EasyLogic™ APF

Active Harmonic Filter

User Manual

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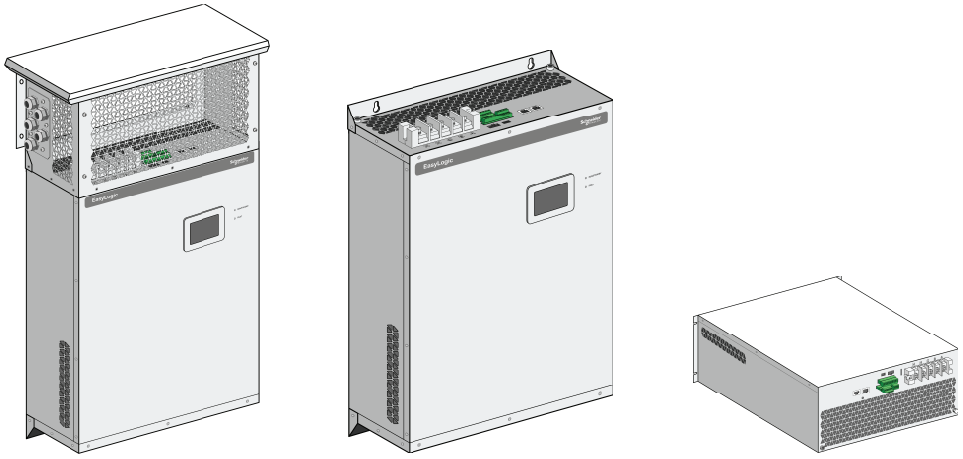
01/2024



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Foreword

Safety Information

Important Information

Read these instructions carefully and look at the equipment to become familiar with the device before trying to install, operate, service, or maintain it. The following special messages may appear throughout this documentation or on the equipment to warn of potential hazards or to call attention to information that clarifies or simplifies a procedure.

The addition of this symbol to a **Danger** or **Warning** safety message indicates that an electrical hazard exists which will result in death or serious injury if the instructions are not followed.

This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages with this symbol to avoid possible injury or death.

⚠⚠DANGER

DANGER indicates a hazardous situation which, if not avoided, **will result in** death or serious injury.

Failure to follow these instructions will result in death or serious injury.

⚠WARNING

WARNING indicates a hazardous situation which, if not avoided, **could result in** death or serious injury.

⚠CAUTION

CAUTION indicates a hazardous situation which, if not avoided, **could result in** minor or moderate injury.

NOTICE

NOTICE is used to address practices not related to physical injury.

Please note

Electrical equipment should be installed, operated, serviced, and maintained only by qualified personnel. No responsibility is assumed by Schneider Electric for any consequences arising out of the use of this material.

A qualified person is one who has skills and knowledge related to the construction, installation, and operation of electrical equipment and has received safety training to recognize and avoid the hazards involved.

Safety Precautions

Installation, wiring, testing and service must be performed in accordance with all local and national electrical codes.

⚠⚠DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- Apply appropriate personnel protective equipment (PPE) and follow safe electrical work practices. Refer to your local regulations.
- This equipment must only be installed in area accessible to electrically skilled personnel and electrically instructed personnel with the proper authorization and serviced by qualified electrical personnel.
- This equipment must only be installed in area without combustible materials.
- Turn off all power to auxiliary contacts and short CT secondary's before working on or inside the equipment.
- Always use a properly rated voltage sensing device to confirm power is off.
- Ensure all disconnect switches are disconnected before servicing equipment. More than one may be present.
- After removing power, wait 15 minutes to allow capacitors to discharge before opening or removing covers.
- Replace all devices and covers before turning on power to this equipment.
- Carefully inspect the interior for tools left behind before replacing covers.
- Verify the rating of the neutral conductor for each unit in the system is greater than the neutral current limit setting.

Failure to follow these instructions will result in death or serious injury.

⚠WARNING

POTENTIAL COMPROMISE OF SYSTEM AVAILABILITY, INTEGRITY, AND CONFIDENTIALITY

- Change default passwords at first use to help prevent unauthorized access to device settings and information.
- Disable unused ports or services and default accounts, where possible, to minimize pathways for malicious attacks.
- Place networked devices behind multiple layers of cyber defenses (such as firewalls, network segmentation, and network intrusion detection and protection).
- Use cyber security best practices (for example, least privilege, separation of duties) to help prevent unauthorized exposure, loss, modification of data and logs, interruption of services, or unintended operation.
- Restrict unit access to authorized personnel only.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Introduction

Active Harmonic Filter

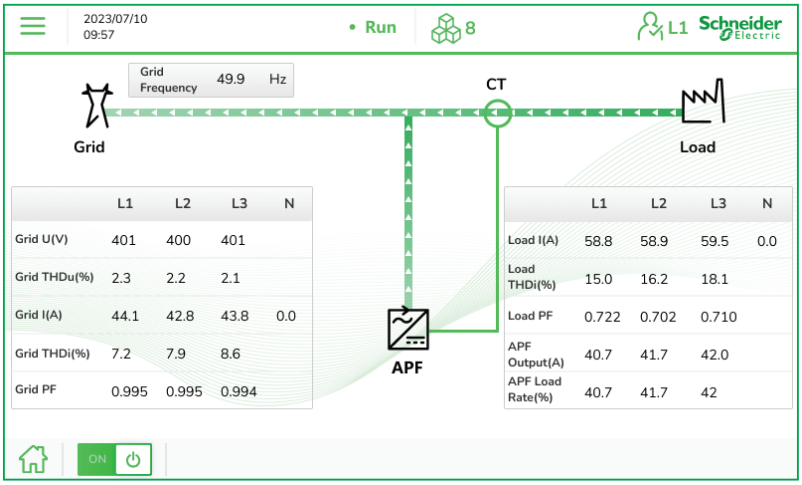
Active Harmonic Filters are static power electronic products that employ digital logic and IGBT semiconductors to synthesize a current waveform that is injected into the electrical network to cancel harmonic currents caused by nonlinear loads. Active Harmonic Filter employ current transformers to measure the load current to determine the content of harmonic current present. By injecting the synthesized current, network harmonic currents are greatly mitigated, thus reducing the heating effects of harmonic current and reducing voltage distortion.

Active Harmonic Filter also have the ability to correct for poor displacement power factor (DPF) and for mains current balancing. DPF correction can be provided for either leading (capacitive) or lagging (inductive) loads that cause poor DPF. Mains current balancing is achieved by measuring the negative and zero sequence current present and injecting the inverse of those currents to balance the current for the upstream network.

Schneider Electric Active Harmonic Filter, EasyLogic™ APF enclosures are available in an IP20 rack-mounted, IP20, and IP31 wall-mounted. EasyLogic™ APF can be powered by three phase conductors to provide corrective current for Line-to-Line connected loads or by three phase conductors and neutral to provide correction for Line-to-Line and Line-to-Neutral connected loads. The amount of neutral current for up to three times the phase current correction. The neutral wiring must be sized appropriately based on the selected neutral current correction.

The EasyLogic™ APF module can be used as an expansion unit, for example, to be installed in other types of cabinets such as Motor Control Center (MCC). After expansion, the whole system is automatically assigned a host unit. The expanded system shall be equipped with an HMI, which allows to view and change the parameter settings of the whole system or any other unit in the parallel system. The expansion unit only needs to connect cables such as power cables and parallel cables.

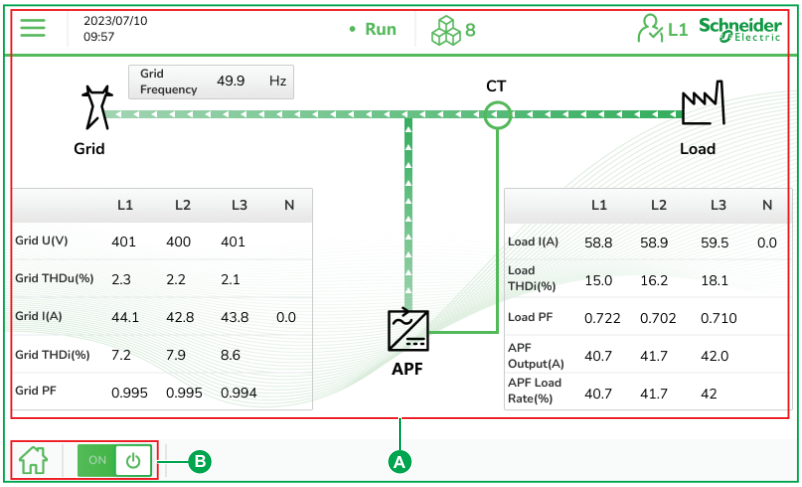
Operation



The HMI of Schneider Electric EasyLogic™ APF is a color touch LCD screen and two sizes: 4.3-inch and 7-inch, and the resolutions are 480*272 pixels, 800*480 pixels. Two touch screens have a brightness of 250 nit. The 4.3-inch HMI is built into the wall-mounted module, and the 7-inch HMI is used externally when the rack-mounted or wall-mounted modules are connected in parallel.

Basic Operating Instructions

Before operating the HMI, please check and understand the basic operation of the HMI. The interface of the HMI of Schneider Electric EasyLogic™ APF includes the information display area and the operation instruction area, as follows:



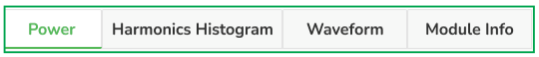
A. This area displays the current operation status of EasyLogic™ APF and real-time measurement indicators of power grid and load, such as THDi indicator. Other similar areas include areas that display charts and curves.

B. This area displays the function buttons that can be operated by EasyLogic™ APF.

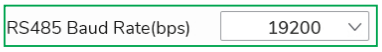
The functions that can be operated on the HMI are indicated by raised or highlighted graphic and text buttons, menus, prompt boxes or input boxes, as shown below:

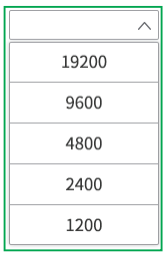
An example of a raised button, which indicates that click to enter the measurement interface.

An example of a raised button, which indicates that click to enter the next page.



An example of a menu, which indicates that click to enter the corresponding information interface, and the menu highlighted in green indicates the currently displayed interface information.





An example of a prompt box, which indicates that click to select the required parameter value in the drop-down prompt box.

An example of an input box, which indicates that click and enter the required parameter value.

An example of a virtual keyboard, which indicates that you need to enter information.

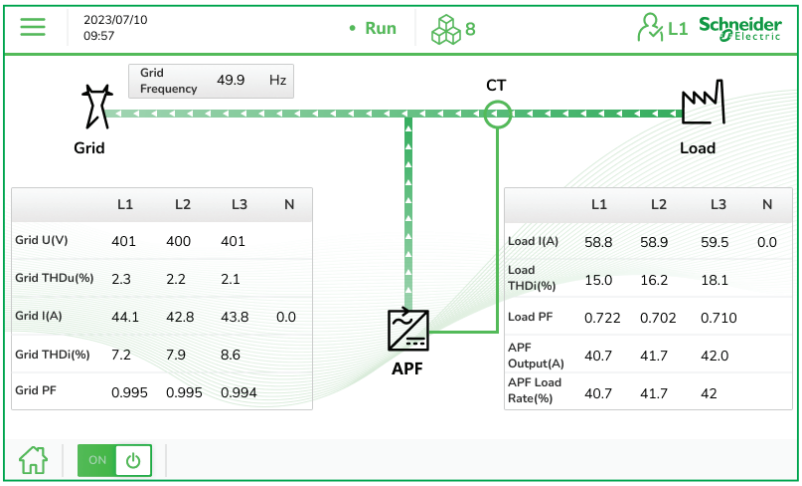
NOTICE
AVOID TAPPING THE HMI IN RAPID SUCCESSION When tapping the touch screen in rapid succession, it will enter the blue calibration interface. **Failure to follow these instructions can result in equipment damage.**

The blue calibration interface is a normal function of the touch screen and entering this interface does not indicate any abnormal function of the screen. If you enter this interface by mistake, you can follow the prompts on the screen and automatically return to the original interface after completing the screen calibration.

Introduction to 7-inch HMI

Home Screen

The home screen of the 7-inch HMI is as follows:



	L1	L2	L3	N
Grid U(V)	401	400	401	
Grid THDu(%)	2.3	2.2	2.1	
Grid I(A)	44.1	42.8	43.8	0.0
Grid THDi(%)	7.2	7.9	8.6	
Grid PF	0.995	0.995	0.994	

	L1	L2	L3	N
Load I(A)	58.8	58.9	59.5	0.0
Load THDi(%)	15.0	16.2	18.1	
Load PF	0.722	0.702	0.710	
APF Output(A)	40.7	41.7	42.0	
APF Load Rate(%)	40.7	41.7	42	

The home screen of HMI is used to display the menu button, date, APF status, number of parallel, user, the Grid, Load and APF output information, home button, On-off button, including:

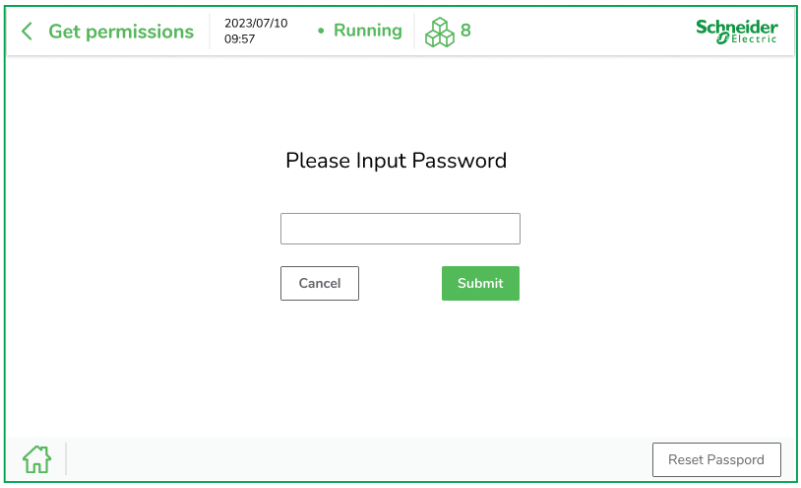
- ☰**:** Menu button, click to menu Interface.
- **Grid:** Display Grid Frequency, Grid U, Grid THDu, Grid I, Grid THDi, Grid PF.
- **Load:** Display Load I, Load THDi, Load PF.
- **APF:** Display APF Output, APF Load Rate.
- ON ⏻**:** You can turn on or turn off the APF.

User Access Permission

The HMI of Schneider Electric APF is configured with four levels of user access permission, namely:

- **Visitor permission:** Visitors can see the home screen.
- **Operator permission:** Level I permissions. Operators can perform after entering permission password of this level, such as entering the setting interface to set common parameters, or to turn on and off the equipment.
- **Admin permission:** Level II permission. After entering permission password of this level, the senior operator can perform more operations on the basis of level I permissions, such as entering the setting interface to set advanced parameters.
- **Manufacturer permission:** Level III permission. The professional operator of the manufacturer can perform more operations on the basis of level II permission after entering permission password of this level. Schneider Electric does not provide level III permission passwords to end customers.

The operation interface for users with level I permission and level II permission to enter permission password is as follows:



⚠CAUTION

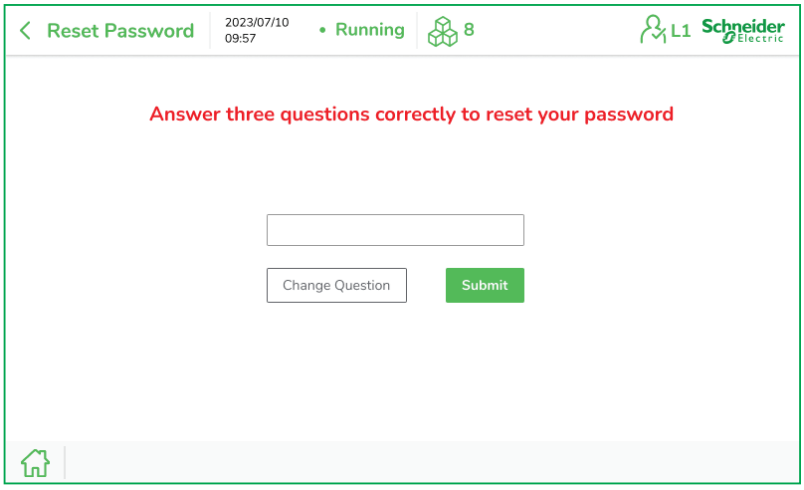
OPERATE THE EQUIPMENT IN COMPLIANCE WITH CYBERSECURITY REQUIREMENTS

Always follow Schneider Electric's cybersecurity guidelines to operate the equipment.

Failure to follow these instructions can result in injury or equipment damage.

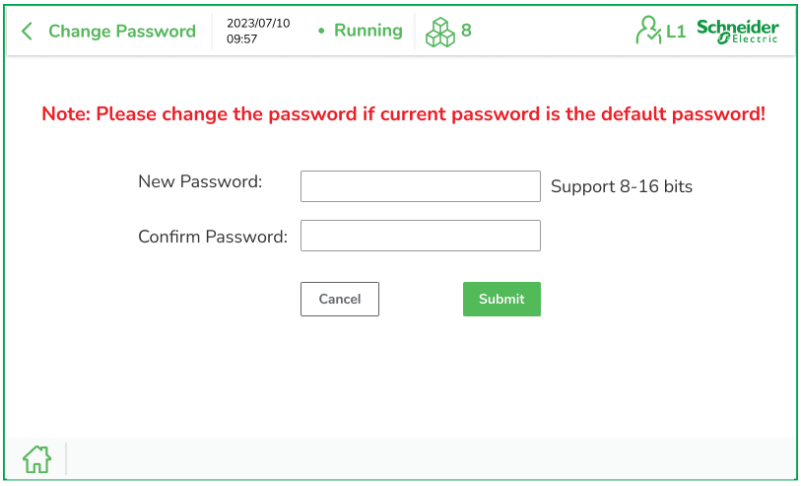
For requirements of Schneider Electric cybersecurity, see Cybersecurity, page 56 chapter.

If necessary, you can reset the password on the above-mentioned interface **Get Permissions**. Click **Reset Password** to enter the following interface to update the password:



Before updating your password, you must answer three password security questions correctly. To set security questions, see Setting Interface, page 17 section for details.

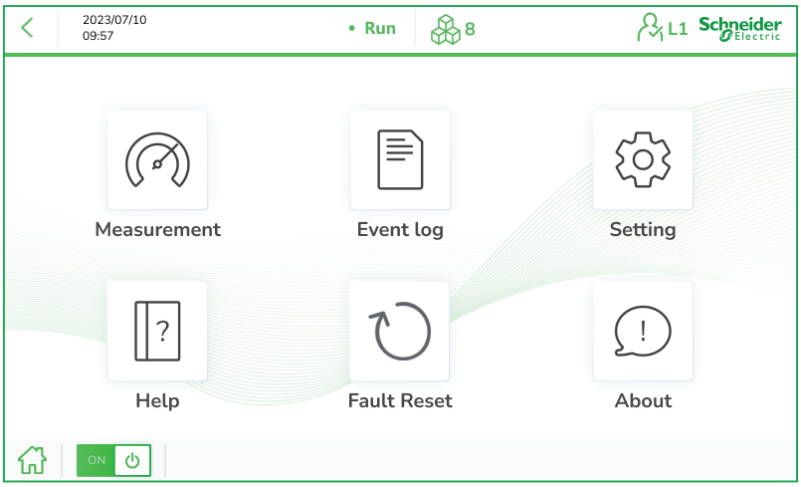
After answering the security questions correctly, you can set the new password as follows:



Menu Interface

Click the ≡ on the home screen to enter the menu interface.

This section introduces the Menu interface of the 7-inch HMI, which contains six sub-menu interfaces: **Measurement**, **Event Log**, **Setting**, **Help**, **Fault Reset**, and **About**.



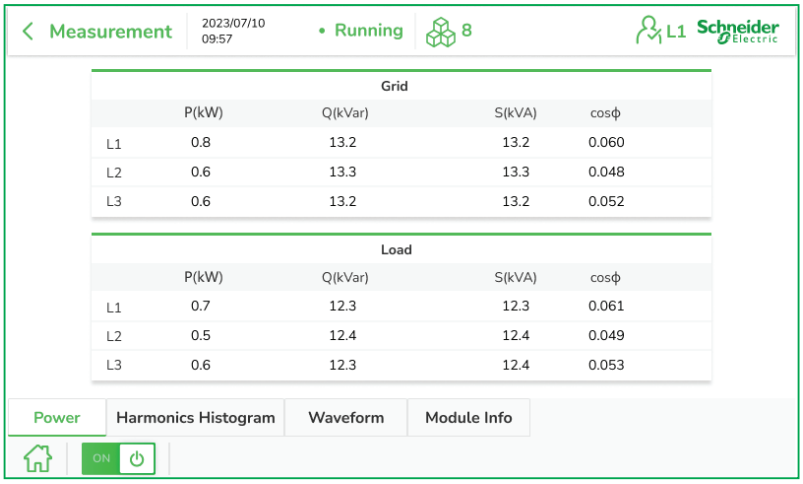
Measurement Interface

Click **Measurement** on the menu screen to enter the measurement interface.

This section introduces the measurement interface of the 7-inch HMI, which contains four sub-menu interfaces: **Power**, **Harmonics Histogram**, **Waveform**, **Module Info**.

Power Measurement Interface

Click the **Power** measurement menu, which contains the power measurement interface that displays the power data at the grid side and load side in real time, including active power (P), reactive power (Q), apparent power (S) and displacement power factor (cosφ).

