Programmable Power Supply Virtual Terminal
Cortex & Nexus Series

User Manual

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Revision History

The following lists the sections added, deleted, or updated in each revision of this manual.

Date	Version	Revised Sections	Revision Details
December 5, 2023	1.0	Initial version created	
April 8, 2024	1.1	3.1, 3.2, 4.5, 7.5	Detailed description of software startup connection; Added application scenarios for various photovoltaic programming content; Added application scenarios for IEC 61000 experiments
July 10, 2024	1.2	4, 7	Added Nexus Series models

Table of Contents

1 Software Overview

1.1 Overview

This software is primarily designed for the Nexus Series Bidirectional Programmable DC Power Supplies (abbreviated as NEXUS-DC), Nexus Series Bidirectional Programmable AC Power Supplies (abbreviated as NEXUS-AC), Cortex Series Regenerative Programmable AC Source/Load Combinations (abbreviated as CORTEX-AC), PRE Series Programmable AC Power Supplies (abbreviated as PRE), PAC Series Programmable AC Power Supplies (abbreviated as PAC), CORTEX Series Bidirectional Programmable DC Power Supplies (abbreviated as CORTEX DC-B), CORTEX Series Programmable DC Power Supplies (abbreviated as CORTEX DC-A), and ZETA Series High-Precision Programmable DC Power Supplies (abbreviated as ZETA).

This software is primarily designed to assist users in conveniently and efficiently operating test power supply equipment. Users can set parameters for the device within the steady-state interface to control its steady-state output to specified values, while simultaneously viewing real-time measurement data of the test power supply. Within the programming interface, users can select different programming types based on actual requirements to edit target waveforms and control the device to output corresponding waveforms. Within the waveform interface, users can edit waveforms and download them to the device for storage. When connected to CORTEX DC-B, NEXUS-DC, or CORTEX DC-A devices, the SAS interface enables selection of various functions for experiments, delivering comprehensive testing capabilities for the photovoltaic industry. When connected to CORTEX DC-B, NEXUS-DC, or CORTEX DC-A devices, the BatSim interface allows custom battery parameters to be downloaded to the device, simulating multiple battery pack output characteristics and charge/discharge profiles. Connect PRE, PAC, CORTEX-AC, and NEXUS-AC devices. The IEC61000 interface simulates seven experiments to replicate test power usage scenarios under different conditions, evaluating the interference immunity of the device under test.

1.2 Feature Overview

- Industrial design, minimalist beauty, distinct user experience
- Intuitive operation, simple and user-friendly interaction
- Simultaneous connection and control of multiple devices
- Hierarchical interface design with intuitive guidance
- Software lock function prevents accidental operation
- Includes demo mode for convenient daily presentations
- Supports importing and exporting configuration data for cross-device operation
- Generates detailed log information for efficient troubleshooting
- Long-term stable and reliable operation

2 Installation

2.1 Software Download

Company Website: http://www.cnaction.com/

2.2 Installing the NI Runtime Engine

(After extracting the ni-visa_19.0.0_offline.zip archive, run Install.exe). Follow the wizard to complete installation. Note: During component selection, only check "NI-VISA.NET Runtime Engine". (A system restart is required after installation).

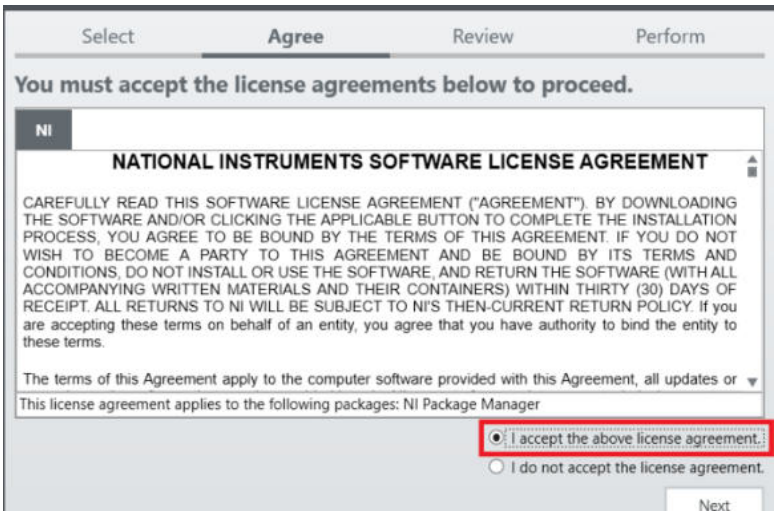


Figure 2.1

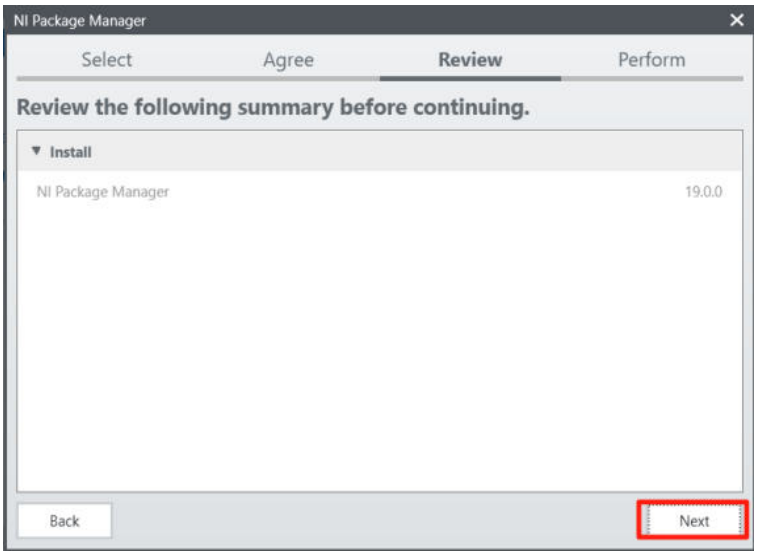


Figure 2.2

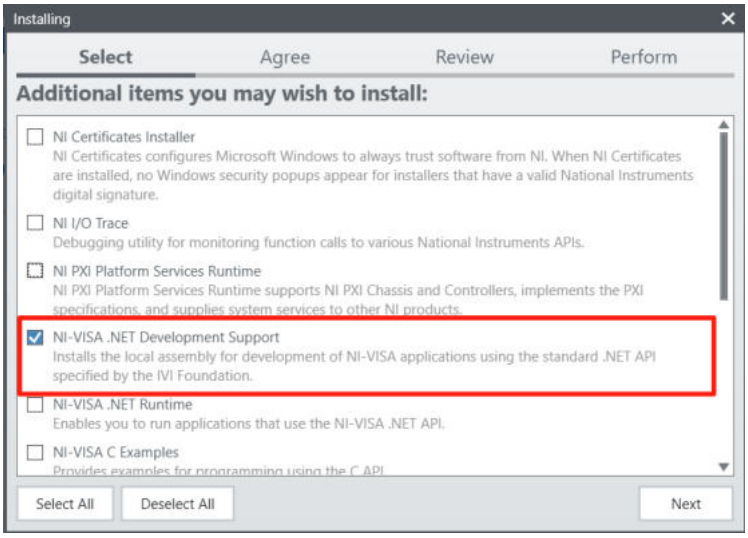


Figure 2.3

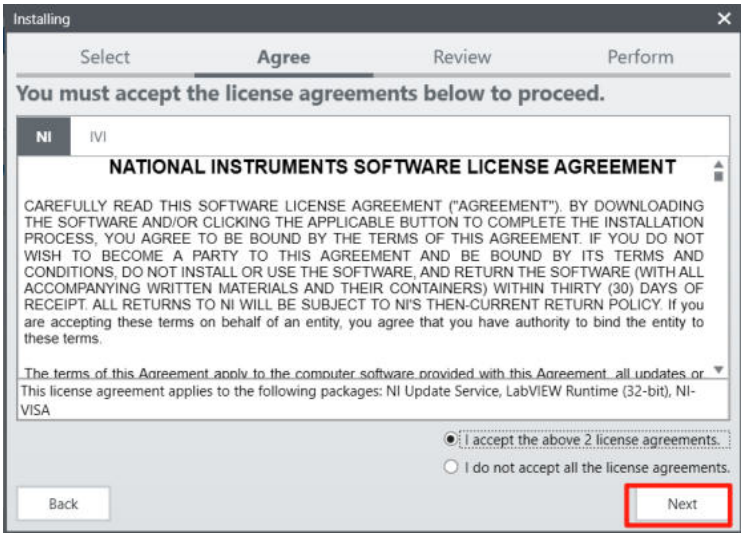


Figure 2.4

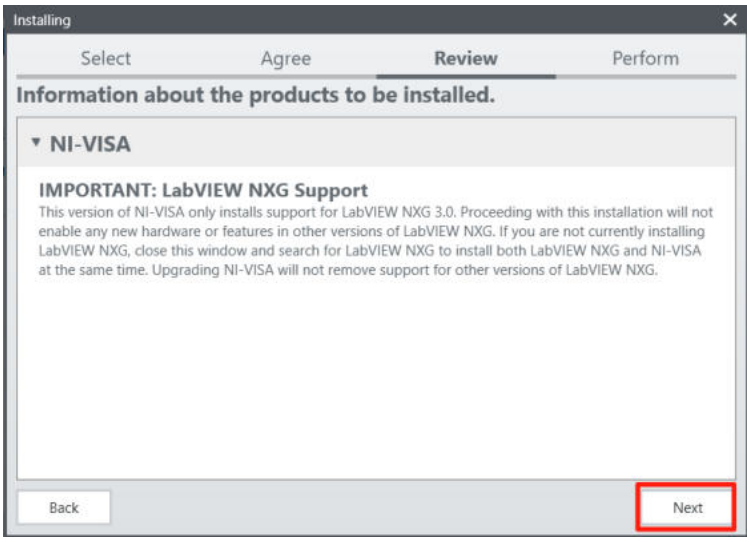


Figure 2.5

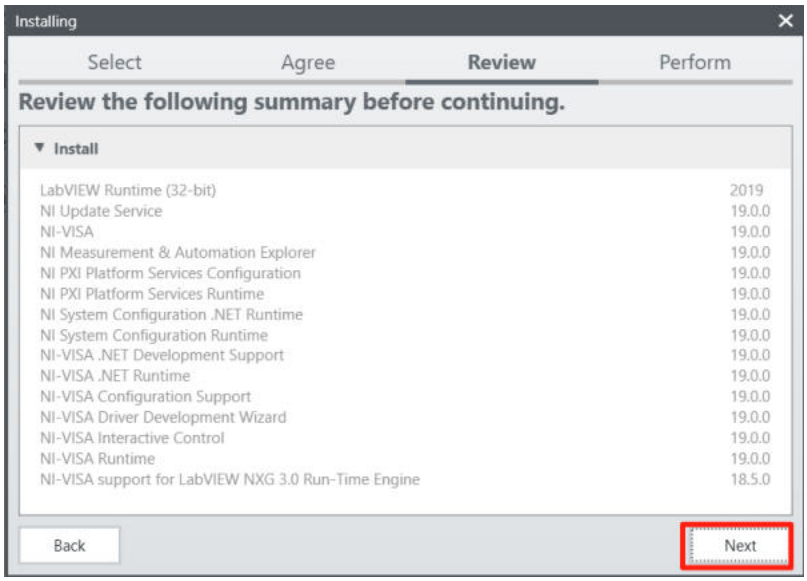


Figure 2.6

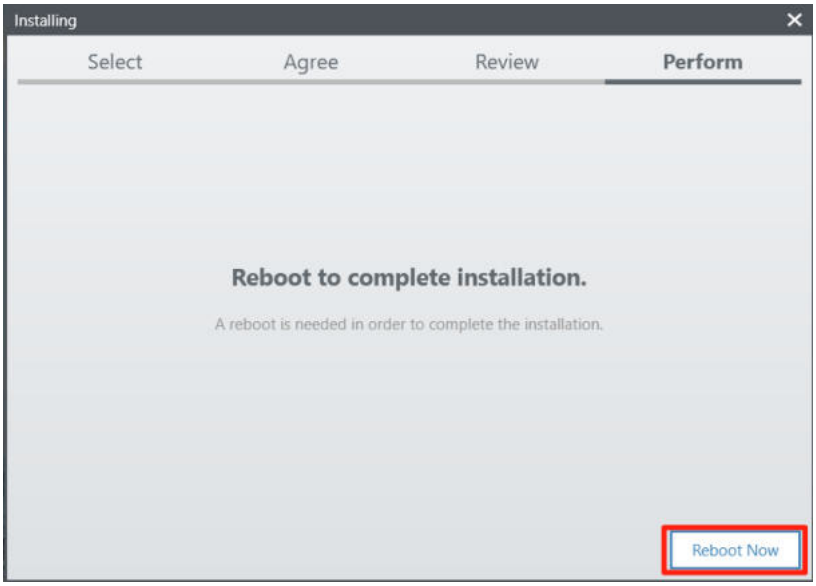


Figure 2.7

2.3 Run the installer

Run the Programmable Power Supply Virtual Terminal (Programmable Power Supply Virtual Terminal.exe). This will sequentially install the runtime environment and the Programmable Power Supply Virtual Terminal. Follow the wizard to complete the installation. (For the first installation, the following drivers must be selected; subsequent installations may manually deselect them.) Supported Operating Systems: WIN7, WIN8, WIN10

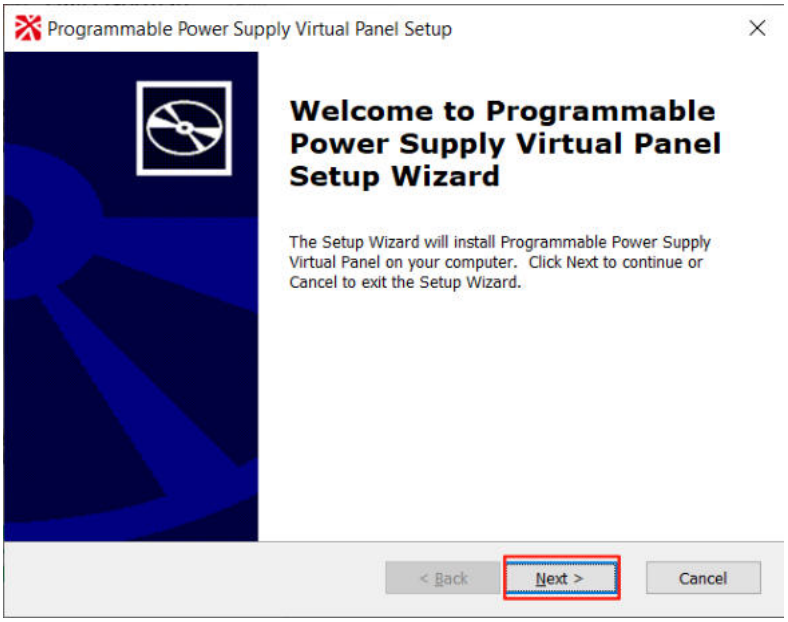


Figure 2.8

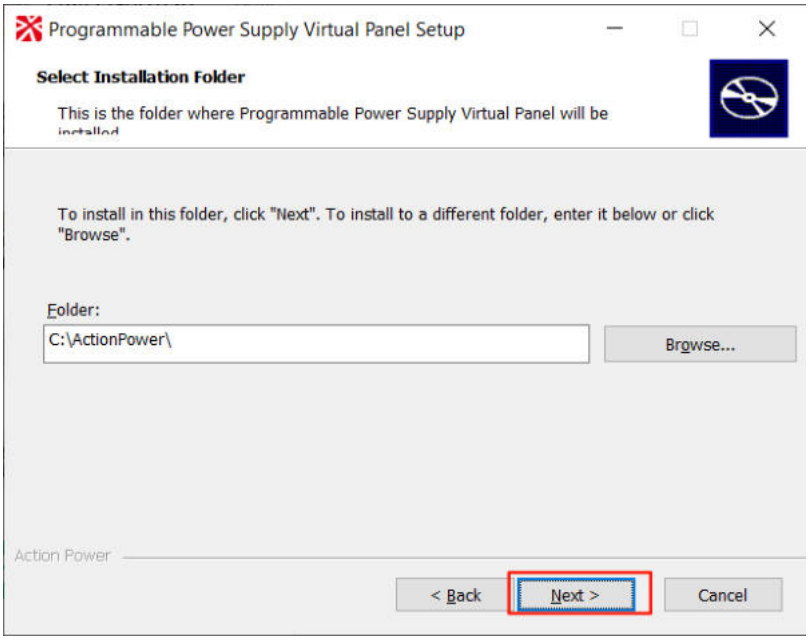


Figure 2.10

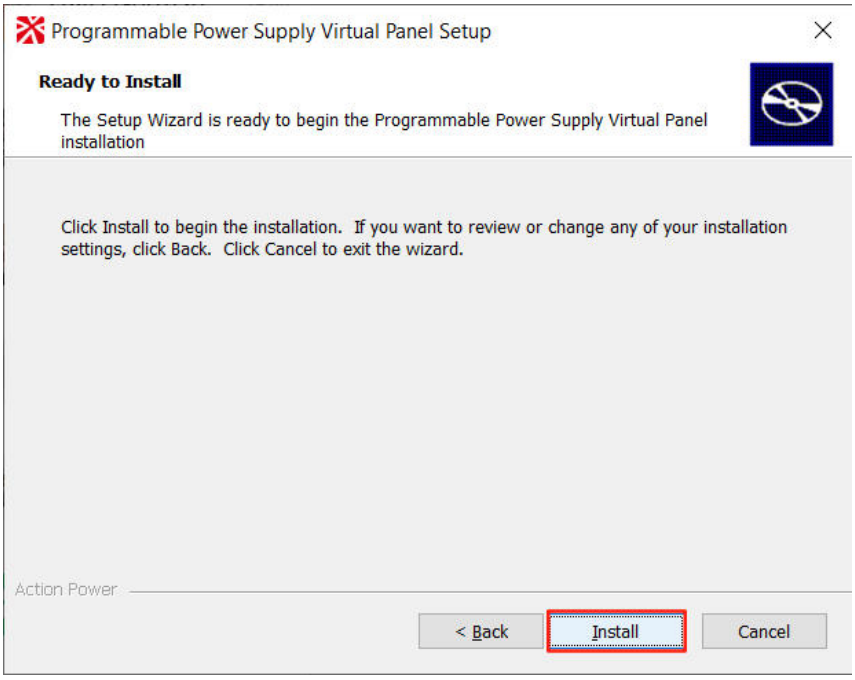


Figure 2.11

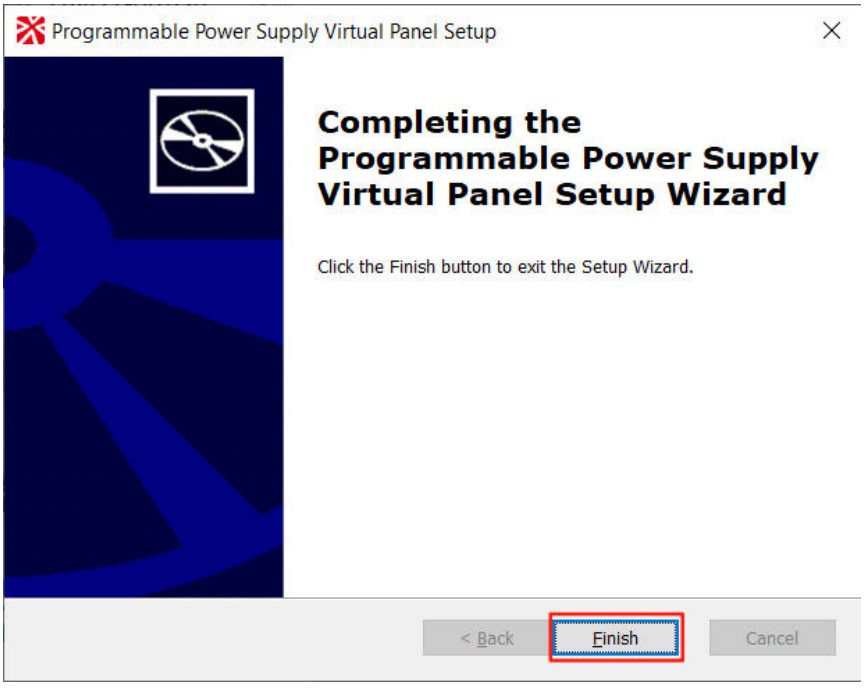


Figure 2.12

3 Software Launch and Connection

3.1 Program Startup

Double-click the "  " icon on your desktop to launch the program. Upon startup, a dialog box will appear for selecting the control mode, as shown in Figure 3.1.1. Checking the "Multi-device Control" option allows simultaneous control of multiple

devices, while selecting "Single-device Control" restricts operation to one device at a time. To permanently retain your selection and skip this prompt in future launches, check the "Do not show again" button in the lower-left corner. Subsequent program launches will bypass the control mode selection interface. Click "OK" to proceed to the software connection interface, or click "Cancel" to exit the program.

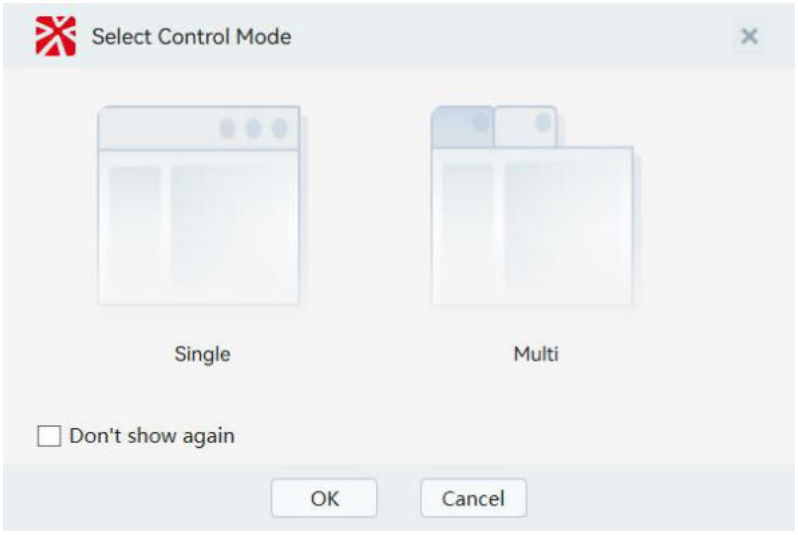


Figure 3.1.1 Control Mode Selection Screen

If you previously selected "Do Not Show Again" in the control mode selection interface but need to re-select the control mode, simply uncheck the "Hide Control Mode" option in Figure 3.1.2.

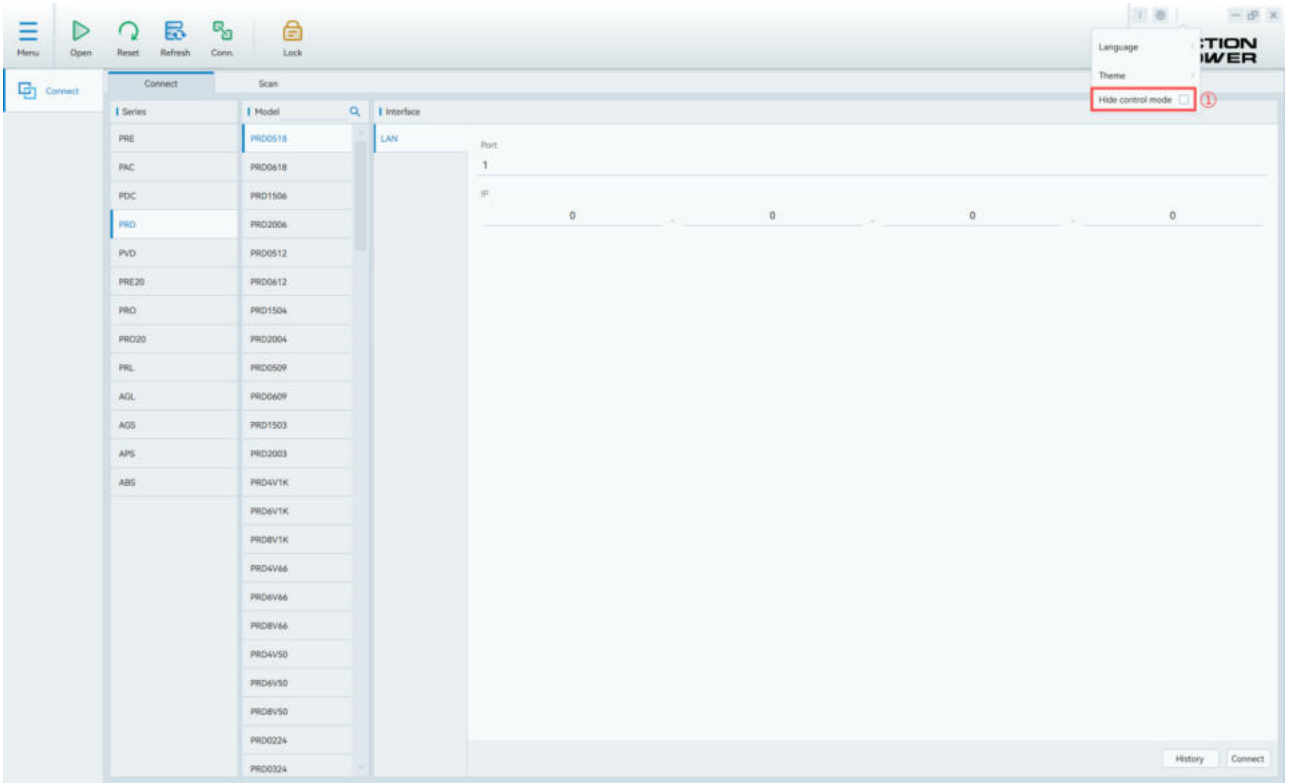


Figure 3.1.2 Hidden Control Mode Diagram

The multi-device control interface is shown in Figure 3.1.3. By default, 10 tabs are available at the top of the interface (as

indicated by 1 in the figure), representing the ability to simultaneously control 10 devices. Operations can be performed on these devices. Clicking 2 in the figure opens the device configuration interface (Figure 3.1.4), where you can delete or add devices. Device names can be customized, but no two devices can have the same name. At least one device must be retained, with a maximum of 20 devices. After configuration, click the "Confirm" button to save settings for them to take effect.

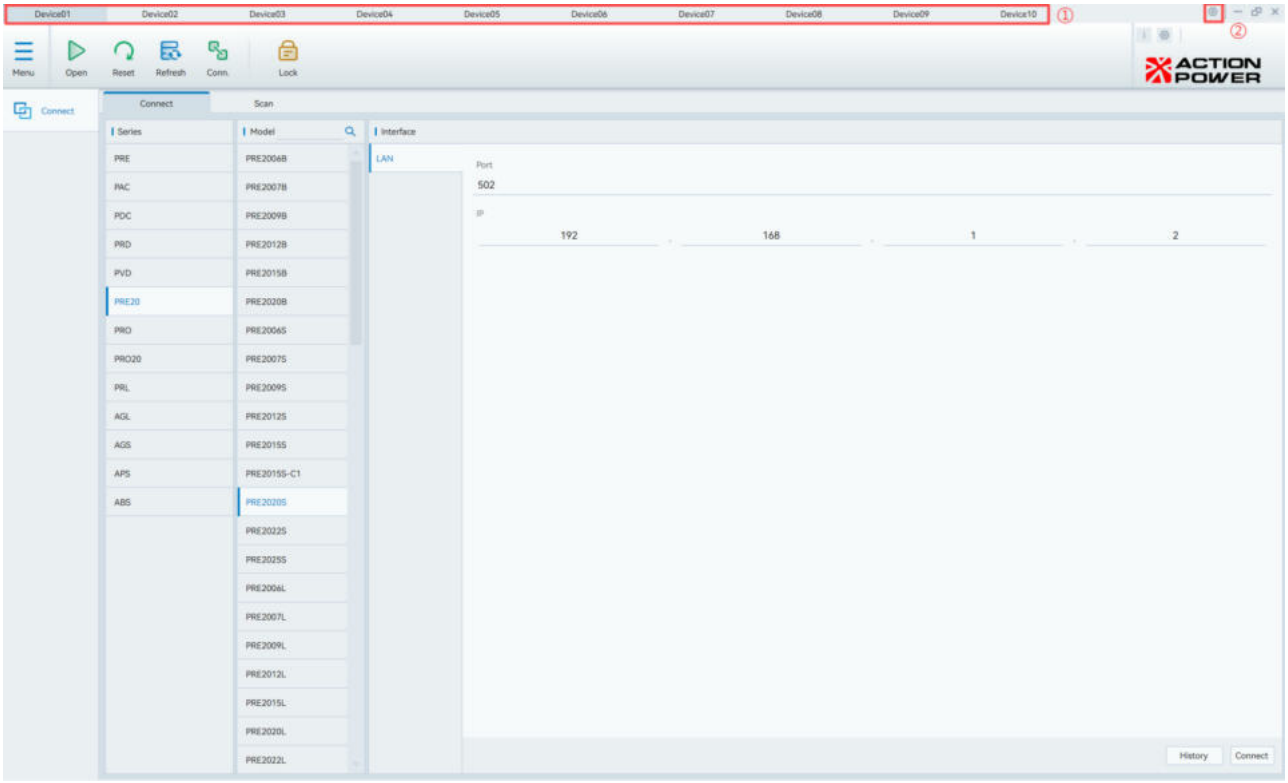


Figure 3.1.3 Multi-Device Control Interface

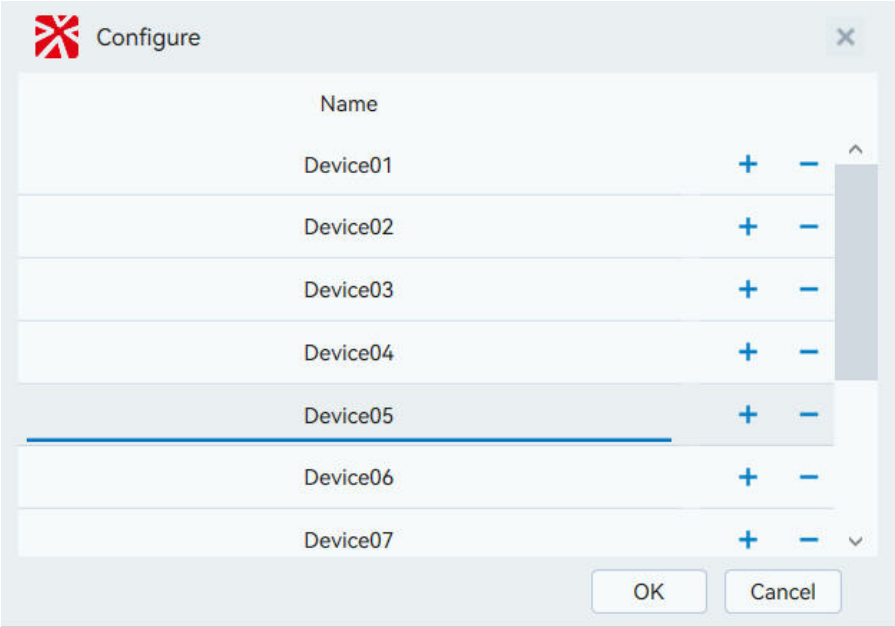


Figure 3.1.4 Multi-Device Control Configuration Interface

During multi-device control, each tab (indicated as 1 in Figure 3.1.3) can connect to one device. These devices may be of the same or different models. Each device operates independently without interfering with others. Switch between tabs to select and control the desired device.

3.2 Connecting Scanning Devices

3.2.1 Connecting Devices

After selecting the control mode, the connection interface appears as shown in Figure 3.2.1.

