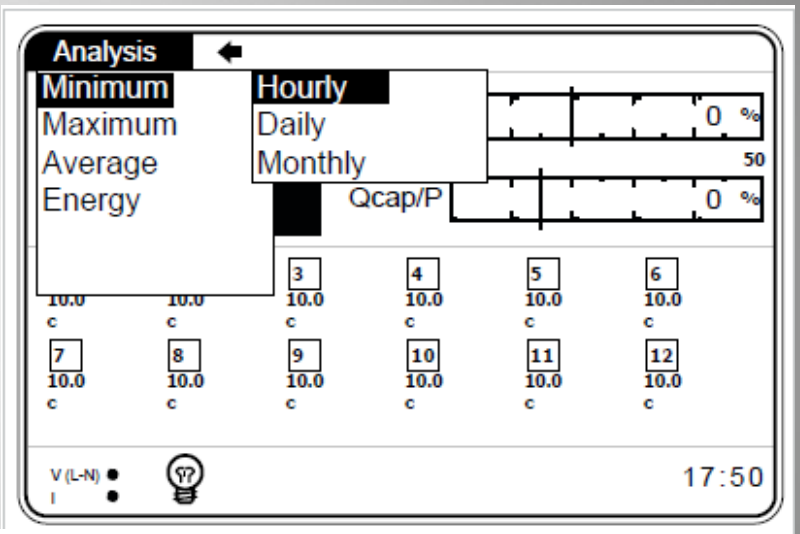


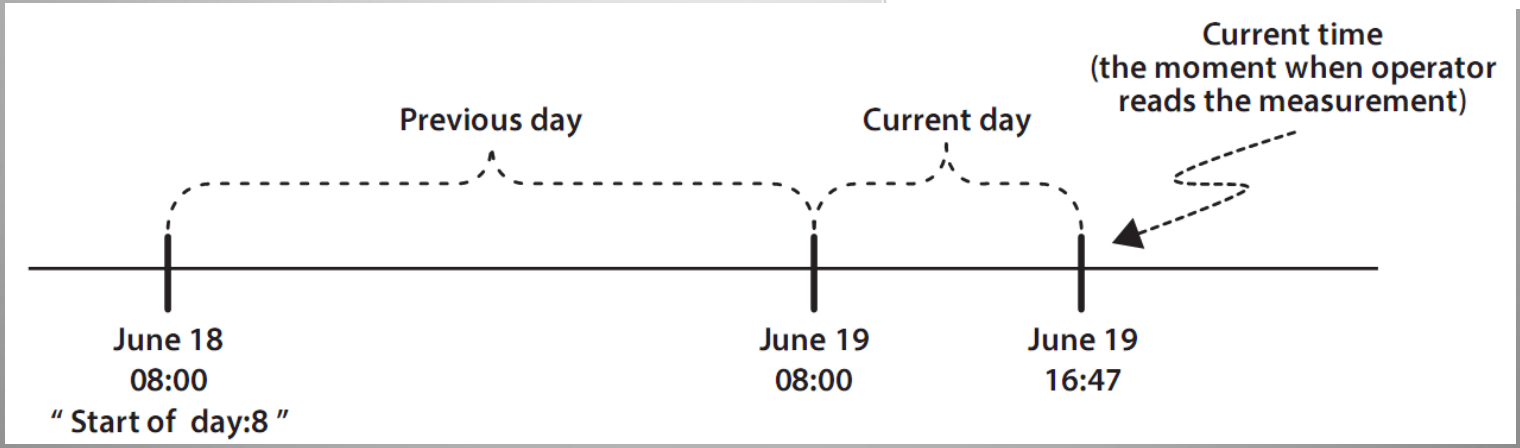


PFW03-M12_24

Analysis Menu (minimum; maximum; average; energy)

Daily: value measured from the day start time to the current time





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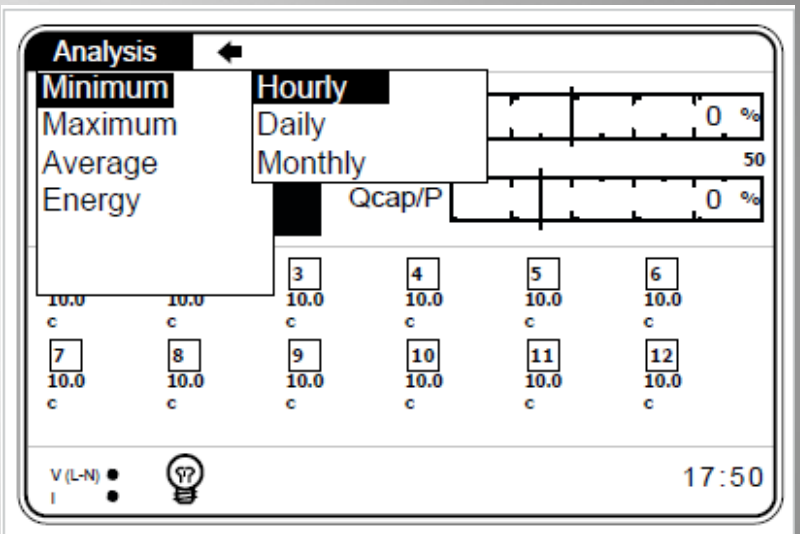
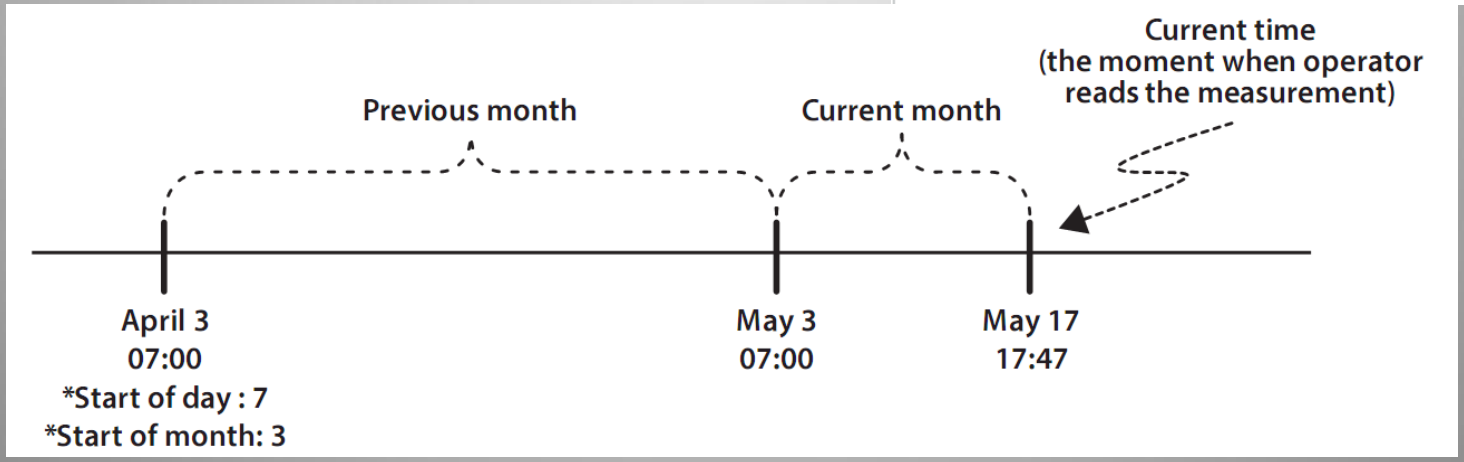
Analysis Menu (minimum; maximum; average; energy)

Monthly: value measured from the first day of the month and the day start time to the current time.





WEG Drives & Controls

Thank you!