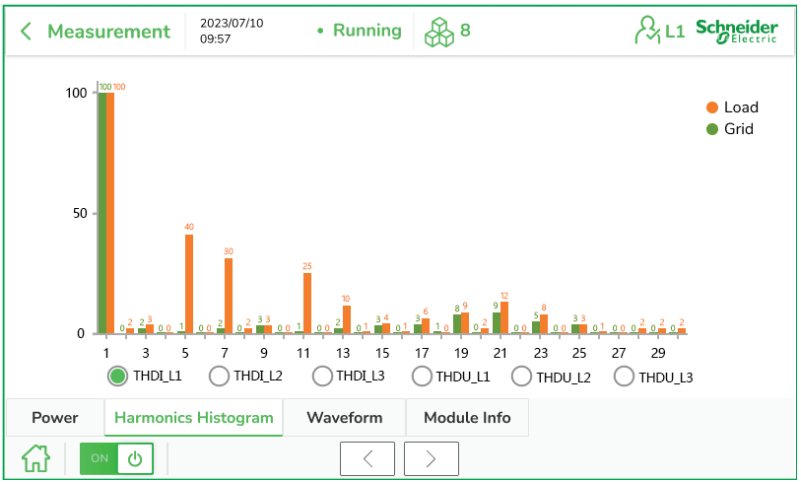


Harmonics Histogram Measurement Interface

Click **Harmonics Histogram** measurement menu, and the interface displays the content of each harmonic at the grid side and load side of any phase in real time in the form of histogram. Under the histogram, click to view different phases of THDi and THDu.

Click **<** or **>** at the bottom of the interface to turn the page back and forth to check the content of each harmonic.

The 7-inch HMI can display the content of 50th harmonic at most.

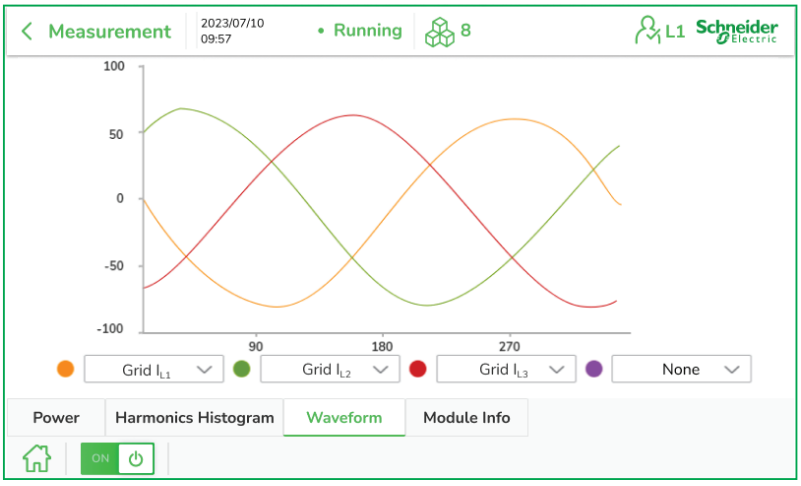


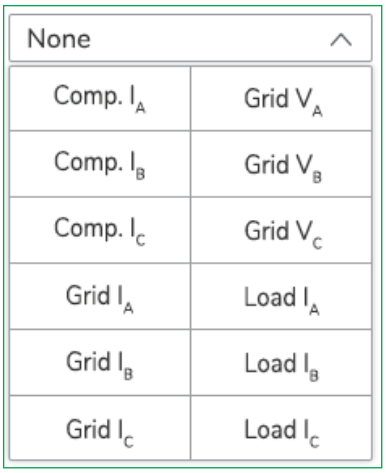
Waveform Measurement Interface

Click the **Waveform** measurement menu, which contains the waveform measurement interface that displays the three-phase current and three-phase voltage at the grid side, the three-phase current at the load side and the compensated three-phase current waveform in real time.

Click the drop-down menu at the bottom of the screen and select the relevant information to be viewed.

The WAVES screen can display up to four different values at the same time. You can click one of the boxes at the bottom of the screen to display a table of the 13 different values available.

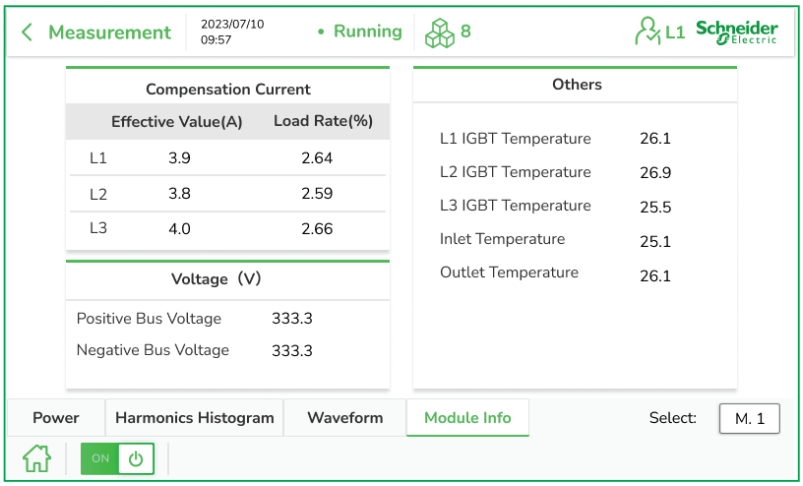




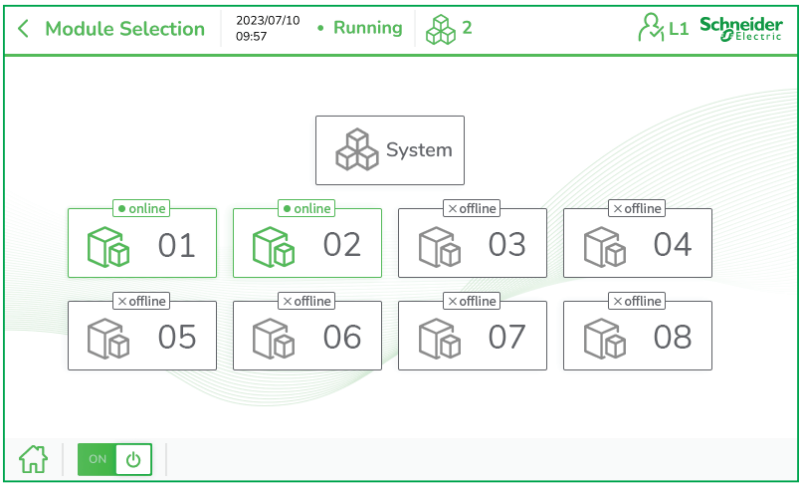
None	The channel does not display waveform
Comp. I_{L1}	L1 compensation current waveform
Comp. I_{L2}	L2 compensation current waveform
Comp. I_{L3}	L3 compensation current waveform
Grid I_{L1}	L1 grid current waveform
Grid I_{L2}	L2 grid current waveform
Grid I_{L3}	L3 grid current waveform
Grid U_{L1}	L1 line-neutral voltage waveform
Grid U_{L2}	L2 line-neutral voltage waveform
Grid U_{L3}	L3 line-neutral voltage waveform
Load I_{L1}	L1 load current waveform.
Load I_{L2}	L2 load current waveform
Load I_{L3}	L3 load current waveform

Module Info Interface

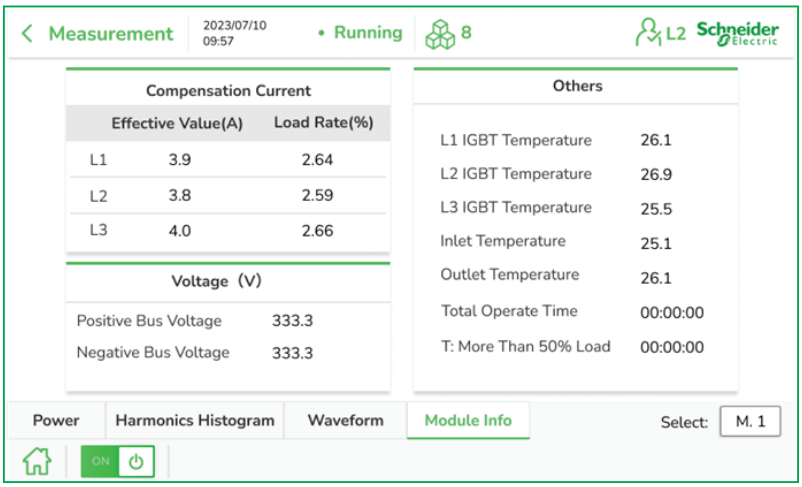
Under level I permission, click **Module Info** measurement menu, which contains **Compensation Current**, **Voltage(V)**, **Others** and **Select**.



- **Compensation Current**: APF compensation current Effective Value (A) and Load Rate (%).
- **Voltage (V)**: APF Bus voltage including Positive Bus Voltage and Negative Bus Voltage.
- **Others**: Displays the IGBT temperature of different phases and the temperature information of inlet and outlet in real time.
- **Select**: Click the tab in the lower right corner of Module Info interface. Select system or any parallel module to view the information.



Under level II permission Click **Module Info** measurement menu, the information of **Others** is different, including **Total Operate Time** and **T:More Than 50% Load**.



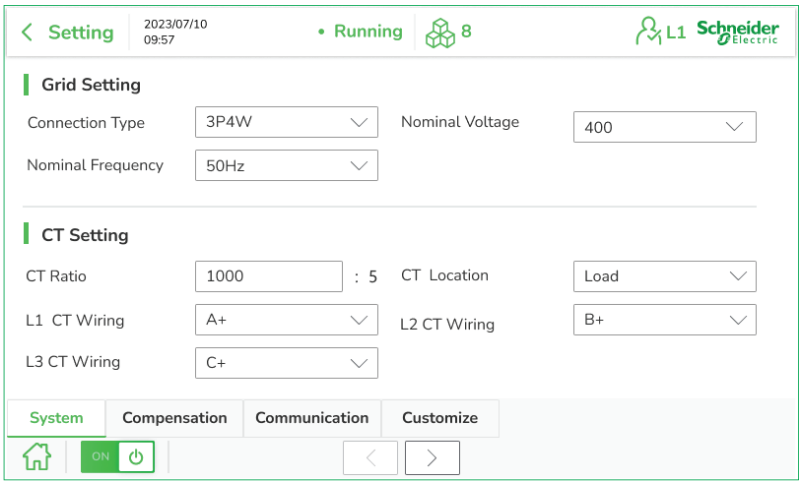
Setting Interface

Schneider Electric APFs main objective is to filter out harmonic current in the power grid, meanwhile to compensate reactive power and unbalance of the power grid. In the setting interface, you can set the corresponding operation mode and adjust the equipment operation parameters according to the on-site power grid status.

Click the **Setting** option on the menu screen to enter the Setting interface.

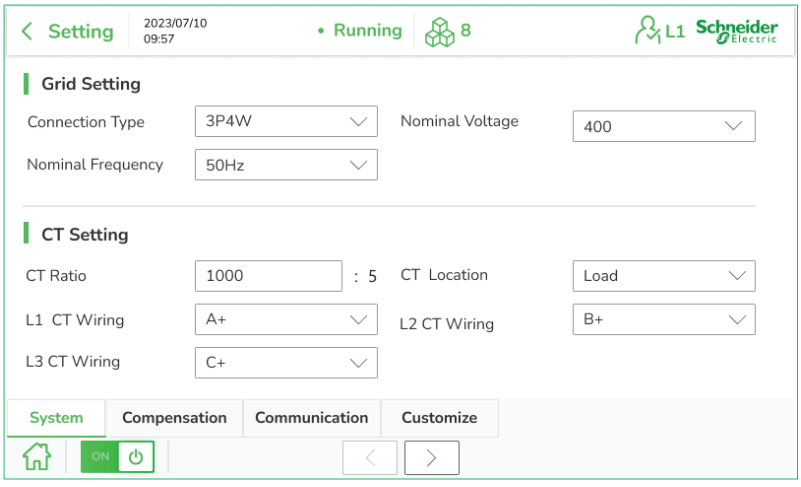
You need to enter the permission password to access different permission setting interfaces. For permission login, see User Access Permission, page 10 section.

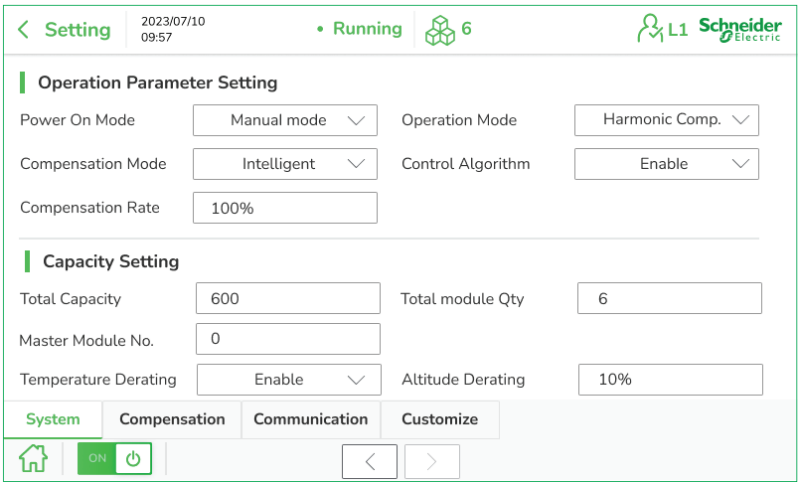
This section introduces the Setting interface of the 7-inch HMI, which contains four sub-menu interfaces: **System**, **Compensation**, **Communication**, and **Customize**.



System Setting Interface

Under level I permission, click the **System** menu, and the interface displays general setting parameters, including **Grid Setting**, **CT Setting**, **Operation Parameter Setting** and **Capacity Setting**.





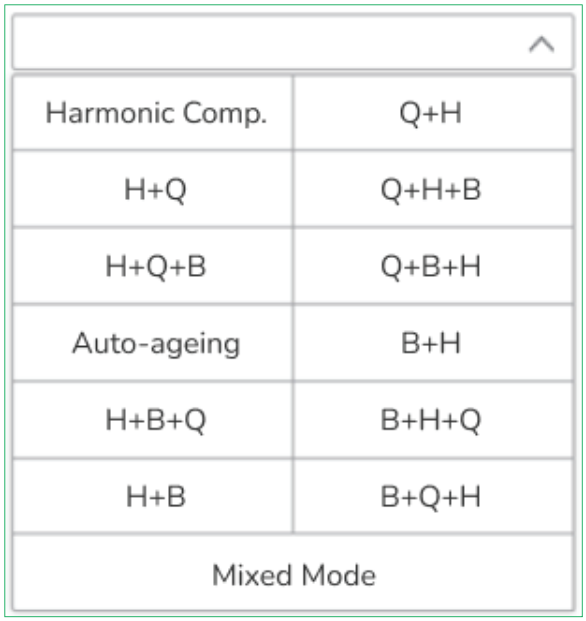
Parameter settings are described as follows:

- **Connection Type**: Select the corresponding 3-phase 3-wire or 3-phase 4-wire parameters according to the wire system applied by the equipment. If this parameter is set incorrectly, it will cause fault alarm.
- **Nominal Voltage**: The working voltage of the APF system is 208 V, 400 V, and 480 V, which can be selected according to the power grid voltage of the APF.
- **Nominal Frequency**: Divided into 50 Hz and 60 Hz Corresponding parameters should be set according to the frequency of the power grid.
- **CT Ratio**: Set the transformation ratio parameters of external CT. APF can only be applied to CT with a secondary side current of 5 A, and the setting range for primary current is 1~3000 A.

NOTICE
USE AND CONFIGURE CT OF CORRECT SPECIFICATION • Use CT that meets the technical requirements of APF. • The same transformation ratio parameters as the CT must be configured and adopted in the HMI. **Failure to follow these instructions can result in equipment damage.**

- **CT Location**: Divided into **Load** side and **Grid** side. It needs to be selected according to actual installation position of the external CT.
- **L1/L2/L3 CT Wiring:** The default value is A+,B+ and C+. If there is a wiring error, you can adjust this setting to correct it without changing the wiring.
- **Power On Mode**: It is divided into **Automatic** and **Manual**.
  - In **Automatic mode**, APF will automatically start filtering output after the system is powered on.
  - In **Manual mode**, the system needs to be started manually in HMI.
  - The system defaults to **Manual mode**.

- **Operation mode**: The drop-down menu of the input contains up to 13 operation modes, including **Harmonic compensation mode**, **Hybrid operation modes**, **Auto-ageing** operation mode, etc. the user can select the corresponding operation mode according to the actual power grid or load status on site.
  - **Harmonic compensation mode**: A simple operation mode aimed at compensating harmonics. After this mode is selected, APF will only filter out harmonics in the power system.
  - **Hybrid operation modes**: If CT Location is grid and Control Algorithm is set as **enable**, t here will be no priority. The compensation of harmonic (H), reactive (Q) and unbalanced (B) current will be distributed in equal proportion to the total available capacity. The others setting, APF will priority compensate in sequence according to the output capacity status of the equipment. For example, the **H+Q+B** operation mode is selected, the APF outputs all current necessary to correct the harmonic current(H) content. Any output capacity left over is used for reactive power (Q), then for load unbalance(B).
  - **Auto-ageing** operation mode: This is a factory test or engineering debugging mode, not an operation mode applicable to the customer's site. After this mode is selected, APF will work in the mode of actively emitting reactive current.

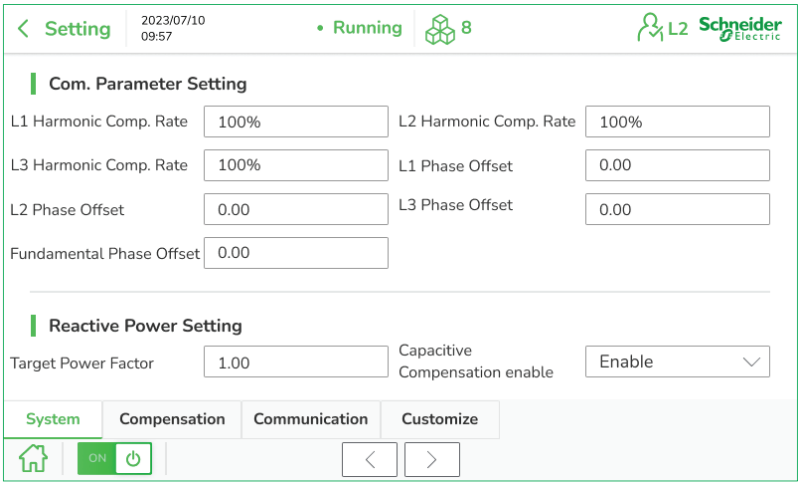


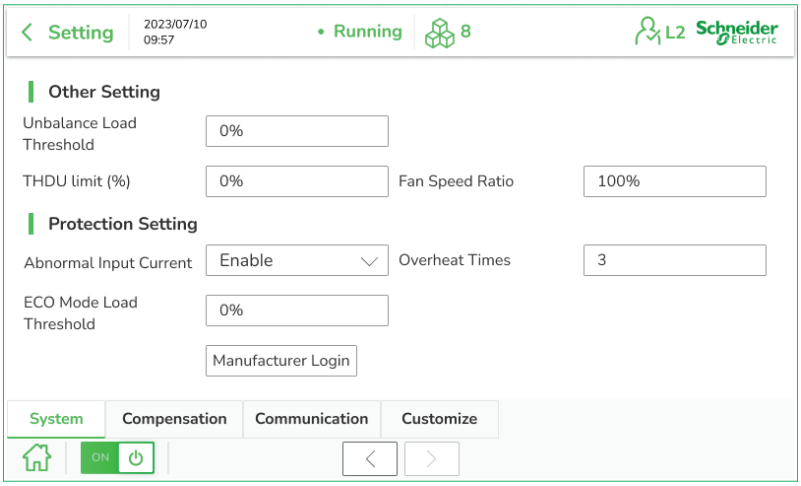
- **Compensation** Mode: It is divided into three types: **Intelligent**, **Sequential**, and **All**.
  - **Intelligent** compensation: Intelligent Fourier algorithm is adopted to intelligently adjust to the best filtering effect, which can avoid resonance to a certain extent.
  - **Sequential** compensation: Fourier algorithm is used to quickly filter out the selected harmonics.
  - **All** compensation: The instantaneous reactive power algorithm is used to quickly filter out various harmonics and reactive power in the system.

  It is recommended to select the **Intelligent** compensation operation mode first. When it is necessary to adjust the harmonic compensation effect of certain orders, adjust to **Sequential** compensation or **All** compensation mode.
- **Control Algorithm**: For this function, **enable** and **disable** can be selected from the drop-down menu of this input box. When CT is located at the power supply side and the equipment is in closed-loop compensation state, it is recommended to set to **enable** to achieve more accurate compensation effect. The default value is **enable**.
- **Compensation Rate**: Set the compensation ratio of the current to be compensated and measured by APF. The setting range is 0% ~ 100%. The default value is 100%.

- **Total Capacity**: Indicates the total capacity of the paralleled system monitored by the HMI. The input box needs to be input according to the total current capacity value of the paralleled module, and the unit is A.
- **Total Module Qty**: Set the total number of modules monitored by HMI. The setting range is 1~8.
- **Master Module No.**: The default value is 0, You can set any module in the parallel system as the master module. However, the master mode is related to the CT installation location and Harmonic mode 2 settings.
- **Temperature Derating**: APF has built-in device temperature protection function, which can automatically derate the output according to the internal monitoring temperature. For this function, **enable** and **disable** can be selected from the drop-down menu of this input box. This function is enabled by default.
- **Altitude Derating**: This parameter is used to control the maximum output of the equipment and is often used to set the altitude derating value. The setting range is 0%~100%. If you set altitude derating 10%, the maximum output is 90% of APF rated capacity.

Under level II permission, click the **System** setting menu to add the following advanced parameter setting items on the basis of level I permission setting parameters: including **Com. Parameter Setting**, **Reactive Power Setting**, **Other Setting**, **Protection Setting**.