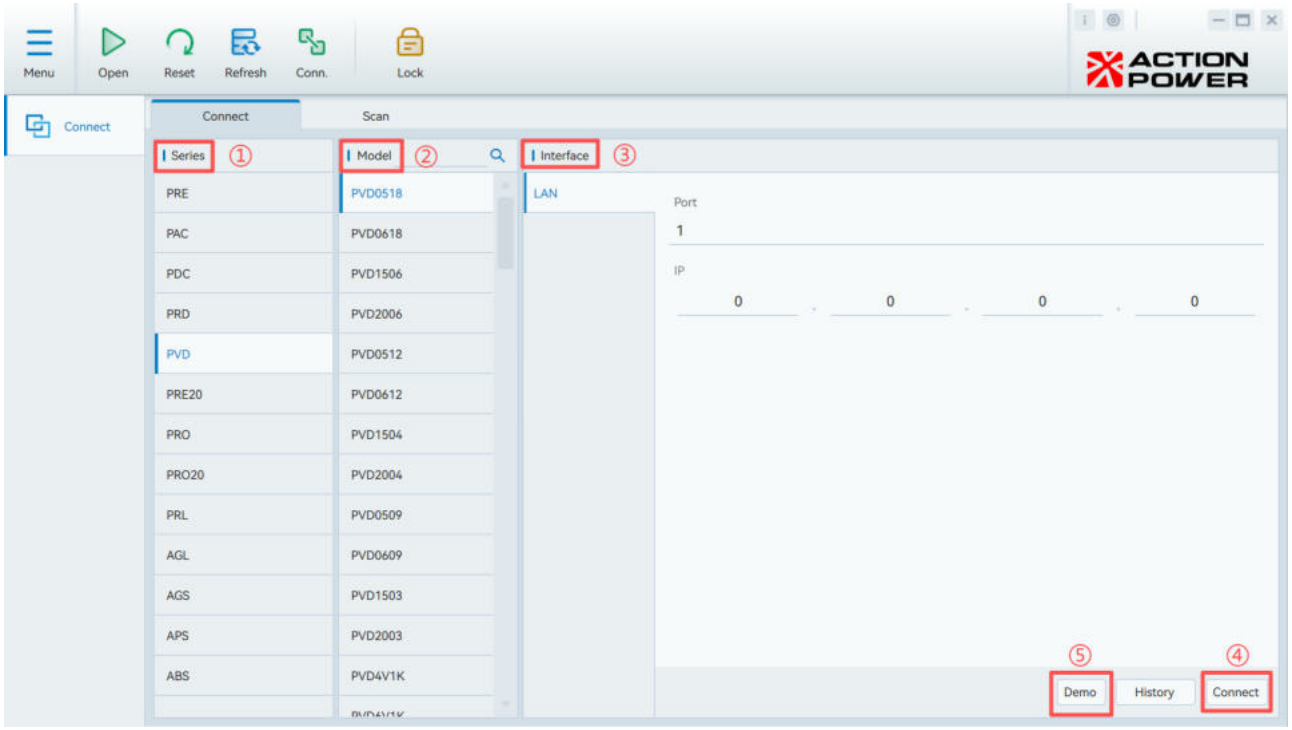


Figure 3.2.1 Device Connection Interface

*Before connecting devices, configure the target device by setting its communication interface to LAN and configuring the communication protocol to SCPI in the device's communication settings. Ensure the software and device are connected via a cable and verify they are on the same network segment.

After configuring the device, initiate the connection process: 1. Select the device series (1 in Figure 3.2.1) 2. Select the device model (2 in Figure 3.2.1) 3. Enter the port and IP address (3 in Figure 3.2.1). Ensure the IP entered here matches the IP displayed in the device's communication interface. 4. Click the Connect button to establish the connection (4 in Figure 3.2.1).

To reconnect to a previously connected device, click the "Connection History" button to view the list of previously connected devices. Select the desired device, click "OK," then click the "Connect" button to initiate the connection. See Figure 3.2.2.

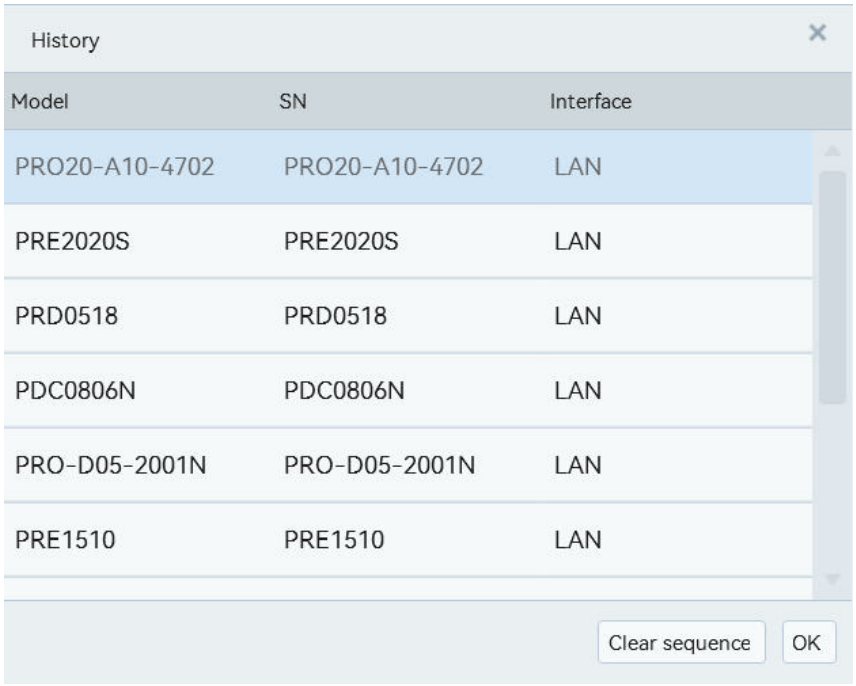


Figure 3.2.2: Connection History Interface

After successfully connecting to the device, the following interface will appear, as shown in Figure 3.2.3. Item 1 indicates a successful connection, Item 2 displays the current device's menu, and Item 3 shows the current device information.

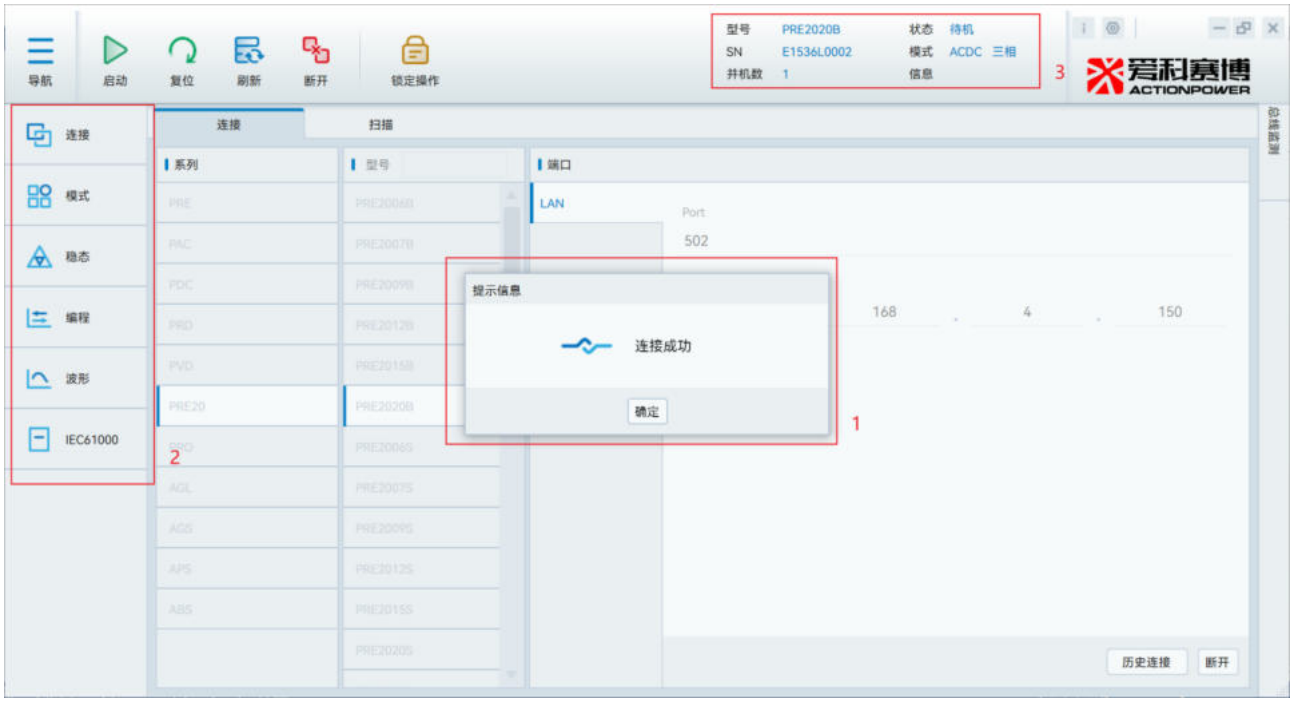


Figure 3.2.3 Connection Success Notification

Selecting an incorrect model will result in connection failure, with the prompt shown in Figure 3.2.4.

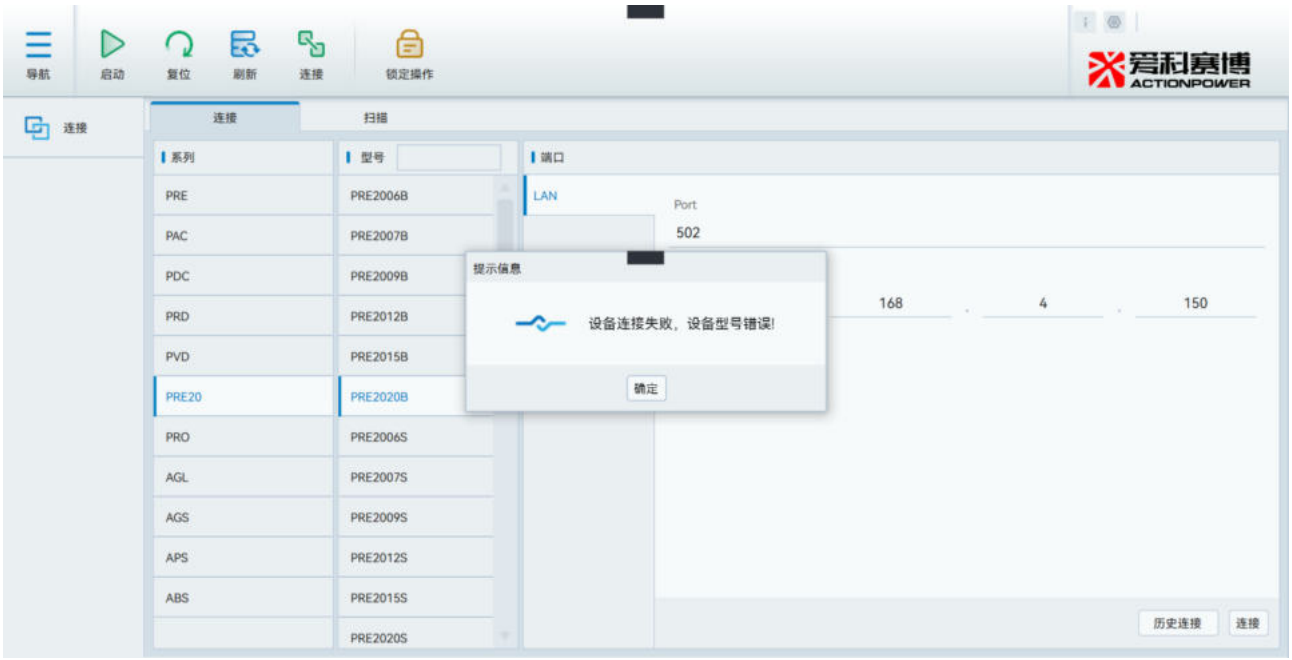


Figure 3.2.4 Connection Failure Due to Incorrect Model

When the prompt in Figure 3.2.5 appears, verify that the IP port is correctly entered, the connection cable is not disconnected, and the device and software are on the same network segment.

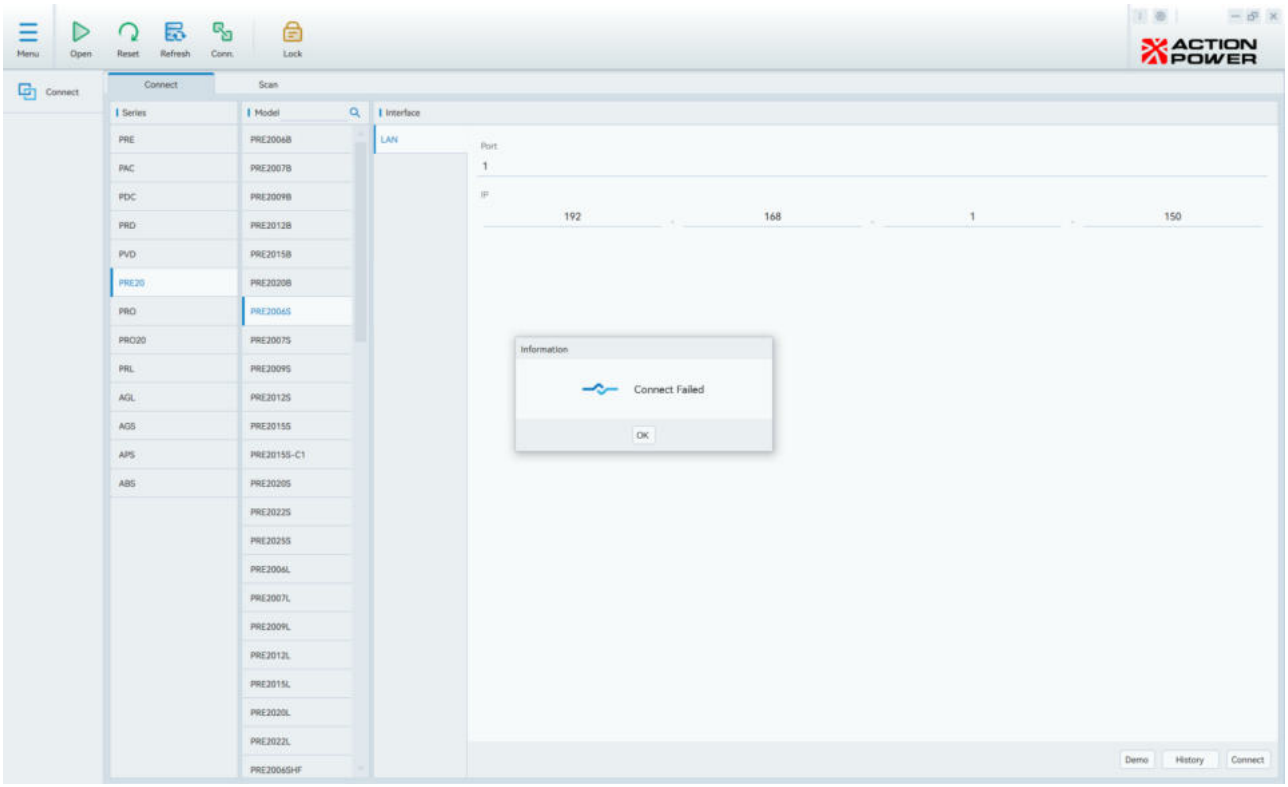


Figure 3.2.5 Connection Failed

3.2.2 Scanning Devices

This software supports scanning only for CORTEX-AC, CORTEX DC-B, and CORTEX DC-A devices.

Before scanning a device, you must configure the device's communication interface to LAN and set the communication protocol to SCPI in the device's communication settings. Ensure both this software and the device are on the same local area network.

Open the scan window, click the Scan button, select the desired device after it appears in the scan results, and click the Connect button to establish the connection. As shown in Figure 3.2.6

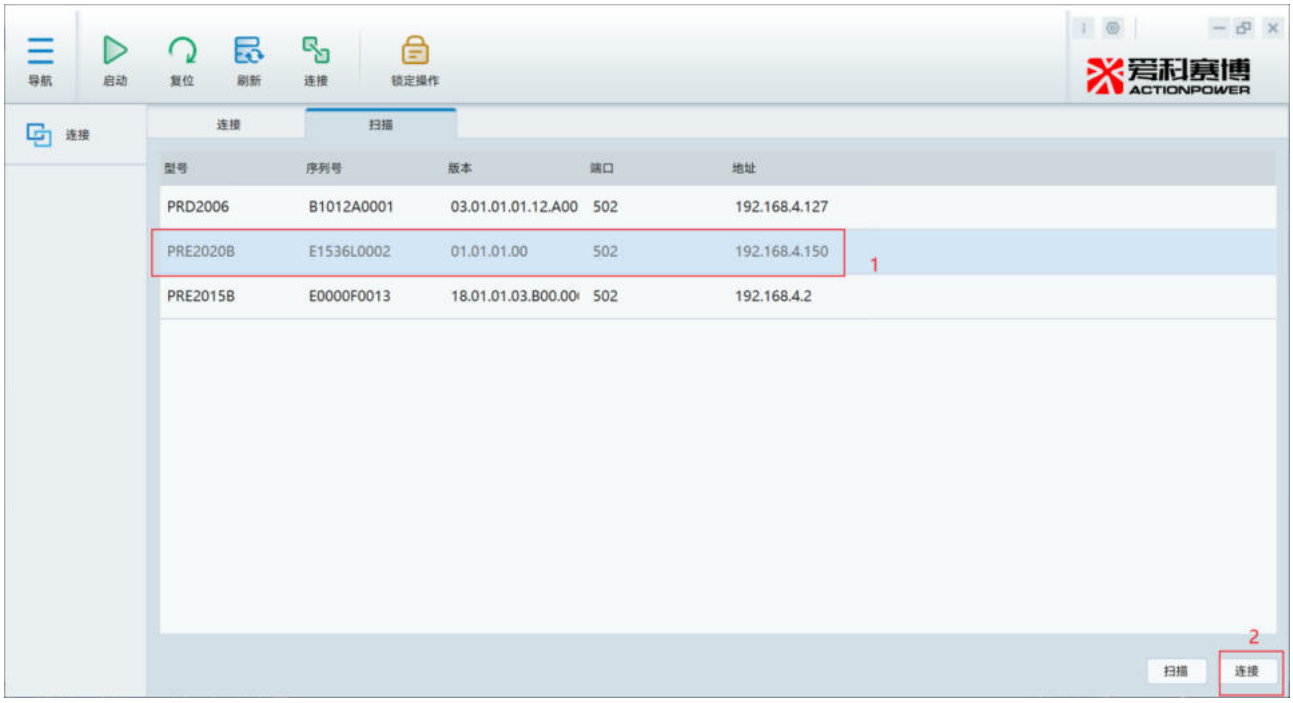


Figure 3.2.6 Device Scan Interface

The successful connection interface is shown in Figure 3.2.7.

Figure 3.2.7 Successful Device Scan Connection

3.3 Software Common Area

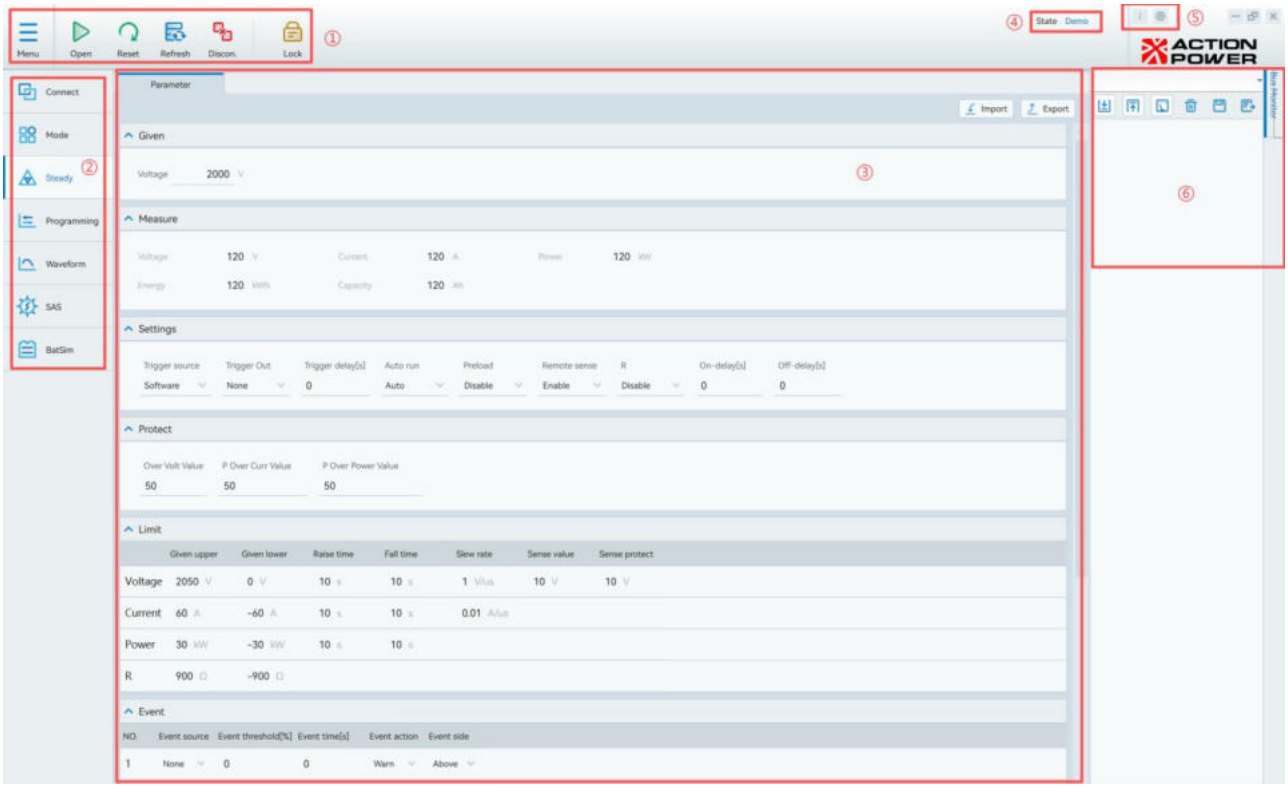


Figure 3.3 Overall Software Layout

After successfully connecting to the device, the software enters the main interface. The overall layout is shown in Figure 3.3.

Note: The current demonstration uses the CORTEX DC-B host computer. Menu contents may vary across different devices, but the framework remains consistent.

As shown in Figure 3.3, the main program interface is divided into six sections:

Area ① displays navigation buttons and device operation shortcuts: Navigation: Controls menu visibility (e.g., 2 in Figure 3.3) Start: Controls device output Reset: Resets device faults Refresh: Synchronizes device parameters Connect: Quick device connection operations Lock Operation: Locks interface operations to prevent accidental touches

Area ② displays the menu selection zone;

Connection menu enables connection and scanning;

The Mode menu currently offers Source Load, SAS, and BatSim modes;

Steady-State Menu: Sets protection limits during stable operation, configures device steady-state output parameters, defines device operation and trigger start-up settings, monitors event occurrence details, and displays real-time output measurements in the measurement area;

Programming Menu: Functions for amplitude and time programming. Single-function programming supports up to 200 sequences. Multiple modes are available for editing voltage and current waveforms. Flexible configuration parameters enable creation of required waveforms.

The Waveform Menu enables superimposing periodic waveform information onto DC output signals, such as DC low-frequency ripple simulation and fluctuation simulation. Beyond standard sine, triangle, and pulse waves, it offers up to 27 user-editable

waveforms, along with waveform preview and external storage import capabilities.

The SAS menu delivers comprehensive testing capabilities for the photovoltaic industry. Its high-precision measurement and control system enables more accurate testing of solar inverter maximum efficiency.

The BatSim menu simulates various battery pack output characteristics and charge/discharge profiles. It supports model configuration, alarm protection settings, and includes a logging function.

Area ③ displays the subpages for switching between menus;

Area ④ displays device connection status information, including status, SN, model, mode, number of parallel units, and test details. During test execution, the current test name appears in the status area.

Area ⑤ displays settings and about functions; settings allow language and theme switching, and include a hidden control mode switch;

Area ⑥ displays the bus monitoring function zone; this area can show hidden send commands, receive commands, and measurement commands while saving them, and can also send commands to the device;

4 CORTEX DC-B, CORTEX DC-A and NEXUS-DC devices

4.1 Mode Settings

4.1.1 Interface Description

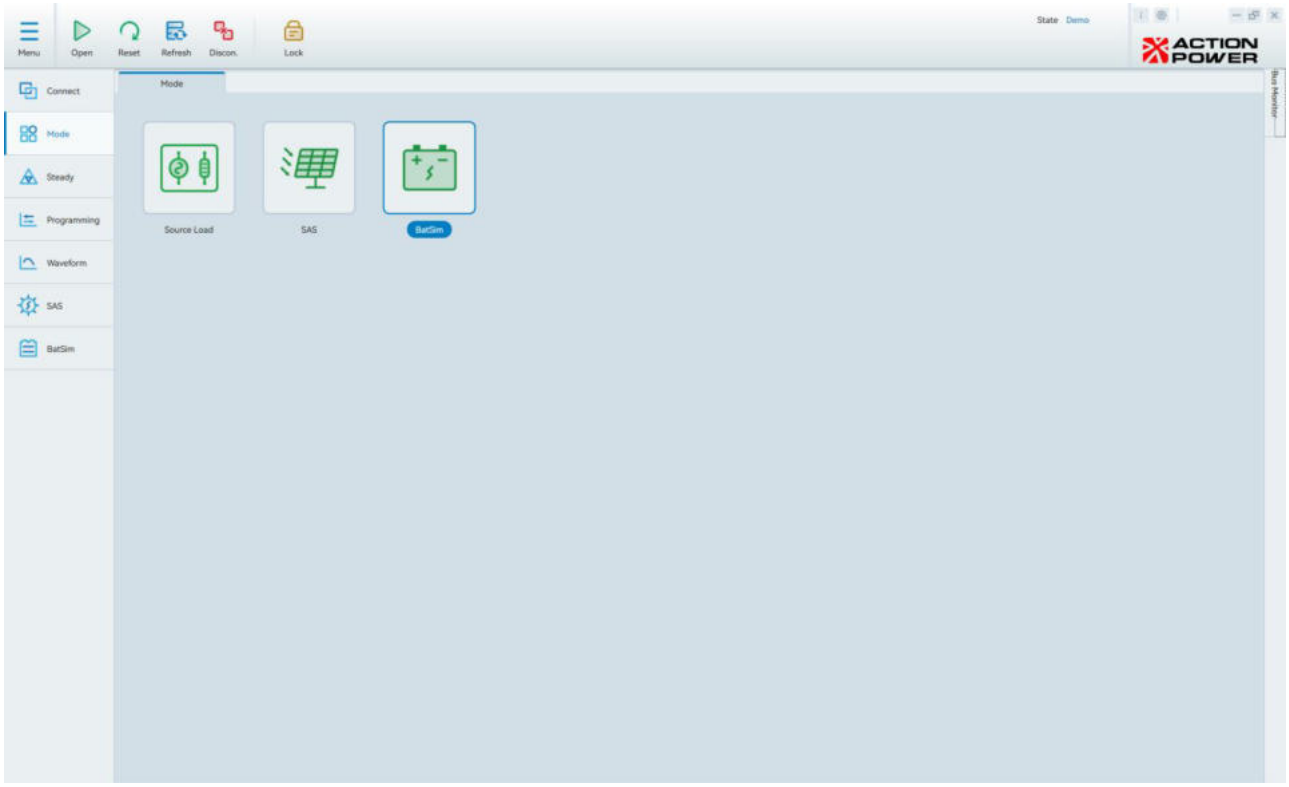


Figure 4.1.1 Mode Interface

The Mode Settings function sets the device's operational state to Source Load Mode, SAS Mode, or BatSim Mode.

[Source/Load]: The device defaults to Source/Load mode. This mode is applicable in testing industries, serving as either a test power supply or test load to achieve multi-functional operation.

Load: The device absorbs power, with positive output voltage and negative output current. Set the device to Load mode when

the user needs to absorb external power.

Source: The device outputs power, with positive output voltage and positive current. Users requiring external power output can set the device to operate in Source mode.

【SAS】: SAS mode (Solar Array Simulator function) is used in the photovoltaic industry. This mode becomes available only after installing a Magic-Box component with PV functionality.

【BatSim】: BatSim mode simulates real-world battery characteristics. Users configure custom battery parameters to emulate charging/discharging behavior, facilitating various tests.

Prerequisites: Successful connection to the device or demonstration mode; device not powered on

4.1.2 Operation Instructions

1. When switching menus, verify that the target menu matches the current mode. If the selected menu conflicts with the current mode, a prompt will appear: "Switch to the corresponding mode." Switch to the appropriate mode before proceeding. For example, in Figure 4.1.2, the current mode is Source-Load mode. Clicking the BatSim menu triggers the prompt: "Switch to BatSim mode."
2. After switching modes, the current mode can be viewed in the mode bar of the status area.
3. After the device starts, mode switching is disabled. The mode selection interface is masked, indicating the device is running. Before switching modes, stop the device first. See Figure 4.1.3.