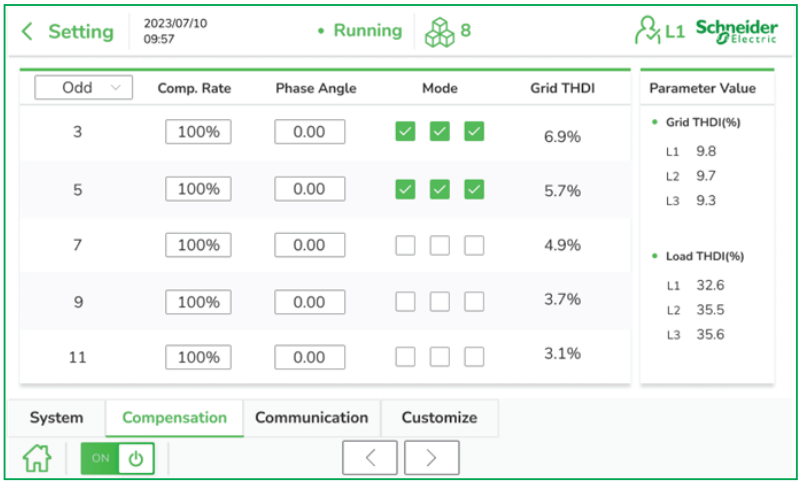


- **L1/L2/L3 Harmonic Comp. Rate:** The harmonic compensation rate can be set by phase according to the measured harmonic current of different phases to be compensated. The setting range is 0% ~ 110%. The default value is 100%.
- **L1/L2/L3 Phase Offset:** If there is phase angle difference between the primary and secondary sides of external CT, this parameter can be set for fine tuning to obtain better measurement effect.

- **Fundamental Phase Offset**: If there is phase angle difference between the primary and secondary sides of external CT, this parameter can be set for fine tuning to obtain better reactive power measurement effect.
- **Target Power Factor**: This input box sets the power factor target value of the power grid when compensating reactive power. The setting range is -1~1. The default value is 1.
- **Capacitive Compensation enable**: For this function, **enable** and **disable** can be selected from the drop-down menu of this input box. This function is enabled by default. When this function is disabled, the capacitive reactive power will not be compensated.
- **Unbalance Load Threshold**: When the unbalance degree of the power grid where the equipment is located exceeds the set value, the system will compensate. The default value is 0%. To adjust this parameter, please contact Schneider Electric for more information.
- **THDU Limit (%)**: When the THDu of the power grid where the equipment is located exceeds the set value, the system will compensate. The default value is 0%. To adjust this parameter, please contact Schneider Electric for more information.
- **Fan Speed Ratio**: The fan speed can be adjusted, and the default value is 100%. The setting range is 50%~100%.
- **Abnormal input Current**: For this function, **enable** and **disable** can be selected from the drop-down menu of this input box. When the field current jumps, it may cause the APF to falsely report an over-current fault. In this case, it can be set to disable this function to facilitate on-site debugging. The default value is **enable**.
- **Overheat times**: When the internal temperature of APF is too high, the equipment will automatically stop output, and automatically recover output after the internal temperature becomes normal. However, when the set value is exceeded, the equipment will stop working and report over-temperature fault, which needs to be manually cleared before it can resume operation. The default value is 3.
- **ECO Mode Load Threshold**: Low load coefficient can be set. If the output of APF system falls below the target parameter, the equipment will stop output compensation. The setting range is 0%~100%. The default value is 0%.

Harmonics Compensation Setting Interface

Click the **Compensation** menu, and the interface displays the following: Harmonics order, compensation rate, **Phase Angle**, compensation **Mode** and **Grid THDI** of each harmonics, three-phase **Grid THDI(%)**, three-phase **Load THDI(%)**.

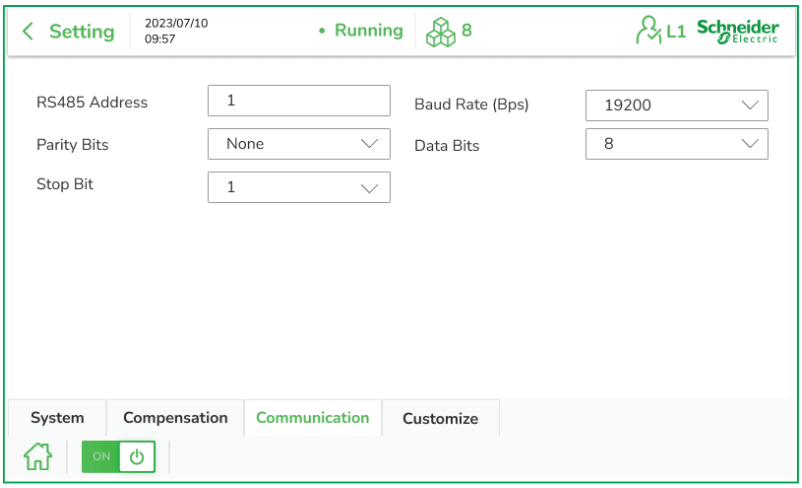


The following parameters can be set in this interface:

- **2~51st harmonic compensation rate**: 0~110% adjustable. Set compensation rate of each harmonic separately by inputting the value, and the maximum compensation is 1.1 times.
- **2~51st harmonic phase angle offset**: Adjustment range -180~180. It is used to set the offset phase angle of this harmonic. It is recommended to debug with a step angle of +/-0.2 degrees.
- **For 3P3W**, harmonic compensation of 3 and its integral multiple will be blocked. The setting of integral multiple of 3 will be invalid.
- **Mode 1/2/3**: Click the tick the mode corresponding to the harmonic to start the compensation of the harmonic.
- **Mode 1**: Conventional compensation mode.
- **Mode 2**: Intelligent compensation mode, which can be used for debugging to avoid resonance. Please contact Schneider Electric for more information.
- **Mode 3**: High-order harmonic compensation mode, which is generally used for harmonic compensation of more than 10th order to obtain better effect than conventional compensation. Please contact Schneider Electric for more information.
- **Odd harmonics**: Click to switch to all odd harmonic settings.
- **Even harmonics**: Click to switch to all even harmonic settings.
- **</>**: Click to view and set harmonics of other orders than those displayed on the current page.

Communication Setting Interface

After clicking the **Communication** menu, and the interface displays the background communication parameters, including **RS485 Address**, **Baud Rate (Bps)**, **Parity Bits**, **Data Bits**, and **Stop Bit**.



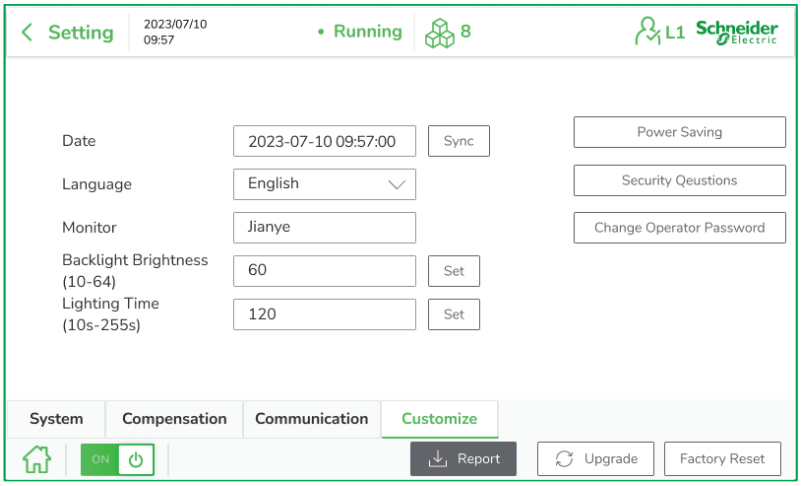
Parameter settings are described as follows:

- **RS485 Address**: Used to set the communication address of HMI.
- RS485 Baud Rate: Used to set the communication rate, and there are five parameters of 19200/9600/4800/2400/1200 for setting.
- **Parity Bits**: Used to set the check mode, including no parity check, odd parity check and even parity check.
- **Data Bits**: Divided into two formats of 7 and 8.
- **Stop Bit**: Divided into two formats of 1 and 2.

Customize Setting Interface

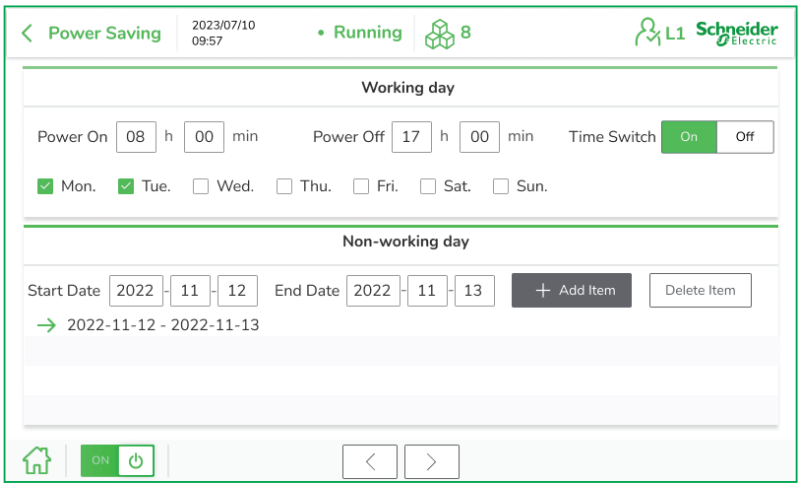
Click the **Customize** menu, and parameters displayed will be **Date**, **Language**, **Monitor**, **Backlight Brightness**, **Lighting Time**, **Power Saving**, **Security**

Questions, **Change Operator Password**, **Report**, **Upgrade**, and **Factory Reset**.

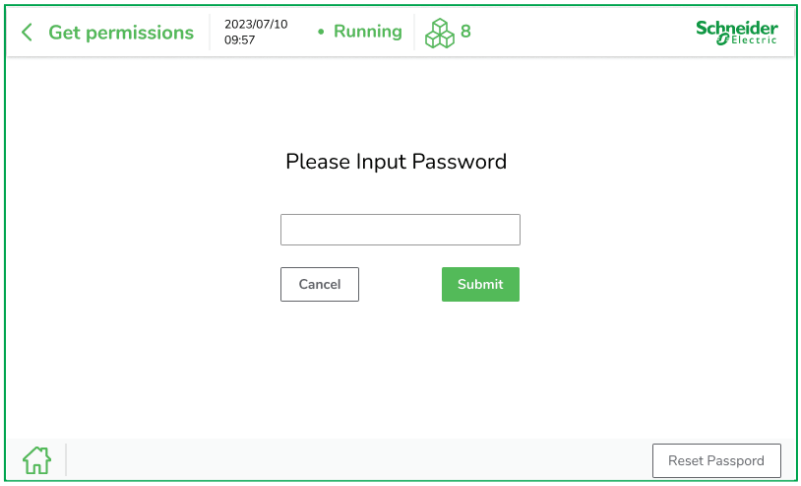


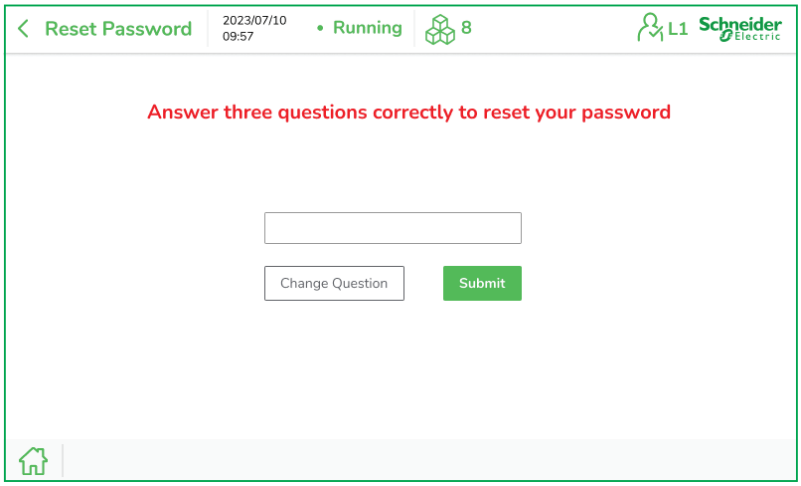
Parameter settings are described as follows:

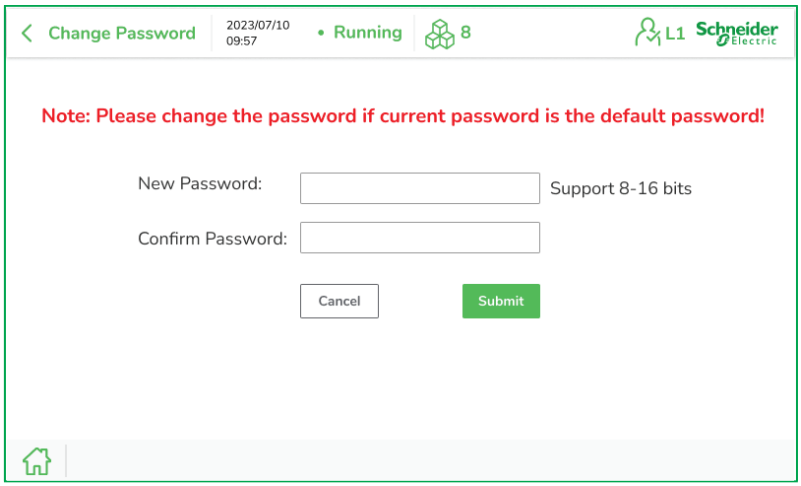
- **Date**: Displays the current internal date and time of HMI. After modification, click **sync** to complete the modification of HMI internal clock.
- **Language**: Displays the language of the current HMI interface (English only).
- **Monitor**: This parameter does not need to be set.
- **Backlight Brightness**: Displays the current backlight brightness value. The brightness value can be modified from 10 to 64. After the backlight setting is completed, the monitor needs to be restarted, however the operation of the module will not be affected and will remain in the original state.
- **Lighting Time**: Displays the lighting duration of the current HMI. The time can be modified from 10 vs to 255 vs.
- Download **Report**: Click to download data in different time ranges. After inserting the USB disk into the USB port of the HMI, click this button and select to download the weekly report, monthly report and annual report to the Record-x folder of the USB disk in the pop-up options.
- Software **Upgrade**: Click this button, and the HMI will upgrade automatically when it detects that there is an upgrade file in the USB disk. For details about software upgrade. see Troubleshooting, page 65 section.
- **Factory Reset**: Restore all default values and delete all alarms and operation records.
- **Special parameters of level I permission (operator permission):** Modify operator password.
- **Special parameters of level II permission (administrator permission):** Modify administrator password.
- **Power Saving**: As shown in the figure below, you can set the on/off time of working days, and the date of non-working days.



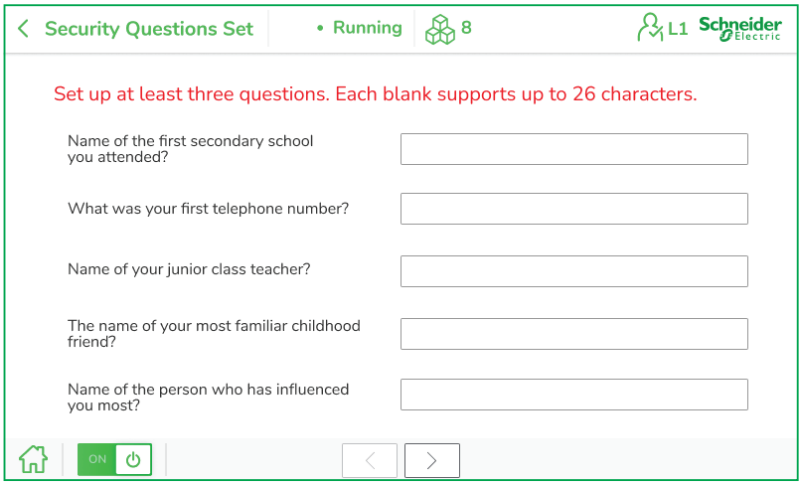
-
  - **Working day**: Select **Working day** in a week (Monday to Sunday is optional) and enter the on-off time of each day, and click **Time Switch** to complete the working day setting.
  - **Non-working day**: Enter the start and end date of the desired rest date, and click the **Add Item** to complete the setting. If you no longer need a certain rest day setting, just click to select **Non-working day setting** (in this case, a green arrow will be added before the selected rest day setting), and then click **Delete Item** to complete the deletion.
- **The password setting interface under each permission is the same:** As shown in the figure below, set a new password and confirm the password.







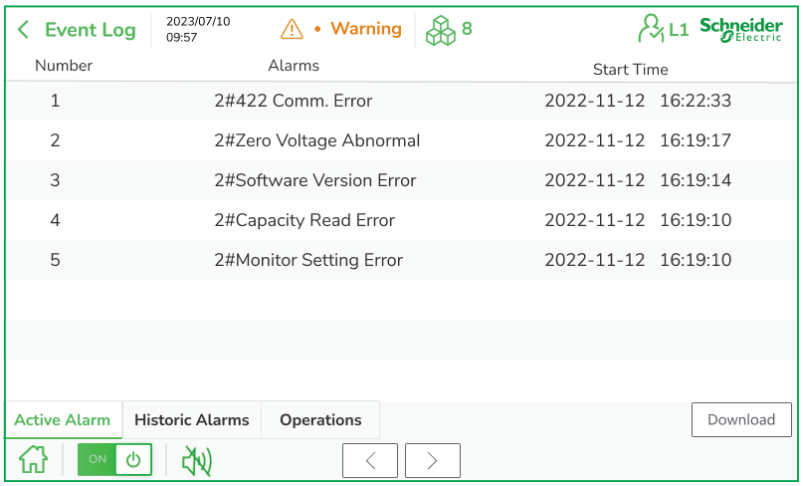
- **Security questions setting**: set password security questions as prompted, as shown in the figure below.



Event Log Interface

Click **Event Log** on menu screen to enter the **Event Log** interface.

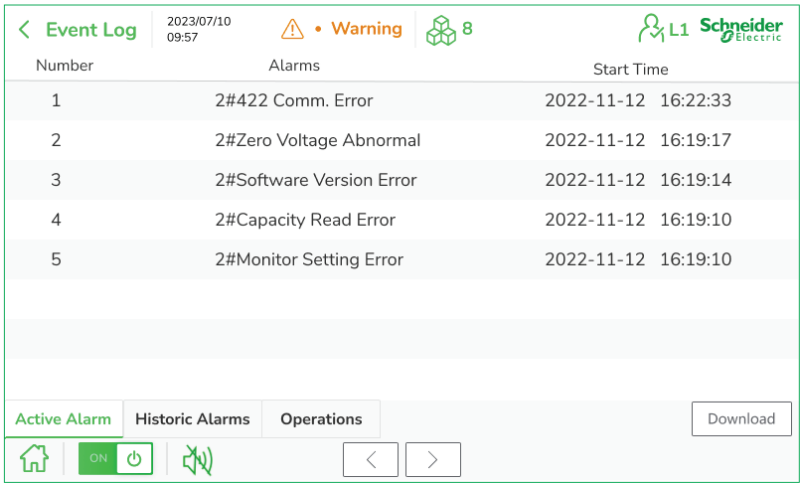
This section introduces the **Event Log** interface of 7-inch HMI, which contains three sub-menu interfaces of **Active Alarm**, **Historic Alarms**, and **Operations**.



Schneider Electric APF 7-inch HMI can record a total of 500 **Active Alarm** and **Historic Alarms**. A total of 1000 **Operations** can be recorded. When the internal record is full, the oldest record will be automatically overwritten.

1. **Active Alarm** interface

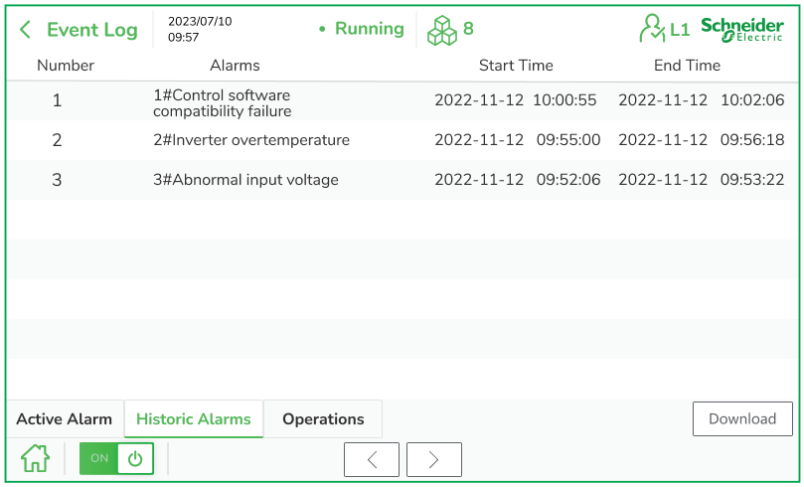
   As shown in the figure, this interface displays active alarm information of the equipment and the occurrence time of the alarm.



   In the **Active Alarm** interface, click at the lower left corner to turn on and off the alarm warning tone of the HMI.

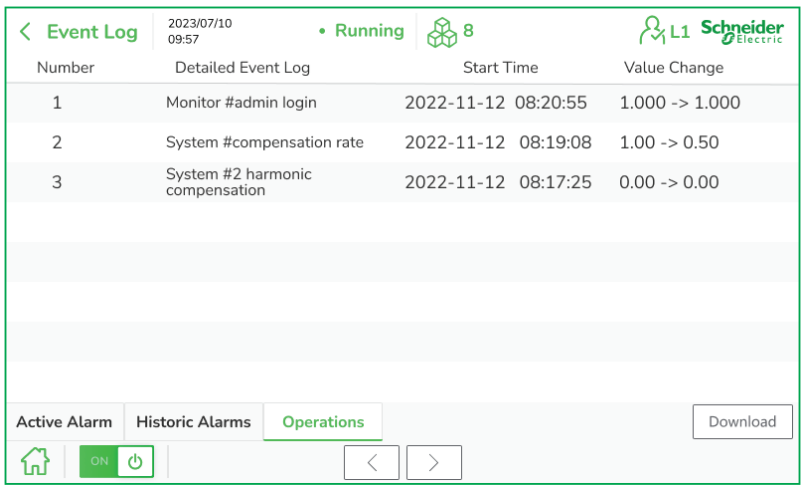
2. **Historic Alarms** interface

   As shown in the figure, this interface displays the historical alarm information of the equipment, the occurrence time and end time of the alarm.



3. **Operations** interface

   As shown in the figure, this interface records operations that distribute parameters to the equipment, including the occurrence time and the change of operations value.



4. **Download**

   In the Event Log interface, click **Download** in the upper right corner to download the alarm records, operation records, historical data and fault point information recorded on the HMI to the USB disk.

   Before downloading, insert the USB disk into the USB port of the HMI. Enter the Event Log interface, click **Download**, and jump to the Get Permissions interface. After obtaining permission confirmation, enter the common operation interface. Click **Download**, the interface will pop up the function selection dialog box. After clicking the data button to be downloaded, and the interface prompts **download succeeded**, the Record-x folder will be automatically generated in the USB disk, which contains the downloaded record report.

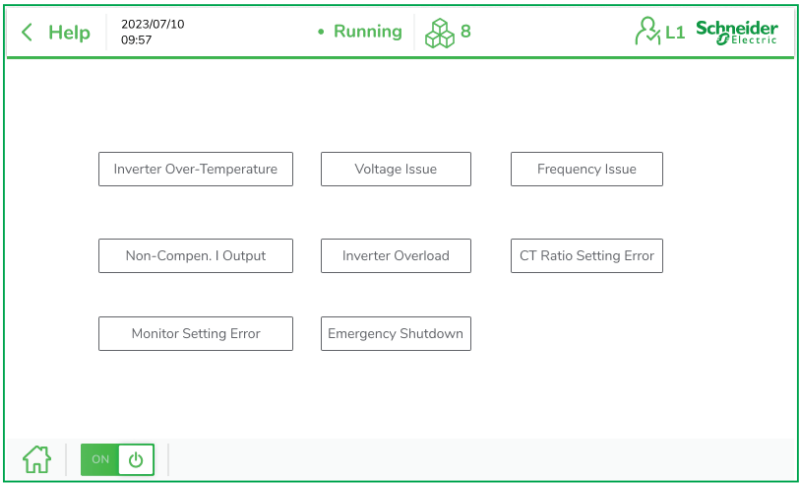
Help Interface

Click **Help** on the menu to enter the Help interface.

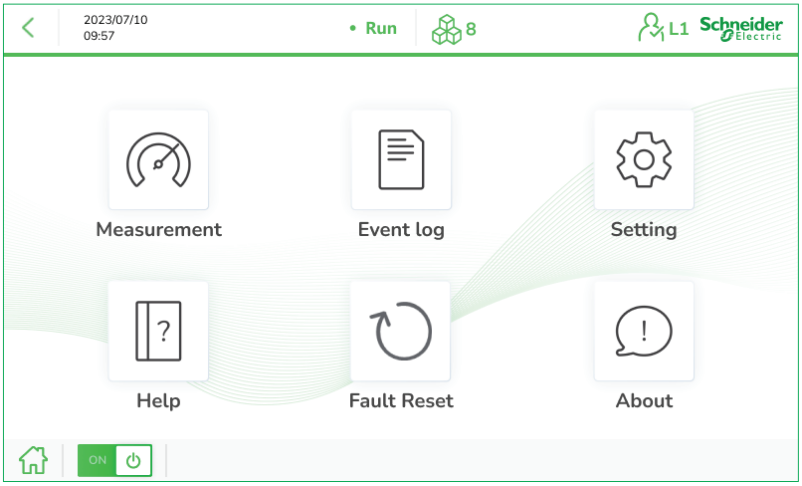
This section introduces the Help interface of the 7-inch HMI, which contains eight sub interfaces of **Inverter Over-temperature**, **Voltage Issue**, **Frequency Issue**, **Non-compen. I output**, **Inverter Overload**, **CT Ratio setting Error**, **Monitor Setting Error** and **Emergency shutdown**.

Introduction to each help topic:

- **Inverter Over-temperature**
- **Voltage Issue**
- **Frequency Issue**
- **Non-compen. I output**
- **Inverter Overload**
- **CT Ratio setting Error**
- **Monitor Setting Error**
- **Emergency shutdown**



Fault Reset

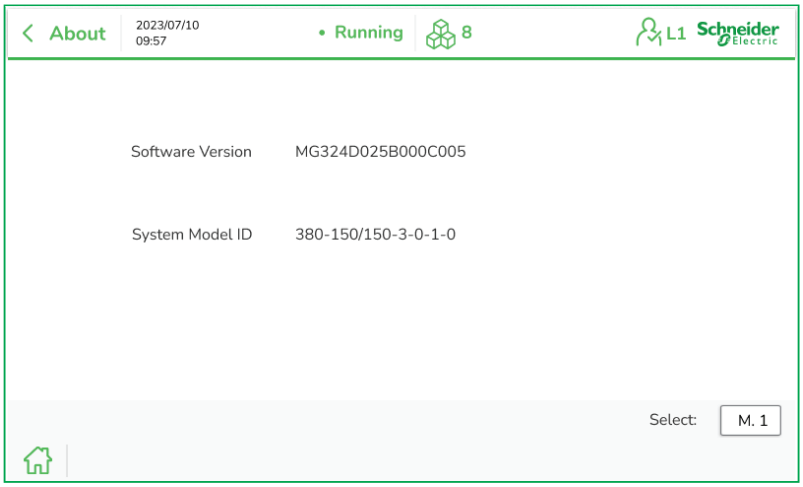


When APF encounters some fault alarms (such as over-temperature alarm), the equipment will automatically enter the operation locking state: the equipment stops harmonic output and cannot automatically resume operation. After the fault is removed, it is necessary to click the **Fault Reset** button to manually clear the fault locking state before restarting the equipment.

It should be noted that the operation of clicking **Fault Reset** only releases the operation locking status of the equipment and does not clear the fault alarm records generated before.

About Interface

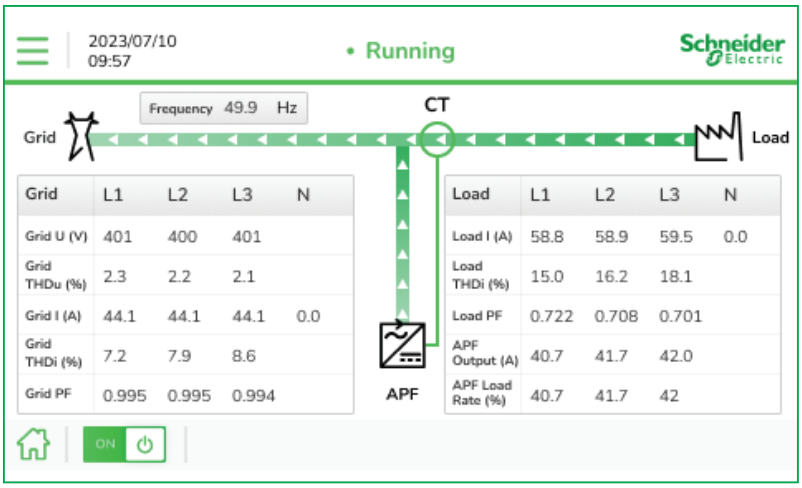
Click **About** on menu screen to enter the about interface.



Introduction to 4.3-inch HMI

Home Screen

The home screen of the 4.3-inch HMI is as follows:

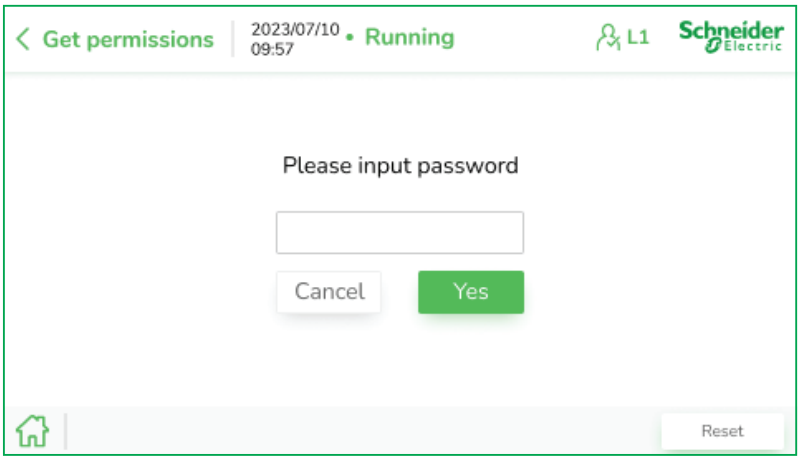


The home screen of HMI is used to display the menu button, date, APF status, user, the Grid, Load and APF output information, home button, On-off button, including:

- ☰**:** Menu button, click to menu Interface.
- **Grid**: Display Grid Frequency, **Grid U (V)**, **Grid THDu (%)**, **Grid I (A)**, **Grid THDi (%)**, **Grid PF**.
- **Load**: Display **Load I (A)**, **Load THDi (%)**, and **Load PF**.
- **APF**: Display **APF Output (A)** and **APF Load Rate (%)**.
- ON ⏻**:** You can turn **ON** or turn **OFF** the APF.

User Access Permission

The permission management of 4.3-inch HMI is similar to that of 7-inch HMI, which is also divided into four levels of access and three levels of permission management. For details, see User Access Permission, page 10 section.



⚠CAUTION

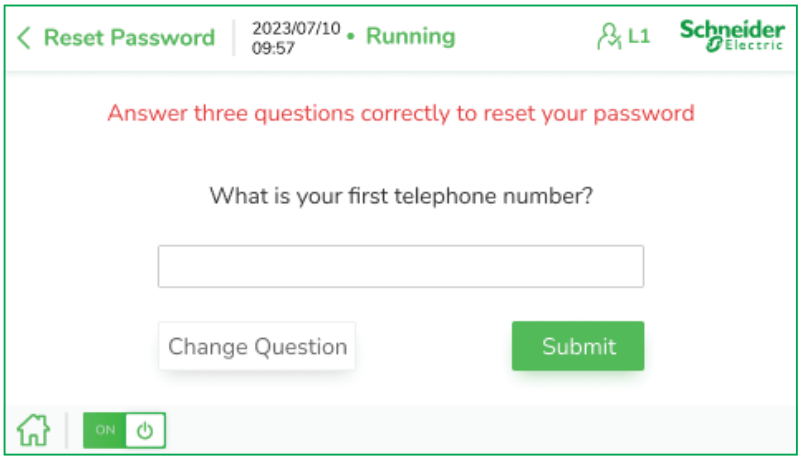
OPERATE THE EQUIPMENT IN COMPLIANCE WITH CYBERSECURITY REQUIREMENTS

Always follow Schneider Electric's cybersecurity guidelines to operate the equipment.

Failure to follow these instructions can result in injury or equipment damage.

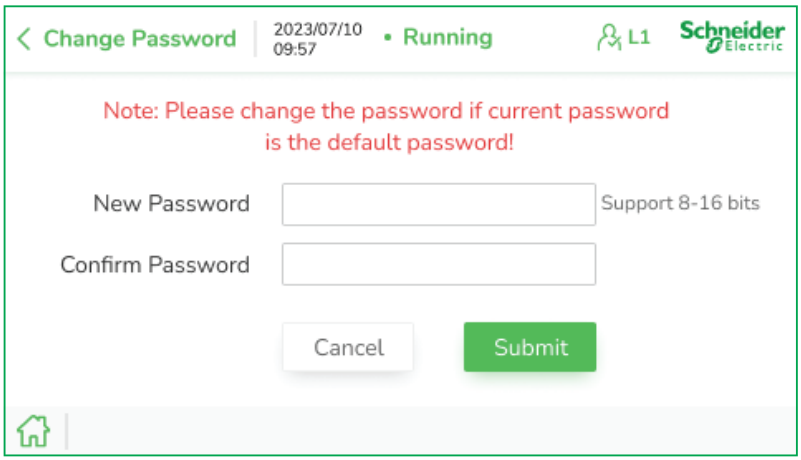
For requirements of Schneider Electric cybersecurity, see Cybersecurity, page 56 chapter.

If necessary, you can reset the password on the above-mentioned interface for entering permissions. Click **Reset Password** to enter the following interface to update the password:



Before updating your password, you must answer three password security questions correctly. To set security questions, see Setting Interface, page 38 section.

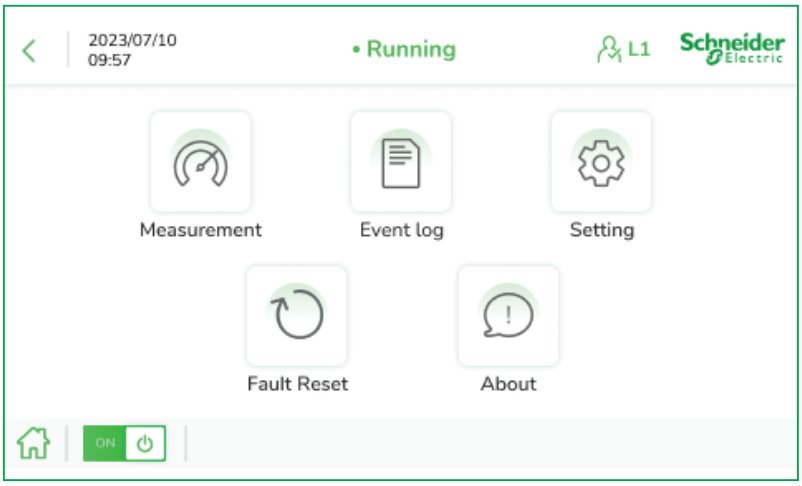
After answering the security questions correctly, you can set the new password as follows:



Menu Interface

Click ☰ on the home screen to enter the Menu interface.

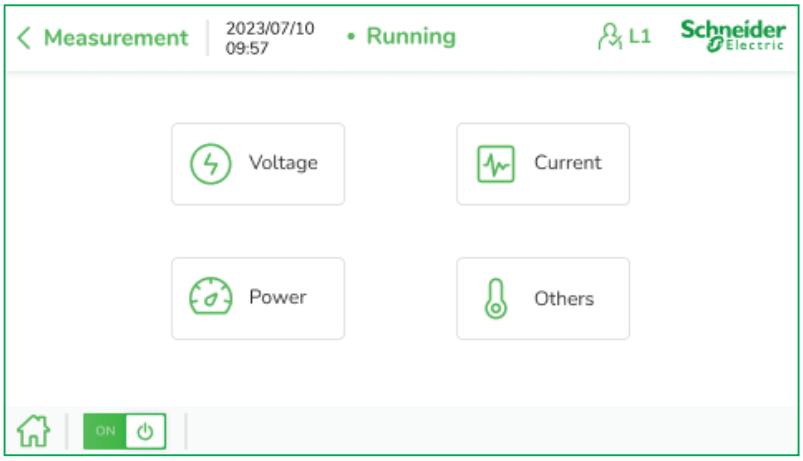
This section introduces the Menu interface of the 4.3-inch HMI, which contains five sub-menu interfaces: **Measurement**, **Event Log**, **Setting**, **Fault Reset** and **About**.



Measurement Interface

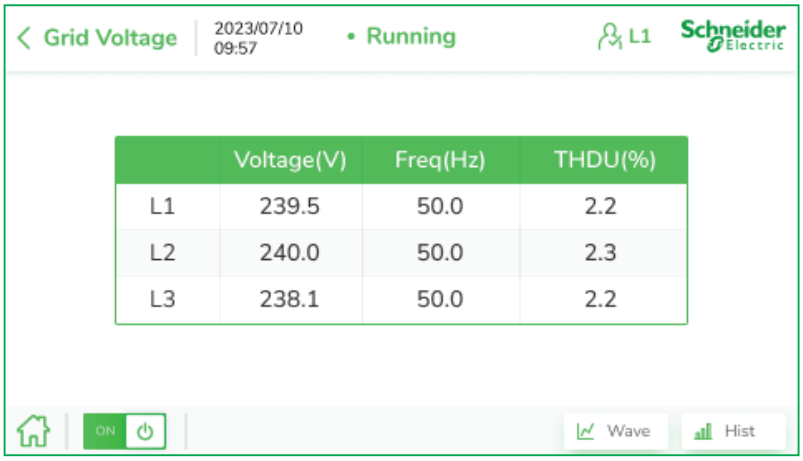
Click the **measurement** on menu screen to enter the measurement interface.

Measurement interface of 4.3-inch HMI is as follows:



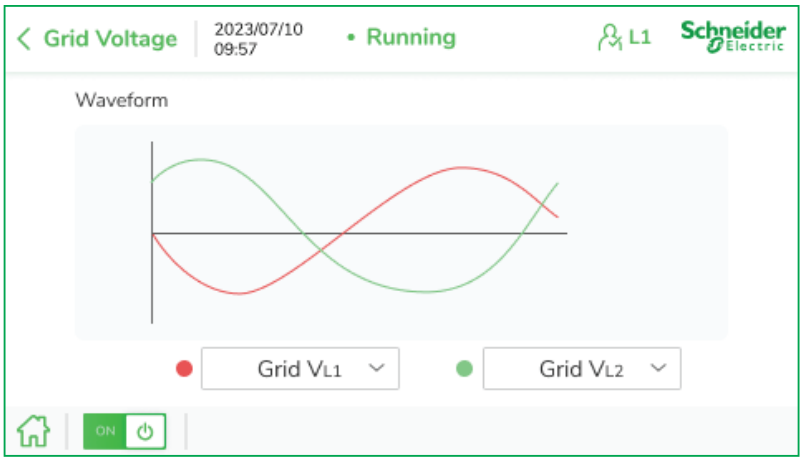
Voltage Measurement Interface

Click **Voltage** under the measurement interface to enter the grid voltage measurement interface. This interface displays: **Voltage(V)**, **Freq(Hz)** and **THDU (%)**.



At the bottom of the interface, click **Wave** and **Histogram** respectively to view corresponding information.

Click **Wave** to enter the waveform display interface, as shown below:



Click **Histogram** to enter the histogram display interface, as shown below:

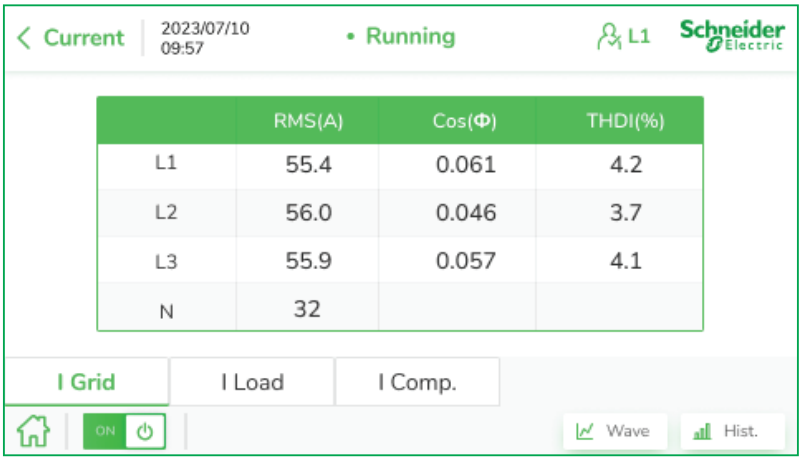
Click buttons of different phases at the bottom of the histogram to view the voltage information of corresponding phases.

Click **<** or **>**in the lower right corner of the screen to turn the page back and forth to check the content of each harmonic. The 4.3-inch HMI screen can display the content of 50th harmonic at most.

Current Measurement Interface

Click **Current** in the measurement interface to enter the current measurement interface, which includes three measurement sub-menu interfaces of **I Grid**, **I Load**, **I Comp.**.

(A): Click the **I Grid** menu to display parameters such as current per phase on the grid side, **Cosφ** and **THDi(%)**.



Click **Wave** and **Histogram** at the bottom of the interface to access relevant information.

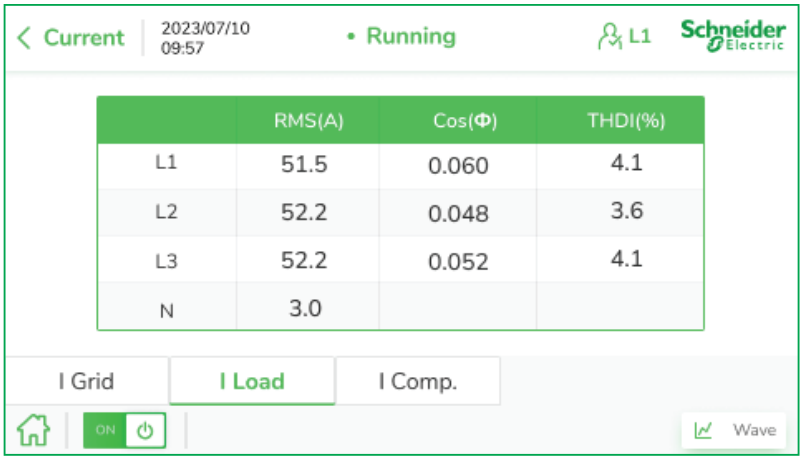
Click **Wave** to enter the grid current waveform interface, as follows:

Click **Histogram** to enter the grid current histogram interface, as follows:

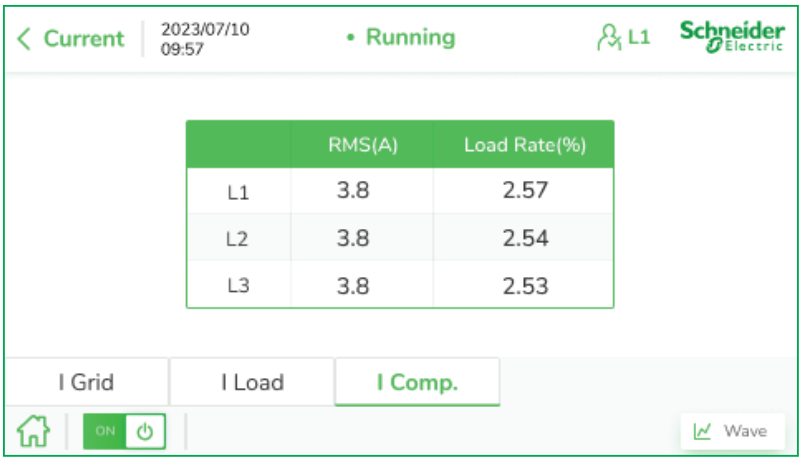
Click buttons of different phases at the bottom of the histogram to view the current information of corresponding phases.