Figure 4.1.2 Schematic Diagram of Switching Non-Current Mode Menus

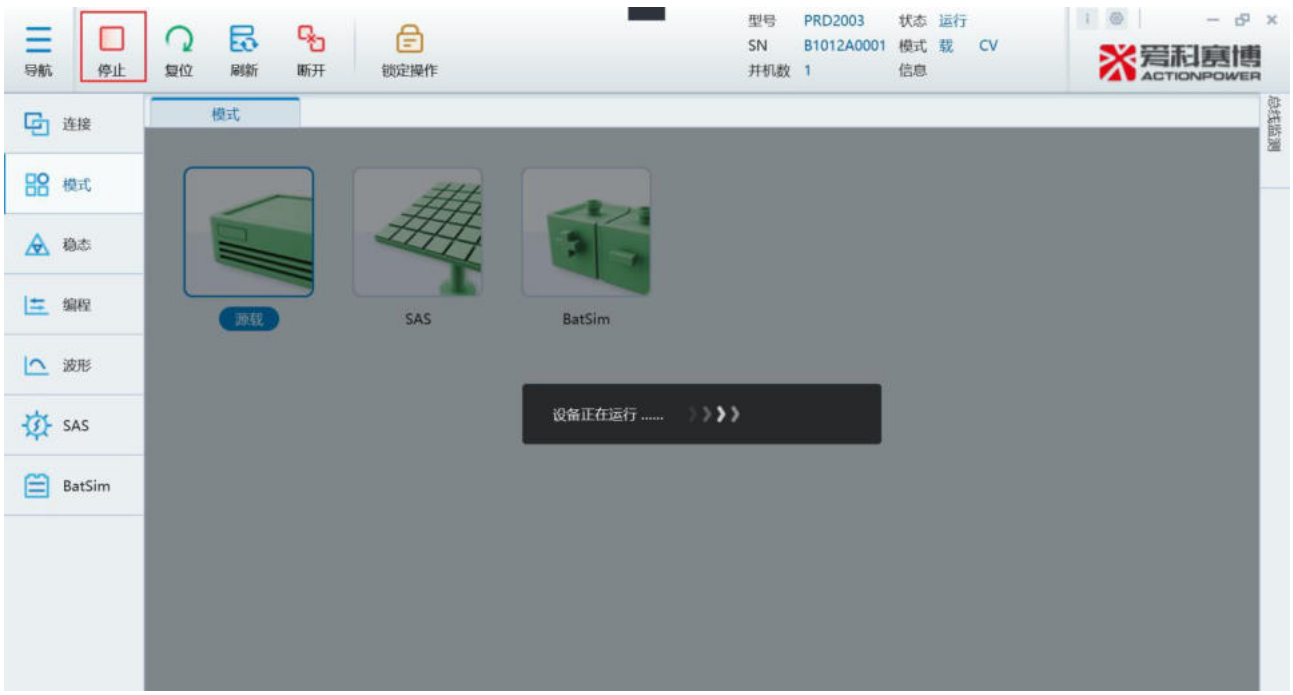
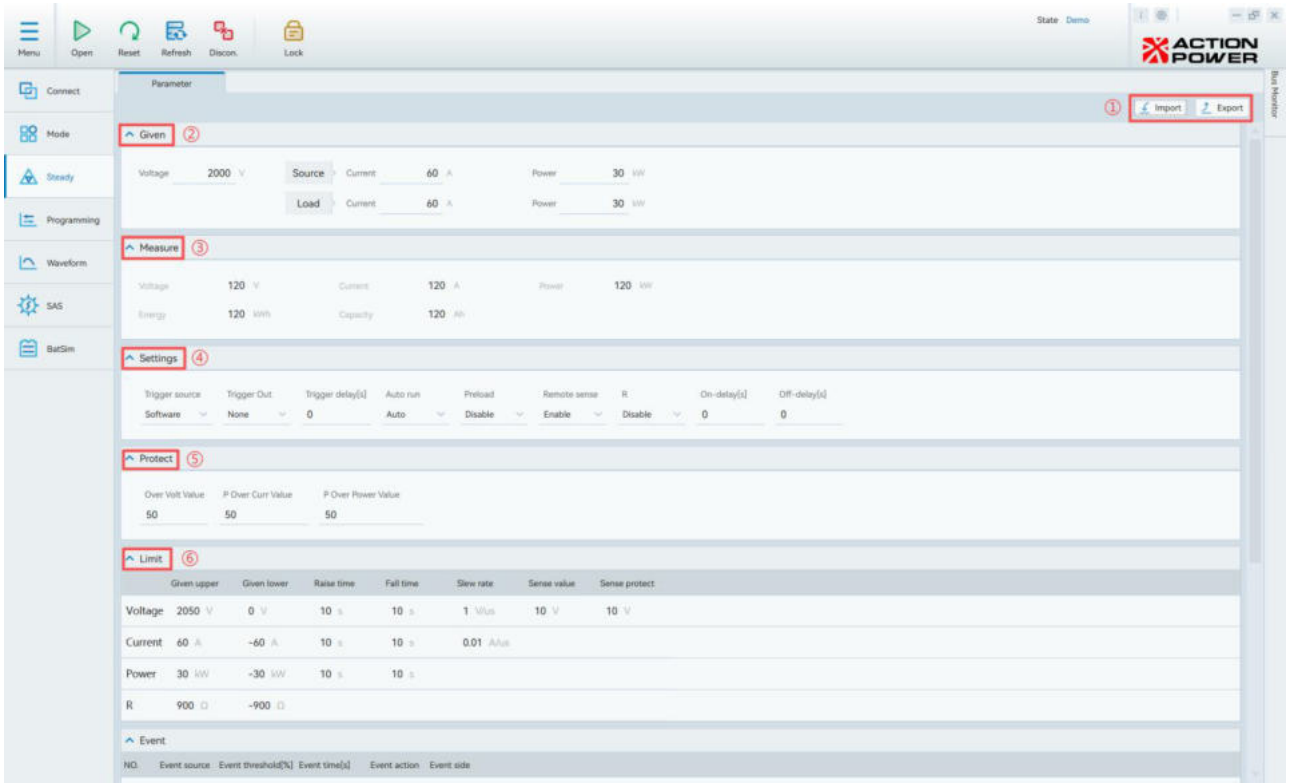


Figure 4.1.3 Schematic Diagram of Mode Switching During Device Operation

4.2 Steady-State Interface

4.2.1 Interface Description



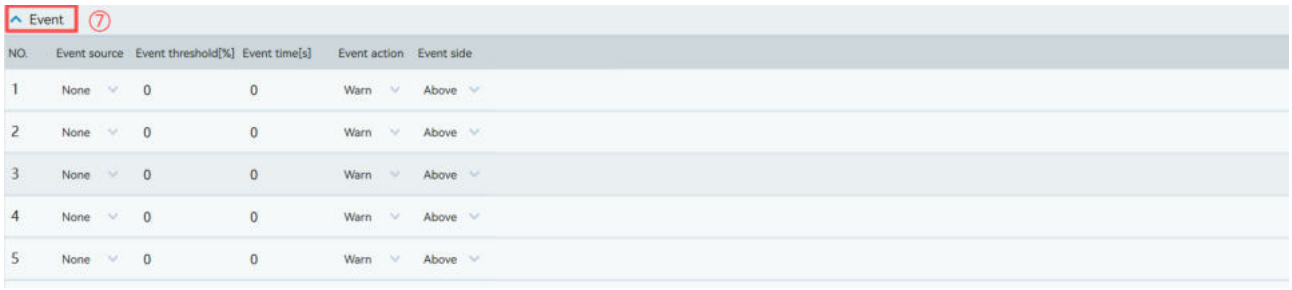


Figure 4.2.1 Steady-State Interface

Prerequisites: Successful device connection or demo mode

1. Function Area: Import/Export current steady-state parameters

2. Given Area: Configure device setpoint voltage, setpoint current, and setpoint power

3. Measurement Area: View real-time output measurements of the current device

4. Setting Area:

The display status of negative interlock enable, communication monitoring, command selection, and timeout settings in the Settings Area depends on the device version.

【Trigger Source】: Internal: Manually click "Trigger" on the device display or send a trigger command via the communication interface to initiate internal triggering. External: Send a trigger signal to the Anyport digital input interface to initiate external triggering.

【Trigger Output】: Single: Outputs a pulse indicator signal only when programming execution begins. Single Step: Emits a pulse indicator signal during each sequence execution. Single Cycle: Emits a pulse indicator signal at the start of each cycle.

【Trigger Delay】: After pressing "Trigger," execution of the programmed sequence begins after the set trigger delay elapses. Setting range: 0~999.999

【Remote Compensation】: Enable: Compensates for voltage drop across the line between the compensation output and the external load. Disable: No compensation.

【Startup Mode】: Refers to the CORTEX DC-B's power-on startup method. Manual mode: When the AC circuit breaker closes, press the Power/Reset button to start. Automatic mode: When the AC circuit breaker closes, the CORTEX DC-B powers on automatically, facilitating integration into ATE systems for one-button startup.

【Voltage Zeroing】: When enabled and the output is connected to non-energized equipment, it allows rapid discharge at a constant current after the output is turned off.

【Internal Resistance】: When enabled, a set impedance is added to the product's output terminals, causing a reduction in output voltage.

【Turn-On Delay】: When the output key is pressed while the product is not outputting, output begins after a preset delay time.

【Turn-off Delay】: When outputting, pressing the output key will halt output after a preset delay period.

【Negative Interlock Enable】: When enabled, the negative overcurrent protection threshold and time, as well as the negative overpower protection threshold and time within the protected zone, cannot be manually adjusted. They automatically adopt the negative values corresponding to the positive protection thresholds and times, with identical durations. When disabled, both can be set independently.

【Communication Monitoring】: When enabled, the device monitors whether the communication link with the device is

disconnected. If disconnected, the device output will be interrupted during operation. When disabled, monitoring is not performed, and the command selection and timeout settings are not displayed.

【Command Selection】: When communication monitoring is enabled, selecting any command causes the device to recognize any received command as indicating an active connection. If a dedicated command is selected, the device only recognizes the connection as active upon receiving that specific command. Failure to receive the dedicated command indicates a disconnected communication link.

【Timeout】: When communication monitoring is enabled, if no command is received within the specified timeout period (determined by the command type based on the command selection setting), the communication connection is considered disconnected.

5. Protection Zone: Set protection thresholds and durations for voltage, current, and power. These thresholds and durations ensure that when the test power supply continuously outputs voltage, current, or power exceeding the protection thresholds for the specified duration, it disconnects from the device under test (DUT) to protect it and triggers a protection alert. (Display of some protection threshold and duration settings depends on the device version.)

6. Limit Zone: Set upper and lower limits for voltage, current, power, and internal resistance. These limits restrict the test power supply's output range.

7. Events: Monitors specific conditions occurring during operation, enabling users to observe and understand the product's working status.

【Event Source】: Select which parameter triggers the action—voltage, current, power, or temperature.

【Event Threshold】: Percentage of the rated value for the selected trigger source

【Event Time】: Time from exceeding the trigger threshold until the event is triggered.

【Event Action】: Log: When an event occurs, select Log if the user needs to record the event in the log. The product continues normal operation during logging. Alarm: When an event occurs, select Alarm if the user needs an alert and output disconnection. After an alarm, the product disconnects the output terminal, and "Event X" flashes in the status display area. Warning: When an event occurs and the user requires a warning prompt, select "Warning" as the action mode. After a warning, the product operates normally, and "Event X" flashes in the status display area.

【Event Side】: Trigger events when voltage/current/power/temperature exceeds the trigger threshold upward. To trigger events when values exceed the threshold upward, set the threshold direction to "Upward." Trigger event when voltage/current/power/temperature falls below the trigger threshold. If the user requires triggering when values drop below the threshold, set the threshold direction to "Down."

4.2.2 Operation Instructions

- The measurement area cannot be modified and is only for displaying the current output measurement value.
- Click the Internal Resistance Enable dropdown in the Settings panel and select Enable. The Internal Resistance input field will appear in both the Setpoint and Measurement panels. Selecting Disable will remove these fields. Default setting is Disabled.
- When the Negative Direction Interlock Enable switch in the Settings panel is enabled, the negative overcurrent and overpower protection thresholds and time settings in the Protection Zone cannot be manually adjusted. The thresholds adopt the negative values corresponding to the positive direction, while the time settings remain consistent with the positive direction.
- When Communication Monitoring Disabled is selected in the Settings panel, Command Selection and Timeout Settings will be hidden.
- Configuration of each zone has no specific sequence.
- Clicking the Import button opens a file selection dialog. Select the desired file (.meas), then click "Open" to import the

steady-state parameter information into the steady-state interface. Clicking Cancel returns to the previous screen.

- Clicking the Export button opens the export dialog. Modify the filename in the bottom input field, then click Save to export the steady-state parameter information to a file. Clicking Cancel cancels the export.
- Example: Event configuration as shown in Figure 4.2.2, trigger schematic as shown in Figure 4.2.3, rated voltage 2000V. In the figure, Event 1's trigger time is less than 1s, so it cannot trigger the event; Event 2 meets the trigger requirements.

Event

NO.	Event source	Event threshold[%]	Event time[s]	Event action	Event side
1	Voltage	25	1	Warn	Above

Figure 4.2.2 Event Configuration Diagram

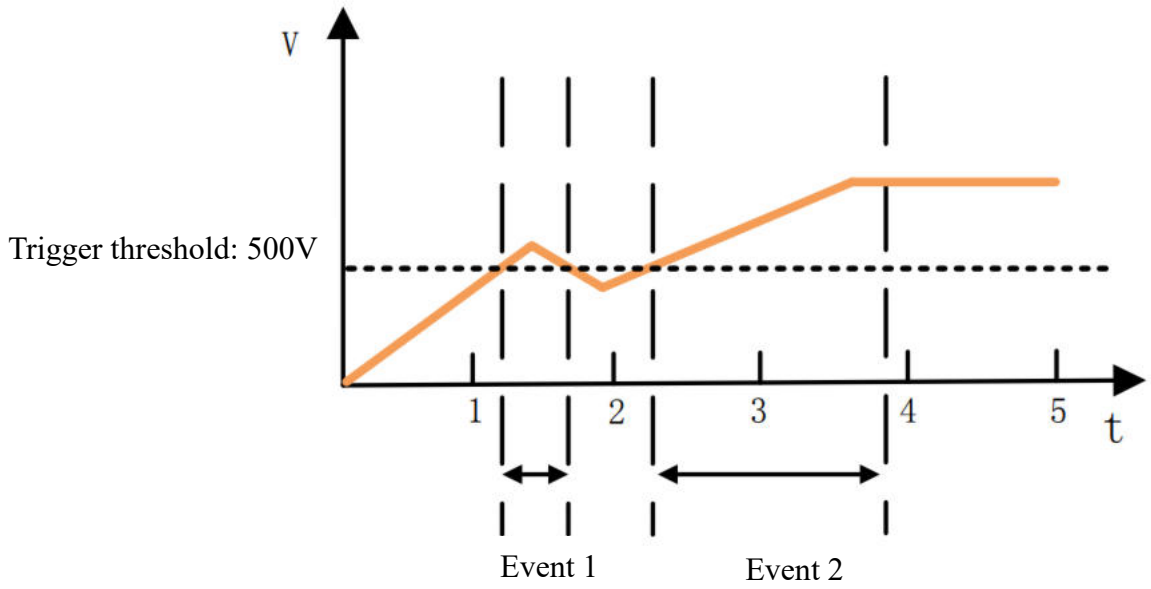
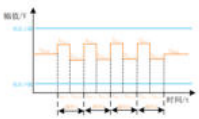
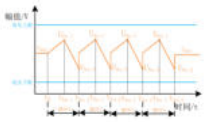


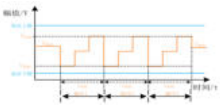
Figure 4.2.3 Event Triggering Diagram

4.3 Programming Function

List programming involves programming a set of relationship curves between time and amplitude (voltage, current, power, resistance). Within each time interval, the amplitude remains constant, enabling simulation of scenarios involving abrupt changes in (voltage, current, power, resistance). Waveform as shown in Figure 

Wave programming involves programming a set of curves describing the relationship between time points and amplitude points (time, amplitude). The key difference between Wave and List programming is that in List programming, the duration of each sequence represents the duration of the current (voltage, current, power, resistance) state. In Wave programming, the duration of each sequence includes the time required for the transition from the previous sequence's (voltage, current, power, resistance) state to the

current sequence's (voltage, current, power, resistance) state. Waveform as shown in the figure 

Step programming describes the function of incrementing/decrementing the initial output value by a fixed step amount until reaching the final value. This feature is suitable for precise over/undervoltage and overcurrent protection threshold measurements, enabling users to quickly locate critical protection values. Waveform as shown in the figure 

Advanced programming mode allows selection of voltage and current only, with options for different waveforms, sequence combinations, and inner loops. Use Advanced programming to simulate complex operating conditions.

4.3.1 List Programming Interface

4.3.1.1 Interface Description

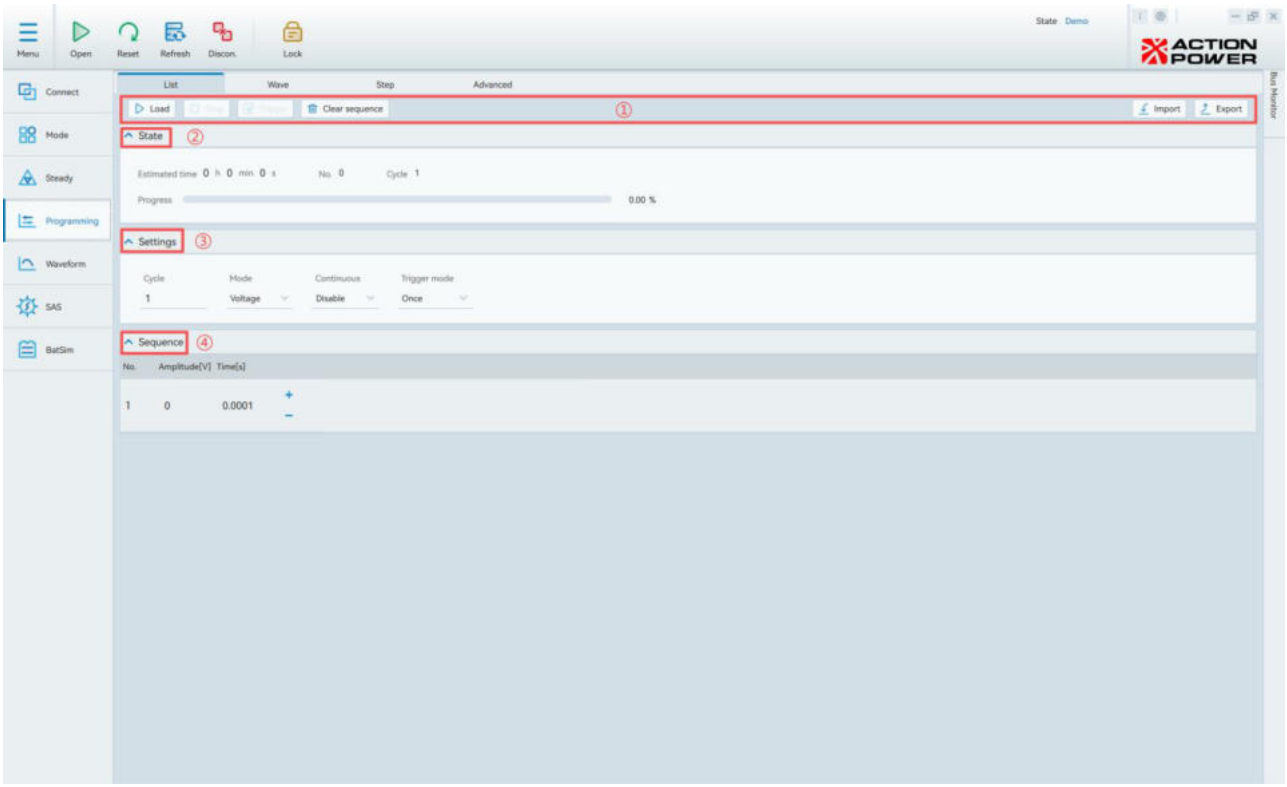


Figure 4.3.1 List Programming Interface

The List Programming function creates a set of curves describing the relationship between voltage/current and amplitude over a time period. Up to 200 sequences of voltage and current data can be programmed.

Prerequisites: 1. Select Source Load Mode; 2. Successful device connection or Demo Mode

1. Function Area: The Load button sends sequence and setting information to the device; the End button concludes the current

experiment; the Trigger button starts the current experiment; the Clear Sequence button clears all sequence entries except one.

2. State Area: Displays current experiment status information.

【Estimated Time】: Total experiment duration calculated based on set loop count and sequence;

[No.]: The sequence number currently being executed;

[Cycle]: Current loop number being executed;

[Progress]: Current progress of the experiment.

3. Settings Area:

【Cycle Count】: Sets the number of times the List programming sequence will be cycled. A cycle count of 0 indicates infinite looping. Valid range: 0~9999999;

【Mode Selection】: Selectable options include Voltage, Current, Power, Resistance;

【Continuous Triggering】: When enabled, the same programmed data can be triggered again without clicking "Load"; simply click "Trigger" directly.

【Trigger Mode】: Auto: Executes sequences sequentially as programmed. Single: Executes only one sequence per trigger.

4. Sequence Area: Each sequence sets corresponding amplitude values based on the selected mode in the settings.

【Time】: Indicates how long this amplitude persists.

4.3.1.2 Operation Instructions

- Configure loop count, mode selection, continuous trigger settings, and trigger mode in the Settings Area.
- Configure sequences in the Sequence Area; up to 200 sequences can be added.
- Click the Start button to activate the device.
- Click the Load button to load experimental data. After loading, other programming interfaces will display the experiment in progress.
- Click the Trigger button to start the experiment. The status bar in the Status Area displays the current experiment type: List
- After the experiment completes, click the End button to conclude the experiment.
- Clicking the Import button opens a file selection dialog. Select the file to import (.List), then click "Open" to import it. Clicking Cancel returns to the previous screen.
- Clicking the Export button opens the export dialog. Modify the filename in the bottom input field. Click Save to export the file; clicking Cancel cancels the export.
- Example: Select "Voltage" as the mode, set the loop count to 4, and add two sequences. The first sequence has a voltage amplitude of 800 and a duration of 5 seconds. The second sequence has a voltage amplitude of 600 and a duration of 7 seconds. The List programming sequence configuration is shown in Figure 4.3.2, and the corresponding waveform diagram is shown in Figure 4.3.3. In the waveform diagram, Uno.1 represents the first sequence, and Uno.2 represents the second sequence. After 4 cycles, the system stabilizes.

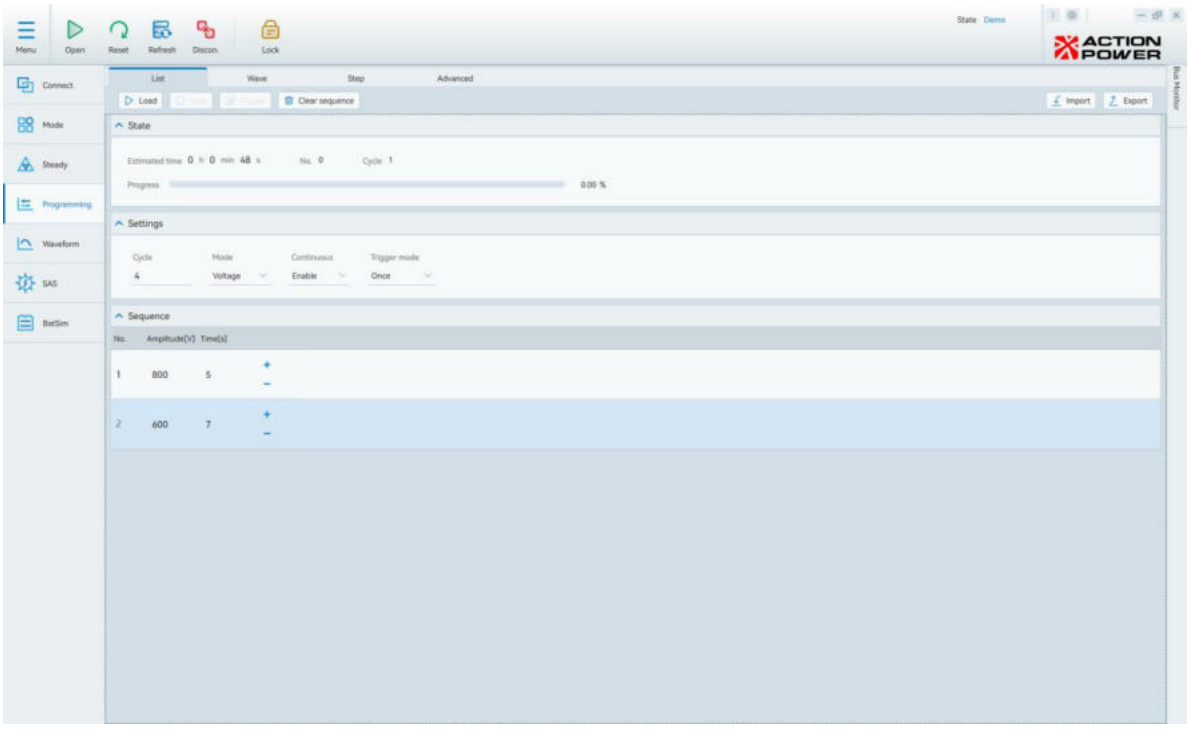


Figure 4.3.2 Example Diagram of List Programming Sequence Configuration

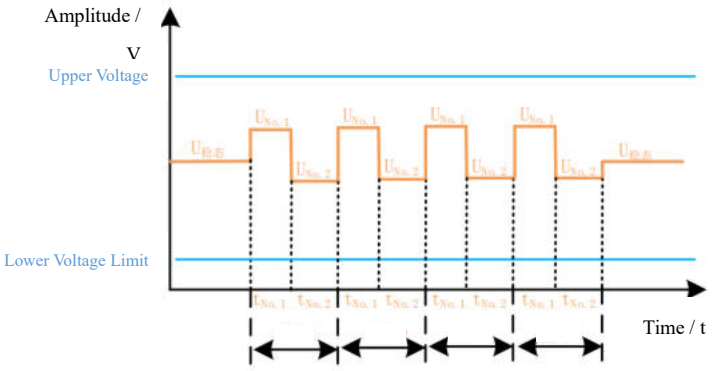


Figure 4.3.3 List Waveform Diagram

4.3.2 Wave Programming Interface

The Wave function programs a set of curves describing the relationship between time points and amplitude points (time, amplitude). For example, the voltage amplitude must reach 1000V after 3 seconds and 200V after 5 seconds. By setting a series of state points at specific times, the system automatically generates connecting lines between these points to program the waveform.

All operations in the Wave interface follow the same processing methods as the List interface. The key difference between Wave and List is that in List, the duration of each sequence represents the duration of the current voltage. In Wave, the duration of each sequence includes the time required for the voltage to transition from the previous sequence to the current voltage.

Example: Select voltage mode, set the loop count to 4, and add two sequences. The first sequence has a voltage amplitude of 800V and a duration of 6 seconds. The second sequence has a voltage amplitude of 550V and a duration of 5 seconds. The Wave programming sequence configuration is shown in Figure 4.3.4, and the corresponding waveform is shown in Figure 4.3.5. In the waveform diagram, Uno.1 represents the first sequence, and Uno.2 represents the second sequence. After 4 cycles, the system

stabilizes at a steady state.

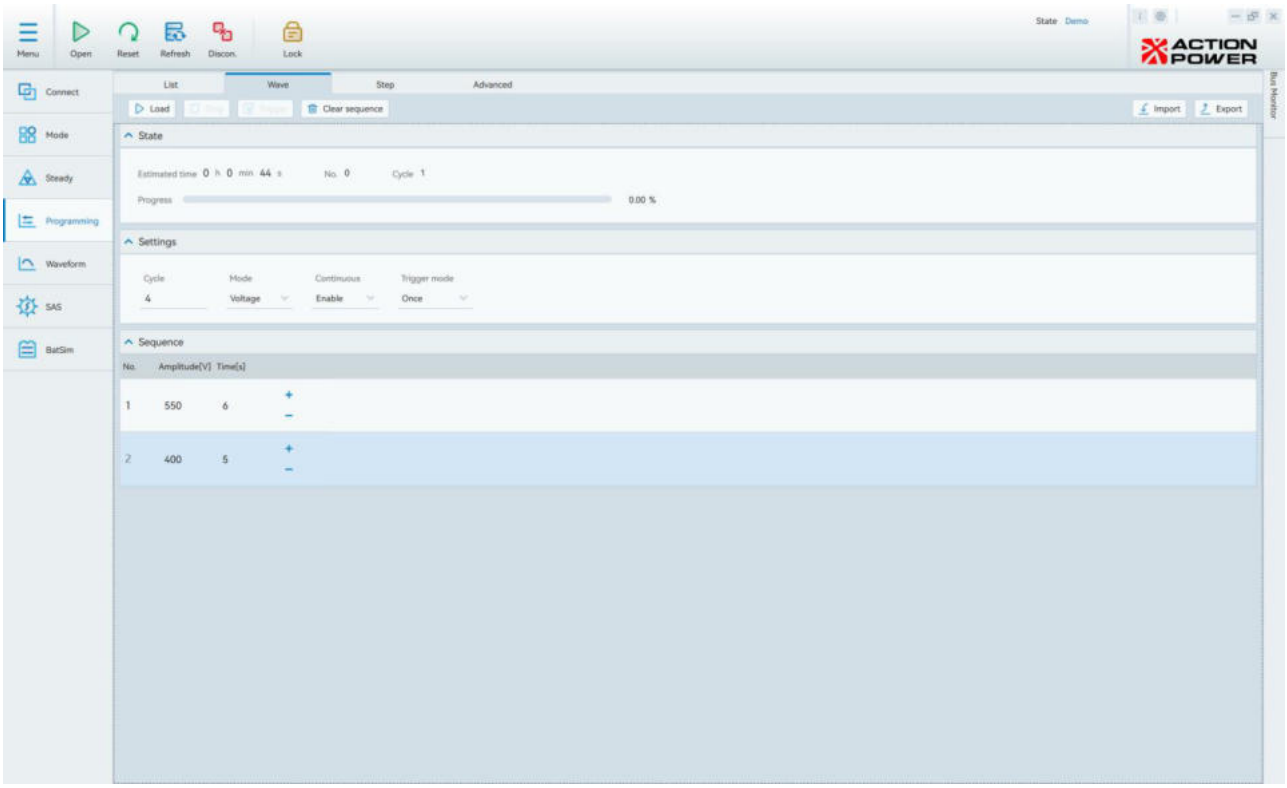


Figure 4.3.4 Example Diagram of Wave Program Sequence Configuration

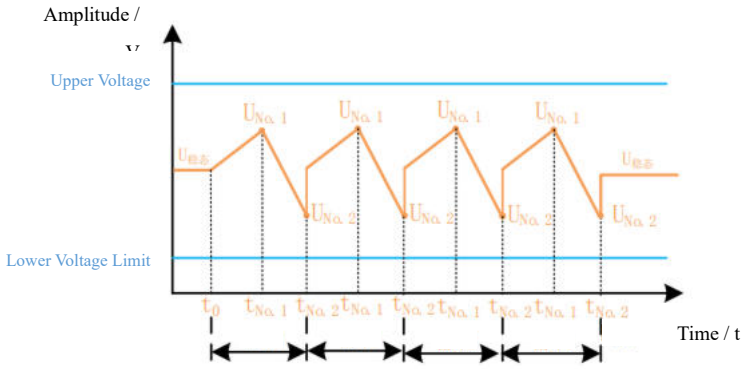


Figure 4.3.5 Wave Waveform Diagram

4.3.3 Step Programming Interface

4.3.3.1 Interface Description

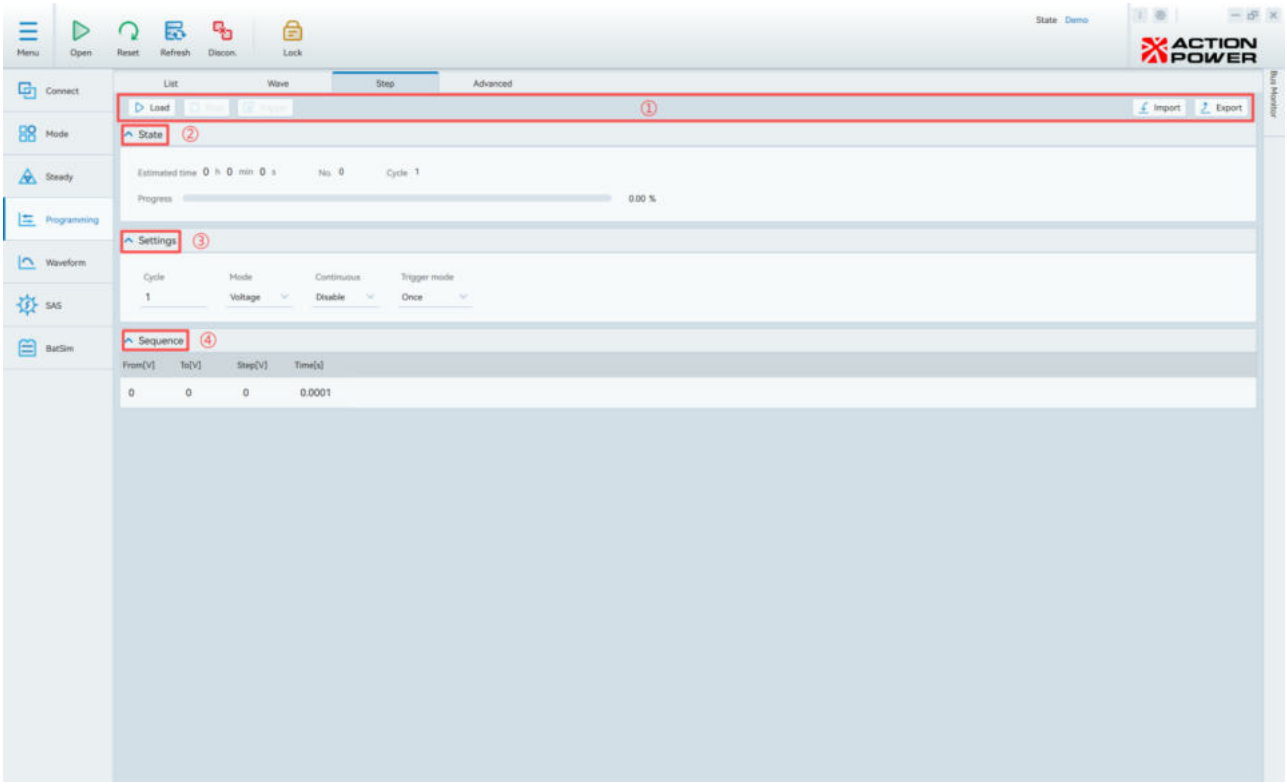


Figure 4.3.6 Step Programming Interface

Step describes the function of incrementing/decrementing the initial output value by a fixed step amount to reach the final value. This feature is suitable for precise measurement of overvoltage/undervoltage and overcurrent protection thresholds, enabling users to quickly locate critical protection values.

Prerequisites: 1. Select Source Load Mode; 2. Successful device connection or Demo Mode

1. Function Area: The Load button transmits sequence and configuration data to the device; the End button concludes the current experiment; the Trigger button initiates the experiment.

2. Status Area: Displays current experiment status information;

【Time】: Total experiment duration calculated based on set cycle count and sequence;

[No.]: Current sequence number being executed;

[Cycle]: Current cycle number being executed;

[Progress]: Current progress of the experiment.

3. Settings Area:

【Cycle Count】: Sets the number of cycles for the Step programming sequence. A cycle count of 0 indicates infinite looping. Valid range: 0~9999999;

【Mode Selection】: Selectable options include voltage, current, power, or resistance;

【Continuous Trigger】: When enabled, the same programmed data can be triggered again without clicking "Load"; simply click "Trigger" directly.

【Trigger Mode】: Auto: Executes sequences sequentially as programmed. Single: Executes only one sequence per trigger.

4. Sequence Area:

【Voltage Change Magnitude】: Refers to the magnitude of voltage change within a specified unit time. Whether it represents voltage or current is determined by the mode selection in the settings.

【Time】: Single-step hold duration.

4.3.3.2 Operation Instructions

- Configure cycle count, mode selection, continuous trigger settings, and trigger mode in the Settings Area.
- Configure the sequence in the Sequence Area.
- Click the Start button to activate the device.
- Click the Load button to load experimental data. After loading, other programming interfaces will display the experiment in progress.
- Click the Trigger button to start the experiment. The status bar in the Status Area displays the current experiment type: Step
- After the experiment completes, click the End button to conclude the experiment.
- Clicking the Import button opens a file selection dialog. Select the desired file (.step), then click "Open" to import it. Clicking Cancel returns to the previous screen.
- Clicking the Export button opens the export dialog. Modify the filename in the bottom input field. Click Save to export the file. Click Cancel to cancel the export.
- Example: Select voltage mode, set the number of cycles to 3, set the start voltage to 300, set the end voltage to 600, set the voltage variation amplitude to 150, and set the single-step hold time to 2 seconds. The Step programming sequence configuration diagram is shown in Figure 4.3.7, and the corresponding waveform diagram is shown in Figure 4.3.8. After 3 cycles, it stabilizes at a steady state.

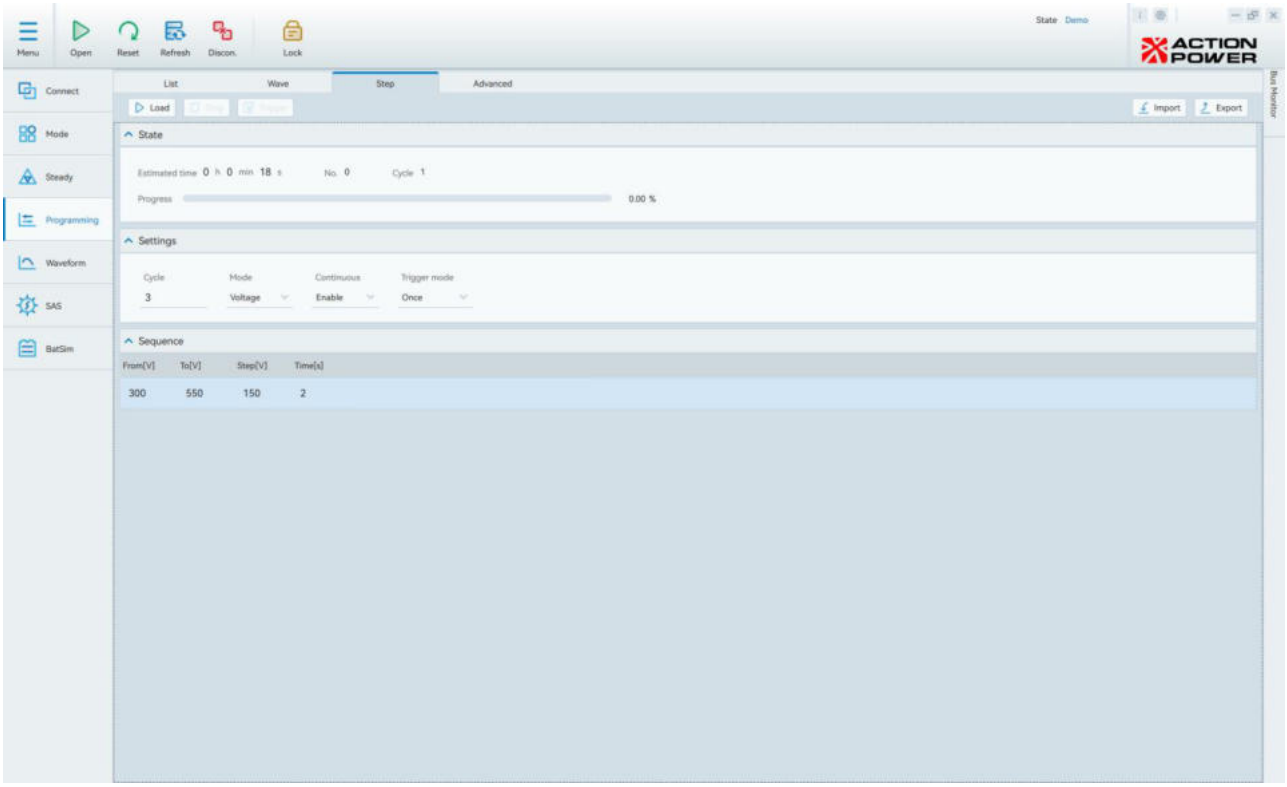


Figure 4.3.7 Step Programming Sequence Configuration Example Diagram

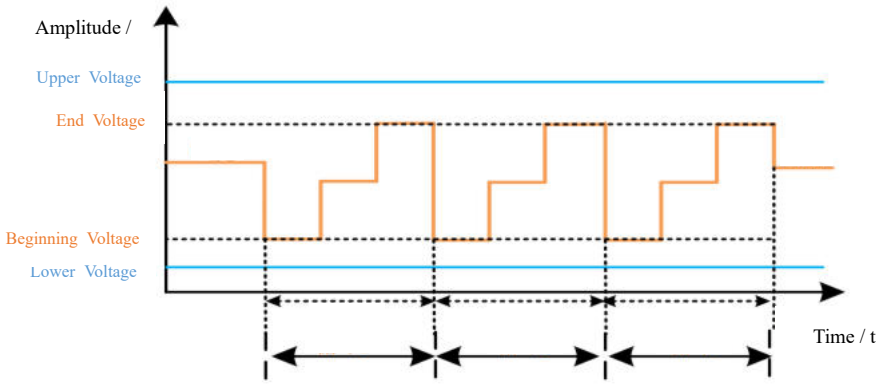


Figure 4.3.8 Step Waveform Diagram

4.3.4 Advanced Programming Interface

4.3.4.1 Interface Description

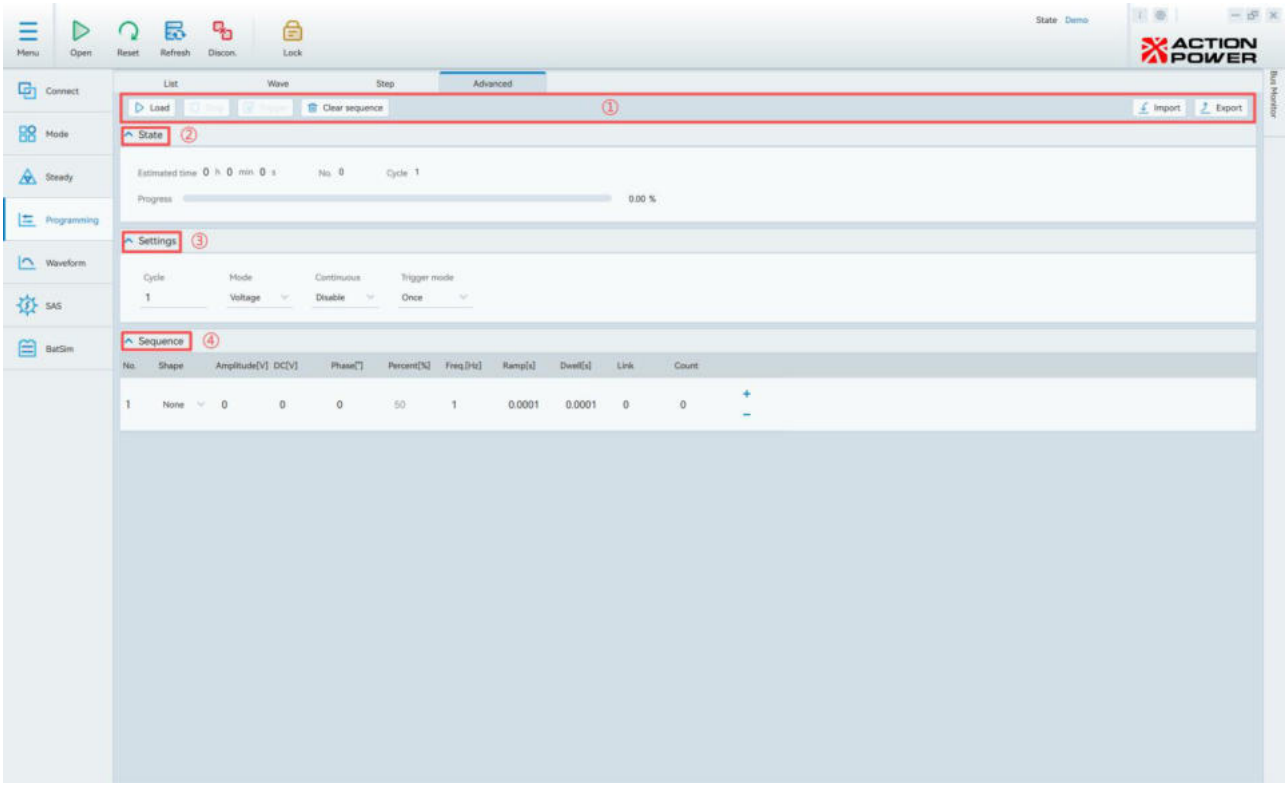


Figure 4.3.9 Advanced Programming Interface

The Advanced feature provides CORTEX DC-B's advanced programming capabilities, enabling the editing of multiple waveforms to simulate complex operating conditions. Up to 100 sequence programs can be added.

Prerequisites: 1. Select Source Load Mode; 2. Successful device connection or Demo Mode

1. Function Area: The Load button sends sequence and configuration data to the device; the End button concludes the current experiment; the Trigger button starts the experiment; the Clear Sequence button removes all but one entry from the sequence.

2. Status Area: Displays current experiment status information.

【Time】: Total experiment duration calculated based on set loop count and sequence length;

[No.]: The sequence number currently being executed;

[Cycle]: Current loop number being executed;

[Progress]: Current progress of the experiment.

3. Settings Area:

【Cycle】: Sets the number of output cycles for the Advanced programming sequence. A cycle count of 0 indicates infinite looping. Valid range: 0~9999999;

【Mode】: Select voltage or current;

【Continuous】: When enabled, the same programmed data can be triggered again without clicking "Load"; simply click

"Trigger" directly.

【Trigger Mode】: Auto: Executes sequences sequentially as programmed. Single: Executes only one sequence per trigger.

4. Sequence Area:

【Waveform】: Select the desired output waveform from sine wave, triangle wave, pulse wave, or Shape04 to Shape30.

【Amplitude】: Sets the amplitude of the expected output waveform. Sinusoidal wave uses half-peak value; other waveforms use peak-to-peak value. Ensure the amplitude is always less than the offset value to prevent waveform distortion.

【Offset】: DC component value of the expected output waveform

【Phase】: Phase of the expected output waveform

【Frequency】: The frequency of the expected output waveform.

【Percentage】: Parameter specific to pulse and triangle waves only;

【Transition Time】: The time required for the state to transition from the previous sequence No. to the current sequence No.

【Hold Time】: Duration of the current sequence No. state;

【Sequence Combination】: Combines the current sequence No. with the preceding X sequences into a single combination;

【Repetition Count】: Number of times the sequence combination is repeated;

4.3.4.2 Operation Instructions

- In the settings area, configure the number of cycles, select the mode, set continuous triggering, and configure the trigger mode
- Configure sequences in the Sequence Area; up to 100 sequences can be added
- Click the Start button to activate the device
- Click the Load button to load experimental data. After loading, other programming interfaces will display the experiment in progress
- Click the Trigger button to start the experiment. The status bar in the Status Area displays the current experiment type: Advanced
- After the experiment completes, click the End button to conclude the experiment.
- Clicking the Import button opens a file selection dialog. Select the file to import (.adva), then click "Open" to import. Clicking Cancel returns to the previous screen.
- Clicking the Export button opens the Export File dialog. Modify the filename in the bottom input field. Click Save to export the file; clicking Cancel cancels the export.
- Example: Advanced allows configuring sequence combinations and repetition counts. The Advanced sequence configuration diagram is shown in Figure 4.3.10. In No.3, set the sequence combination to 1 and the repetition count to 2. After waveform triggering, it will rapidly transition from steady state to No.1 and begin executing the Advanced programming. Upon reaching No.3, since the sequence combination is set to 1, this sequence is combined with the previous sequence (No.1). With the repetition count set to 2, the combination repeats twice. The waveform is shown in Figure 4.3.11.

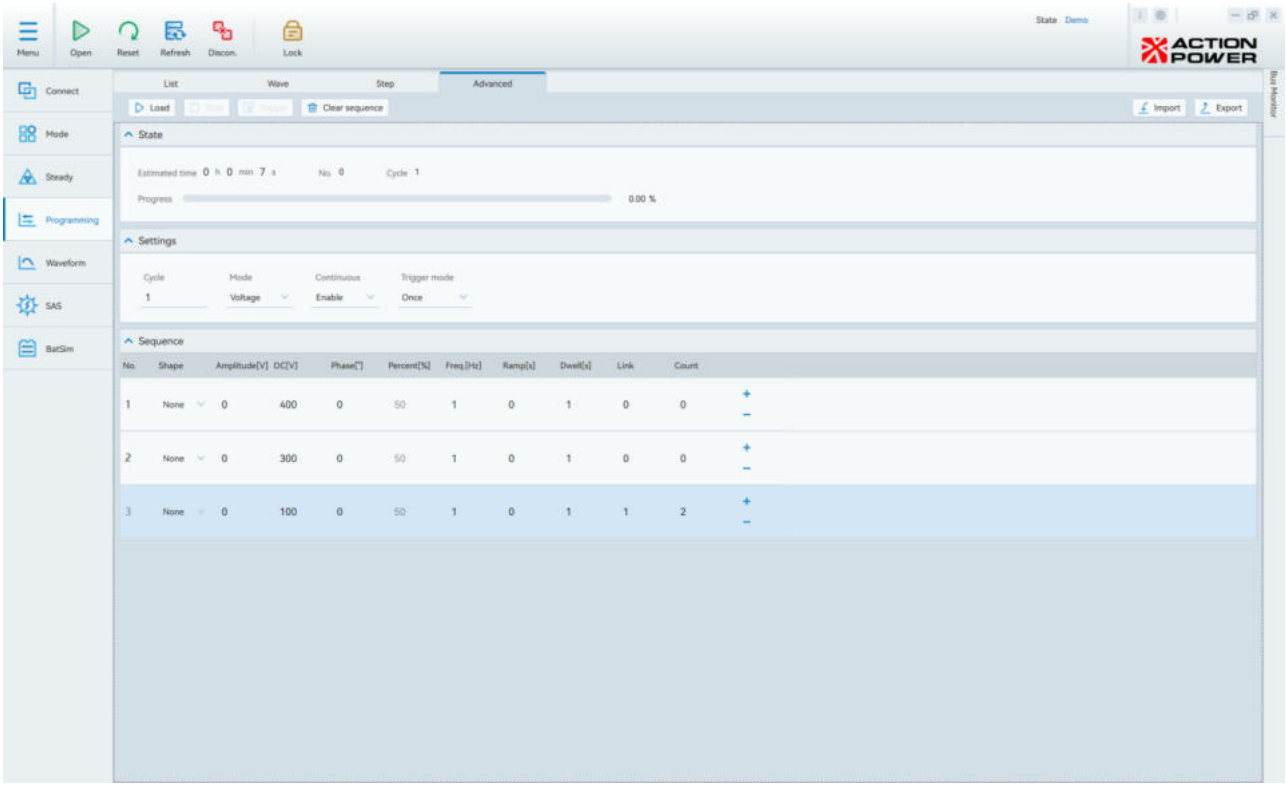


Figure 4.3.10 Schematic Diagram of Advanced Sequence Configuration

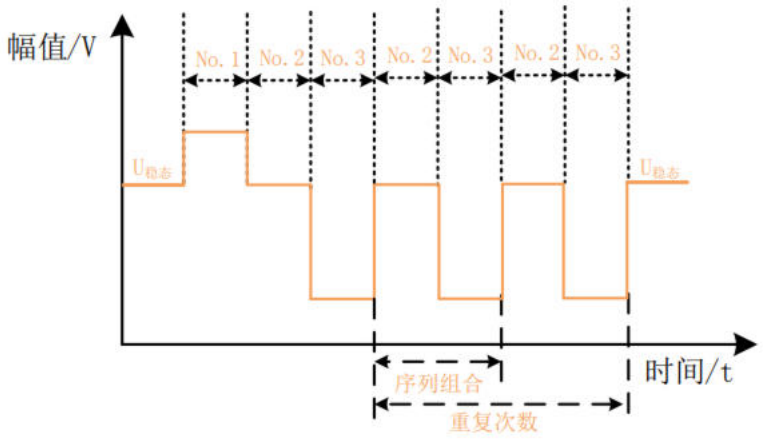


Figure 4.3.11 Advanced Sequence Combination Waveform Diagram

4.4 Waveform

4.4.1 Waveform Data Interface

4.4.1.1 Interface Description

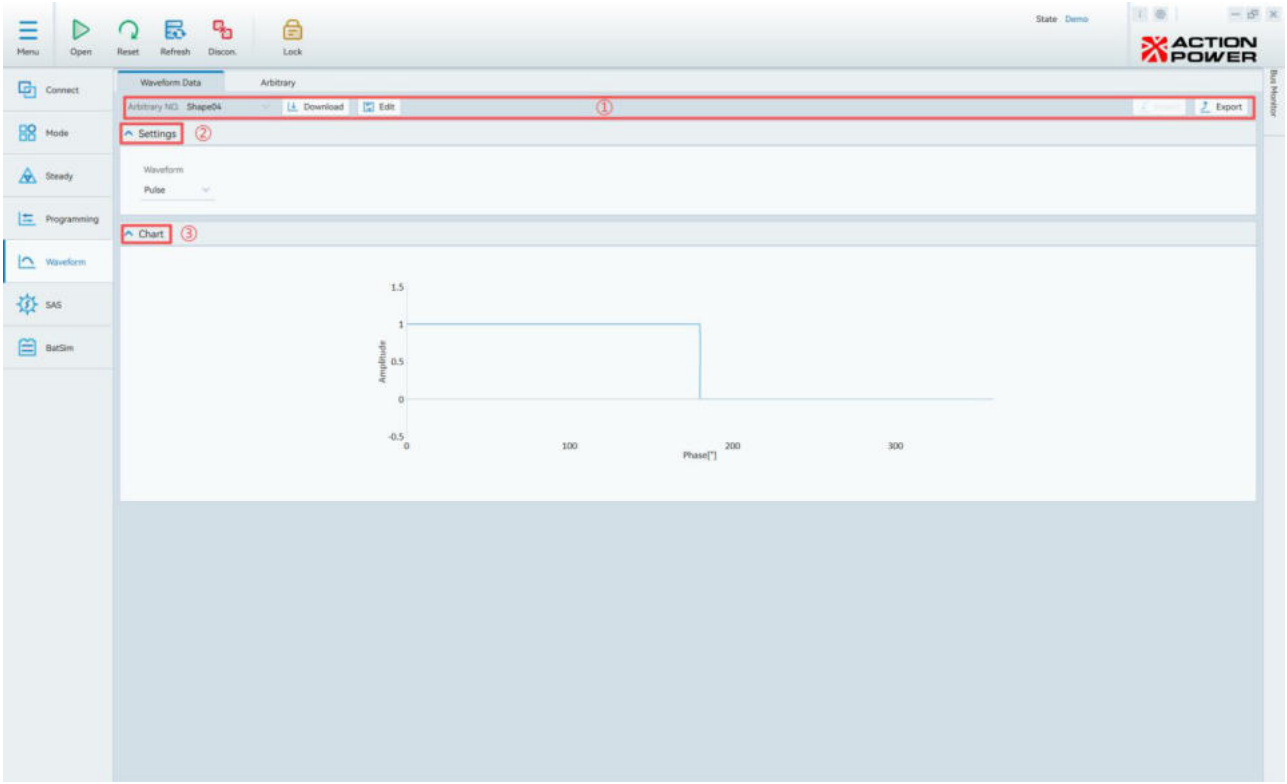


Figure 4.4.1 Waveform Data Interface

Figure 4.4.2 Waveform Editing Interface

CORTEX DC-B provides users with 27 customizable waveforms (Shape04~Shape30) for editing. CORTEX DC-B only recognizes waveforms validated and processed by dedicated host software. This interface primarily serves to edit the 27 customizable waveforms (Shape04~Shape30) reserved for users. After editing, these waveforms can be downloaded to the device. When selecting waveforms for Advanced programming, these 27 custom waveforms become available.

Prerequisites: 1. Select Source Load Mode; 2. Successful device connection or Demo Mode

1. Function Area: Download Waveform: Downloads custom waveforms to the device; Edit Waveform: Click the Edit Waveform button to open the waveform editing interface (as shown in Figure 4.4.2). Edit waveforms within this interface. Edited waveforms can be viewed in the Waveform Data interface.

2. Configuration Area: Waveform Type: Select waveform type.

3. Waveform Preview Area: Preview custom waveforms

4.4.1.2 Operation Instructions

- Select the custom waveform ID to edit in the Function Area
- In the Configuration Area, select the waveform type. Note: When selecting any waveform, the Import button becomes available. Click the Import button to import the desired waveform.
- Click the Edit Waveform button Edit the waveform in the waveform editing page
- Preview the waveform in the Waveform Preview Area
- Click the Download Waveform button to download the waveform to the device
- Clicking the Import button opens a file selection dialog. Select the desired file (.cust or .csv), then click "Open" to import. Clicking Cancel returns you to the previous screen.
- Clicking the Export button opens the Export File dialog. Modify the filename in the bottom input field. Click Save to export the file; clicking Cancel cancels the export.
- When the waveform type is set to Sine Wave or Arbitrary Wave in the configuration, the percentage cannot be configured.
- The Import button is only enabled when the waveform type is set to Arbitrary Waveform. For other waveform types, the Import button remains disabled.
- After device startup, the waveform data page displays a masking overlay indicating the device is operational and unavailable for interaction.

4.4.2 Arbitrary Waveform Interface

4.4.2.1 Interface Description

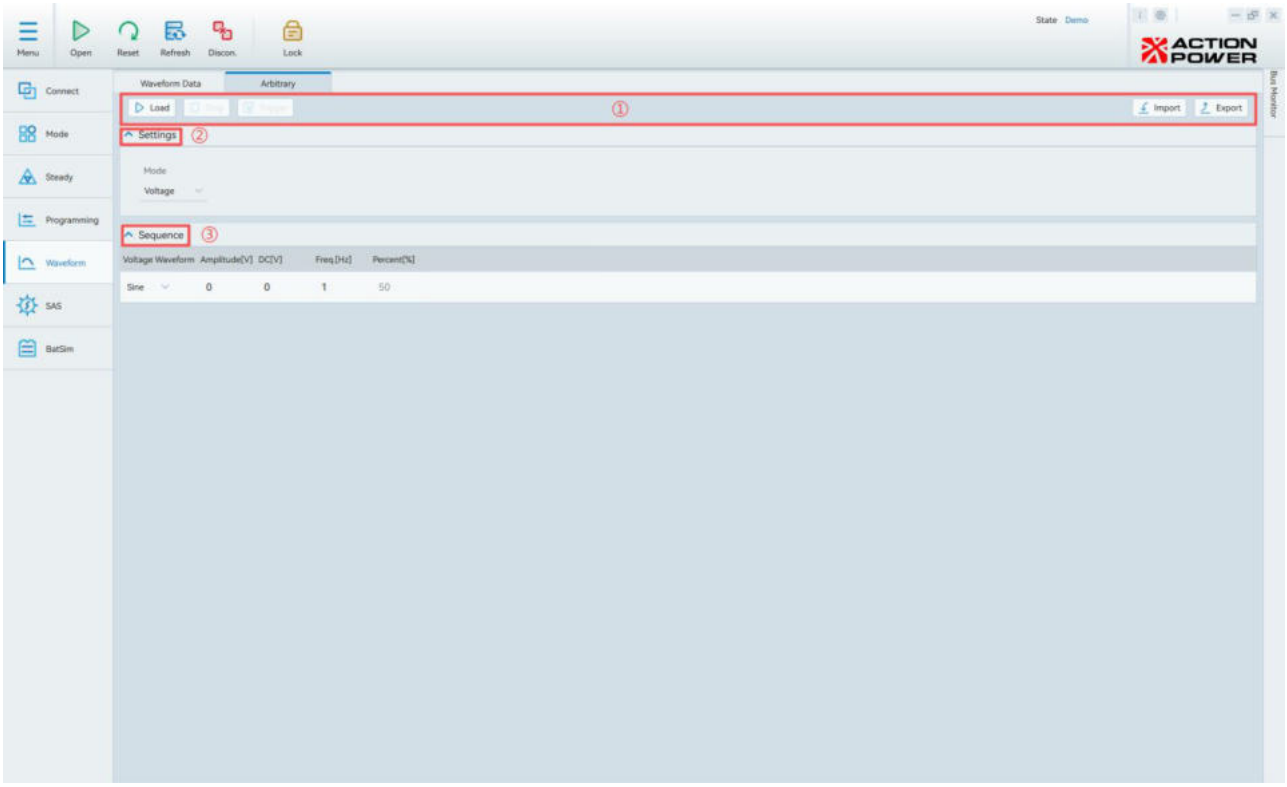


Figure 4.4.3 Arbitrary Wave Interface Design Prototype

Enables overlaying periodic waveform information onto DC output signals, such as simulating DC low-frequency ripple or wave fluctuations.

Prerequisites: 1. Select Source Load mode; 2. Successful device connection or demonstration mode.

1. Function Area: The Load button transmits sequence and configuration data to the device; the End button concludes the current experiment; the Trigger button initiates the experiment.

2. Settings Area:

【Mode】: The edited waveform is used to adjust the output voltage or output current.

3. Sequence Area:

【Amplitude】: Expected amplitude of the output waveform.

【DC】: DC component value of the expected output waveform;

【Freq】: Expected frequency of the output waveform, with a resolution of 0.01Hz, minimum value of 0.01Hz, and maximum value of 10000Hz;

【Percent】: Specific to pulse and triangle waveforms only, corresponding to pulse duty cycle and triangle wave symmetry parameters. Resolution: 0.01. Minimum: 0. Maximum: 100.

4.4.2.2 Operation Instructions

- Select the mode in the settings area
- Configure sequences in the sequence area
- Click the Start button to activate the device
- Click the Load button to load experimental data
- Click the Trigger button to start the experiment. The status bar in the Status Area displays the current experiment type: Arbitrary Wave
- After the experiment is complete, click the End button to finish the experiment
- Clicking the Import button opens a file selection dialog. Select the file to import (.anyw), then click "Open" to import. Clicking Cancel returns to the previous screen
- Clicking the Export button opens the export dialog. Modify the filename in the bottom input field. Click Save to export the file; clicking Cancel cancels the export.
- Voltage and current percentage settings are only available when selecting triangle wave or pulse wave waveforms. For other waveforms, these percentage settings are disabled.
- Example: Selecting sine wave, triangle wave, or pulse wave for arbitrary wave programming is illustrated in Figures 4.18 to 4.20. Set the amplitude, frequency, and offset for these three waveforms. Set the triangle wave percentage to 25% and the pulse wave percentage to 75%.

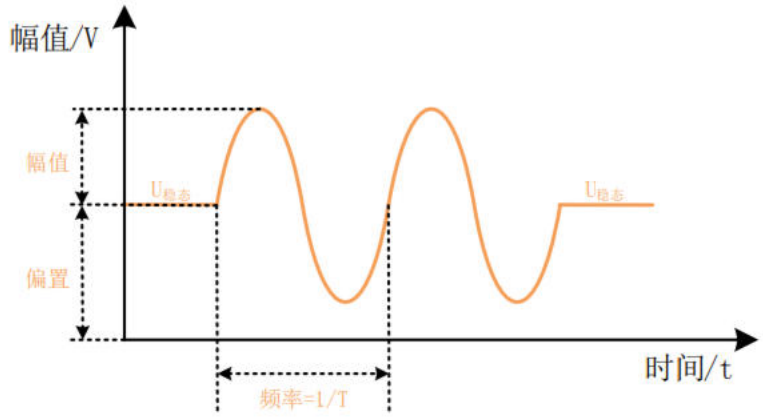


Figure 4.4.4 Sine Wave Diagram

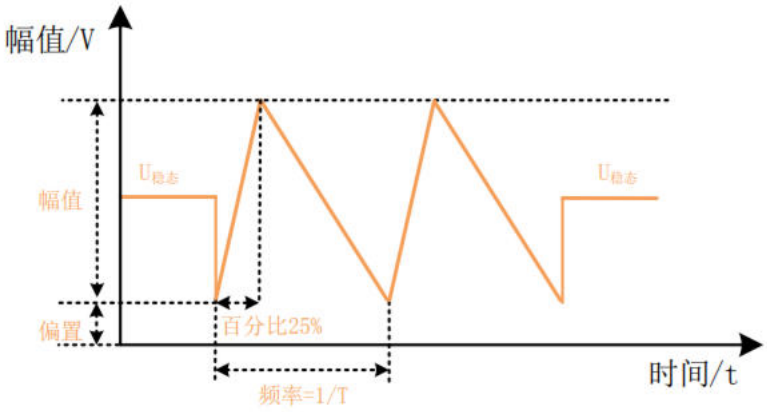


Figure 4.4.5 Triangular Wave Diagram

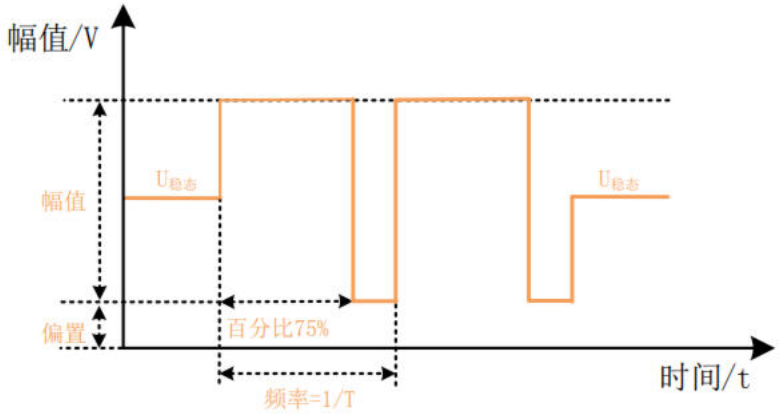


Figure 4.4.6 Pulse Wave Diagram

4.5 SAS PV Interface

The SAS solar cell simulator function precisely simulates the I-V characteristic curve output of solar panels. It incorporates SAS models from standards such as EN50530 and Sandia for testing static and dynamic MPPT of photovoltaic inverters. Its high-precision measurement and control system enables more accurate testing of the maximum tracking efficiency of solar inverters.