Click **<** or **>** in the lower right corner of the screen to turn the page back and forth to check the content of each harmonic.

(B): Click **I Load** menu to display parameters such as current per phase on the load side, cosφ and THDi.



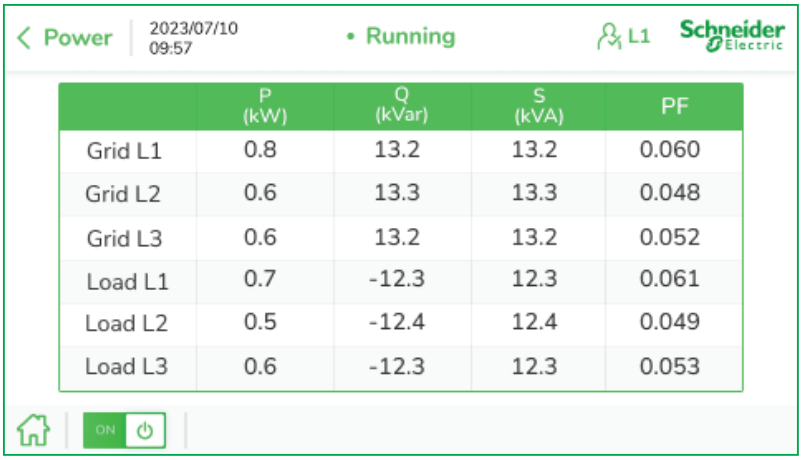
(C): Click the **I Comp.** menu to display parameters such as compensation current and load rate of each phase.



Click the **Wave** enter the compensation current waveform interface, which is similar to the grid current waveform interface and the load current waveform interface.

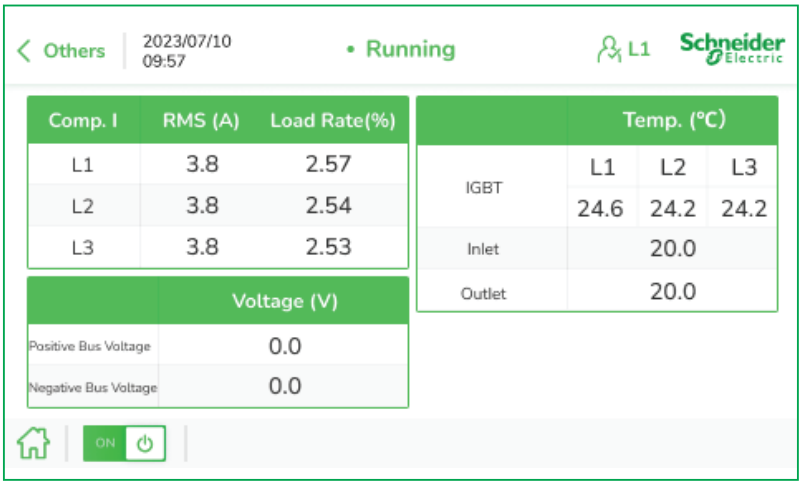
Power Measurement Interface

Click **Power** in the measurement interface to enter the power measurement interface. This interface displays the active power, reactive power, apparent power and power factor of each phase on the grid side or load side.



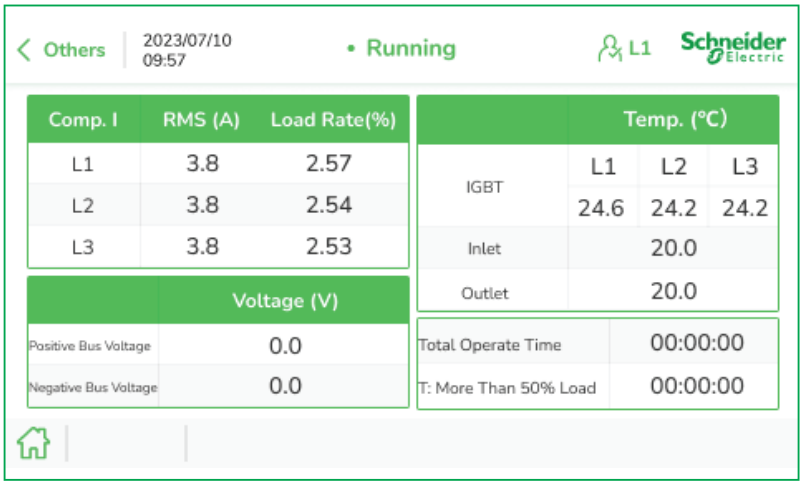
Other measurement interface

Under level I permission, Click **Others** measurement menu, which contains **Comp. I**, **Voltage(V)**, **Temp.(**℃**)**.



- **Comp. I** APF compensation current Effective Value **RMS (A)** and **Load Rate (%)**.
- **Voltage (V)**: APF Bus voltage including **Positive Bus Voltage** and **Negative Bus Voltage**.
- **Temp. (**℃**)**: Displays the **IGBT** temperature of different phases and the temperature information of **Inlet** and **Outlet** in real time.

Under level II permission , click **Others** measurement menu, there are more informations, including **Total Operate Time** and **T:More Than 50% Load**.

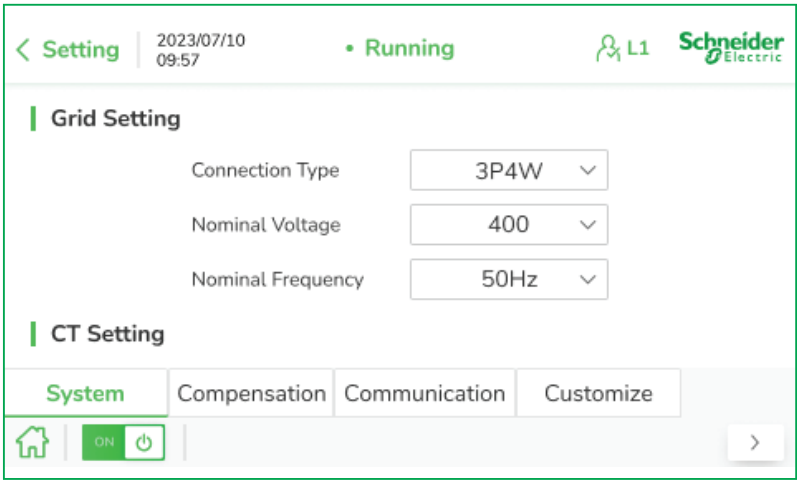


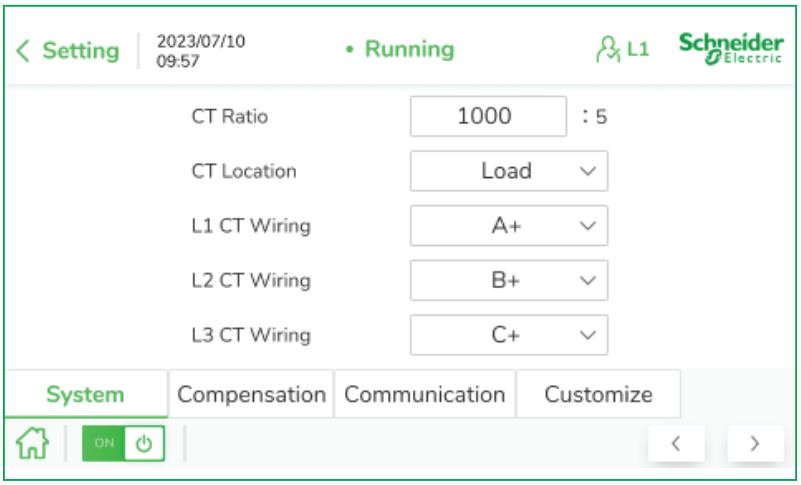
Setting Interface

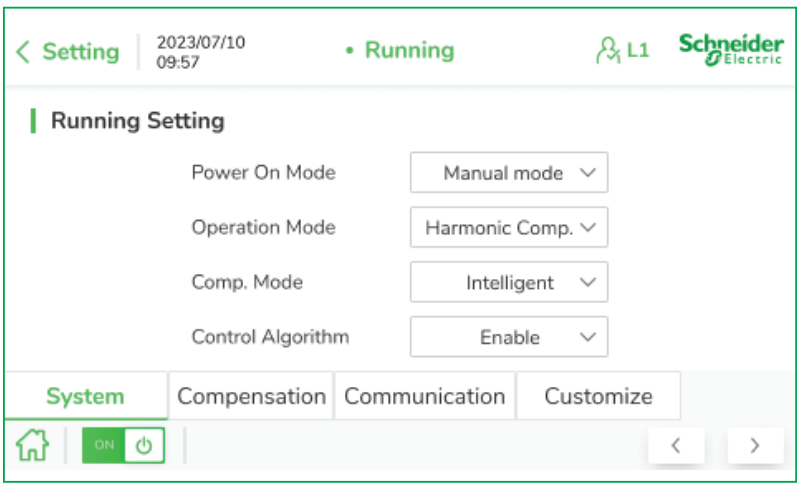
Click the **Setting** on menu screen to enter the setting interface.

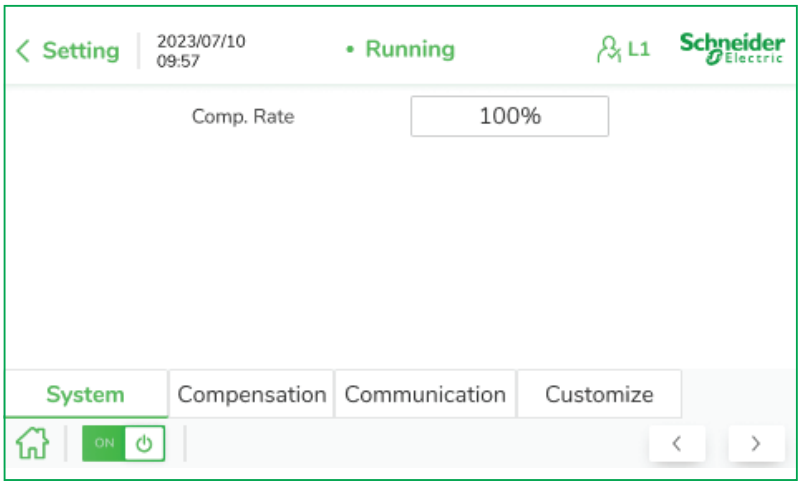
System Setting Interface

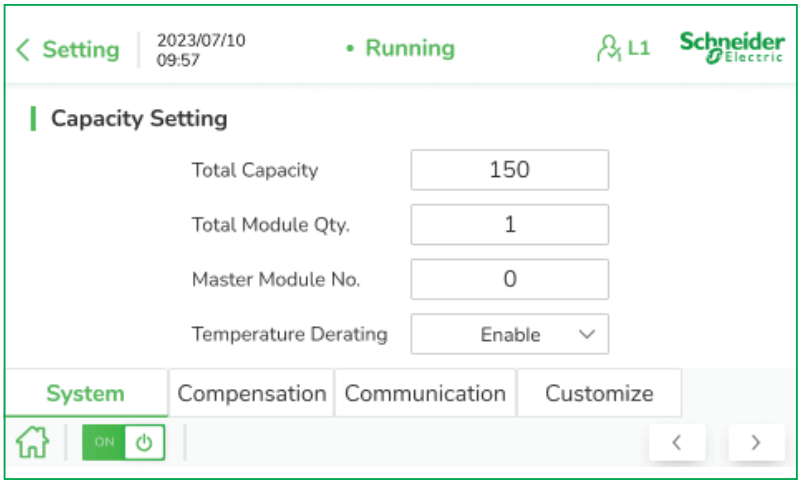
Under level I permission, click **Setting** menu, and the interface displays common setting parameters, including **Grid Setting**, **CT Setting**, **Running Setting**, **Capacity Setting**.

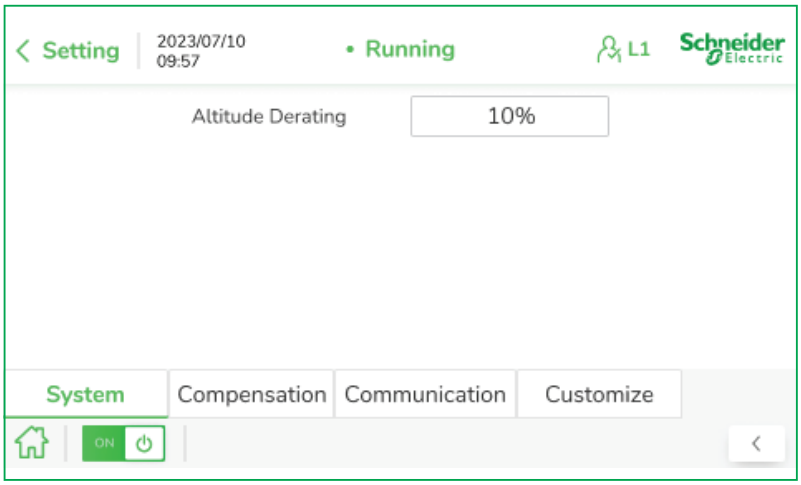












Parameter settings are described as follows:

- **Connection Type**: Select the corresponding **3P3W** (3-phase 3-wire) or **3P4W** (3-phase 4- wire) parameters according to the wire system applied by the equipment. If this parameter is set incorrectly, it will cause fault alarm.
- **Nominal Voltage**: The working voltage of the APF system is 208 V, 400 V, and 480 V, which can be selected according to the power grid voltage of the APF.
- **Nominal Frequency**: Divided into 50 Hz and 60 Hz.. Corresponding parameters should be set according to the frequency of the power grid.
- **CT Ratio**: Set the transformation ratio parameters of external CT. APF can only be applied to CT with a secondary side current of 5 A, and the setting range for primary current is 1~30000 A.

- **CT Location**: Divided into **Load** side and **Grid** side. It needs to be selected according to actual installation position of the external CT.

  NOTICE

  USE AND CONFIGURE CT OF CORRECT SPECIFICATION

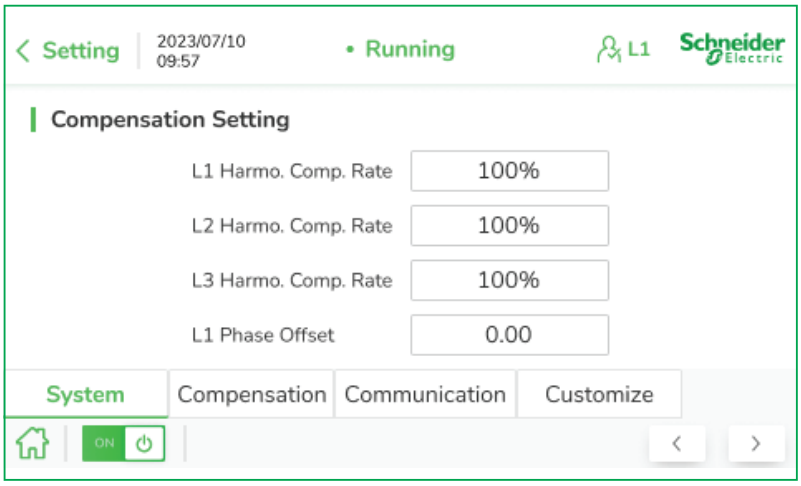
  - Use CT that meets the technical requirements of APF.
  - The same transformation ratio parameters as the CT must be configured and adopted in the HMI.

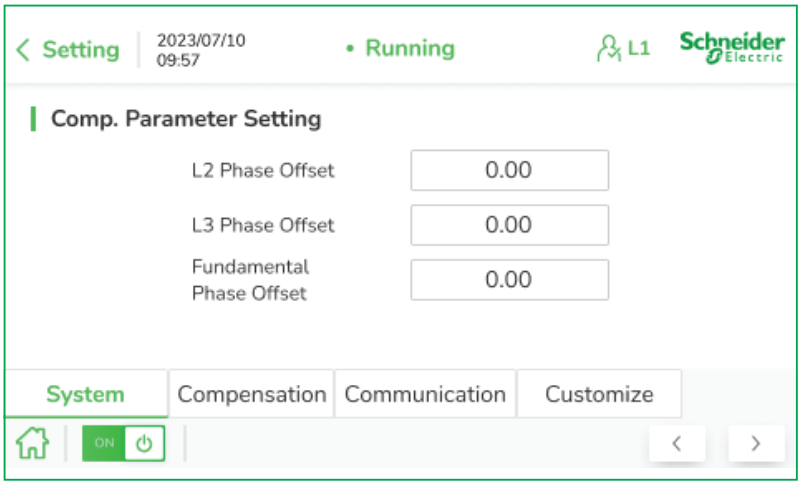
  Failure to follow these instructions can result in equipment damage.

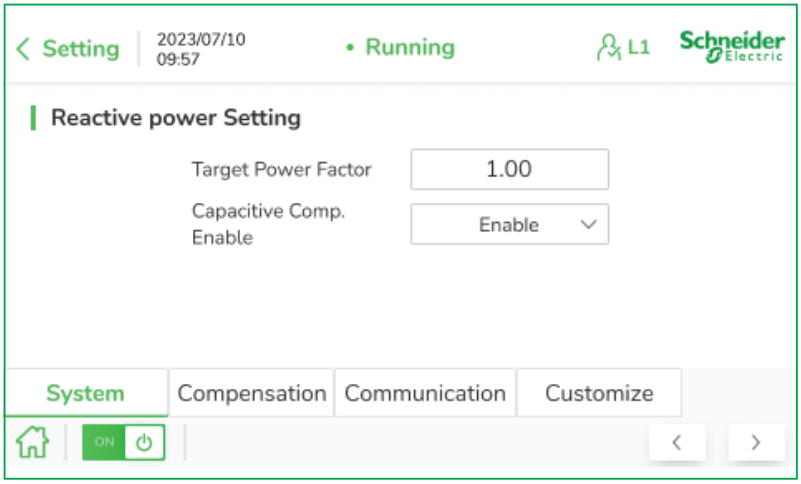
- **L1/L2/L3 CT Wiring**: The default value is A+,B+ and C+. If there is a wiring error, you can adjust this setting to correct it without changing the wiring.
- **Power On Mode**: It is divided into **Automatic mode** and **Manual mode**.
  - In **Automatic mode**, APF will automatically start filtering output after the system is powered on.
  - In **Manual mode**, the system needs to be started manually in HMI.
  - The system defaults to **Manual mode**.
- **Operation mode**: The pull-down menu of the input box contains up to 13 operation modes, different combinations of harmonic (H), reactive power (Q) and unbalance (B), Auto-aging operation mode, etc. the user can select the corresponding operation mode according to the actual power grid or load status on site. Similar to the 7-inch HMI, please refer to Setting Interface, page 17 section.
- **Compensation Mode**: It is divided into three types: **Intelligent**, **Sequential** and **All**.
  - **Intelligent** compensation: Intelligent Fourier algorithm is adopted to intelligently adjust to the best filtering effect, which can avoid resonance to a certain extent.
  - **Sequential** compensation: Fourier algorithm is used to quickly filter out the selected harmonics.
  - **All** compensation: The instantaneous reactive power algorithm is used to quickly filter out various harmonics and reactive power in the system.

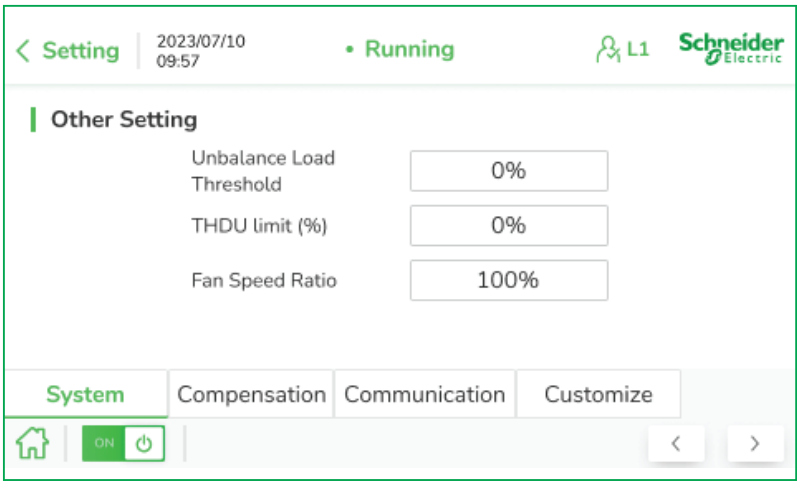
  It is recommended to select the **Intelligent** compensation operation mode first. When it is necessary to adjust the harmonic compensation effect of certain orders, adjust to **Sequential** compensation or **All** compensation mode.
- **Control Algorithm**: For this function, **enable** and **disable** can be selected from the drop-down menu of this input box. When CT is located at the power supply side and the equipment is in closed-loop compensation state, it is recommended to set to **enable** to achieve more accurate compensation effect. The default value is **enable**.
- **Compensation Rate**: Set the compensation ratio of the current to be compensated and measured by APF. The setting range is 0%~100%. The default value is 100%.
- **Total Capacity**: Indicates the capacity of module, and the unit is A.
- **Total Module Qty.**: Set the number of module. The setting is 1.
- **Master Module No.**: The default value is 0.
- **Temperature Derating**: APF has built-in device temperature protection function, which can automatically derate the output according to the internal monitoring temperature. For this function, **enable** and **disable** can be selected from the drop-down menu of this input box. This function is enable by default.
- **Altitude Derating** : This parameter is used to control the maximum output of the equipment and is often used to set the altitude derating value. The setting range is 0%~100%. If you set altitude derating 10%, the maximum output is 90% of APF rated capacity.