In SAS mode, the device defaults to executing static curve experiments upon startup. The static curve incorporates Sandia_Basic, EN50530_Basic, Simple, Sandia_Advanced, and EN50530_Advanced models. Users can modify model parameters to test the maximum tracking efficiency of solar inverters.

Curve scanning differs from static curve testing by incorporating variable changes in voltage, current, irradiance, and temperature. The rates of change for voltage, current, irradiance, and temperature are constant.

Weather simulation experiments are available only with the Sandia_Advanced and EN50530_Advanced models. These control only illumination and temperature variations, with non-fixed rates determined by user settings. The final output calculates the solar inverter's maximum power point tracking efficiency.

Curve programming verifies the inverter's operational status and MPPT tracking capability under continuous multiple IV curve conditions.

Shading experiments simulate conditions where cloud cover causes inconsistent illumination and temperature across different areas of a PV array in real-world environments. By setting cloud movement direction and total duration, dynamic cloud movement scenarios can be simulated to test the tracking efficiency of PV inverters under these conditions.

Static Sequence Test incorporates Sandia_Basic, EN50530_Basic, Sandia_Advanced, and EN50530_Advanced models. Users can

modify model parameters and customize sequences, including adjustable voltage and power settings. Upon sequence completion, the tracking efficiency for that sequence is calculated and displayed.

Static MPPT Experiment Built-in models: Sandia_Basic, EN50530_Basic, Sandia_Advanced, EN50530_Advanced. Users can modify model parameters and customize sequences, including customizable power percentage and voltage within sequences. Upon sequence completion, the tracking efficiency for that sequence is calculated and displayed.

Dynamic MPPT experiments include built-in Sandia_Basic, EN50530_Basic, Sandia_Advanced, and EN50530_Advanced models. Users can modify model parameters and customize sequences, including customizable start/end values for irradiance and temperature, as well as customizable ramp-up time, peak duration, ramp-down time, and trough duration. After sequence completion, the tracking efficiency for that sequence is calculated and displayed.

Custom Curve Experiment enables user-defined IV curves. Curve parameters can be stored to or read from the device to verify inverter operation and MPPT tracking performance under specific curve conditions.

4.5.1 Static Curve Interface

4.5.1.1 Interface Description

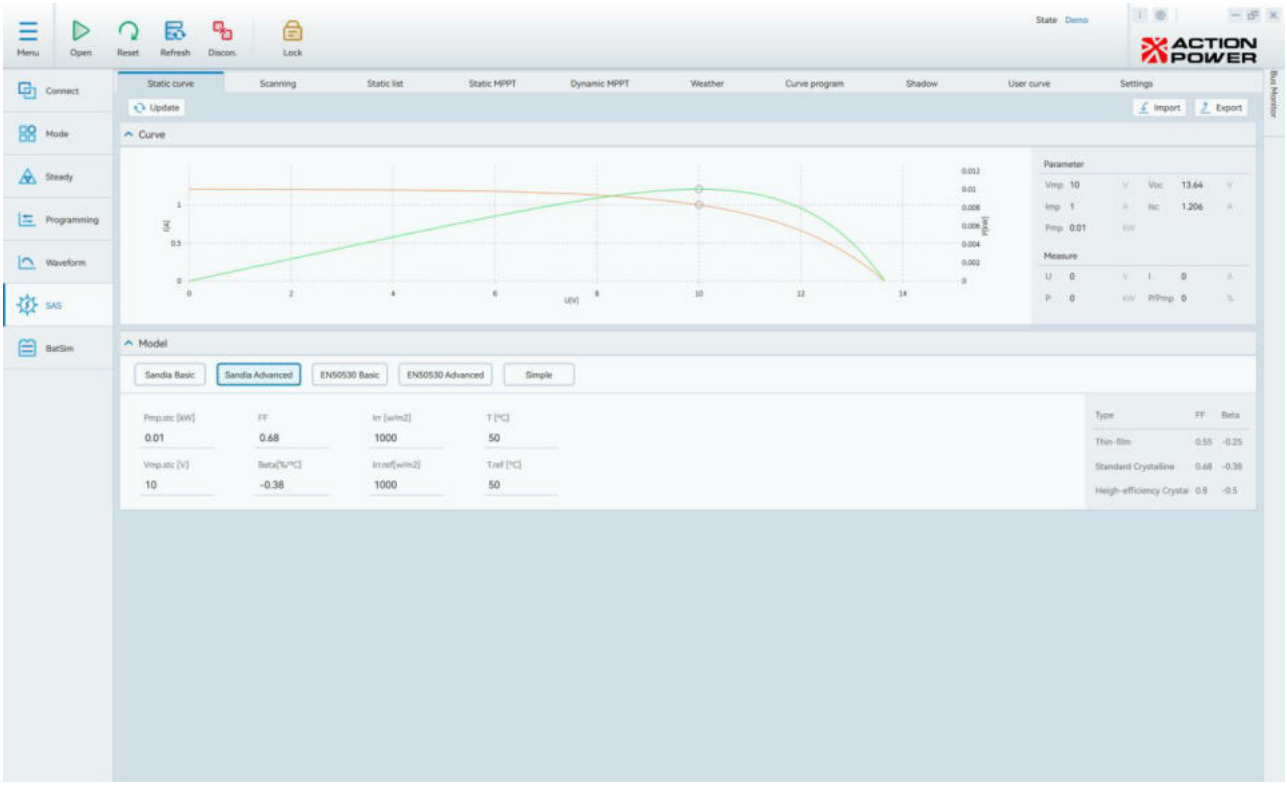


Figure 4.5.1 Static Curve Interface

Prerequisites: 1. Current mode is SAS mode. 2. Successful connection to device or demonstration mode.

Function Area: Click the Update button to send experiment data and refresh the preview graph.

Curve Area: Preview displays waveforms corresponding to the selected test standards and parameters in the model; calculates and displays current curve characteristic parameters based on model parameters; shows real-time measurement data

Model Area:

Sandia_Basic, EN50530_Basic, Simple Model Parameters:

【Vmp】: Voltage at Maximum Power Point;

【Imp】: Current at maximum power point;

【Pmp】: Power at maximum power point;

【Voc】: Open-circuit voltage;

【Isc】: Short-circuit current;

Sandia Advanced model parameters:

【Pmp.stc】: Power at maximum power point;

【Vmp.stc】: Maximum power point voltage;

【FF】: Fill factor, defined as FF = Vmp × Imp / Voc × Isc;

【Beta】: Temperature coefficient. This parameter affects the degree to which current and voltage require scaling due to temperature changes in the cell array;

【Irr】: Solar irradiance;

【T】: Solar cell array temperature;

【Irr.ref】: Solar irradiance under reference or rated conditions;

【T.ref】: Solar cell array temperature under reference or rated conditions

EN50530_Advanced model parameters:

【Pmp.stc】: Power at maximum power point;

【Vmp.stc】: Voltage at maximum power point;

【Irr】: Solar irradiance;

【T】: Solar panel temperature;

【PV Tech】: Panel material;

【Irr.stc】: Irradiance under standard test conditions;

【T.stc】: Solar irradiance under standard test conditions;

4.5.1.2 Operating Instructions

- Select models in the model area
- Configure model parameters
- Click the Update button to send experimental data and refresh the preview image
- Click the Start button; the status bar in the status area displays the current status: Static Curve
- Clicking the Import button opens a file selection dialog. Select the desired file (.stat), then click "Open" to import. Clicking Cancel returns to the previous screen
- Clicking the Export button displays a selection box. Choose either Export Parameters or Export Curves. After selection, the Export File dialog box appears. Modify the name in the filename input field at the bottom. Click the Save button to export the file. Clicking Cancel cancels the export.
- The black circle on the curve indicates the maximum power point.
- Red dots on the curve are plotted based on measured values to display the tracking trajectory.

4.5.2 Curve Scan Interface

4.5.2.1 Interface Description

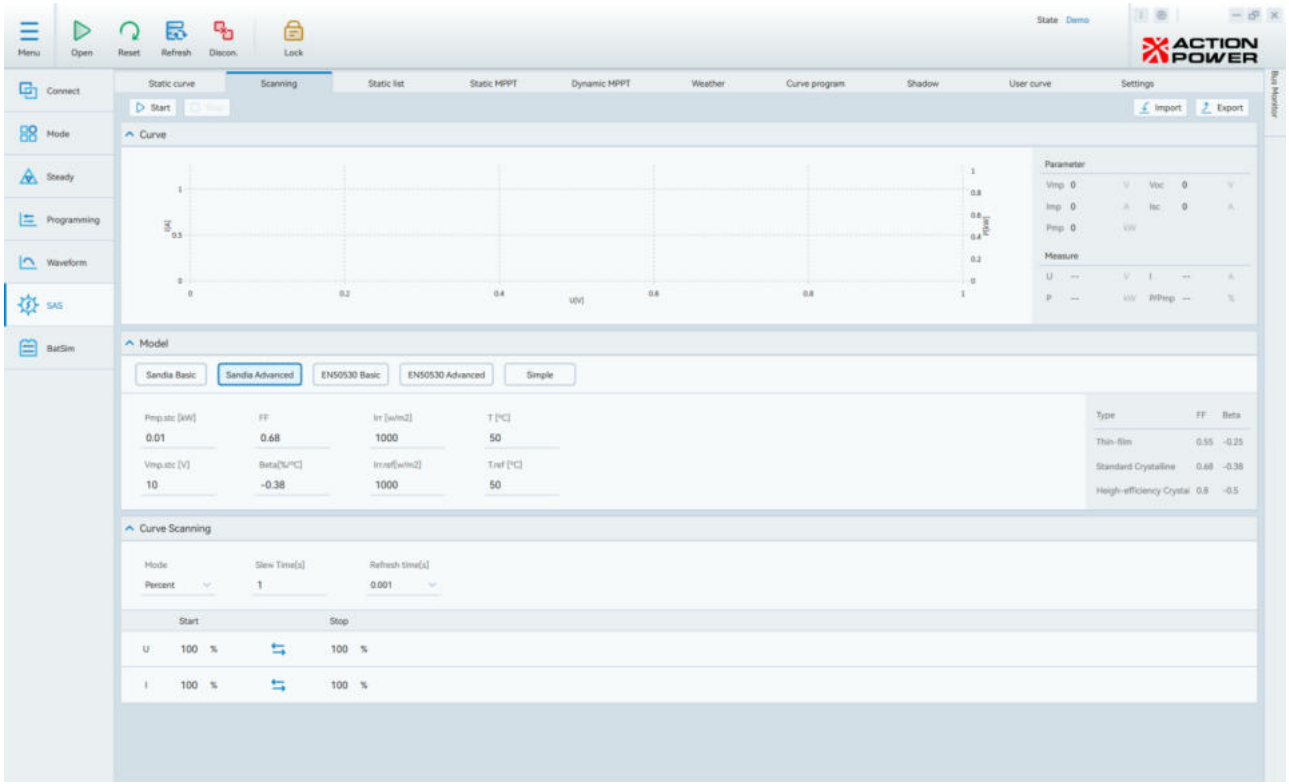


Figure 4.5.2 Curve Scan Window

Curve scanning performs scaling tests on static curves based on percentages of open-circuit voltage and short-circuit current. Scaling can also be performed based on irradiance and temperature to simulate MPPT efficiency of solar arrays under dynamic weather conditions, enabling more accurate testing of PV inverter characteristics.

Prerequisites: 1. Current mode is SAS mode. 2. Successful connection to the device or demonstration mode.

Function Area: Start Button: Sends test data and initiates scanning commands. End Button: Terminates the current test.

Model Area Parameters: Identical to static curve model area parameters.

Curve Scan Area:

【Slew Time】: Total duration of curve scanning;

【Refresh Time】: Switching time per step from start to finish

4.5.2.2 Operation Instructions

- Select the model in the model area
- Configure model parameters
- Configure relevant parameters in the curve scan configuration area. When selecting an advanced model, curve scan mode selection is available

- Click the Start button to initiate the experiment. The status bar in the status area displays the current experiment type: Curve Scan
- Click the End button to conclude the experiment after completion
- Clicking the Import button opens a file selection dialog. Select the desired file (.scan), then click "Open" to import. Clicking Cancel returns to the previous screen.
- Clicking the Export button opens the Export File dialog. Modify the filename in the bottom input field. Click Save to export the file; clicking Cancel cancels the export.
- Clicking the bidirectional symbol between Start and End during curve scanning swaps their set values.
- The black circle on the curve indicates the maximum power point.
- Red dots on the curve are plotted based on measured values to display the tracking trajectory.

4.5.3 Static List Interface

4.5.3.1 Interface Description

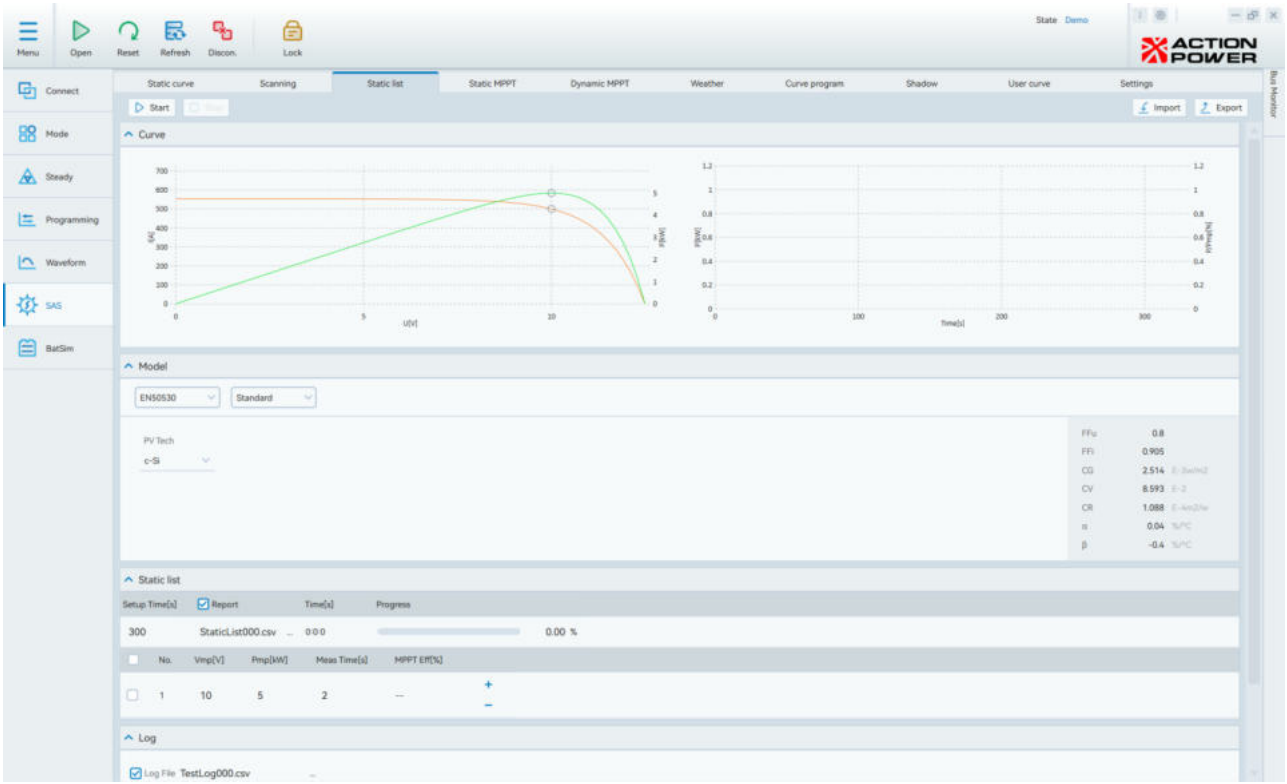


Figure 4.5.3 Static Sequence Interface

Prerequisites: 1. Current mode is SAS mode. 2. Successful connection to the device or demonstration mode

Function Area: Click the Start button to send experimental data and begin executing the static sequence. Click the End button to abandon the experiment.

Model Area:

EN50530 Standard:

【PV Tech】: Panel material;

Sandia Standard:

【FF】: Fill factor;

EN50530_Custom:

【Irr】: Irradiance;

【T】: Solar panel temperature;

【Irr.stc】: Solar irradiance under standard test conditions.

【T.stc】: Solar module temperature under standard test conditions;

Sandia_Custom:

【FF】: Fill factor, defined as FF = Vmp × Imp / Voc × Isc;

【Beta】: Temperature coefficient. This parameter affects the degree to which current and voltage require scaling due to changes in array temperature;

【Irr】: Solar irradiance;

【T】: Solar cell array temperature;

【Irr.ref】: Solar irradiance under reference or rated conditions;

【T.ref】: Solar cell array temperature under reference or rated conditions

Static Sequence Section:

Part One:

Configure the wait time for each step of the experiment, the report path, calculate the total theoretical duration of the experiment, and track its progress.

Part Two:

【Vmp】: Voltage at Maximum Power Point;

【Pmp】: Power at maximum power point;

【Meas Time】: Duration

4.5.3.2 Operation Instructions

- Select the model in the model area
- Configure model parameters
- Configure relevant parameters and sequences in the static sequence configuration area. Clicking the plus sign after a sequence will duplicate the current sequence information and add it to the sequence list. Up to 100 sequences can be added. Clicking the minus sign after a sequence will delete the current sequence. Up to one sequence can be deleted.
- Configure log information
- Click the Start button to initiate the experiment. The status bar in the status area displays the current experiment type: Static Sequence.
- After the experiment completes, click the End button to stop it.
- Import Button Clicking this button opens a file selection dialog. Select the desired file (.sles), then click "Open" to import it. Clicking "Cancel" returns to the previous screen.
- Clicking the Export button opens the Export File dialog. Modify the filename in the bottom input field, then click Save to export

the file. Clicking Cancel cancels the export.

- Report: Generates a summary report of experimental results from the static sequence section
- Log: Records each data point during the experiment at intervals specified by the configured measurement cycle.
- Static Sequence Report: Checking the box before the report will generate the corresponding report; unchecking it will not generate the report.
- Selecting the checkbox in the first column of the sequence list header selects all sequences. Deselecting this checkbox deselects all sequences.
- Clicking the checkbox before a sequence will execute that sequence once it starts.
- Upon sequence completion, the tracking efficiency of the current sequence will be displayed in the MPPT Eff[%] column.
- The curve on the right side of the graph area shows the power and tracking efficiency versus time.
- The black circles on the curve indicate the maximum power points.
- Red dots on the curve are plotted based on measured values to display the tracking trajectory.
- Check the box before the log file name to generate a log; uncheck it to disable logging.
- The checkbox before each parameter controls whether it is printed in the log. Checking it prints the parameter; unchecking it suppresses it.
- Click the three dots after the report or log filename to open the Export Configuration File dialog. Modify the filename in the bottom input field, then click the Save button to complete the filename change.

4.5.4 Static MPPT Interface

4.5.4.1 Interface Description

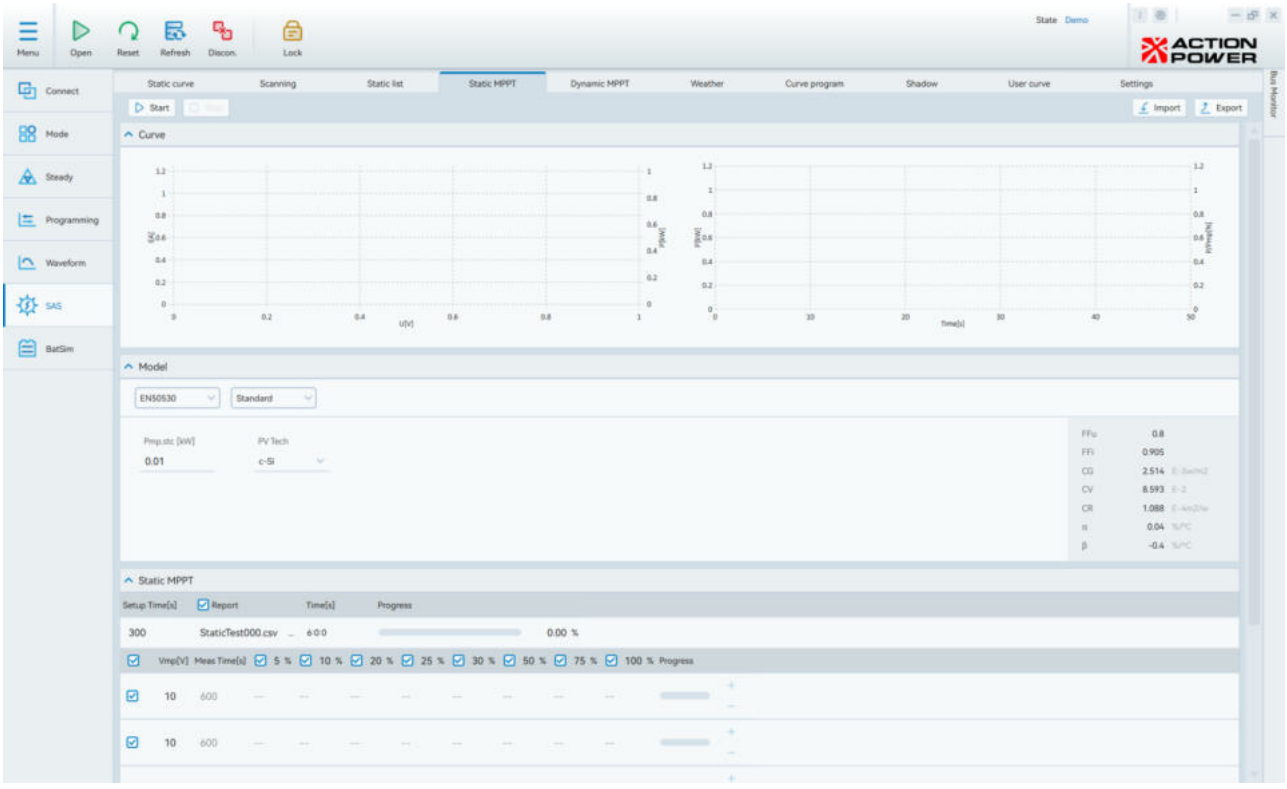


Figure 4.5.4 Static MPPT Interface

Verify the MPPT tracking efficiency of the inverter's static curve

Prerequisites: 1. Current mode is SAS mode. 2. Successful device connection or demo mode.

Function Area: Click the Start button to send experimental data and initiate static MPPT; click the End button to abandon the experiment

Model Area: Pmp.stc: Power at maximum power point;

EN50530 Standard:

【PV Tech】: Panel material;

Sandia Standard:

FF: Fill factor;

EN50530_Custom:

【Irr】: Irradiance;

【T】: Solar panel temperature;

【Irr.stc】: Solar irradiance under standard test conditions.

【T.stc】: Solar cell array temperature under standard test conditions.

Sandia_Custom:

【FF】: Fill factor, defined as FF = Vmp × Imp / Voc × Isc;

【Beta】: Temperature coefficient. This parameter affects the degree to which current and voltage require scaling due to module temperature changes;

【Irr】: Solar irradiance;

【T】: Solar cell array temperature;

【Irr.ref】: Solar irradiance under reference or rated conditions;

【T.ref】: Solar cell array temperature under reference or rated conditions.

Static MPPT Zone:

Part One:

Configure wait time for each power point test, report path, calculate theoretical total test time, and track test progress

Part Two:

Static MPPT experiment parameter settings Power percentage and maximum voltage

4.5.4.2 Operating Instructions

- Select the model in the model area
- Configure model parameters
- Configure static MPPT experiment information. When selecting the custom model type, experiment items within static MPPT can be added or removed, and the measurement duration can be modified. Clicking the plus sign next to an experiment will duplicate the current experiment information and add it to the experiment table. Up to 50 experiments can be added. Clicking the minus sign next to an experiment will delete the current experiment. Up to one experiment can be deleted. When selecting the standard model type, only 3 experiment entries are available and cannot be added or deleted. The measurement duration

cannot be modified.

- Check the box before the static MPPT zone percentage to execute the current power. The current power is calculated as the percentage multiplied by the Pmp.stc of the model zone. The next row will only be executed after all selected power points in the current row have been processed.
- Upon completing the current power point, the tracking efficiency at that power level will be displayed in the corresponding position.
- Configure log information
- Click the Start button to initiate the experiment. The status bar in the status area displays the current experiment type: Static MPPT.
- Click the End button to conclude the experiment after completion.
- Clicking the Import button opens a file selection dialog. Select the desired file (*.seec), then click "Open" to import it. Clicking Cancel returns to the previous screen.
- Clicking the Export button opens the export dialog. Modify the filename in the bottom input field, then click Save to export the file. Clicking Cancel cancels the export.
- Report: Generates a summary report of experimental results from the static MPPT sequence area.
- Log: Records each data point during the experiment at intervals based on the configured measurement cycle.
- Static MPPT Report: Checking the box before the report will generate the corresponding report; unchecking it will not generate it.
- Selecting the checkbox in the first column of the sequence list header selects all sequences. Deselecting this checkbox deselects all sequences.
- Clicking the checkbox before an experiment will execute that experiment once it begins.
- Checking the box before the log filename generates the log; unchecking it suppresses log generation.
- The checkbox before each parameter controls whether it is printed in the log. Checking it prints the parameter; unchecking it suppresses printing.
- Click the three dots next to the report or log filename to open the Export Configuration File dialog. Modify the filename in the bottom input field, then click the Save button to complete the filename change.
- The curve on the right side of the graph area displays the power and tracking efficiency versus time curve.
- The black circles on the curve indicate the maximum power points.
- Red dots on the curve are plotted based on measured values to display the tracking trajectory.

4.5.5 Dynamic MPPT Interface

4.5.5.1 Interface Description

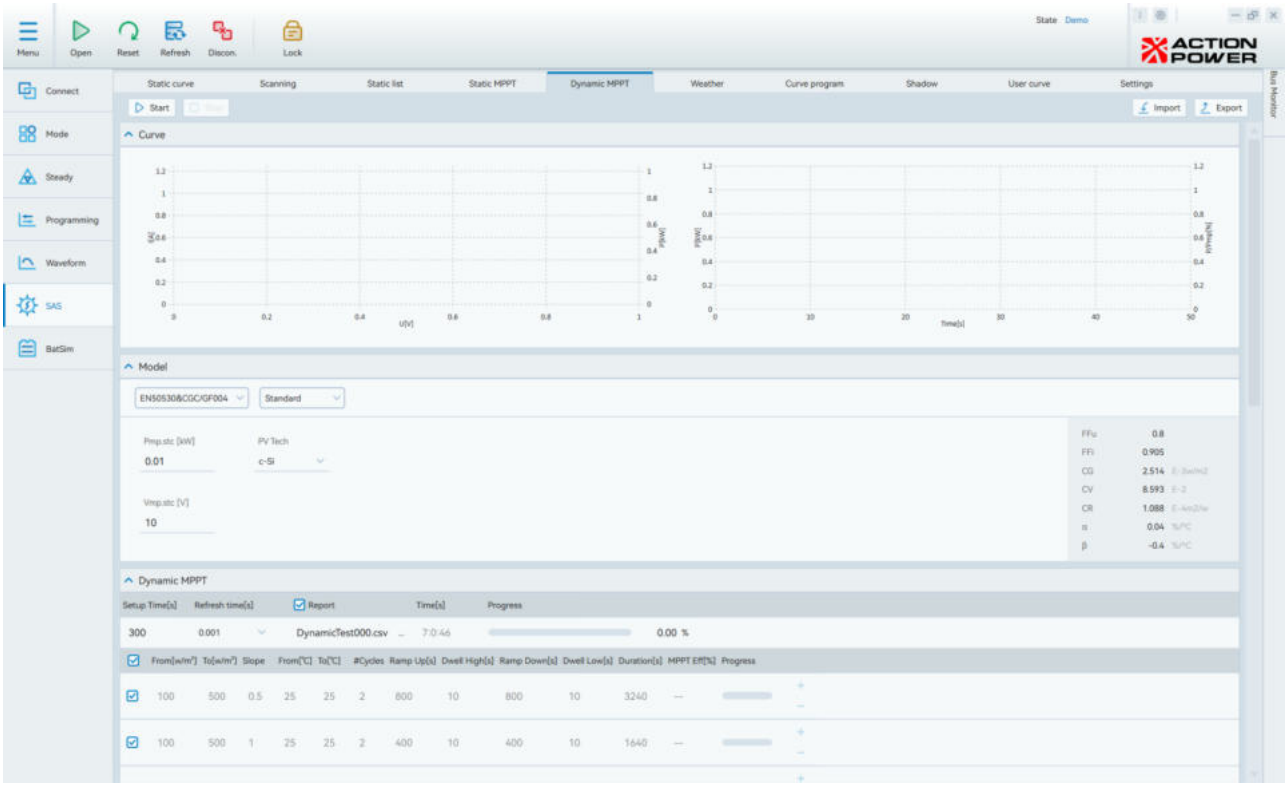


Figure 4.5.5 Dynamic MPPT Interface

Verify MPPT tracking efficiency during inverter dynamic curve changes

Prerequisites: 1. Current mode is SAS mode. 2. Successful device connection or demonstration mode.

Function Area: Click the Start button to send experimental data and initiate dynamic MPPT; click the End button to abandon the experiment

Model Area:

【Pmp.**stc**】: Power at maximum power point;

【Vmp.**stc**】: Voltage at maximum power point;

EN50530 Standard:

【PV Tech】: Panel material;

Sandia Standard:

【FF】: Fill factor;

EN50530_Custom:

【Irr.stc】: Irradiance under standard test conditions.

【T.stc】: Solar cell array temperature under standard test conditions;

Sandia_Custom:

【FF】: Fill factor, defined as FF = Vmp × Imp / Voc × Isc;

【Beta】: Temperature coefficient. This parameter affects the degree to which current and voltage require scaling due to module temperature variations;

【Irr.ref】: Solar irradiance under reference or rated conditions;

【T.ref】: Solar array temperature under reference or rated conditions

Dynamic MPPT Zone:

Part One:

Configure experiment wait time, report path, calculate theoretical total experiment time, and track experiment progress

Part Two:

Dynamic MPPT Experiment Parameter Settings Built-in standard parameters or custom mode selection to define illumination, temperature start/end values, cycle count, climb time, peak duration, descent time, and trough duration

4.5.5.2 Operating Instructions

- Select the model in the model area
- Configure model parameters
- In the Dynamic MPPT configuration area, set relevant parameters and experiments. When selecting the custom model type, experiments within Dynamic MPPT can be added or removed, and configuration parameters can be modified. When selecting the standard model type, experiments cannot be added or deleted, and configuration parameters cannot be altered.
- Clicking the plus sign next to an experiment will duplicate the current experiment information and add it to the experiment table. Up to 100 experiments can be added.
- Clicking the minus sign after an experiment deletes the current experiment. You can delete experiments until only one remains.
- Clicking the checkbox before an experiment will enable its execution once started.
- Experiment sequences in Dynamic MPPT involve variations in light intensity and temperature, along with corresponding time intervals and cycles. Upon completion, the tracking efficiency for the current sequence will be displayed in the MPPT Eff[%] column.
- Configure Log Information
- Click the Start button to initiate the experiment. The status bar in the status area displays the current experiment type: Dynamic MPPT.
- After the experiment completes, click the End button to stop it.
- Clicking the Import button opens a file selection dialog. Select the desired file (*.dyec), then click "Open" to import it. Clicking Cancel returns to the previous screen.
- Clicking the Export button opens the Export File dialog. Modify the filename in the bottom input field, then click Save to export the file. Clicking Cancel cancels the export.
- Report: Generates a summary report of experimental results from the Dynamic MPPT sequence area
- Log: Records each data point during the experiment at intervals defined by the configured measurement cycle.
- Dynamic MPPT Report: Checking the box before the report will generate the corresponding report; unchecking it will not generate it.
- Selecting the checkbox in the first column of the sequence list header selects all sequences. Deselecting this checkbox

deselects all sequences.

- Checking the box before the log filename generates the log; unchecking it prevents log generation.
- The checkbox before each parameter controls its inclusion in the log: checked means the parameter is printed; unchecked means it is not printed.
- Click the three dots next to the report or log filename to open the Export Configuration File dialog. Modify the filename in the bottom input field, then click the Save button to complete the filename change.
- The curve on the right side of the graph area displays the power and tracking efficiency versus time curve.
- The black circles on the curve indicate the maximum power points.
- Red dots on the curve are plotted based on measured values to display the tracking trajectory.

4.5.6 Weather Simulation

4.5.6.1 Interface Description

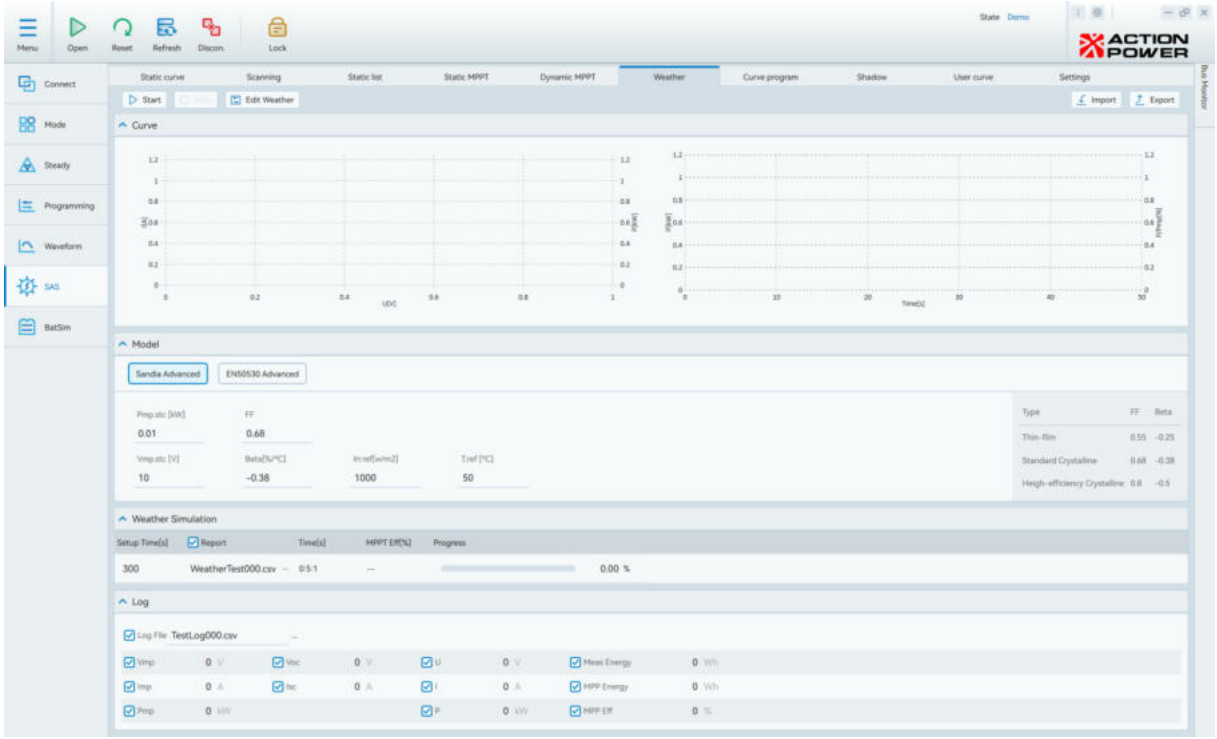


Figure 4.5.6 Weather Simulation Interface

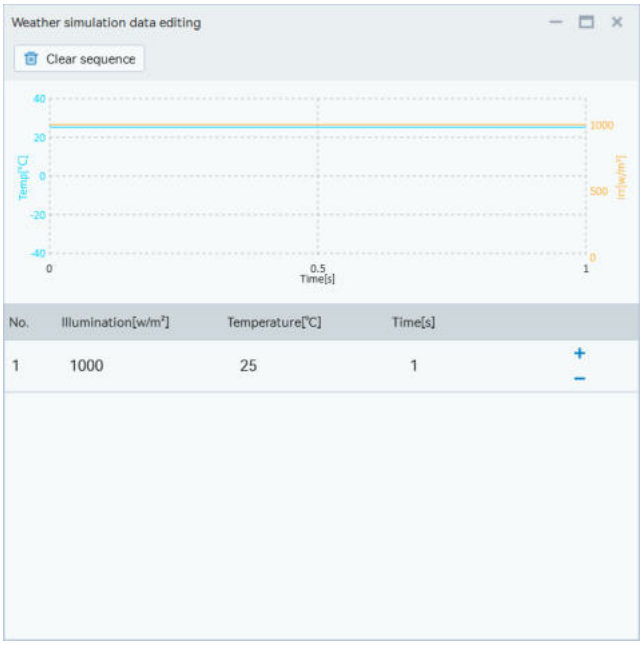


Figure 4.5.7 Weather Simulation Data Editing Interface

This feature allows testing the maximum power point tracking characteristics of the inverter under any weather conditions.

Prerequisites: 1. Current mode is SAS mode. 2. Successful device connection or demonstration mode.

Function Area: Click the Start button to send experimental data and begin the experiment. Click the End button to abandon the experiment. Click Edit Weather to open the interface for editing weather simulation data.

Model Area:

【Pmp.stc】: Maximum power point power;

【Vmp.stc】: Voltage at maximum power point;

EN50530_Advanced:

【PV Tech】: Panel material;

【Irr.stc】: Solar irradiance under standard test conditions

【T.stc】: Solar cell array temperature under standard test conditions;

Sandia_Advanced:

【FF】: Fill factor, defined as FF = Vmp × Imp / Voc × Isc;

【Beta】: Temperature coefficient. This parameter affects the degree to which current and voltage require scaling due to module temperature changes;

【Irr.ref】: Solar irradiance under reference or rated conditions;

【T.ref】: Solar array temperature under reference or rated conditions

Weather Simulation Zone:

【setup time】: Experiment waiting time;

【Time】: Theoretical total experiment duration.

Weather Simulation Data Editing Interface:

【Time】: Duration of current illumination and temperature.

4.5.6.2 Operation Instructions

- Select models in the model area
- Configure model parameters
- In the weather simulation configuration area, set the preparation time, whether to generate a report, and the report path.
- When editing weather simulation data, clicking the plus sign after a sequence will duplicate the current sequence information and add it to the sequence list. Clicking the minus sign after a sequence will delete the current sequence. You can delete sequences until only one remains, and you can add up to 1000 weather entries. Clicking the Clear Sequences button will clear the sequence list until only one remains.
- The weather simulation experiment simulates light and temperature changes to test the inverter's maximum power point tracking characteristics.
- Configure log information
- Click the Start button to initiate the experiment. The status bar in the status area displays the current experiment type: Weather.
- Upon completion of the weather simulation sequence, tracking efficiency will be displayed in the Weather Simulation section under MPPT Eff[%].
- After the experiment is complete, click the "End" button to finish the experiment.
- Clicking the Import button opens a file selection dialog. Select the desired file (.sedy), then click "Open" to import it. Clicking Cancel returns to the previous screen.
- Clicking the Export button opens the Export File dialog. Modify the filename in the bottom input field, then click Save to export the file. Clicking Cancel cancels the export
- Report: Generates a summary report of weather simulation experiment results
- Log: Records each data point during the experiment at intervals based on the configured measurement cycle.
- Weather Simulation Report: Checking the box before the report will generate the corresponding report; unchecking it will not generate it.
- Checking the checkbox before the log filename generates the log; unchecking it prevents generation.
- Parameter printing in the log is controlled by the checkbox preceding each parameter. Checking it prints the parameter; unchecking it suppresses printing.
- Click the three dots next to the report or log filename to open the Export Configuration File dialog. Modify the filename in the bottom input field, then click the Save button to complete the filename change.
- The curve on the right side of the graph area displays the power and tracking efficiency versus time curve.
- The black circles on the curve indicate the maximum power points.
- Red dots on the curve are plotted based on measured values to display the tracking trajectory.

4.5.7 Curve Programming

4.5.7.1 Interface Description

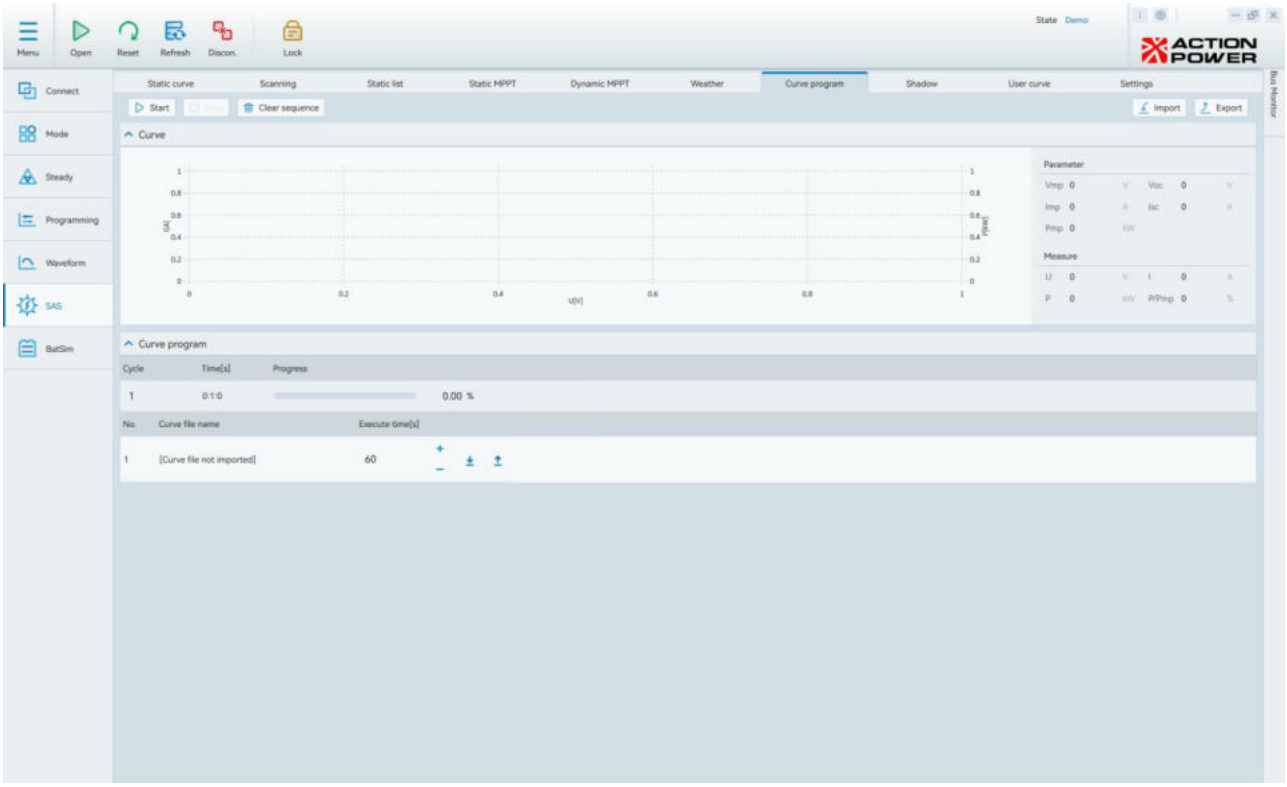


Figure 4.5.8 Curve Programming Interface

Verify the inverter's operational status and MPPT tracking functionality under continuous multiple different IV curve conditions

Prerequisites: 1. Current mode is SAS mode. 2. Successful connection to the device or demonstration mode.

Function Area: Click the Start button to send test data and begin the experiment. Click the End button to abandon the experiment. Clicking the Clear Sequence button will clear all entries in the sequence except one, and will also clear the curve data within that single sequence.

Curve Programming Area:

【Cycle**】**: Total number of times all sequences will be executed in a loop;

【Time】: Theoretical total experiment time;

【Progess**】**: Current sequence curve execution time

4.5.7.2 Operation Instructions

- In the curve programming area, click the import button as needed: to import the required curve
- Set the execution time for this curve, with a minimum value of 5 seconds
- Click the plus sign after a sequence to add a new sequence to the sequence list. Up to 100 sequences can be added.
- Clicking the minus sign after a sequence deletes the current sequence. You can delete sequences until only one remains

- Click the export button in the curve programming area to export the curve as needed
- Set the number of cycles
- Click the Start button to begin execution. The status bar in the status area displays the current experiment type: Curve Programming.
- After the experiment concludes, click the End button to stop the experiment.
- Clicking the Import button opens a file selection dialog. Select the desired file (.cvpg), then click "Open" to import it. Clicking Cancel returns to the previous screen.
- Clicking the Export button opens the Export File dialog. Modify the filename in the bottom input field, then click Save to export the file. Clicking Cancel cancels the export.
- The black circle on the curve indicates the maximum power point
- Red dots on the curve are plotted based on measured values to display the tracking trajectory

4.5.8 Shadow masking interface

4.5.8.1 Interface Description

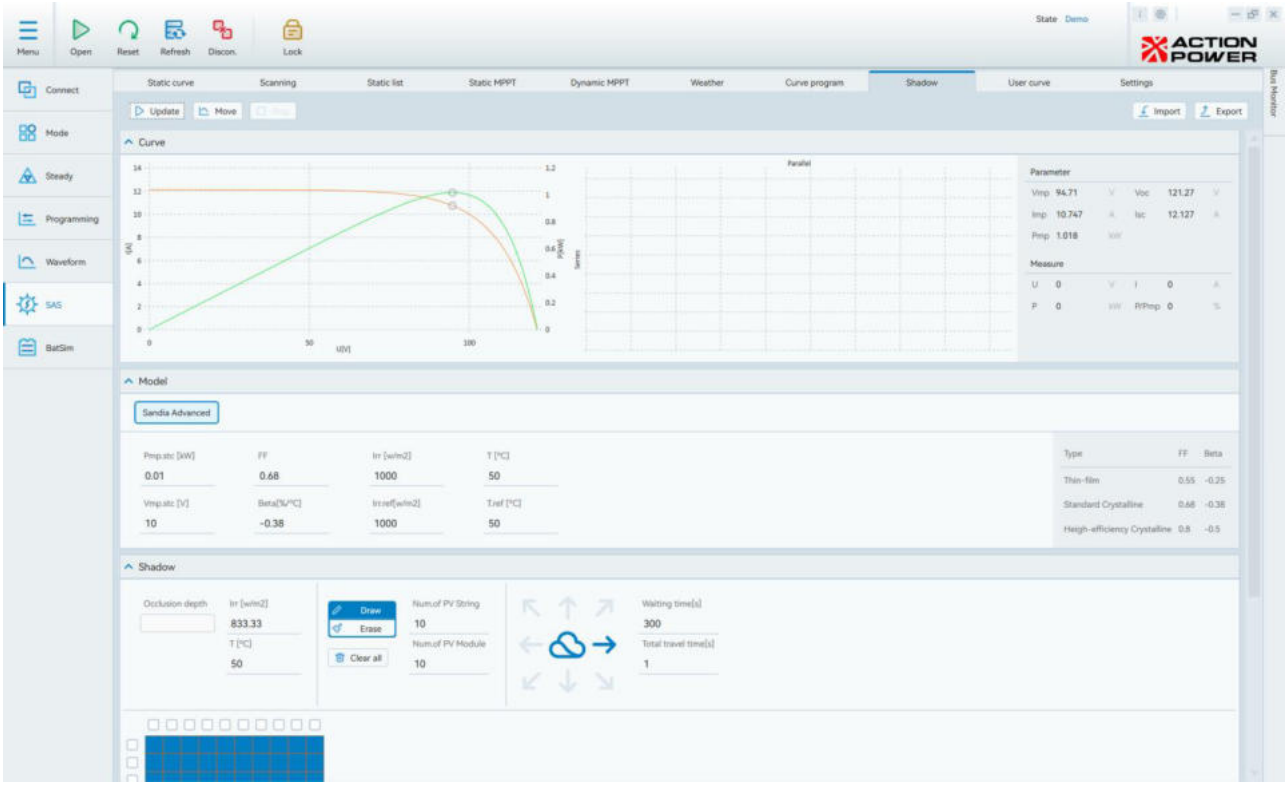


Figure 4.5.9 Shading Interface

Used to simulate conditions where different areas of a PV array experience inconsistent light exposure and temperature due to cloud shading in real-world environments. This interface tests the tracking efficiency of PV inverters under such conditions.

Prerequisites: 1. Current mode is SAS mode. 2. Successful device connection or demonstration mode.

Functional Areas: - Click "Update" to refresh static shading experiment data. - Click "Move" to transmit experiment data and

initiate dynamic shadowing. - Click "Stop" to pause the experiment. - Click "Export" to select curve export and parameter export. - Click "Import" to import parameters.

Curve Area: Preview displays waveforms and movement trajectories based on selected test standards and parameters in the model. Real-time measurements of characteristic parameters appear on the right.

Model Area:

【Pmp.stc】: Power at the point of maximum power;

【Vmp.stc】: Maximum power point voltage;

【FF】: Fill factor, defined as FF = Vmp × Imp / Voc × Isc;

【Beta】: Temperature coefficient. This parameter affects the degree to which current and voltage require scaling due to temperature changes in the cell array;

【Irr】: Solar irradiance;

【T】: Solar cell array temperature;

【Irr.ref】: Solar irradiance under reference or rated conditions;

【T.ref】: Solar cell array temperature under reference or rated conditions

Shadowed Area:

Part One:

Set the shading depth with 6 adjustable levels. Each level allows configuration of corresponding light intensity and temperature, series/parallel connections, movement direction, wait time, and total movement time;

Part Two:

Actual series/parallel connections can be configured by plotting the shading area above

4.5.8.2 Operation Instructions

- Configure Model Parameters
- Set occlusion depth and temperature in the shadow occlusion area
- Set the number of series and parallel connections
- Set cloud layer movement direction, wait time, and total movement time
- Draw cloud occlusion regions
- Click the Update button to perform a static occlusion experiment. The status bar in the status area displays the current experiment type: Shadow Occlusion
- Click the Move button as needed to conduct dynamic occlusion experiments
- During dynamic occlusion experiments, click the stop button to pause the experiment
- After clicking the Export button, select Export Curve to open the export dialog. Modify the filename in the bottom-most field (*.curv), then click Save to export the file. Click Cancel to cancel export.
- Clicking the Export button opens the Export File dialog. Modify the filename in the bottom-most field (*.shad), then click Save to export. Click Cancel to cancel export.
- Clicking the Import button opens the Import File Selection dialog. Select the configuration file and click Open. Parameters in the Shadow Occlusion interface will update.

- When drawing occlusion blocks: - Checking the checkbox above a column selects all blocks in that column. - Checking the leftmost checkbox of a row has the same effect. Click the Clear All button to remove all drawn occlusion blocks.
- To draw, hold down the left mouse button and start dragging. Release the left mouse button to complete the drawing.
- To erase a block, click the Erase button. Hold down the left mouse button and drag over the block to erase. Release the mouse button to complete the erasure.
- Cloud movement has 8 directions. Clicking "Move" will shift the cloud layer along the selected direction.
- The maximum power point in the curve is indicated by a black circle.
- The diagram on the right side of the curve area corresponds to the shading blocks drawn in the shading area.
- In the shadow occlusion drawing area, the total number of rows and columns in the drawing area updates when the number of series or parallel connections changes.
- Clicking the move button initiates cloud movement along the selected direction after a specified delay.

4.5.9 User Curve Interface

4.5.9.1 Interface Description

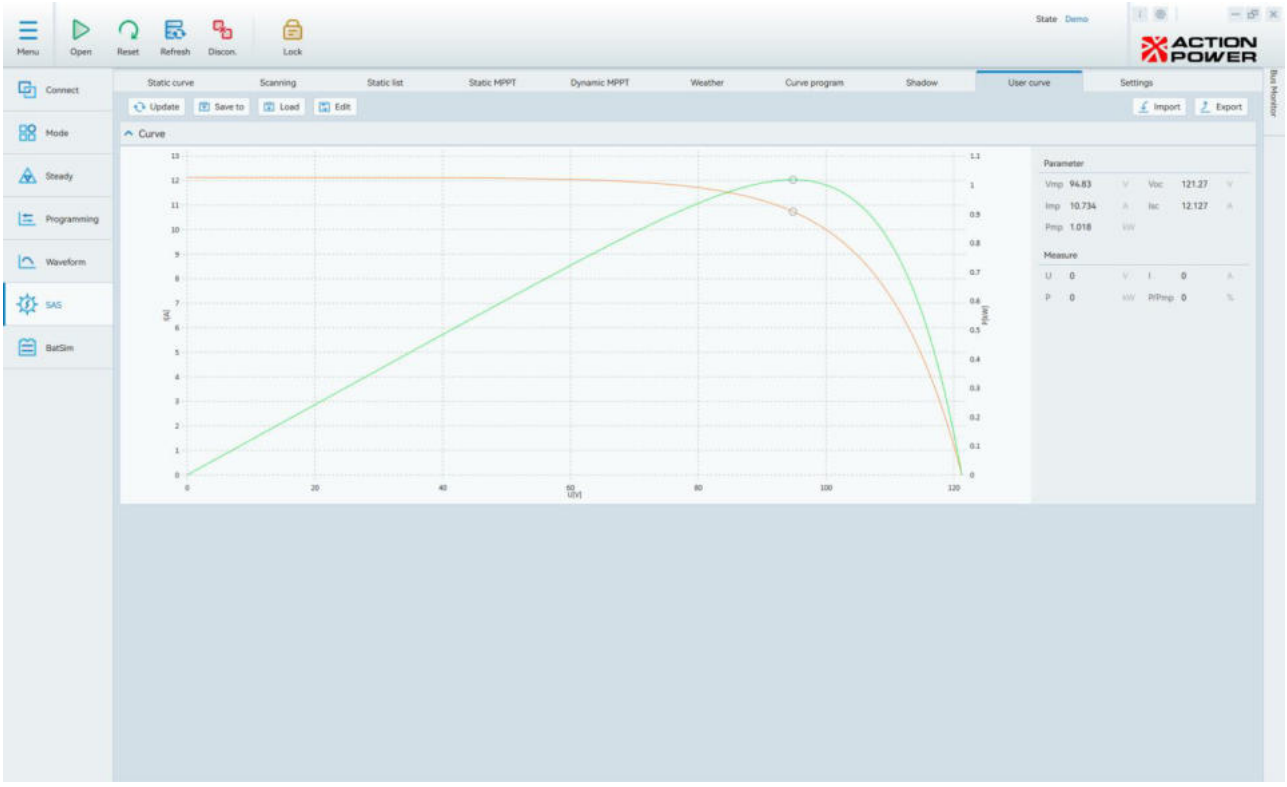


Figure 4.5.10 Custom Curve Page Design Prototype

Enables user-defined IV curves to verify inverter operation and MPPT tracking under specific curve conditions.

Prerequisites: 1. Current mode is SAS mode. 2. Successful device connection or demo mode.

Function Area: - Click "Update" to send custom curve test data and update the curve. - Click "Store To" to save current waveform data to the corresponding device ID area. - Click "Read" to retrieve data from the corresponding device ID. - Click "Edit" to manually modify curve parameters. - Click the "Import/Export" button to import or export curves.

Curve Area: Previews actual waveforms based on imported data or read data points.

4.5.9.2 Operation Instructions

- Click the Import button to select and import a curve.
- Click the Update button to update the curve. The status bar in the Status Area displays the current experiment type's custom curve.
- Click the Edit button to modify the curve.
- Click the Save To button to store the current curve to the selected curve in the device
- Click the Read button to retrieve the selected curve from the device
- Clicking the Import button opens a file selection dialog. Select the file to import (.curv, .csv), then click "Open" to import. Clicking Cancel returns to the previous screen.
- Clicking the Export button opens the Export File dialog. Modify the name in the bottom filename input field. Click Save to export the file. Click Cancel to cancel exporting.
- The black circle on the curve indicates the maximum power point.
- Red dots on the curve are plotted based on measured values to display the tracking trajectory.

4.5.10 Photovoltaic Configuration Interface

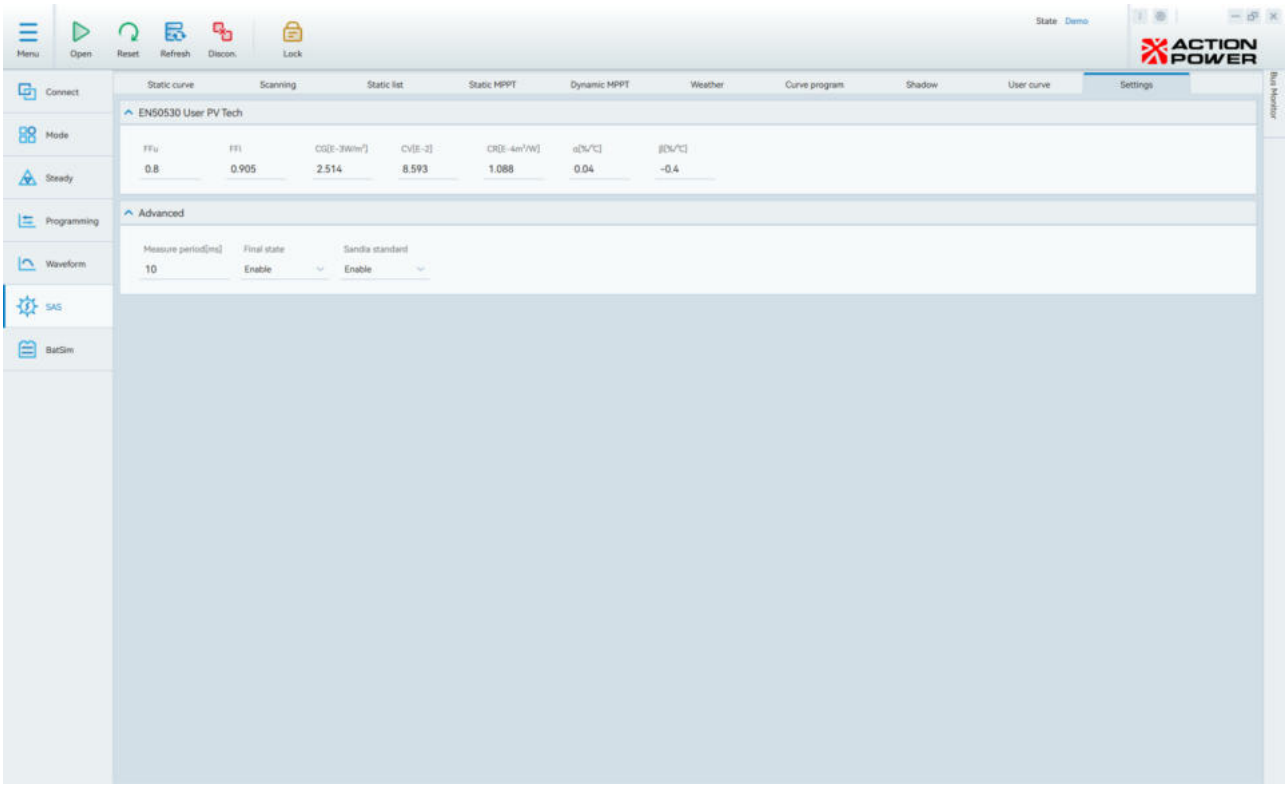


Figure 4.5.11 Configuration Interface Design Prototype

Prerequisites: 1. Current mode is SAS mode. 2. Successful device connection or demo mode.

When using the EN50530 model in experiments and selecting "User" for panel material, parameters from EN50530 User PV Tech will be applied.

【FFu】： MPP open-circuit voltage ratio

【FFi】: MPP Short-Circuit Current Ratio

【CG, CR, CV】: Correction factors

【α】: Current temperature coefficient

【β】: Voltage Temperature Coefficient

【Measure period】: The time interval between measuring two data points. This affects the testing cycle of photovoltaic experiments, causing variations in the log generation interval.

【Final state】： Applicable to curve scanning, static sequence, static MPPT, dynamic MPPT, weather simulation, and curve programming experiments. If enabled, the operating point will remain at the curve value at the end of the experiment.

【Sandia standard】: When generating normalized curves using Sandia mode, the mode scales set parameters proportionally to provide specified voltage and power under appropriate test conditions. This causes actual parameters in the Sandia mode function editor to differ from values set in curve parameters. Enabling S Standardization causes the system to correct the actual parameters of the I-V curve in Sandia mode to match the values set in the curve parameters.

4.6 BatSim Interface

Simulates output characteristics and charge/discharge profiles for various battery packs including lithium manganese oxide, lithium cobalt oxide, lithium iron phosphate, nickel metal hydride, ternary lithium, lithium titanate, and lead-acid batteries. Configurable parameters include series/parallel connections, temperature, SOC, internal resistance, and cell capacity. Supports first-order, second-order, and third-order RC battery models with customizable parameters for comprehensive battery pack simulation.

4.6.1 Interface Description

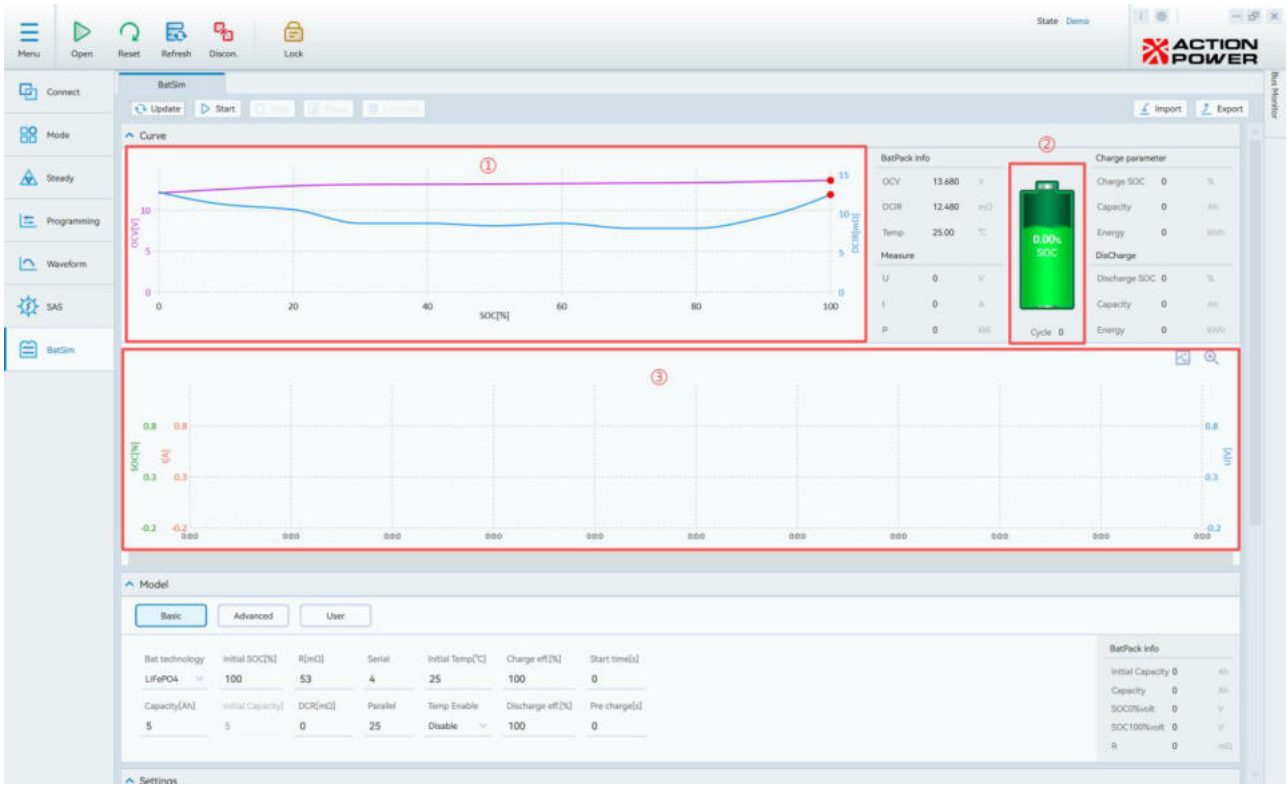


Figure 4.6.1 BatSim Interface Design Prototype

Prerequisites: 1. Current mode is BatSim mode 2. Successful device connection or demo mode

Functional Areas: The Update button sends model configuration to the device and refreshes interface curves and parameters; Start button initiates the experiment; End button concludes the experiment; Pause button halts the experiment; Resume button continues the experiment; Clicking Edit Curve opens the curve editing window.