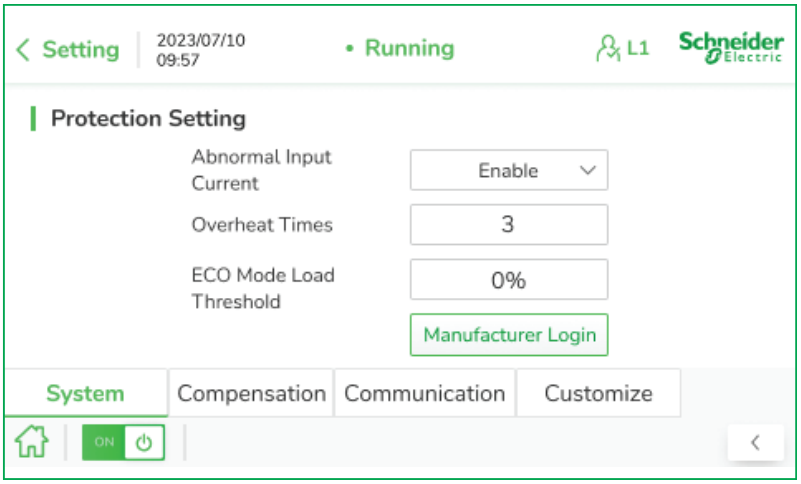
Under level II permission, click **System** setting menu to add the following advanced parameter setting items on the basis of level I permission setting parameters: including **Compensation Setting**, **Comp. Parameter Setting**, **Reactive power Setting**, **Other Setting** and **Protection Setting**.











- **L1/L2/L3 Harmonic Comp. Rate:** The harmonic compensation rate can be set by phase according to the measured harmonic current of different phases to be compensated. The setting range is 0%~110%. The default value is 100%.
- **L1/L2/L3 Phase Offset:** If there is phase angle difference between the primary and secondary sides of external CT, this parameter can be set for fine tuning to obtain better measurement effect.
- **Fundamental Phase Offset**: If there is phase angle difference between the primary and secondary sides of external CT, this parameter can be set for fine tuning to obtain better reactive power measurement effect.
- **Target Power Factor**: This input box sets the power factor target value of the power grid when compensating reactive power. The setting range is -1~1. The default value is 1.
- **Capacitive Comp. Enable**: For this function, **enable** and **disable** can be selected from the drop-down menu of this input box. This function is enabled by default. When this function is disabled, the capacitive reactive power will not be compensated.
- **Unbalance Load Threshold**: When the unbalance degree of the power grid where the equipment is located exceeds the set value, the system will compensate. The default value is 0%. To adjust this parameter, please contact Schneider Electric for more information.
- **THDU Limit(%)**: When the THDu of the power grid where the equipment is located exceeds the set value, the system will compensate. The default value is 0%. To adjust this parameter, please contact Schneider Electric for more information.
- **Fan Speed Ratio**: The fan speed can be adjusted, and the default value is 100%. The setting range is 50%~100%.

- **Abnormal Input Current**: For this function, **Enable** and **Disable** can be selected from the drop-down menu of this input box. When the field current jumps, it may cause the APF to falsely report an over-current fault. In this case, it can be set to disable this function to facilitate on-site debugging. The default value is **Enable**.
- **Overheat Times**: When the internal temperature of APF is too high, the equipment will automatically stop output, and automatically recover output after the internal temperature becomes normal. However, when the set value is exceeded, the equipment will stop working and report over-temperature fault, which needs to be manually cleared before it can resume operation. The default value is 3.
- **ECO Mode Load Threshold**: Low load coefficient can be set. If the output of APF system falls below the target parameter, the equipment will stop output compensation. The setting range is 0%~100%. The default value is 0%.

Harmonic Compensation Setting Interface

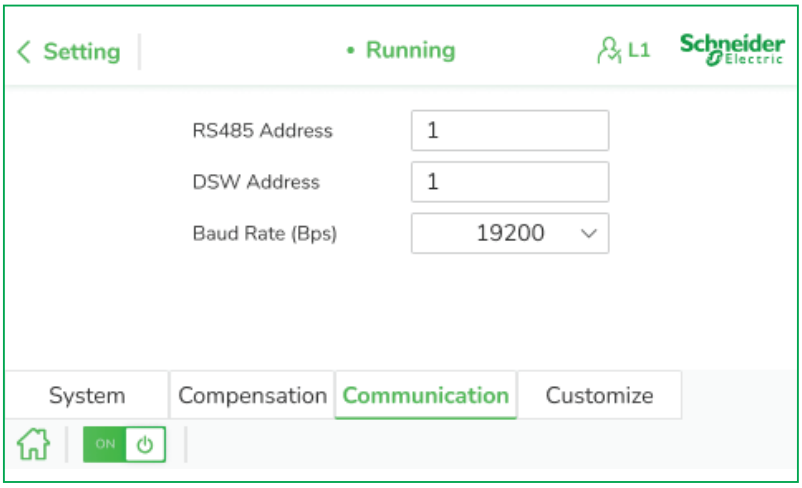
Click **Compensation** tab, and the interface displays the following: Harmonics order, compensation rate, **Phase Angle**, compensation **Mode**, **Load THDI(%)** and **Grid THDI(%)**

The following parameters can be set in this interface:

- **2~51st harmonic compensation rate**: 0~110% adjustable. Set compensation rate of each harmonic separately by inputting the value, and the maximum compensation is 1.1 times.
- **2~51st harmonic phase angle offset**: Adjustment range -180~180. It is used to set the offset phase angle of this harmonic. It is recommended to debug with a step angle of +/-0.2 degrees.
- **For 3P3W**, harmonic compensation of 3 and its integral multiple will be blocked. The setting of integral multiple of 3 will be invalid.
- **Mode 1/2/3**: Click the tick the mode corresponding to the harmonic to start the compensation of the harmonic.
- **Mode 1**: Conventional compensation mode.
- **Mode 2**: Intelligent compensation mode, which can be used for debugging to avoid resonance. Please contact Schneider Electric for more information.
- **Mode 3**: High-order harmonic compensation mode, which is generally used for harmonic compensation of more than 10th order to obtain better effect than conventional compensation. Please contact Schneider Electric for more information.
- **Odd harmonics**: Click to switch to all odd harmonic settings.
- **Even harmonics**: Click to switch to all even harmonic settings.
- **</>**: Click to view and set harmonics of other orders than those displayed on the current page.

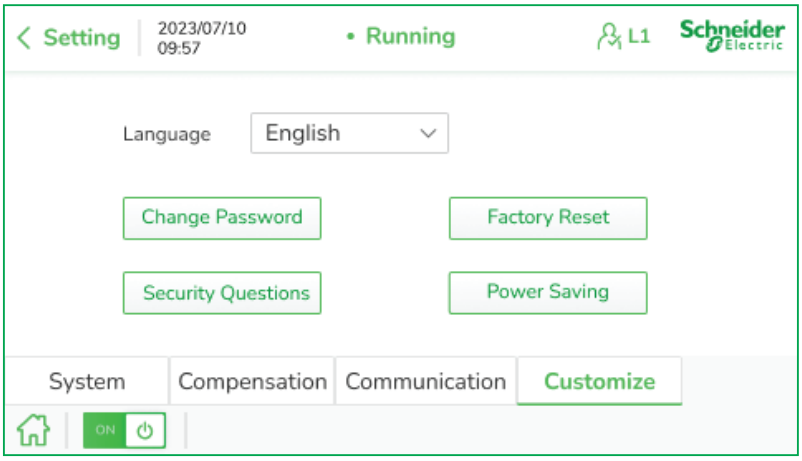
Communication Setting Interface

As shown in the figure, click **Communication**, and the interface will display the background communication parameters, including Local address, Master address and Baud rate. Similar to the 7-inch HMI, please refer to Communication Setting Interface, page 22 for description of parameter settings.

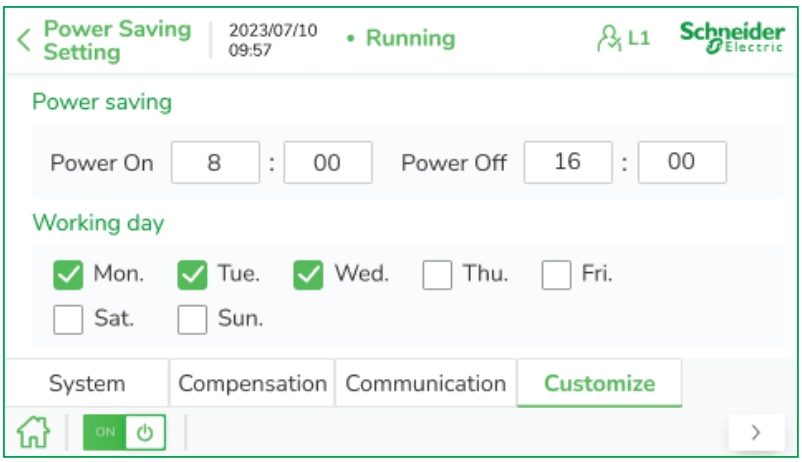


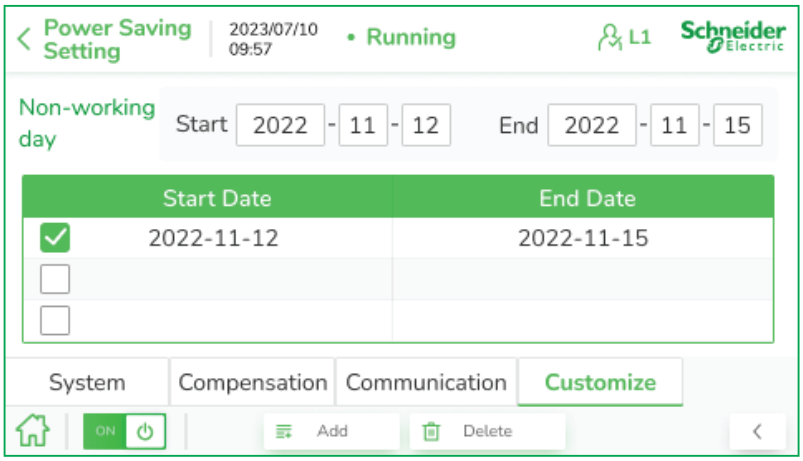
Customize Setting Interface

Click the **Customize** tab, and the interface displays the following parameters: **Language**, **Change Password**, **Security Questions**, **Factory Reset**, **Power Saving**.

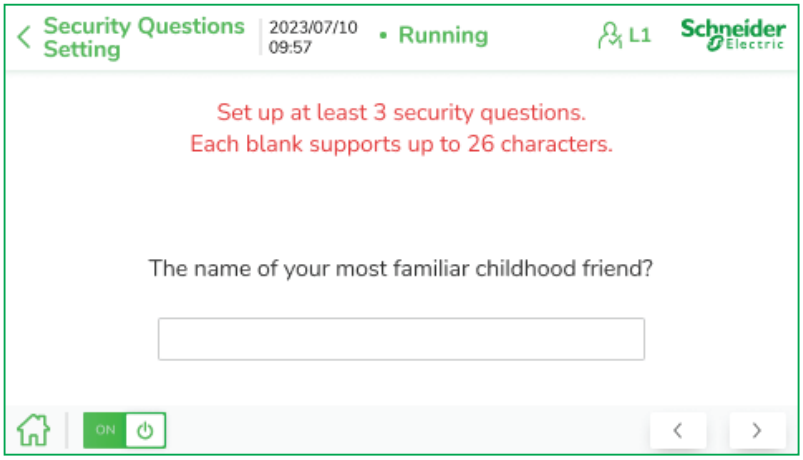


Click **Power Saving** setting button to enter the time setting interface, as follows:





When setting security questions, please note that at least three security questions are set, and each question supports up to 26 characters.



Event Log Interface

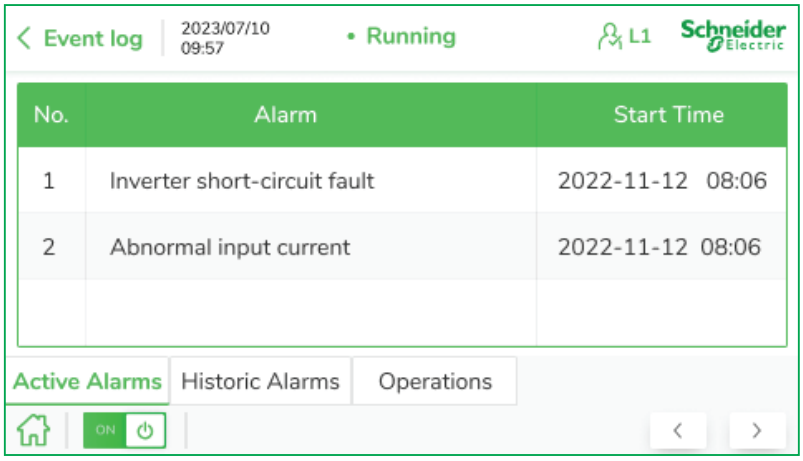
Click **Event log** on the home screen to enter the record interface.

This section introduces the record interface of 4.3-inch HMI, which contains three sub-menu interfaces of **Active Alarms**, **Historic Alarms**, and **Operations**.

Similar to the 7-inch HMI, the 4.3-inch HMI can also record a total of 100 **Active Alarms** and **Historic Alarms**. A total of 100 **Operations** can be recorded. When the internal record is full, the oldest record will be automatically overwritten. The 4.3-inch HMI has no record download function.

1. **Active Alarms** interface

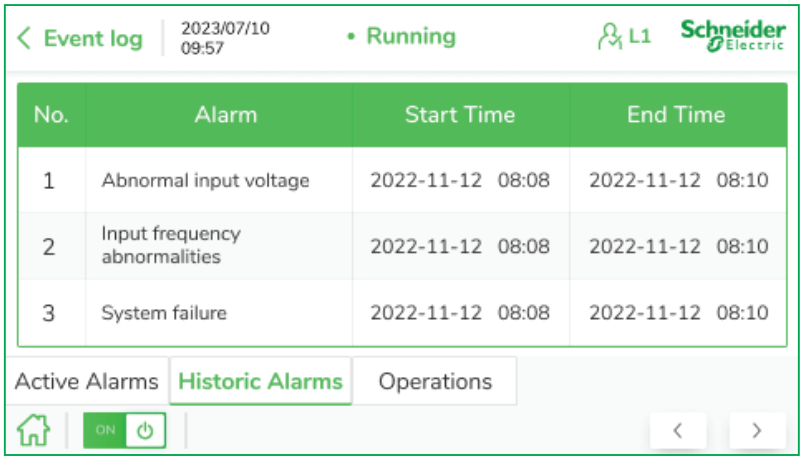
   As shown in the figure, this interface displays current alarm information of the equipment and the occurrence time of the alarm.



   Click **<** and **>** in the lower right corner of the screen to view more event records.

2. **Historic Alarms** interface

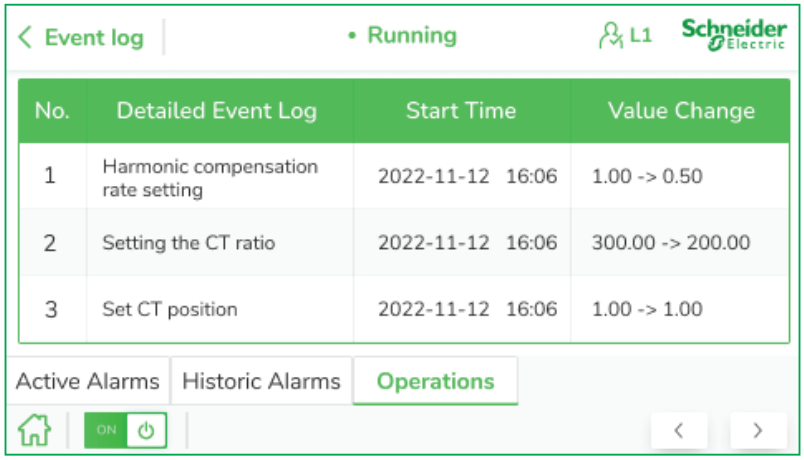
   As shown in the figure, this interface displays the historical alarm information of the equipment, the occurrence time and end time of the alarm.



   Click **<** and **>** in the lower right corner of the screen to view more event records.

3. **Operations** record interface

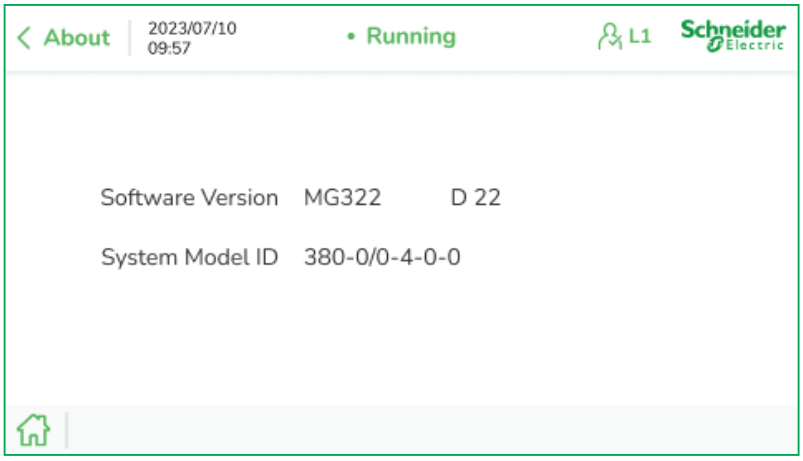
   As shown in the figure, this interface records operations that distribute parameters to the equipment, including the occurrence time and the change of operation value.



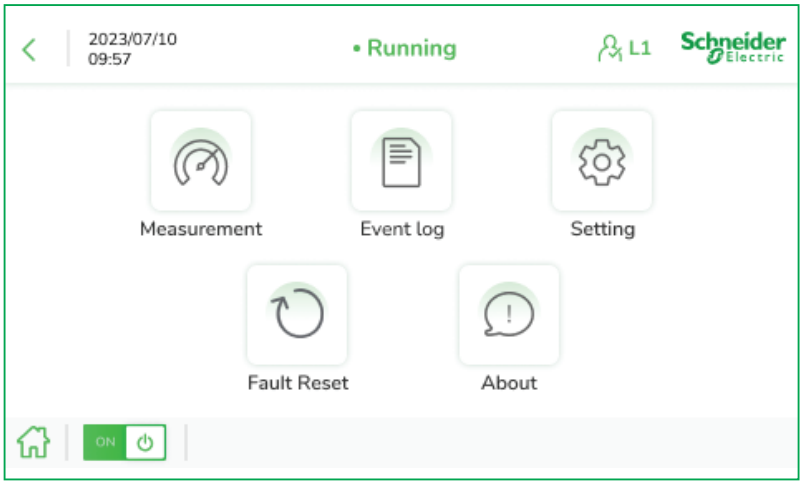
   Click **<** and **>** in the lower right corner of the screen to view more event records.

About Interface

Click **About** in the menu screen to enter the interface and view the version information of HMI.



Fault Reset



When APF encounters some fault alarms (such as over-temperature alarm), the equipment will automatically enter the operation locking state: the equipment stops harmonic output and cannot automatically resume operation. After the fault is removed, it is necessary to click **Fault Reset** to manually clear the fault locking state before restarting the equipment.

It should be noted that the operation of clicking **Fault Reset** only releases the operation locking status of the equipment and does not clear the fault alarm records generated before.

Operation Instructions for Startup/Shutdown and Debugging

This section will introduce the power on/off and debugging process of Schneider Electric APF. For convenience of illustration, the interface of 7-inch HMI will be introduced. The operation of 4.3-inch HMI is similar and will not be repeated.

Startup Steps

After the Schneider Electric APF module (or multi-module paralleled system) is powered on, startup process can be performed.

⚠⚠DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- Apply appropriate personnel protective equipment (PPE) and follow safe electrical work practices. Refer to your local regulations.
- This equipment must only be installed in area accessible to electrically skilled personnel and electrically instructed personnel with the proper authorization and serviced by qualified electrical personnel.
- This equipment must only be installed in area without combustible materials.
- Turn off all power to auxiliary contacts and short CT secondary's before working on or inside the equipment.
- Always use a properly rated voltage sensing device to confirm power is off.
- Ensure all disconnect switches are disconnected before servicing equipment. More than one may be present.
- After removing power, wait 15 minutes to allow capacitors to discharge before opening or removing covers.
- Replace all devices and covers before turning on power to this equipment.
- Carefully inspect the interior for tools left behind before replacing covers.
- Verify the rating of the neutral conductor for each unit in the system is greater than the neutral current limit setting.

Failure to follow these instructions will result in death or serious injury.

⚠⚠DANGER

DANGER OF ELECTRIC SHOCK, EXPLOSION OR FLASH BURN

- After the power port of the equipment is powered on, the internal auxiliary power supply of the equipment will be automatically turned on.
- Appropriate sensing devices with rated voltages should always be used to confirm that the power is on.

Failure to follow these instructions will result in death or serious injury.

The startup steps are as follows:

1. Close the circuit breaker between the mains and the module or system.

   After power on, the auxiliary power supply in the system starts automatically and the HMI lights up. The green operation indicator on the module panel will flash, indicating that the equipment is in standby state.

2. Check equipment status

   In standby mode, click **Measurement** on the menu screen, select the **Power** menu, and check the power grid, Whether the electrical parameter values (voltage, current, frequency, power, etc.) are consistent with the actual state, and whether the parallel modules are normally online.

3. Start harmonic output

   When the equipment is in standby state:

   - If Power On Mode is set to **Automatic** before, the system will automatically start filtering output when the system self-test meets the startup conditions, and the green operation indicator on the module panel keeps on, and the HMI control screen displays that the module is running.
   - If Power On Mode is set to **Manual** before, only when click the **Power On** button in the bottom left corner power on and permission is confirmed that the system starts filtering output, and the green operation indicator on the module panel keeps on, and the HMI control screen displays that the module is running. The system is in **Manual** by default.
   - After the module starts filtering output, click **Measurement** on the menu screen to view the harmonic treatment effect and the internal temperature monitoring results of the module under the Other measurement interface.

Shutdown Steps

When the APF module (or multi-module paralleled system) needs to be powered off, a shutdown can be performed.

The shutdown steps are as follows:

1. Turn off harmonic output

   On HMI home screen interface and click the **Power Off** button. After the permission is confirmed, the module will close harmonic output.

   ⚠⚠DANGER

   DANGER OF ELECTRIC SHOCK, EXPLOSION OR FLASH BURN

   - Pressing the shutdown button can only stop harmonic output of the equipment and cannot completely power off the equipment.
   - Appropriate sensing devices with rated voltages should always be used to confirm that the power is off.

   Failure to follow these instructions will result in death or serious injury.

   In this state, operations such as module maintenance are prohibited.

2. Disconnect the circuit

   Disconnect the circuit breaker between the mains and the module or system, and the system will be completely powered off.

   ⚠⚠DANGER

   DANGER OF ELECTRIC SHOCK, EXPLOSION OR FLASH BURN

   - Wait 15 minutes after the power is cut off to allow the capacitor in the module to discharge
   - Appropriate sensing devices with rated voltages should always be used to confirm that the power is completely off inside the equipment.

   Failure to follow these instructions will result in death or serious injury.

System Parameter Configuration

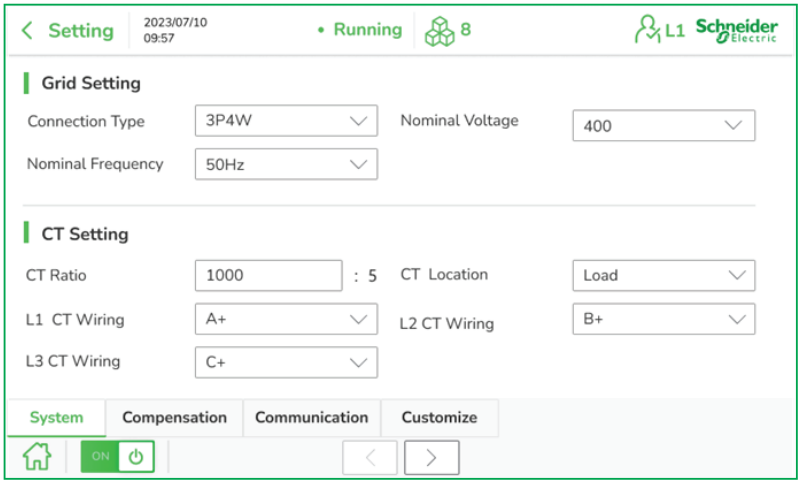
When APF module is powered on and the HMI lights up, it is necessary to set parameters of the module or paralleled system before starting harmonic output, so that the APF has the desired harmonic output capability. The Quick Parameters Setting section will introduce how to quickly set the APF to achieve basic harmonic output capability, while the advanced parameter settings section will introduce how to set the APF to have more functions to adapt to more complex application scenarios.

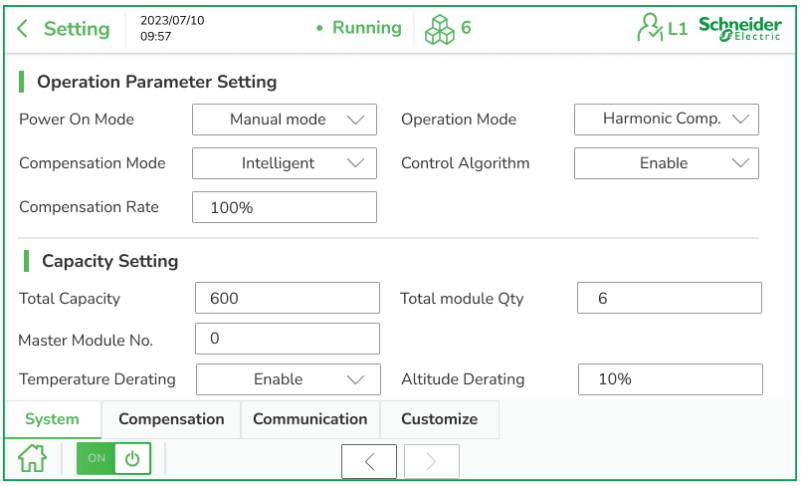
Quick Parameter Setting

Schneider Electric APF can configure the common operating parameters of the module through level I permission (operator permission) in the system setting interface, so that the APF has the basic harmonic output capability.

Common basic settings are:

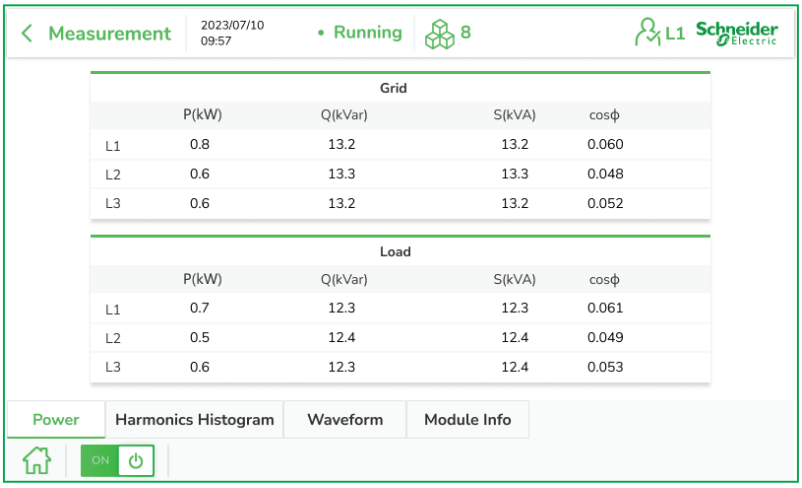
- **Operation Mode** setting: Select harmonic compensation mode.
- **Connection Type**: Select the corresponding 3-phase 3-wire or 3-phase 4-wire ccording to the actual wiring system.
- **Nominal Voltage**: The working voltage of the APF system is 208 V, 400 V, and 480 V, which can be selected according to the power grid voltage of the APF.
- **Nominal Frequency**: Divided into 50 Hz and 60 Hz. Corresponding parameters should be set according to the frequency of the power grid.
- **CT Ratio**: Set the transformation ratio parameters of external CT.
- **CT Location**: Divided into **Load** side and **Grid** side. It needs to be selected according to actual installation position of the external CT.
- **L1/L2/L3 CT Wiring**: The default value is A+,B+ and C+. If there is a wiring error, you can adjust this setting to correct it without changing the wiring.
- **Power On Mode**: Select manual startup and select automatic startup after debugging.
- **Compensation Mode** setting: Select intelligent compensation mode.
- **Compensation Rate** setting: Enter 100%.
- **Operation Mode**: Harmonic compensation mode aimed at compensating harmonics.
- **Total Capacity** setting: Set according to the total capacity of parallel module, and the unit is A.
- **Total Module Qty** setting: Set according to the actual number of modules monitored by HMI.
- **Other parameters**: Keep the default settings.





After completing the above settings, it is necessary to first return to the menu screen of HMI and click the **measurement** to observe whether the actual status parameters of power grid and load, measurement waveforms and other data are true and correct, so as to judge whether the CT and power line are correctly connected. After confirming that parameter settings are correct and APF has no fault alarm, then click power **ON**. After the permission is confirmed, the equipment starts harmonic output, and automatically monitors and governs power grid harmonics.

Status parameters of power grid and load before APF filtering on site are as follows:

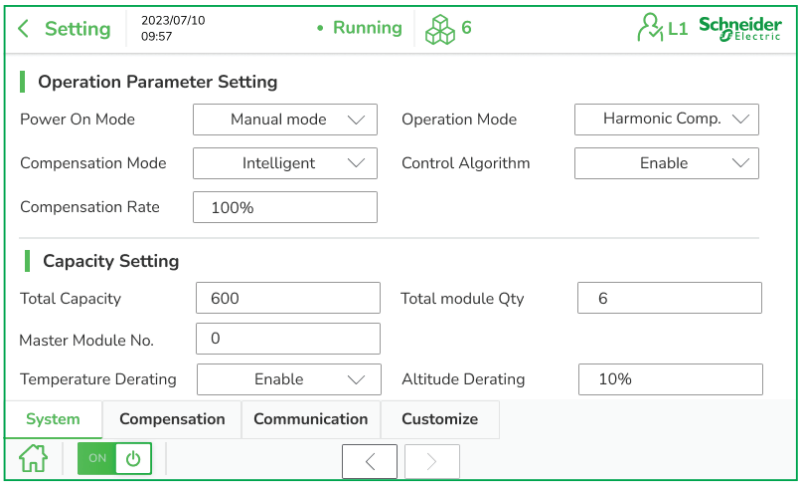


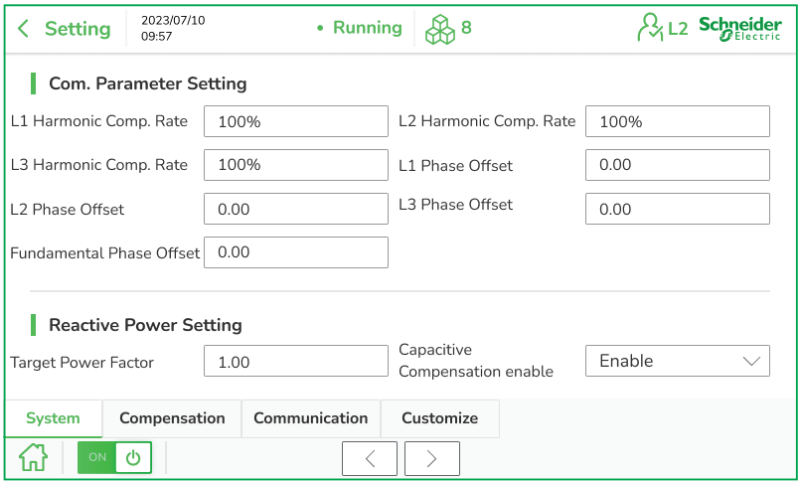
Advanced Parameter Setting

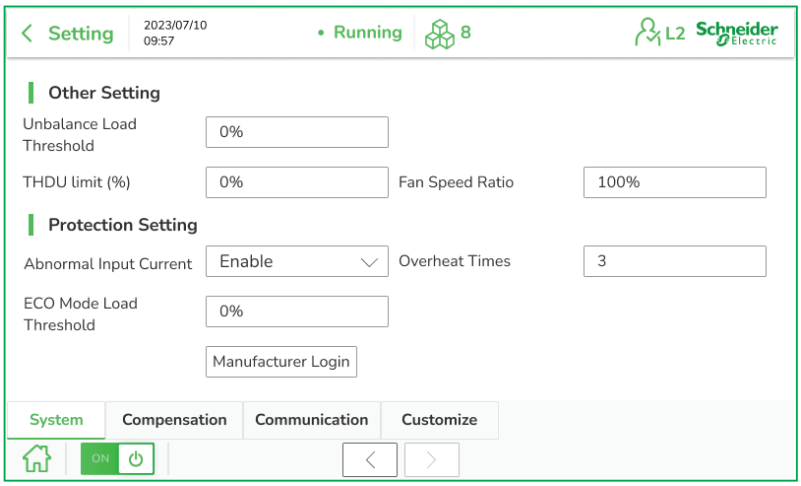
In the actual operation site of APF, the effect of APF filter will be affected by the power quality of the power grid and the change of environmental conditions such as temperature and climate. Schneider Electric APF provides targeted parameter settings for reactive power, unbalance or temperature change at the application site to improve the equipment's adaptability to complex application scenarios.

In addtion to the quick parameter setting, some advanced parameters could be adjusted to fulfill different application needs.

In consideration of the professional operation needed in parameter adjustment, some parameters need higher permissions (level II permission) to be set.







1. When there are not only harmonics and reactive power in the power system.

   The settings need to be adjusted as follows:

   - **Operation Mode** setting: Select the mode of harmonic + reactive power (H+Q) or reactive power + harmonic(Q+H). Please refer to Setting Interface, page 17 section for introductions of the operation mode.
   - **Target Power Factor** setting: Enter 1.
   - **Capacitive Compensation enable**: Select enable.

2. When there are not only harmonics but also unbalance in the power system.

   The settings need to be adjusted as follows:

   - **Operation Mode** setting: Select the mode of harmonic + unbalance(H +B) or unbalance + harmonic(B+H). Please refer to Setting Interface, page 17 section for introductions of the operation mode.
   - **Unbalance Load Threshold** setting: Enter 0%.

3. When there are not only harmonics but also reactive power and unbalance in the power system.

   The settings need to be adjusted as follows:

   - **Operation Mode** setting: Select the mode of harmonic + reactive power+ unbalance(H+Q+B) or other different combination of the three modes. Please refer to Setting Interface, page 17 section for introduction of the operation mode.
   - **Target Power Factor** setting: Enter 1.
   - **Capacitive Compensation enable**: Select enable.
   - **Unbalance Load Threshold** setting: Enter 0%.

4. When the ambient temperature at APF site exceeds the specified ambient temperature limit.

   The settings need to be adjusted in addition to previous settings:

   - **Temperature Derating** setting: Select enable.

5. When APF is applied in high altitude.

   The settings need to be adjusted in addition to previous settings:

   - **Altitude Derating**: Enter the corresponding factor according to the actual altitude. You can also refer to the following table for quick settings.

Altitude	≤ 1500 m	≤ 2000 m	≤ 2500 m	≤ 3000 m	≤ 3700 m
Derating factor	0%	5%	10%	15%	22%

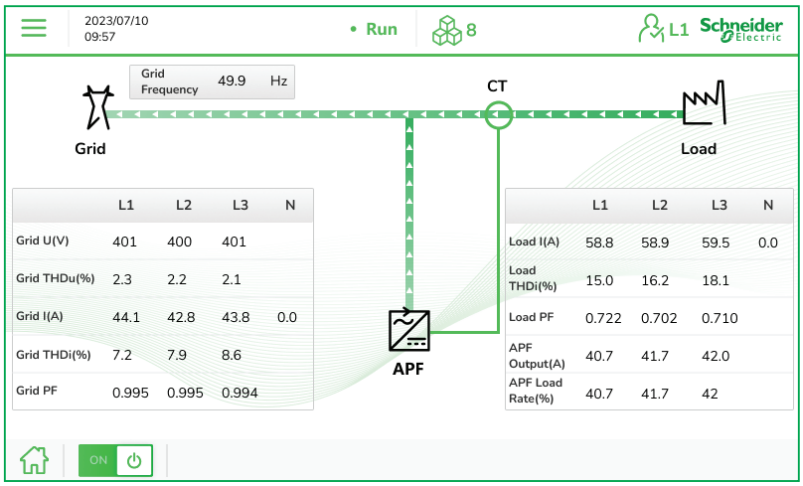
System Debugging

After the APF module or system is powered on, if it completes parameter setting and turns on harmonic output of the equipment, APF will automatically monitor the power grid status and conduct harmonic control. But sometimes it is necessary to manually adjust and optimize the system parameters on the basis of automatic compensation to further optimize the harmonic control effect of APF.

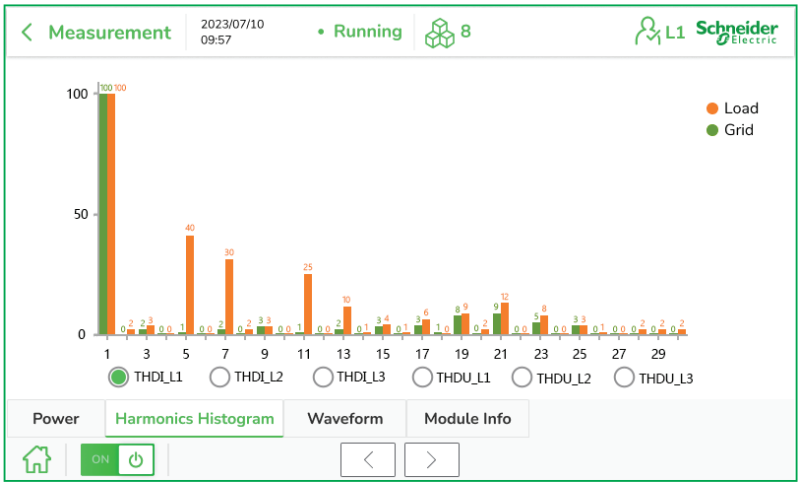
Debugging steps:

1. Before debugging, check whether there are alarm items on the screen interface first, and check whether the data (THDi, etc.) on the measurement interface are consistent with the actual working condition.

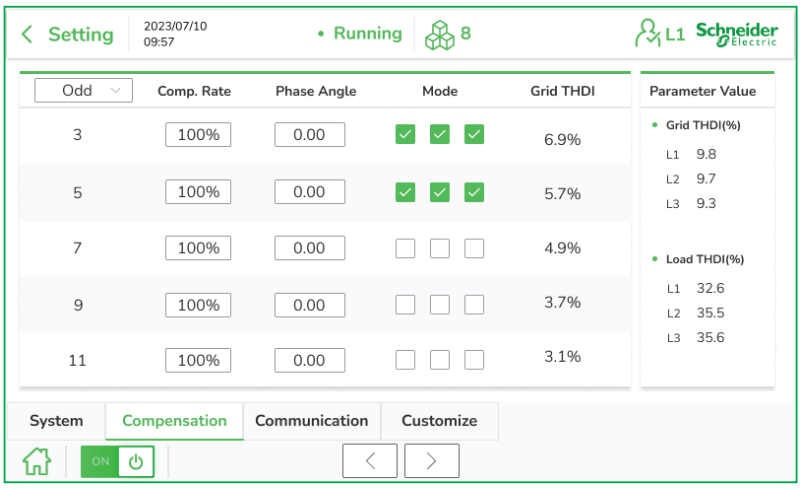
   During debugging, it is recommended to use power analyzer for comparison measurement to facilitate debugging and optimization.



2. Enter the harmonic menu from the measurement interface of the menu screen, observe the content of each harmonic on the grid side from the harmonic distribution diagram, and select each harmonic that needs to be optimized and compensated.



3. Return to the Home screen and enter the Setting interface and select the **System** to change the **Compensation** mode from **Intelligent** to **Sequential**.
4. Click **Compensation** under the setting interface to enter the harmonic compensation setting interface.



5. According to the harmonics to be optimized selected in step 2, adjust the compensation rate parameters of each harmonic one by one (the maximum value can be set to 110%), and observe the THDi data on the interface. If it meets the standard, the debugging is completed. If not, proceed to step 6.
6. Still in the harmonic compensation interface, adjust the phase angle parameters of each harmonic one by one (it is recommended to conduct phase angle offset debugging at a step angle of +/- 0.2 degrees) until the filtering requirements are met.

After the above debugging, APF can control the harmonics within the range required by the standard. If any problems are encountered during debugging, please consult Schneider Electric customer service hot-line for relevant help.

Cybersecurity

At Schneider Electric, we have always regarded cybersecurity as a key requirement, and are committed to providing more reliable, stable and safe products to minimize potential network risks, so as to better protect our customers' lives, property and the environment.

Cybersecurity aims to protect your system, communication network and equipment from possible damage, data tampering or confidential information disclosure. In addition to suggestions for APF in this article, it is strongly recommended that you follow Schneider Electric's defense-in-depth approach to achieve cybersecurity, which is described in the system technical specification How to reduce vulnerability to cyber-attacks . In addition, you can find more useful resources and up-to-date information on Schneider Electric's Cybersecurity Support Portal.

⚠WARNING

CHANGE DEFAULT PASSWORD AT FIRST USE

Changing the default password at first use helps prevent unauthorized access and changes to important data such as operating parameters and configuration of the device.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Equipment Safety

- Digital signature technology based on public key infrastructure (PKI) is used to ensure the authenticity and integrity of device firmware and prevent malicious code injection
- Use verification technology to ensure the integrity of important configuration and business data stored in the equipment
- Provide password-based access control (see and User Access Permission, page 30 section) to ensure that only authorized personnel can access and change equipment configuration
- After entering wrong password for 3 consecutive times, the equipment will be locked for 5 minutes, which effectively alleviates the possibility of brute force attack
- Supports password reset through security questions (see and User Access Permission, page 30 section). Users need to set the security questions at first use and keep the answers properly
- Provide keys to ensure that only authorized personnel can have APF cabinet door keys and access to important interfaces (such as USB, TF) and components
- The equipment is shipped with the debugging port disabled to prevent attackers from reading and changing the firmware and configuration parameters in the equipment
- Strict input verification ensures that only legitimate data from HMI and Modbus RTU are accepted

Password Management

The password is an important line of defense against network attacks or damage to the equipment. The default password is as follows:

- Level I (Operator) password: 08080808

- Level II (Administrator) password: 87654321

The following rules shall be followed for the first time to modify the default password:

- The new password contains 8 to 16 characters
- The password must contain at least any two of the following combinations of characters:
- Numbers
- Uppercase letters
- Lowercase letters
- Special characters

Best practices on passwords, including but not limited to:

- Change the password regularly and do not reuse the old password
- Do not share personal passwords
- Do not display password when entering password
- Do not transmit passwords by email or any other means
- Do not save your password on PC or other devices
- Supports password reset through security questions. It is strongly recommended that users set security questions and corresponding answers according to prompts at first use and keep the answers properly

Access Control

APF provides the possibility of local access and Modbus RTU based remote access. You must ensure that only authorized users can access it.