Model Area:

Model Parameters:

【Initial SOC】: Initial state of charge (SOC) of the individual battery cell;
【Initial Capacity】: Initial capacity of the individual cell;
【Initial Temp】: Initial temperature of the individual cell;
【Serial】: Number of individual cells connected in series within the battery pack;
【R】: Equivalent impedance of the individual cell;
【Capacity】: Cell capacity;
【DCR】: Equivalent impedance of cables in the battery pack;
【Parallel】: Number of individual cells connected in parallel within the battery pack;
【Temp Enable】: Enable/disable temperature influence on the battery model;
【Pre charge】: Time for output voltage soft-start to open-circuit voltage
【Start time】： Time at which the test delay begins;
【Charge Eff】: Energy conversion efficiency during battery charging;
【Discharge Eff】: Energy loss efficiency during battery discharge;
【Measurement Interval】: Time interval for virtual terminal printing of battery log data;

Batpack info:

【Initial Capacity】: Initial SOC of the battery pack;
【Capacity】: Initial capacity of the battery pack;
【SOC0% Volt】: Open-circuit voltage of the battery pack when SOC is 0%;
【SOC100% Volt】: Open-circuit voltage of the battery pack at 100% SOC;
【R】: Equivalent impedance of the battery pack;

Configuration Area:

【Loop Test】: Enable/Disable experimental cycle function;
【Cycles】： Number of simulated battery test cycles to execute;
【Cutoff SOC】： End condition for a single cycle (SOC);
【Cutoff Capacity】: End condition for a single cycle (capacity);

Protection Parameters:

【Protect】: Enable/Disable experimental protection function;
【Charge SOC】: Cell SOC protection threshold during charging;
【Discharge SOC】: Cell SOC protection threshold during discharge;
【Charge Volt】: Cell voltage protection threshold during charging;
【Discharge Volt】: Cell voltage protection threshold during discharge;
【Fuse Current】: Charge or discharge current protection threshold;

Batpack Protect:

【Charge SOC】: Pack SOC protection threshold during charging;
【Charge Volt】: Battery pack SOC protection threshold during discharge;
【Discharge SOC】: Battery pack voltage protection threshold during charging;
【Discharge Volt】: Battery pack voltage protection threshold during discharge;

Alarm Parameters:

【Alarm】： Enable/Disable experimental alarm functionality;

【Charging SOC】: Cell SOC alarm threshold during charging;

【Discharge SOC】: Cell SOC alarm threshold during discharge;

【Charge Volt】: Cell voltage alarm threshold during charging;

【Discharge Volt】: Cell voltage alarm threshold during discharge;

Batpack Alert:

【Charge SOC】: Pack SOC alarm threshold during charging;

【Charge Voltage】: Pack SOC alarm threshold during discharge;

【Discharge SOC】: Battery pack voltage alarm threshold during charging;

【Discharge Voltage】: Pack voltage alarm threshold during discharge;

4.6.2 Operation Instructions

- Select the model in the model area
- Configure model parameters
- Configure parameters in the configuration area
- Configure log information
- Click the Update button to refresh interface curves and parameter information
- Click the Start button to begin the experiment. The status bar in the status area displays the current experiment type: BatSim
- Click the Pause button to pause the experiment
- Click the Resume button to continue the experiment
- Click the End button to conclude the experiment after completion
- Curve 1: Generates characteristic curves based on the current battery model. The red points on Curve 1 are determined by OCV and DCIR.
- Curve 2 shows the relationship between SOC, current, voltage, and time.
- In Curve 2: Real-time refresh enabled: Enables real-time curve updates; Zoom enabled: Allows scaling of the curve.
- Area 3 displays battery status: Stop, Charge, Discharge, Pause, Idle, Precharge.
- Check the box before the log file name to generate a log; uncheck it to disable logging.
- The print control for parameters in the log is determined by the checkbox before the parameter. Checking it prints the parameter; unchecking it suppresses printing.
- The log printing interval is configured in the measurement cycle within the configuration area.
- Clicking the Import button opens a file selection dialog. Select the desired file (.bats), then click "Open" to import. Clicking "Cancel" returns to the previous screen.
- Clicking the Export button opens the export dialog. Modify the filename in the bottom .bats input field. Click Save to export the file; clicking Cancel cancels the export.

5 ZETA Device

5.1 Steady-State Interface

5.1.1 Interface Description

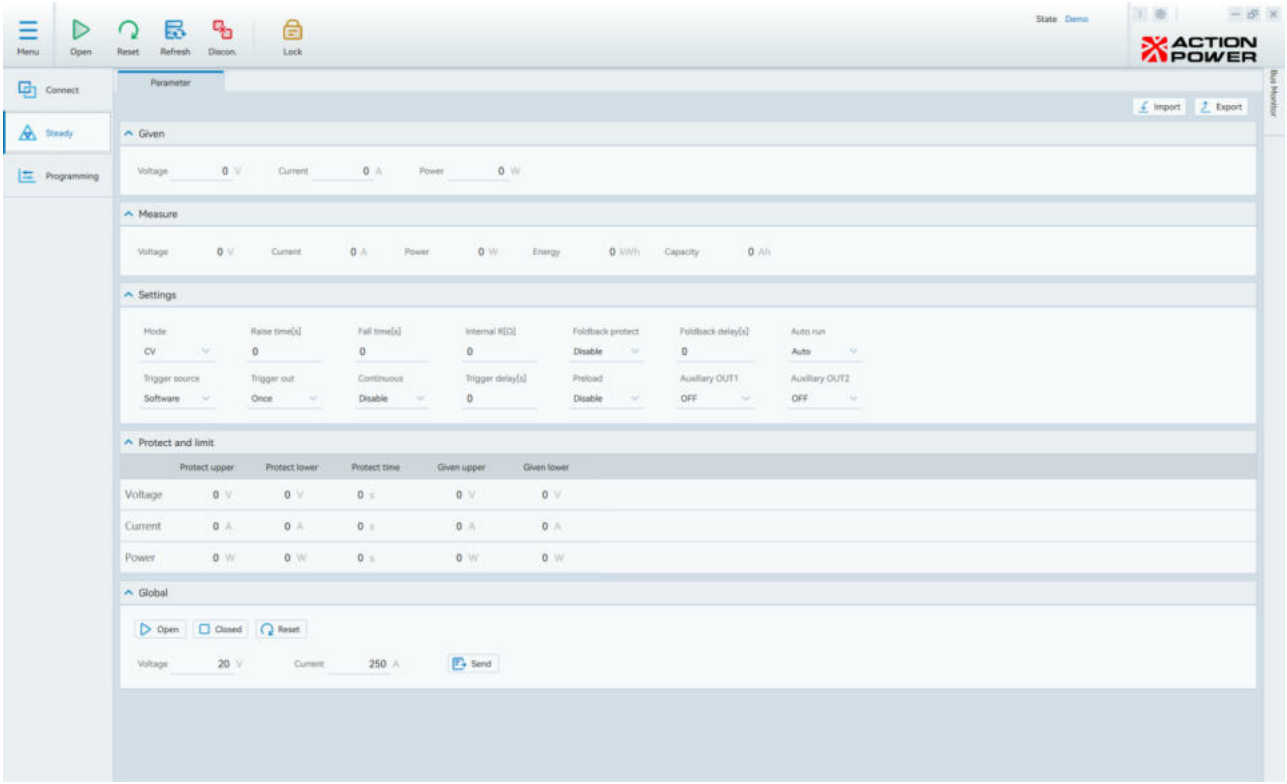


Figure 5.1 Steady State (ZETA) Page

Prerequisites: Device successfully connected or demonstration mode

Specified Area: Set voltage, current, power

Measurement Area: Real-time display of current device output measurements

Settings Area:

【Mode】: CV (Constant Voltage), CC (Constant Current), CVCP (Constant Voltage Constant Power), CCCP (Constant Current Constant Power)

【Raise/Fall Time】**:** Rise and fall time refer to the duration required to reach the rated value from 0. Users can set the rise/fall slope accordingly.

【Foldback Protect】**:** When operating in CV mode, if load overload causes output current limiting, resulting in output voltage falling below the voltage setpoint. Or when operating in CC mode, if improper load or an open circuit causes output voltage limiting, resulting in output current falling below the current setpoint. Foldback protection activates, shutting down power output to protect the load. Foldback protection is only effective in CV and CC modes.

【Auto Run】: Auto Mode: After power-up with no faults or after fault clearance, the power supply automatically starts up to operational status and begins output. Manual Mode: After power-up with no faults or after fault reset, the power supply enters standby mode. Set the operating mode and voltage/current setpoints as required. Press the OUT key to enter operational status and output

voltage or current.

【Trigger source】: Internal: Manually click "Trigger" on the display or send a trigger command via the communication interface to initiate internal triggering. External: Send a trigger signal through an external trigger signal input to initiate external triggering.

【Trigger Out】: Single: Triggered once upon receiving a trigger signal. Single Step: Triggered once per step executed after receiving a trigger signal. Single Cycle: Triggered once per cycle executed after receiving a trigger signal.

【Continuous】: Continuous triggering supports skipping idle state after programming completion. Enabled continuous triggering bypasses idle state directly to initialization state upon programming finish, keeping the trigger system active. Disabled continuous triggering enters idle state after programming, disabling the trigger system.

【Trigger Delay】: After receiving the first trigger signal, the trigger function executes after the configured delay time.

【PreLoad】: When enabled, a discharge load is applied to facilitate faster discharge during shutdown.

【Auxiliary OUT1】When connected, REMOTE-21 and REMOTE-11 output a low level; when disconnected, REMOTE-21 and REMOTE-11 output a high level.

【Auxiliary OUT2】When connected, REMOTE-20 and REMOTE-11 output a low level. When Auxiliary OUT2 is disconnected, REMOTE-20 and REMOTE-11 output a high level.

Protection and Limits: Set voltage, current, power upper/lower limits, and protection upper/lower limits

Global Settings: Used for handling multiple devices in parallel operation

Click the Send button to set voltage and current setpoints for all power supplies

Click the Start button to activate output on all power supplies

Click the Stop button to halt output from all power supplies

Click the Reset button to restore all power supplies to factory settings, reset all parameters to default values, and delete user-defined parameters

5.1.2 Operation Instructions

- The measurement area cannot be modified and is only for displaying the current output measurement values.
- There is no specific order for configuring each region.
- Clicking the Import button opens a file selection dialog. Select the file to import (.stdy), then click "Open" to import it. Clicking Cancel returns you to the previous screen.
- Clicking the Export button opens the export dialog box. Modify the name in the filename input field at the bottom. After modification, click the Save button to export the file. Clicking Cancel cancels the export.

5.2 Programming Interface

5.2.1 Basic Programming

5.2.1.1 Interface Description

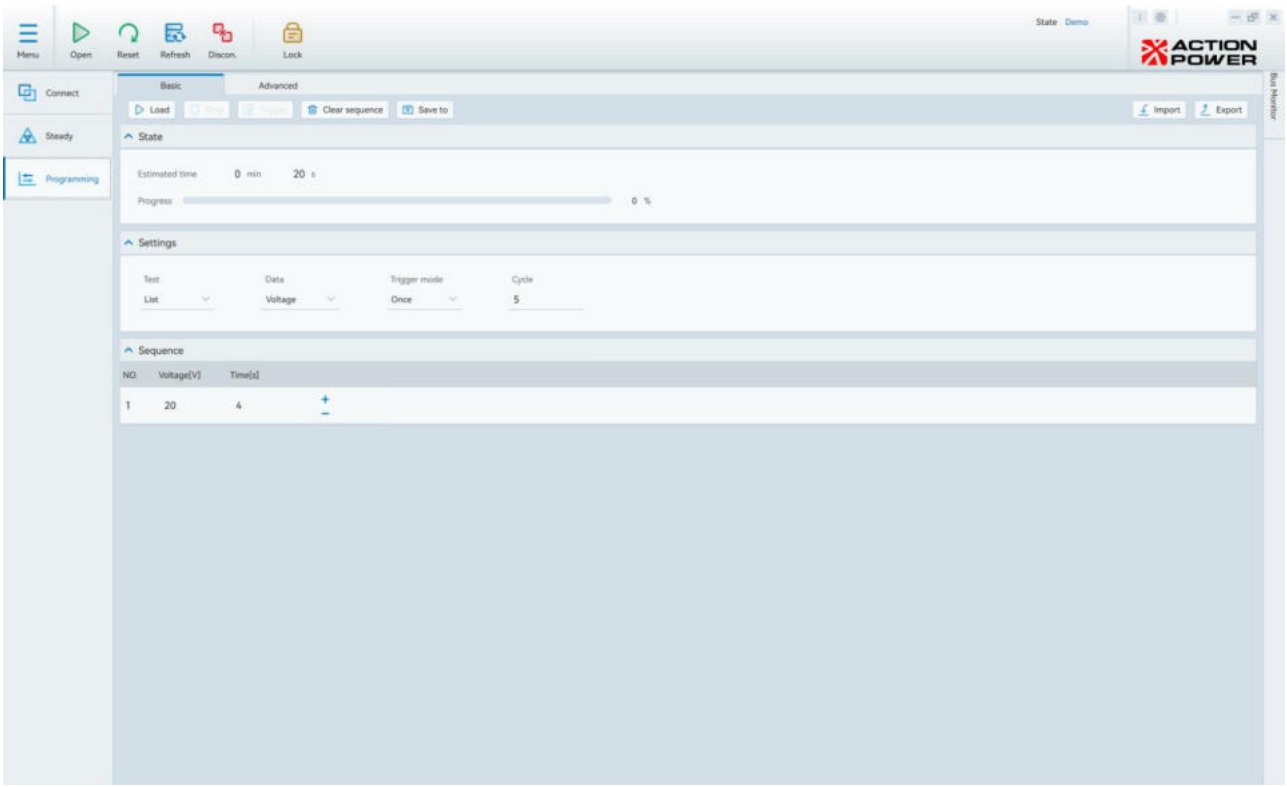


Figure 5.2.1 Basic Programming Page

Prerequisites: Successful device connection or demo mode

Function Area: - Start button: Sends sequence and settings to the device - End button: Terminates the current experiment - Trigger button: Initiates the current experiment - Clear Sequence button: Clears all sequence entries except the first one - Save To button: Stores settings and sequence information to the selected storage unit

States Area: Displays current experiment status information;

【Estimated Time】: Total experiment duration calculated based on set loop count and sequence length;

【Progress】: Current execution progress of the experiment.

Settings Area:

【Cycle】: Sets the number of times the basic programming sequence will be cycled.

【Test】: Choose between List or Wave. The key difference between Wave and List is that in List, each sequence's duration represents the current voltage's duration, while in Wave, each sequence's duration includes the transition time from the previous voltage to the current voltage.

【Data】: Voltage, Current;

【Trigger Mode】: Auto: Executes sequentially according to the programmed order. Single: Executes only one sequence per trigger.

Sequence Area: Each sequence sets its corresponding amplitude based on the experimental data selected in the settings.

【Time】: Indicates how long this amplitude persists.

5.2.1.2 Operation Instructions

- In the Settings Area: Select experiment, choose experimental data, select trigger mode, and set loop count.
- Configure sequences in the Sequence Area; up to 200 sequences can be added.
- Click the Start button to activate the device.
- Click the Start button to send experiment information to the device.
- Click the Trigger button to initiate the experiment. The status bar in the Status Area displays the current experiment type. Basic Programming
- Click the Save To button to send data for storage to the selected storage unit
- After the experiment ends, click the End button to conclude the experiment
- Once basic programming begins, advanced programming is unavailable; advanced programming options will be masked.
- Clicking the Import button opens a file selection dialog. Select the file to import (.basev, .basec), then click "Open" to import. Clicking Cancel returns to the previous screen.
- Clicking the Export button opens the Export File dialog. Modify the filename in the bottom input field. Click Save to export the file; clicking Cancel cancels the export.
- Example: Select List for the experiment, choose Voltage for the experimental data, configure the sequence as shown in Figure 5.2.2, and the corresponding waveform is shown in Figure 5.2.3.

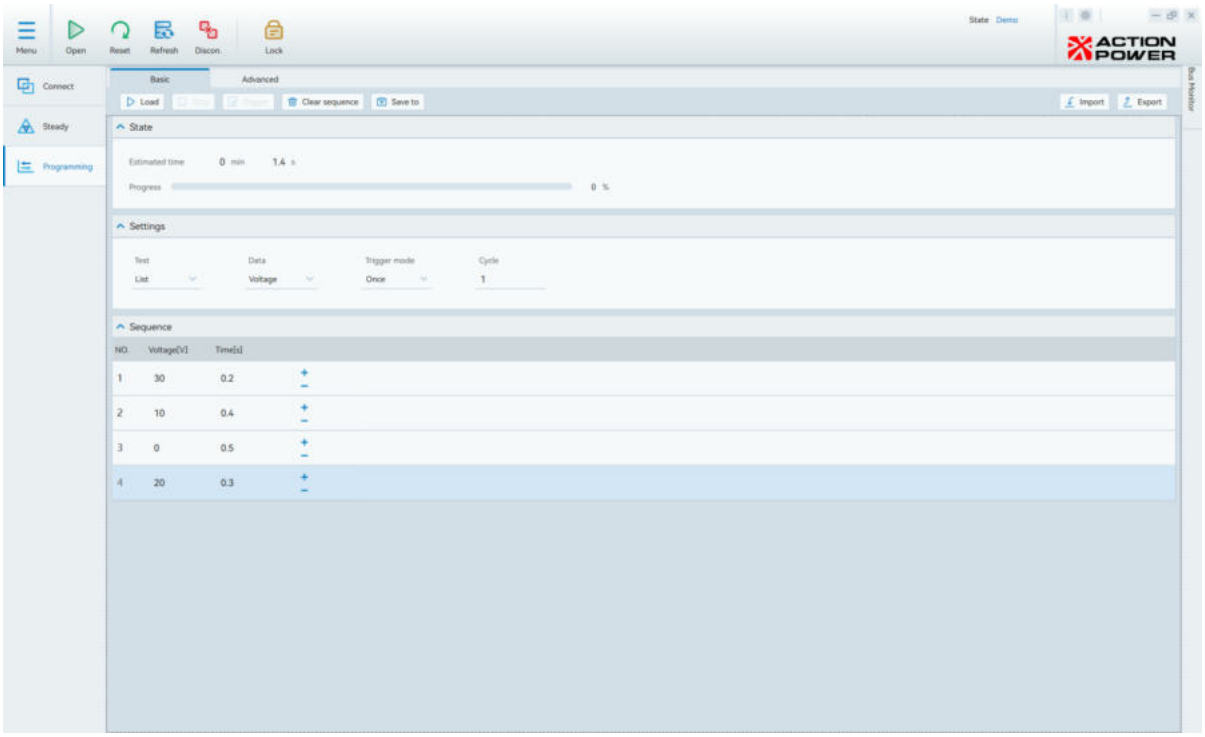


Figure 5.2.2 Example diagram of List sequence configuration

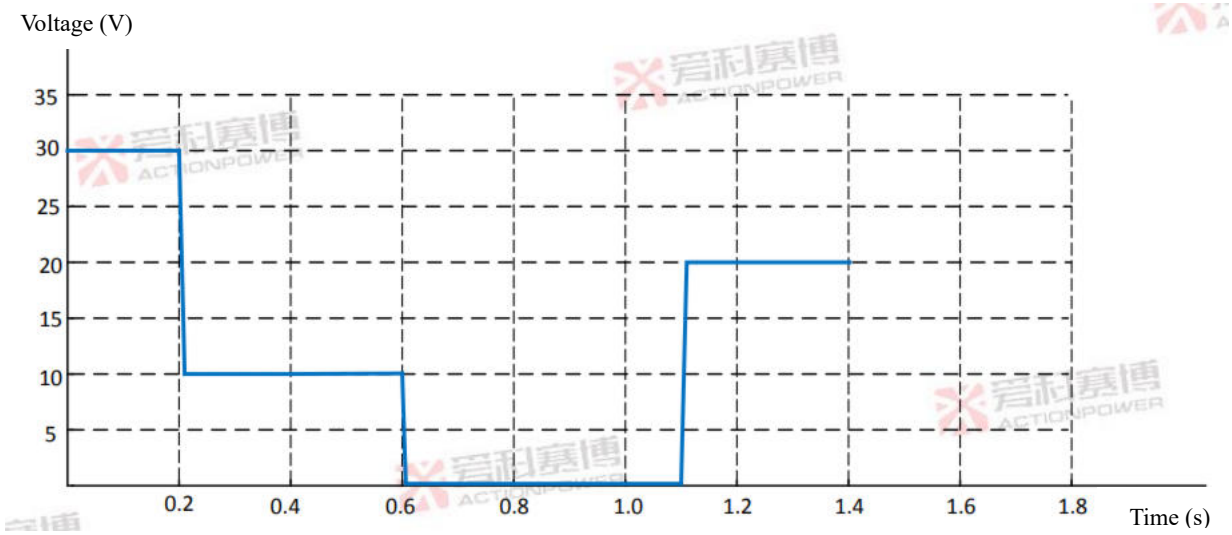


Figure 5.2.3 Example diagram of List waveform

➢ Example: Experiment type selected as Wave, experimental data selected as voltage. Sequence configuration as shown in Figure 5.2.4, corresponding waveform diagram as shown in Figure 5.2.5

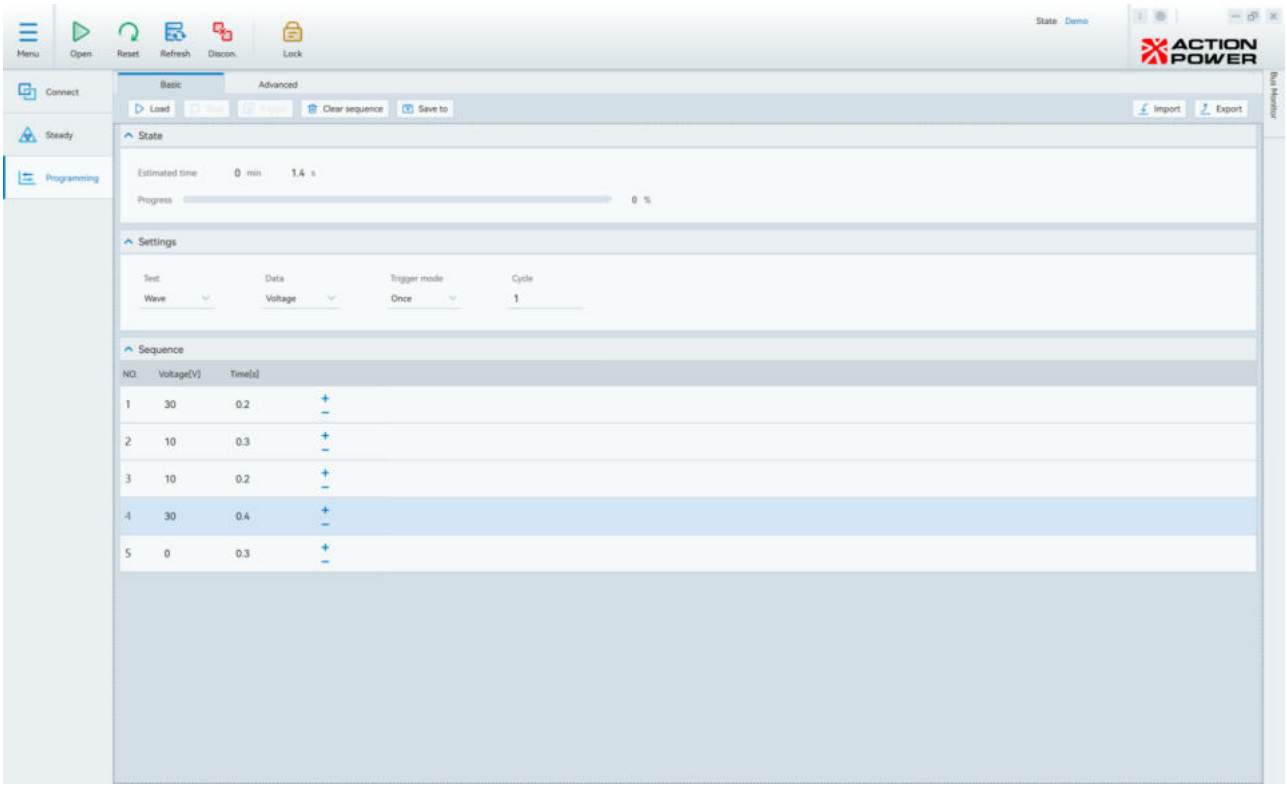


Figure 5.2.4 Wave Sequence Configuration Example Diagram

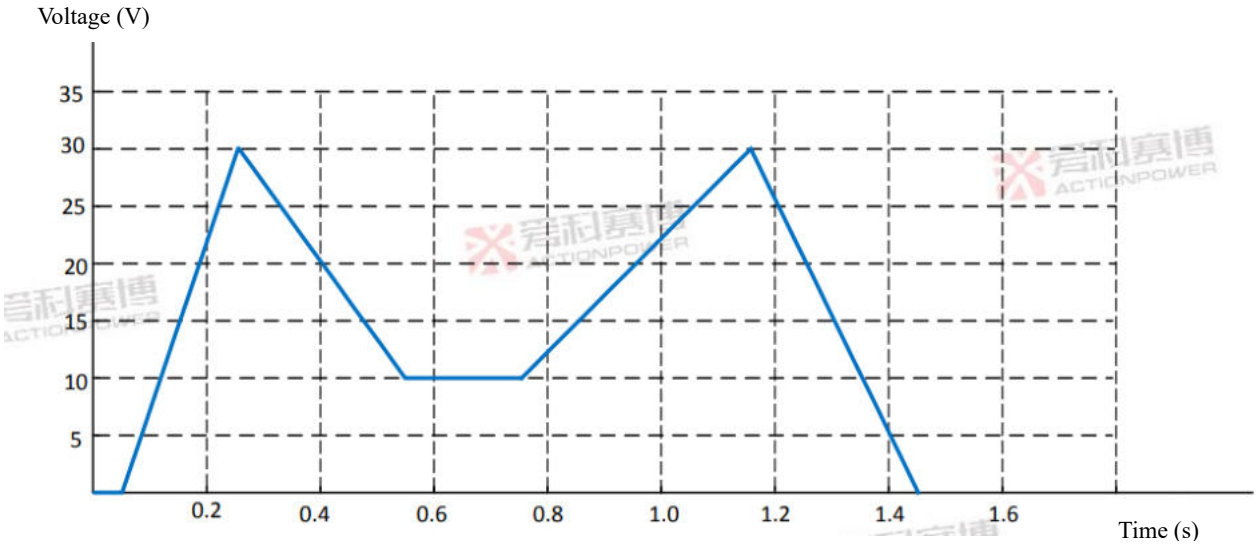


Figure 5.2.5 Waveform Example Diagram

5.2.2 Advanced Programming

5.2.2.1 Interface Description

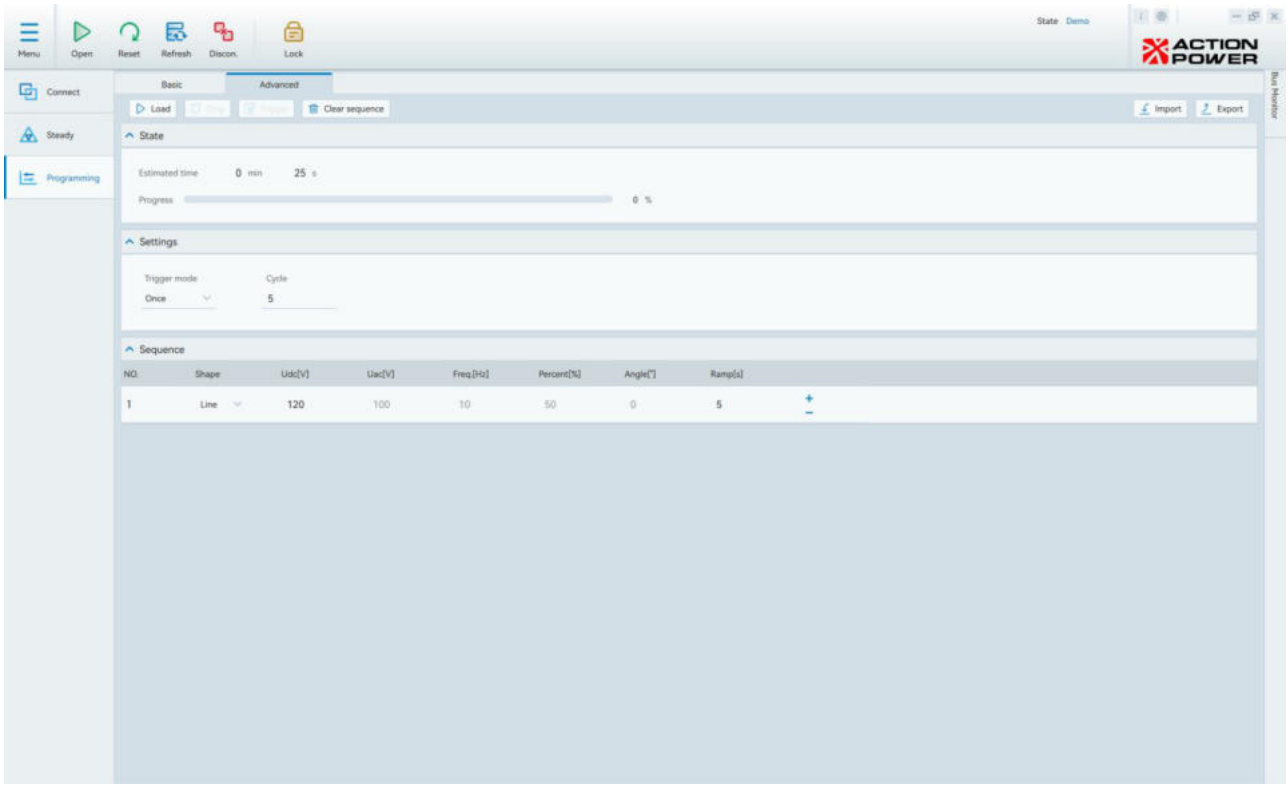


Figure 5.2.6 Advanced Programming Interface

Prerequisites: Successful device connection or demo mode

Function Area: The Start button sends sequence and configuration information to the device; the End button concludes the

current experiment; the Trigger button initiates the experiment; the Clear Sequence button removes all but one entry from the sequence.

State Area: Displays current experiment status information.

【Estimated time】: Total experiment duration calculated based on set loop count and sequence;

[Progress]: Current execution progress of the experiment.

Settings Area:

[Cycle]: Sets the number of times the basic programming sequence will be cycled through.

【Trigger Mode】: Auto: Executes sequences sequentially according to programming order. Single: Executes only one sequence per trigger.