Local Access

It provides various possibilities for attackers to access and control devices locally. Installs the APF in a secure area and implements and manages access rules for the secure area. It is recommended that:

- This area remains locked at all times
- The area is equipped with an access control system, and only authorized personnel can have the keys or access codes
- Communication ports and network cables entering the secure area, as well as connection ports on communication equipment outside the room are protected

Modbus RTU based Remote Access

APF only provides remote access interface for Modbus RTU. When monitoring and control software (SCADA) local system or clairvoyance accesses APF through Modbus RTU via gateway, it is recommended that:

- The Modbus communication cables and ports are protected
- Ensure that the computer using Modbus RTU to access APF requires a login username and password
- Passwords follow strong password rules
- Set the computer lock screen to lock the computer screen when it is not used or when the timer times out

- The operating system on the computer shall be reinforced and anti-virus software shall be installed, and the virus library shall be kept updated
- The computer is not allowed a direct connection to the Internet

Firmware Update

When you need to upgrade firmware, please refer to HMI Software Upgrade or contact Schneider Electric Technical Support Engineers or local agents to help you complete the upgrade.

Safe Disposal

When the equipment needs to be disposed, please use **Factory Reset** (see Setting Interface, page 17 and Setting Interface, page 38 section) and destroy it through safe channels to ensure that the equipment will not be re deployed to your operation system or used illegally.

Network Security Vulnerabilities or Events

You can visit Schneider Electric Cybersecurity Vulnerability Portal (https://www.se.com/ww/en/work/support/cybersecurity/vulnerability-policy.jsp) to review vulnerability management policy or report potential Cybersecurity vulnerabilities or events.

Open-source Library License Statement

The following open-source libraries are used in this product, all of which comply with the open-source license.

Library name	Open source license
atftp	https://www.gnu.org/licenses/gpl.html
bridge-utils	https://www.gnu.org/licenses/gpl.html
busybox	https://www.gnu.org/licenses/gpl.html
dbus-glib	https://www.gnu.org/licenses/gpl.html
glibc	https://www.gnu.org/copyleft/lesser.html
gmp	https://www.gnu.org/copyleft/lesser.html
iperf	https://opensource.org/licenses/NCSA
iproute2	https://www.gnu.org/licenses/gpl.html
iw	http://www.isc.org/downloads/software-support-policy/isc-license/
kmod	https://www.gnu.org/copyleft/lesser.html
libatomic1	https://www.gnu.org/licenses/gpl.html
libffi	https://opensource.org/licenses/MIT
libgpg-error	https://www.gnu.org/copyleft/lesser.html
Libiniparser	https://opensource.org/licenses/MIT
libnl	https://www.gnu.org/copyleft/lesser.html
libsanitizer	http://www.linfo.org/bsdlicense.html

libts	https://www.gnu.org/licenses/gpl.html
libusb	https://www.gnu.org/copyleft/lesser.html
linux_kernel	https://www.gnu.org/licenses/gpl.html
linuxconsoletools	https://www.gnu.org/licenses/gpl.html
mtd	https://www.gnu.org/licenses/gpl.html
netbsd-resolv	http://www.linfo.org/bsdlicense.html
openssl	https://www.openssl.org/source/license.html
readline	https://www.gnu.org/licenses/gpl.html
safestring	https://opensource.org/licenses/MIT
snmp	https://www.agentpp.com/licenses/SNMP_PP_LICENSE.txt
sqlite3	http://en.wikipedia.org/wiki/Public_domain
uboot	https://www.gnu.org/licenses/gpl.html
util-linux	https://www.gnu.org/licenses/gpl.html
zlib	http://zlib.net/zlib_license.html

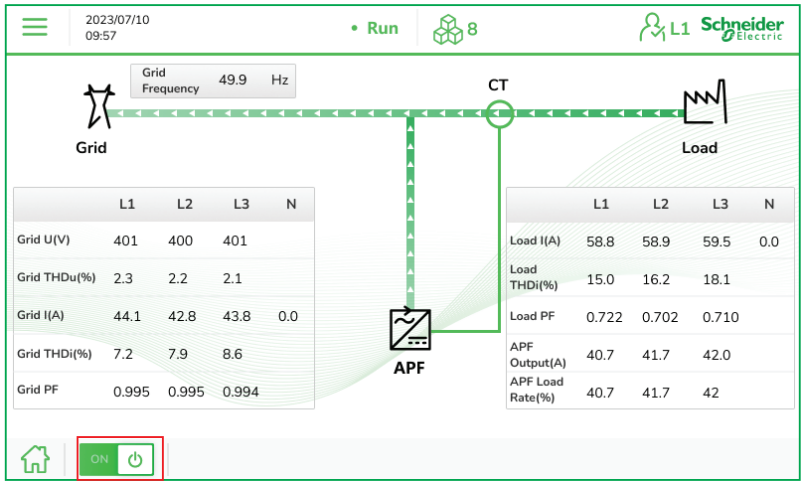
EasyLogic™ APF HMI Firmware Upgrade Instruction

1. **HMI Communication Upgrade**
   - **Upgrade Media Requirement**

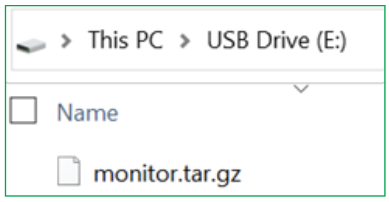
     (1) USB Disk.

   - **Upgrade Process**

     (1) Turn Off EasyLogic™ APF.

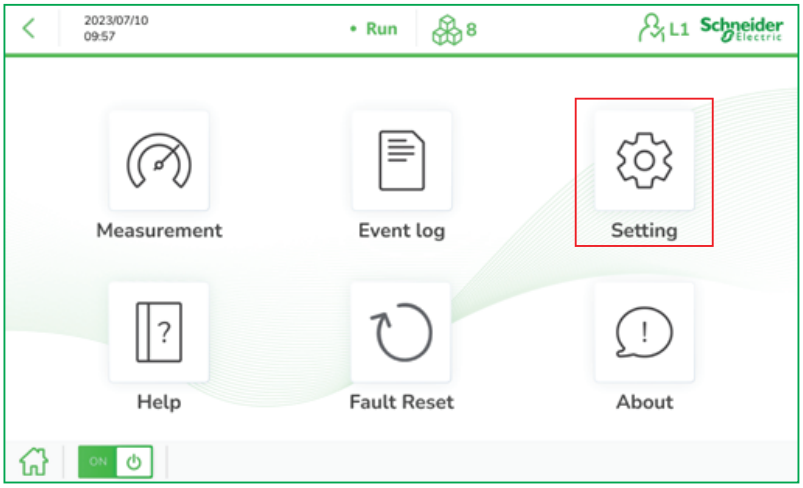


     (2) Copy monitor.tar.gz file to USB Disk.

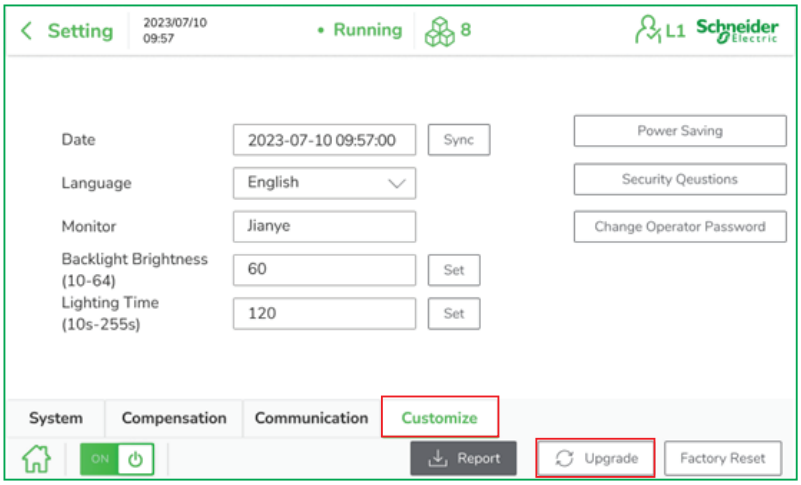


(3) Insert USB Disk into the slot on the left side of HMI (as shown below).

(4) Select **Setting** and key in password (08080808) to proceed.



(5) Select **Customize** and then click **Upgrade**.



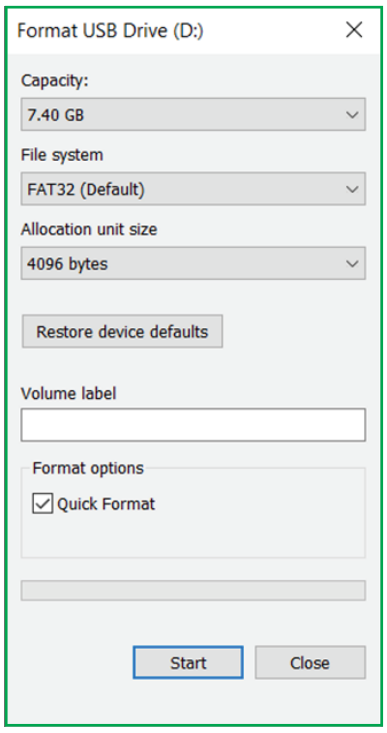
You will hear a few beep sound once upgrade is started. Then HMI will be restarted and upgrade is completed with a few beep sound.

2. **HMI Interface Upgrade**

- **Upgrade Media Requirement**

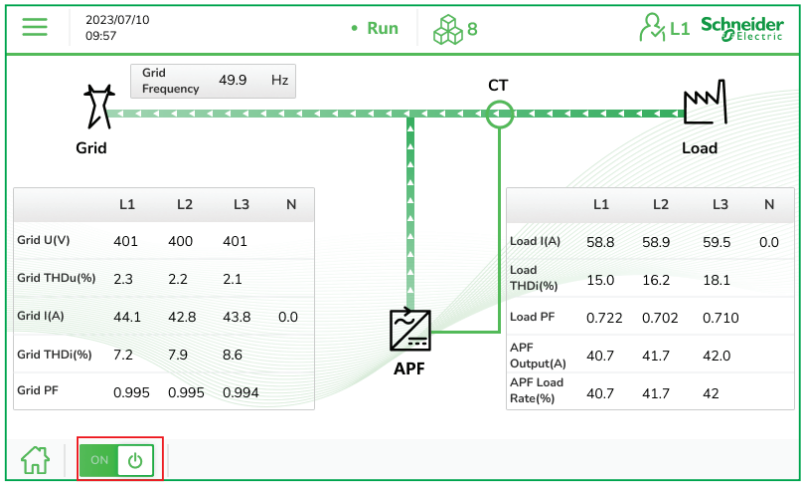
  (1) SD card and SD card reader.

  (2) SD card capacity should be 2G - 8G, and file system of SD card must be FAT32 format.

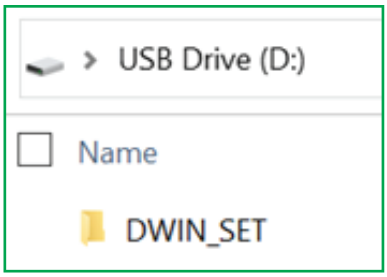


- **Upgrade Process**

  (1) Turn Off EasyLogic™ APF.



(2) Copy DWIN_SET folder to SD card.



(3) Insert SD card into the slot on the left side of HMI (as shown below). You will hear a click sound once SD card is inserted successfully.

(4) After SD card is inserted, blue screen will appear for a while, followed by all the latest HMI interfaces flashing one by one. It will take 1-2 mins to complete this process.

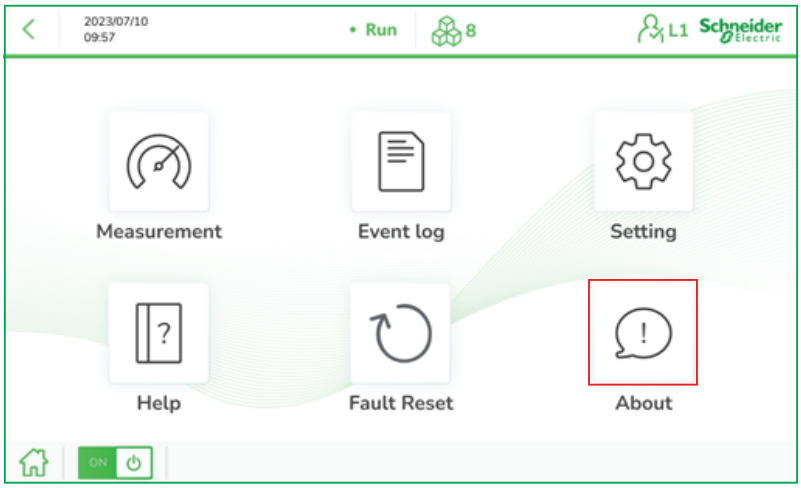
(5) Once completed, you will see the startup interface (as shown below).

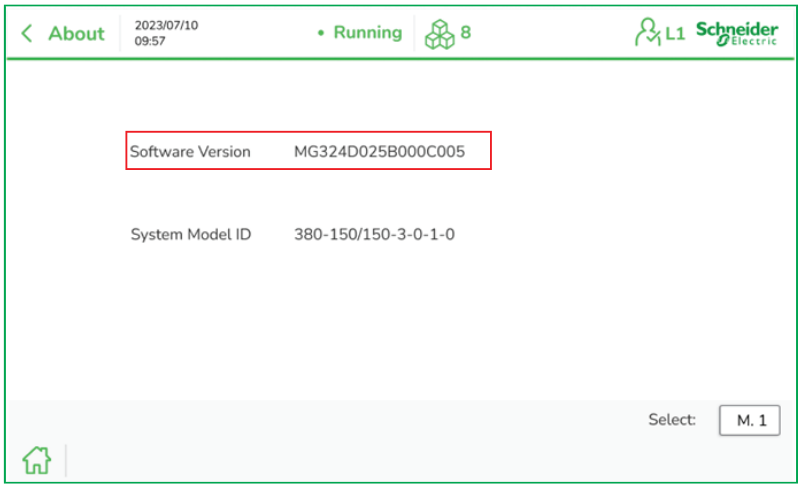
(6) Remove SD card and restart HMI (switch off and on APF power) to complete the upgrade.

3. **Power Off, then Power on the Circuit breaker of EasyLogic™ APF**

4. **Check the Software version**

   You can click **About** to check the **Software Version** before and after upgrade.





Troubleshooting

When the Schneider Electric APF encounters a fault, the red fault light on the equipment housing will light up, and the HMI will also display the fault information and give a buzzer alarm.

In general, in case of minor fault, the equipment will automatically stop harmonic output and automatically resume operation when the equipment is in normal state. In case of serious fault, the equipment will not restart automatically after output stops and it needs to be manually restarted after troubleshooting. In case of emergency, it is necessary to press EPO to forcibly stop harmonic output of the equipment.

⚠⚠DANGER

THERE IS A DANGER OF UNEXPECTED OPERATION OF EQUIPMENT

- Pressing the EPO emergency stop button can only stop harmonic output of the equipment and cannot completely power off the equipment.
- Appropriate sensing devices with rated voltages should always be used to confirm that the power is off.

Failure to follow these instructions will result in death or serious injury.

To completely power off the equipment, disconnect the front circuit breaker of the APF line.

The common fault information and solution of Schneider Electric APF are as follows for reference.

No.	Fault information	Description	Solution
1	Inverter short circuit	The current flowing through any IGBT exceeds the set value	Check whether IGBT, Hall, bus capacitor, inverter inductor and input relay are short circuited
2	Output Current Abnormal	1. False alarm caused by excessive load current 2. Resonance	1. For false alarm, set **Abnormal Input Current** to **disable** through parameter setting to shield false alarm 2. For system resonance, it is necessary to find the resonance frequency of the system first, and then close the resonance frequency and the harmonic compensation orders near the frequency to eliminate or weaken the resonance 3. If full compensation mode or higher harmonic compensation mode is used resonance may occur. If there is no other alternative method, you can try switching compensation mode to intelligent compensation mode, or alternatively reduce the high harmonic compensation rate to avoid resonance
3	Fan Fault	One or more fans are blocked, and the fan module is disconnected or damaged	The fan needs to be replaced. Please contact Schneider Electric Product Engineer
4	Inverter over-temperature	The temperature of the radiator exceeds the maximum allowable operating temperature	Check whether the ambient temperature is too high, whether the air inlet and outlet of the system are unblocked, and whether the fan works normally; Otherwise, please contact Schneider Electric Product Engineer
5	CT Ratio Setting Error (4.3 inch) Transformer reverse fault (7 inch)	The actual load current is greater than the rated detection current of CT	If the CT ratio is too small, the current transformer needs to be replaced and this needs to be 1.5 to 2 times the maximum load
6	Inverter Overload	1. Resonance 2. Filter fault	It is necessary to confirm whether the compensation current detection of APF is correct; If there is any problem, please contact Schneider Electric Product Engineer
7	System Fault	During normal operation of APF, the sum of the positive bus voltage and the negative bus voltage exceeds the set value A or is lower than the set value B, or the difference between the positive bus voltage and the negative bus voltage exceeds the software set value C	Please contact Schneider Electric Product Engineer
8	Software Version Error	Mismatch between DSP software and CPLD software versions	Please contact Schneider Electric Product Engineer; Power off and update DSP and CPLD software
9	Monitor Setting Error	1. The system is powered on for more than 50s, and no DSP is set for monitoring 2. There is a conflict in parameter settings	Please contact Schneider Electric Product Engineer to reset system parameters
10	Capacity Read Error	Native capacity setting error	Contact Schneider Electric Product Engineer
11	Emergency Shutdown	There are generally several reasons for this fault: 1. The emergency stop button is closed 2. The emergency stop button is incorrectly selected 3. Monitoring false alarm 4. EPO wiring error 5. Module internal relay fault	Check the cause step by step. If there is any problem, please contact Schneider Electric Product Engineer
12	Voltage Abnormal	When this alarm occurs, it can generally be inferred that: 1. The field voltage exceeds the allowable range of the module 2. The wiring system of the module is inconsistent with the actual wiring system (including default phase) 3. The internal fuse of the module is damaged	1. For voltage over the limit, it is a normal phenomenon and can be recovered by itself after the voltage is restored 2. If the module wiring system is inconsistent with the actual wiring, it is necessary to change the module wiring system or change the wiring mode through advanced password according to the actual requirements of the site 3. For module failure, the equipment code and software version shall be recorded and timely reported to Schneider Electric customer service

No.	Fault information	Description	Solution
13	Communication Failure (only 7inch)	1. 485 wiring error 2. Filter dialing error 3. Incorrect parameter setting 4. Large number of subordinate modules and delayed communication occurs 5. The monitor is disconnected from the filter host	1. If the dial switch is not 000, reset the dial switch 2. For internal wiring of the module, it shall be operated by Schneider Electric Customer Service Engineer 3. Corresponding to the parameter setting error it is required to set **number of parallel units** as the actual number of modules 4. For dialing error, the module shall be coded continuously from 000 according to the user manual 5. For wiring problems, correct the wiring Generally, this fault does not exist in the module itself. If it does not belong to the above problems through troubleshooting timely feedback of the on-site situation is required 6. For communication delay, restart after power off
14	Frequency Abnormal	1. The frequency exceeds the limit 2. The voltage sag causes false alarms	1. For frequency exceeding the limit, please contact Schneider Electric Customer Service Engineer 2. For false alarm caused by voltage sag, it shall be fed back to Schneider Electric Customer Service
15	Bus Diff Abnormal	1. The module wiring system setting is inconsistent with the actual wiring 2. The bus sampling circuit is abnormal	1. Correct the wiring mode 2. If there is still abnormal bus difference after the wiring mode is corrected, contact Schneider Electric Product Engineer for solution
16	Soft Start Fault	1. The thyristor is damaged, or the thyristor drive line is in poor contact 2. Bus sampling circuit is abnormal 3. The setting error of **three-phase n-wire** is inconsistent with the actual wiring	1. The thyristor and the drive line need to be disassembled for inspection 2. Check whether the setting of **three-phase n-wire** on the monitor is consistent with the actual wiring, and whether the N-wire is missed or misconnected. In case of cabinet type paralleled system, the N-wire between modules shall not be connected when adopts three-phase three-wire 3. Pay attention to whether the input wiring has negative sequence. If the three-phase voltage waveform displayed in the monitor is not in the order of **A-B-C**, it belongs to negative sequence
17	422 Communication Failure (4.3inch) 422 Comm. Error (7inch)	1. 422 communication line is in poor contact or is dropped 2. 422 communication circuit is damaged. Since the 422 communication is connected in series, if a module in the middle fails, it will cause 422 communication failures in all modules at the back end	1. In the paralleled system, check whether **CT position** of the monitor is set correctly and whether it is falsely set to **power side** 2. Power off and re-plug the 422-communication line and troubleshoot other faults of other modules in the system. If 422 communication failure still cannot be recovered after troubleshooting, contact the Customer Service Engineer of Schneider Electric for assistance
18	CAN Communication Failure (4.3inch) CAN Comm. Error (7inch)	1. The CAN communication line is in poor contact or is dropped 2. No matching resistor is added during multi-module communication, or too many matching resistors are added 3. CAN-H and CAN-L are reversely connected	1. In the paralleled system, check whether **CT position** of the monitor is set correctly and whether it is falsely set to **power side** 2. Power off and re-plug the CAN communication line, and check whether the wiring is dropped or reversed 3. Power off and use a multimeter to measure the total resistance at both ends of CAN-H and CAN-L, and check the number of matching resistors added on the bus. If no resistor is added, add corresponding resistors. If too many resistors are added, remove some resistors

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