Sequence Area: Waveforms can be selected from line, triangle, sine, or square wave;

5.2.2.2 Operation Instructions

- Select trigger mode and set loop count in the Settings Area
- Configure sequences in the Sequence Area; up to 100 sequences can be added
- Click the Start button to activate the device
- Click the Start button to send experiment information to the device
- Click the Trigger button to initiate the experiment. The status bar in the Status Area displays the current experiment type. Advanced Programming
- Click the End button to conclude the experiment after completion
- Once advanced programming begins, basic programming becomes unavailable and will be masked.
- Clicking the Import button opens a file selection dialog. Select the desired file (.adva), then click "Open" to import it. Clicking Cancel returns you to the previous screen.
- Clicking the Export button opens the Export File dialog. Modify the filename in the bottom input field. Click Save to export the file; clicking Cancel cancels the export.
- Example: Sequence configuration as shown in Figure 5.2.7, corresponding waveform diagram as shown in Figure 5.2.8

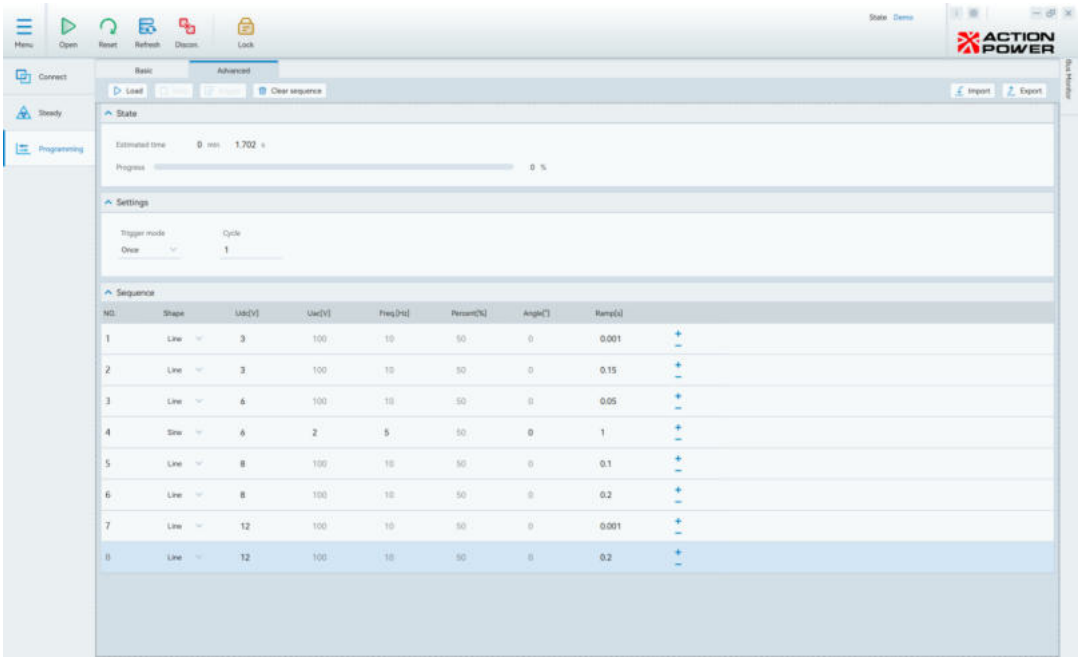


Figure 5.2.7 Example diagram of advanced programming sequence configuration

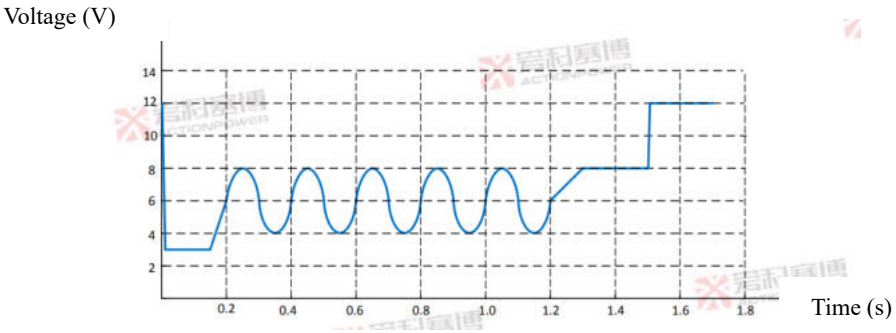


Figure 5.2.8 Example diagram of advanced programming waveform

6 PRE and PAC Devices

6.1 Steady-State Interface

6.1.1 Steady-State Parameters

6.1.1.1 Interface Description

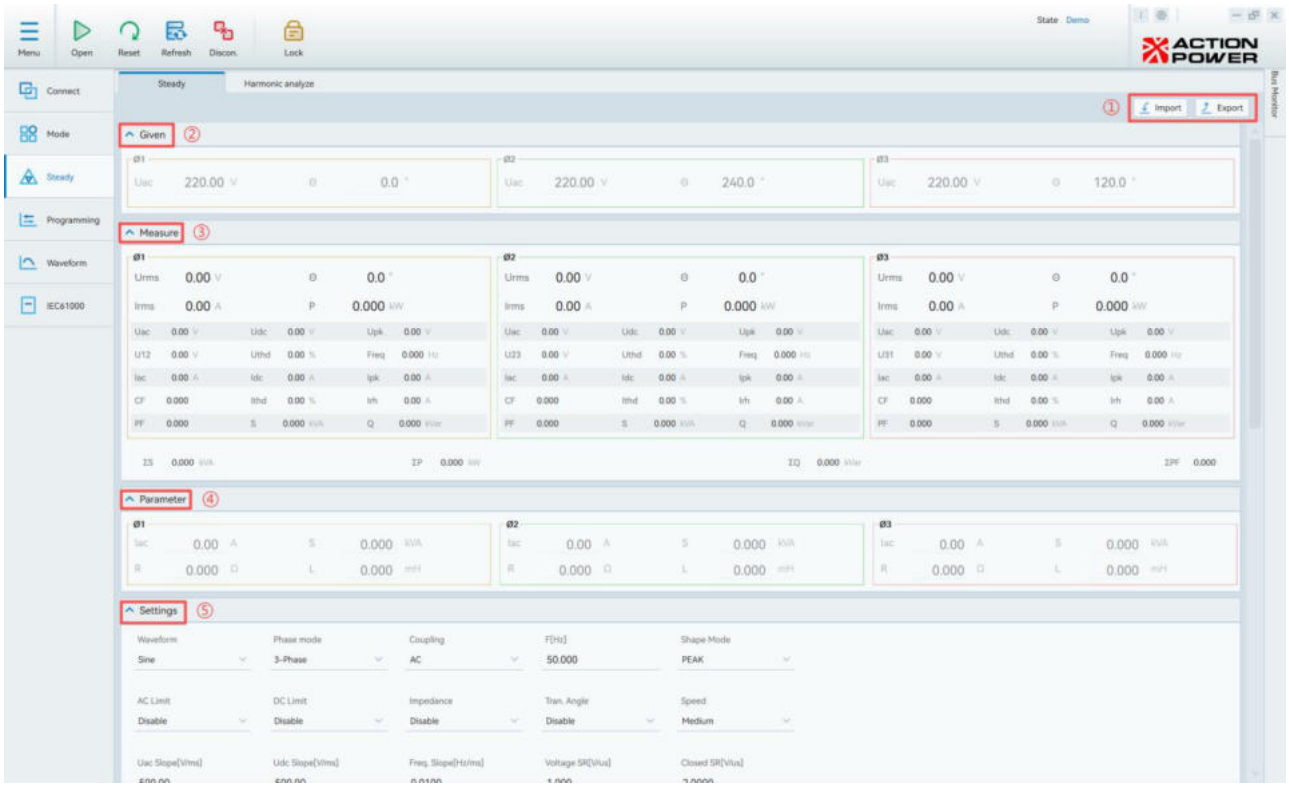


Figure 6.1.1 Steady-State Parameters Window (AC)

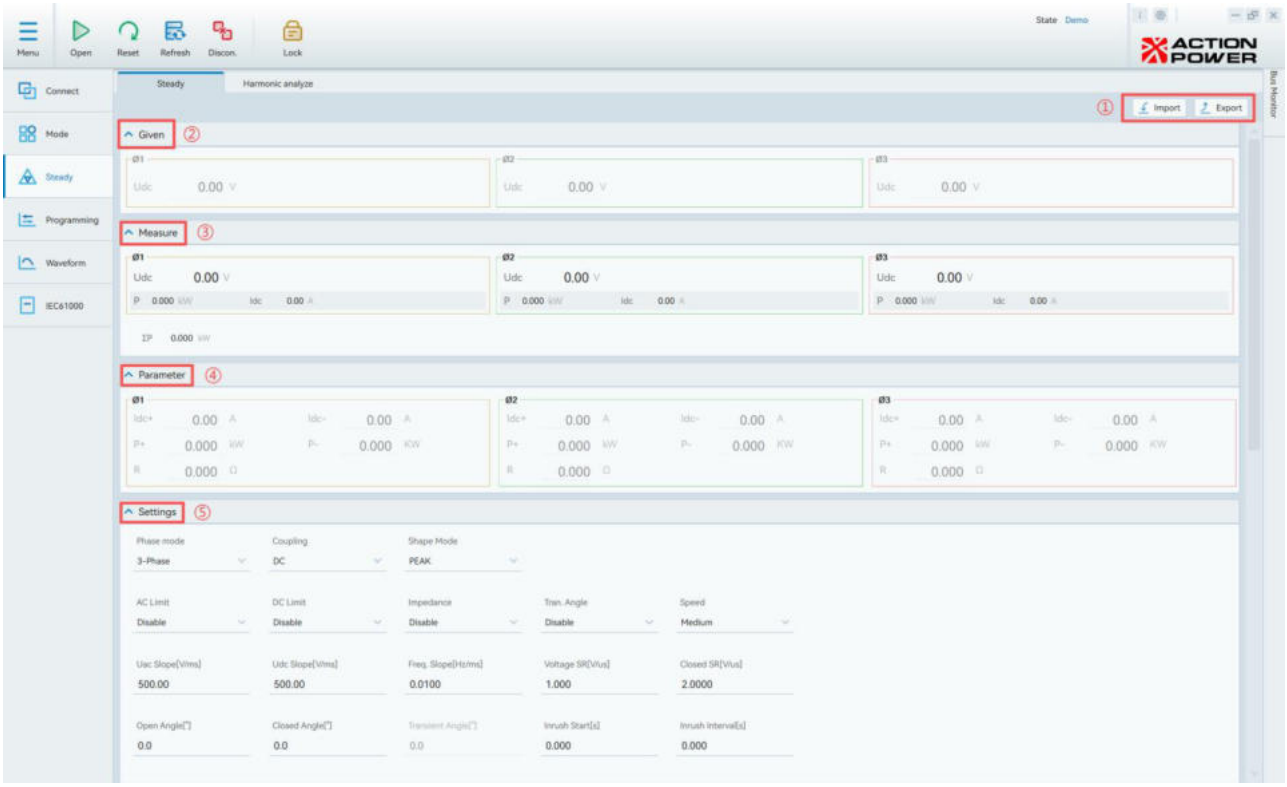


Figure 6.1.2 Steady-State Parameters Window (DC)

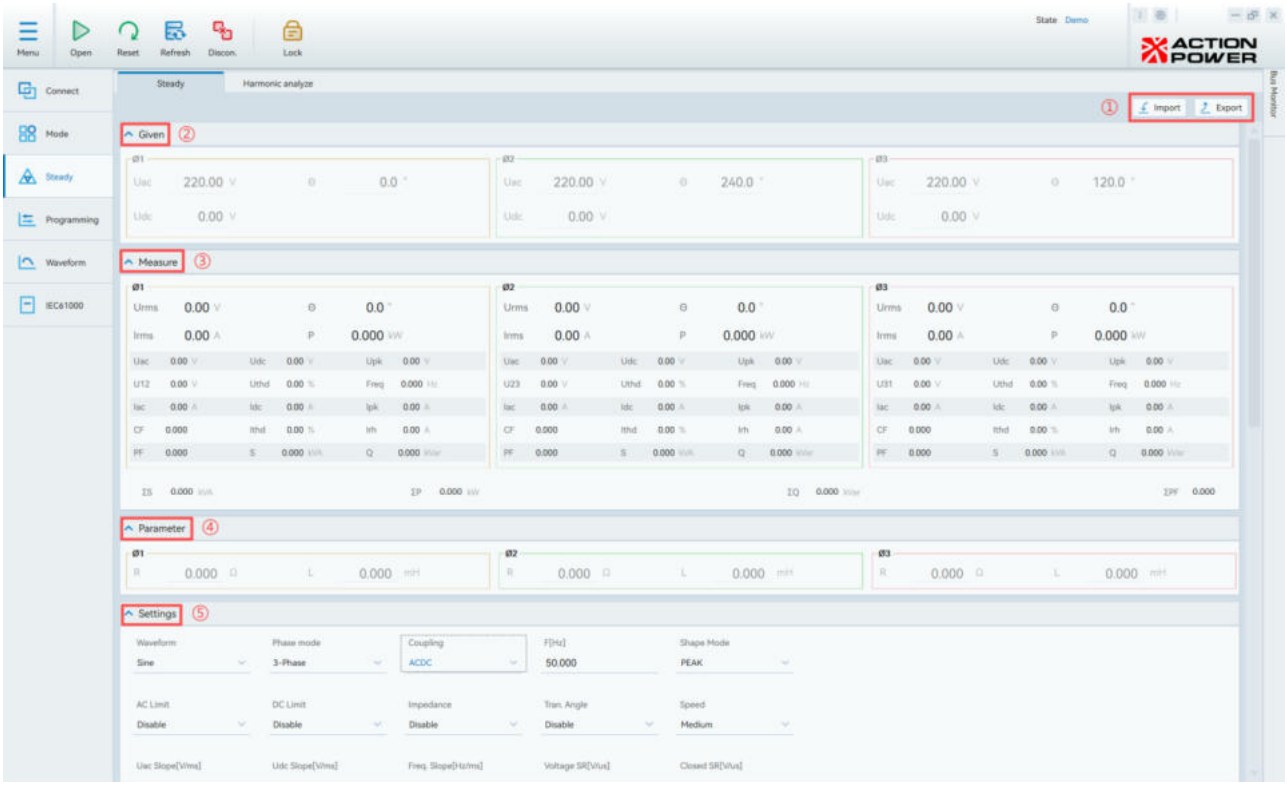


Figure 6.1.3 Steady-State Parameters Window (AC+DC)

Selecting different coupling modes corresponds to different steady-state parameter windows: AC, DC, and AC+DC correspond to Figures 6.1.1, 6.1.2, and 6.1.3 respectively.

Prerequisites: Successful device connection or demonstration mode

1. Function Area: Import/Export current steady-state parameters

2. Input Area:

【Uac】: RMS value of AC voltage component;

【Udc】: RMS value of the DC voltage component

【θ】: Initial phase angle

3. Measurement Area: Real-time display of current device output measurements

【Urms】**:** Square root of the sum of the square of the AC component RMS value and the DC component average value;

【Irms】**:** Square root of the square root of the sum of the square root of the DC component of the current and the square root of the square root of the AC component of the current;

【Upk】**:** Absolute value of voltage peak

【Uthd】**:** Total voltage harmonic distortion ratio

【ULL】: Line voltage RMS value

【Iac】**:** RMS value of the AC component of current

【Idc】**:** DC component effective value of current

【Ipk】**:** Absolute value of current peak

【CF】: Current peak factor

【Ithd】: Total current distortion ratio

【F】: Output frequency

【PF】: Power factor

【S】: Apparent power

【Q】: Reactive Power

【P】: Active Power

【∑S】: Total apparent power

【∑P】: Total active power

【∑Q】: Total reactive power

4. Configuration Zone:

【Transient Trigger Output】: "Single Step" outputs a 50μs pulse at the start of the sequence; "Single Cycle" outputs a 50μs pulse at the start of each cycle; "Single Time" outputs a 50μs pulse only at the start of the first sequence.

【Harmonic Trigger Output】: "Fundamental" indicates outputting a 50μs pulse width per fundamental cycle; "Single" indicates outputting a 50μs pulse width at the start of harmonic operation.

【Interharmonic Trigger Output】: Descriptions for each item are identical to the above two.

【Trigger Mode】: "Auto" runs until completion after triggering, requiring a pulse of at least 50μs width; "Single-Step" requires a

trigger command for each sequence to run, requiring a pulse of at least 50μs width.

【Trigger Source】: "Local Software" refers to local operation and communication operations; "External Hardware" refers to the "Trigger Terminal".

【R】: Load Resistance

【L】: Load Inductance

【SR】: Slew Rate

【Uac(V/MS)】: AC voltage slope

【Udc(V/MS)】: DC voltage slope

5. Protection Zone:

【Time】: Refers to the duration counted after the power supply detects an output parameter exceeding the protection threshold. If the output parameter remains above the threshold after the count completes, protection is triggered. The minimum configurable time is 1ms.

6.1.1.2 Operation Instructions

- First modify settings in the Configuration Zone
- Then modify settings in the Setpoint Zone and Protection Zone. There is no specific order for modifying settings in these zones.
- Coupling mode and output phase number will be displayed in the Status Zone mode field after configuration.
- The measurement area cannot be modified and is for displaying current output measurement values only.
- Clicking the Import button opens a file selection dialog. Select the desired file (.meas), then click "Open" to import. Clicking Cancel returns to the previous screen
- Clicking the Export button opens the Export File dialog. Modify the filename in the bottom input field, then click Save to export the file. Clicking Cancel cancels the export.
- Data import is disabled in Run mode; the import button appears grayed out. Editing is not possible, but export operations remain available.

6.1.2 Harmonic Analysis Interface

6.1.2.1 Interface Description

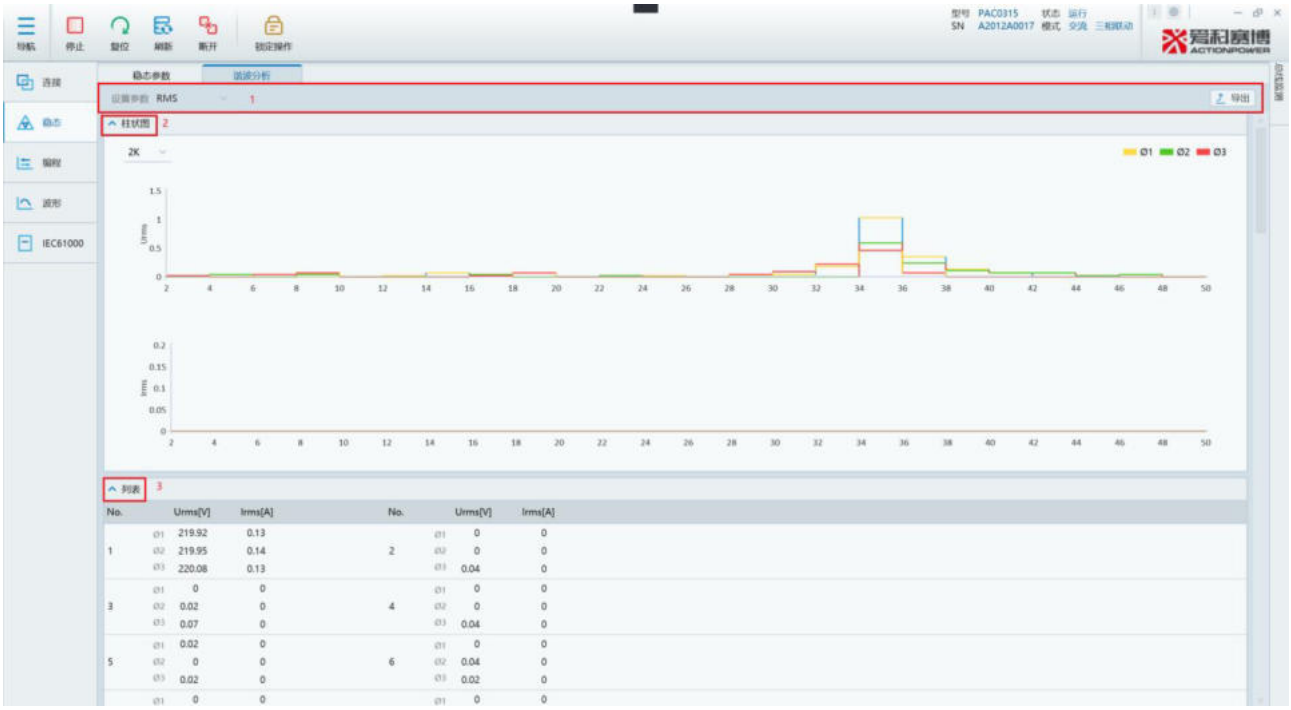


Figure 6.1.4 Harmonic Analysis Interface

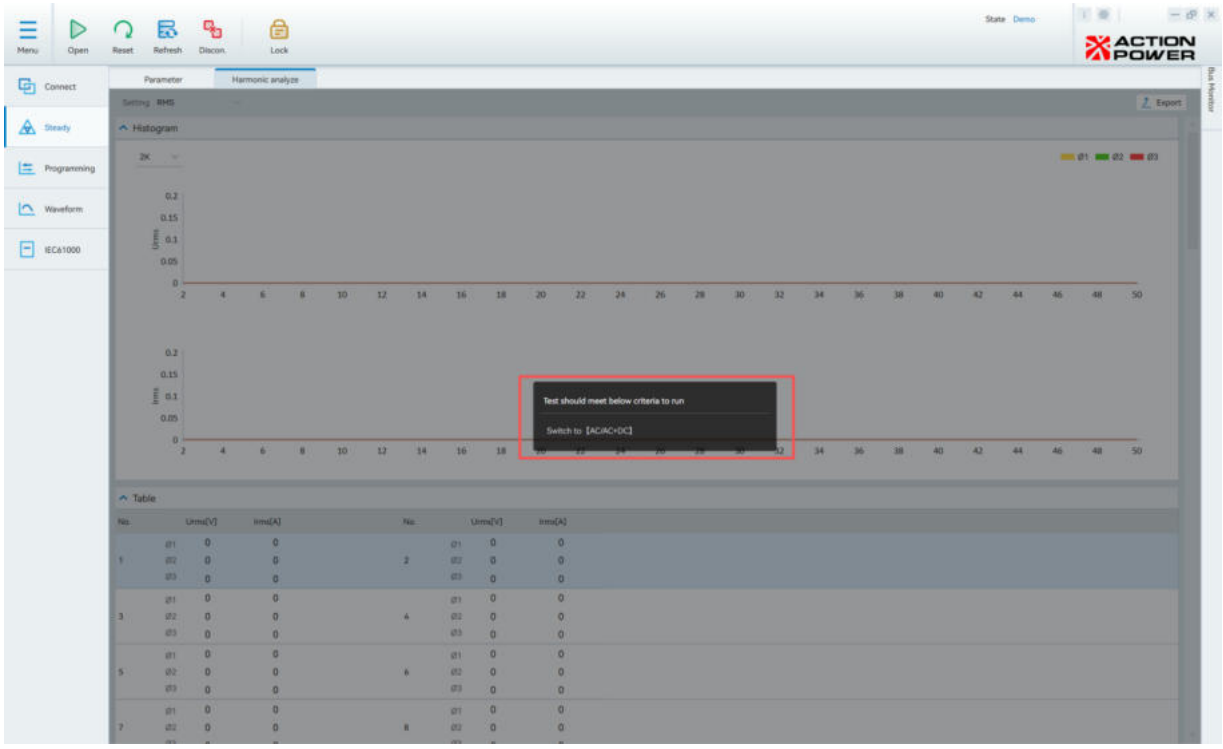


Figure 6.1.5 Harmonic Analysis Prompt

The Harmonic Analysis interface displays current harmonic content and RMS values. This feature is unavailable when the coupling mode is set to DC; it must be adjusted to AC or AC/DC mode. The prompt message is shown in Figure 6.1.5.

Prerequisites: Successful device connection with coupling mode set to AC, AC/DC, or Demo mode

1. Function Area: Settings Parameters: Select parameters to view. RMS: View effective value. THD: View harmonic content percentage. Export Button: Export current interface data.

2. Bar Chart Area: View parameter information via bar chart. The horizontal axis represents the nth harmonic.

3. List Area: Real-time display of harmonic content or RMS values for different frequencies based on parameters set in the Function Area. Note: The number of frequencies displayed in the harmonic analysis interface depends on the frequency range set in steady-state mode.

6.1.2.2 Operation Instructions

- First, set the parameters to view in the function area.
- View parameter information at different frequencies in the bar chart. Use the dropdown menu in the upper-left corner to adjust the displayed frequency range.
- View corresponding parameter information in real time in the list area.
- Clicking the Export button opens the Export File dialog. Modify the filename in the bottom-most field (*.analy), then click Save to export the file. Clicking Cancel cancels the export.
- Different frequencies correspond to different list area sequences and histogram horizontal axes, as detailed in the table below.

Frequency	Harmonic Order Display Range	Bar Chart X-Axis Display Range
40~100	100	50
100–200	10000/frequency	50
200–3200	10000/frequency	10000/frequency

6.2 Programming Interface

If an IEC 61000 test is currently running, switching to the programming menu will display the message: "IEC 61000 test is in progress. Please complete the test before switching."

6.2.1 List Interface

6.2.1.1 Interface Description

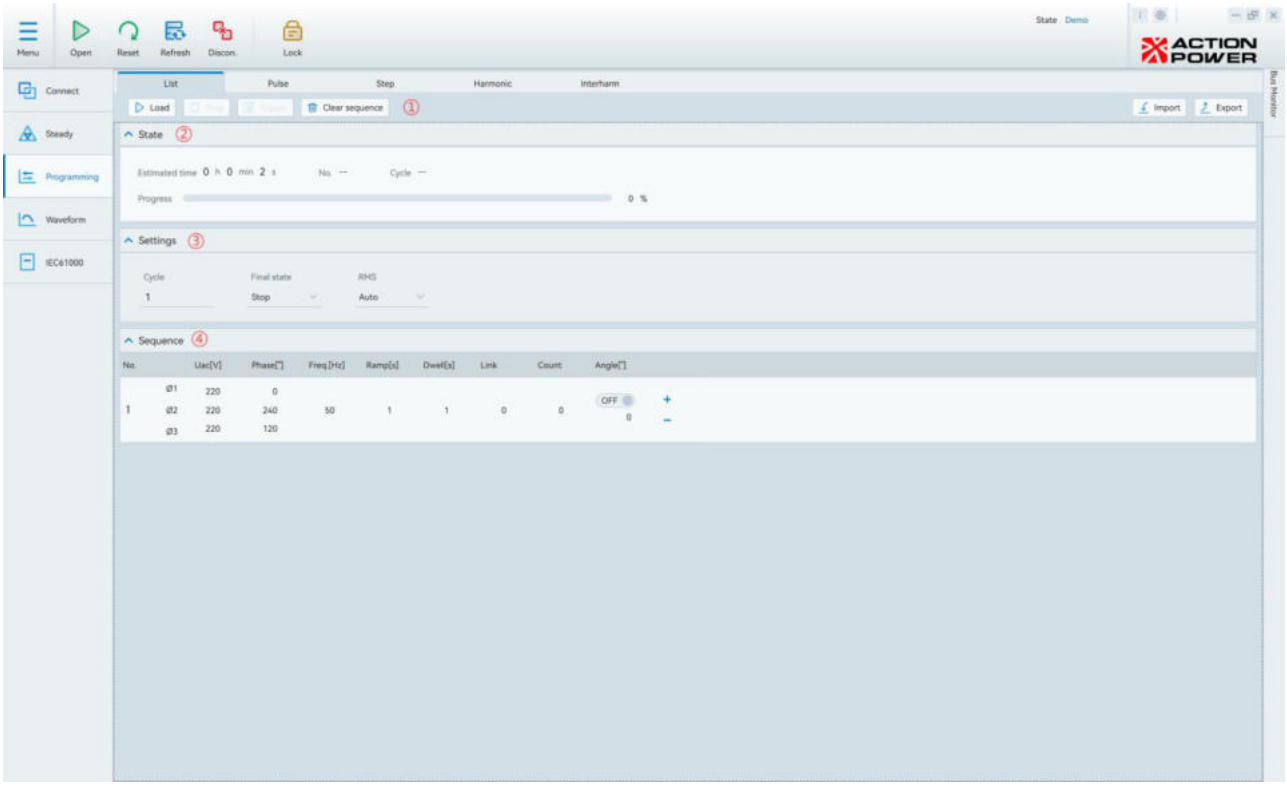


Figure 6.2.1 Transient List Interface

The Transient List supports combined programming to accommodate ramp and step tests.

Prerequisites: Successful device connection or demo mode

1. Function Area: The Load button transmits sequence and configuration data to the device; the Stop button concludes the current experiment; the Trigger button initiates the experiment; the Clear Sequence button reduces the sequence to a single entry.

2. Status Area: Displays current experiment status information;

【Estimated Time】: Total experiment duration calculated based on set loop count and sequence length;

[No.]: The sequence number currently being executed;

[Cycle]: Current cycle number being executed;

[Progress]: Current progress of the experiment.

3. Settings Area:

【Cycle】: Total number of cycles for transient List, range 0–1000 (0 indicates infinite loop)

【Final State】: Device state selection after transient list completion. "Hold" maintains the last sequence output state; "Exit" returns to steady-state condition upon completion.

【RMS】: Setting for the output voltage RMS value during transient list execution. See Table 6.1 for details.

RMS Mode	Description
Auto	Effective value control is active when the waveform type is sine wave, clipped wave, or one of the 30 built-in harmonics in custom waveforms. It is inactive for other waveforms.
Enable	RMS control is enabled for all waveforms
Disabled	RMS control disabled for all waveforms

Table 6.1 RMS Mode Description Table

4. Sequence Area:

【Uac】: Target AC voltage values for each phase of the current sequence;

【Phase】: Target relative AC phase values for each phase in the current sequence;

【Freq】: Target frequency value for the current sequence;

【Ramp】: Target time for transitioning from steady state or previous sequence to the current sequence's AC voltage target value, DC voltage target value, and frequency;

【Dwell】: Target duration for the current sequence;

【Link】: Number of upward sequence combinations for the current sequence;

【Count】: Number of repetitions for the current sequence combination;

【Angle】: Absolute phase angle at the start of the current sequence. Enabled for value setting; disabled by default. Phase angle and time describe different dimensions of the same waveform and are mutually convertible. When phase angle and hold time values conflict, the device prioritizes phase angle changes.

PRE and PAC series models support both AC and DC operation. Therefore, setting different modes in steady-state mode will result in distinct operational states, as detailed in Table 6.2 below.

Coupling Mode	Sequence Bar	State Mode	**Number of Output Phases**	Sequence Bar	Status Mode
AC	DC Voltage Not Displayed	AC	**Single-phase**	Displays only Ø1	Single-phase
DC	Display DC voltage only	DC	**Three-phase**	Simultaneously displays Ø1, Ø2, Ø3; voltages do not interfere with each other	Three-phase
AC+DC	Both AC and DC setpoint data	AC/DC	**Three-phase interlocking**	Simultaneously displays Ø1, Ø2, Ø3,	Three-phase interlocking

	displayed			and mutual influence between voltages	

Table 6.2 Status Table for Different Coupling Modes

6.2.1.2 Operating Instructions

- In the Settings section, configure the number of cycles, select the end condition, and set the valid value mode.
- Configure sequences in the Sequence Area; up to 100 sequences can be added
- Click the Open button to activate the device.
- Click the Load button to load experimental data. Once initiated, other programming interfaces will display the ongoing experiment.
- Click the Trigger button to start the experiment. The status bar in the Status area displays the current experiment type: Transient List.
- After the experiment completes, click the End button to terminate it.
- Clicking the Import button opens a file selection dialog. Select the file (.List) to import, then click "Import" button to import it. Clicking Cancel returns to the previous screen. The Import button is disabled while the device is running.
- Clicking the Export button opens the Export File dialog. Modify the filename in the bottom input field. Click Save to export the file; clicking Cancel cancels the export.
- Example: Select AC for the coupling mode and three-phase synchronous output. The transient list configuration is shown in Figure 6.2.2, with the corresponding waveform in Figure 6.2.3.

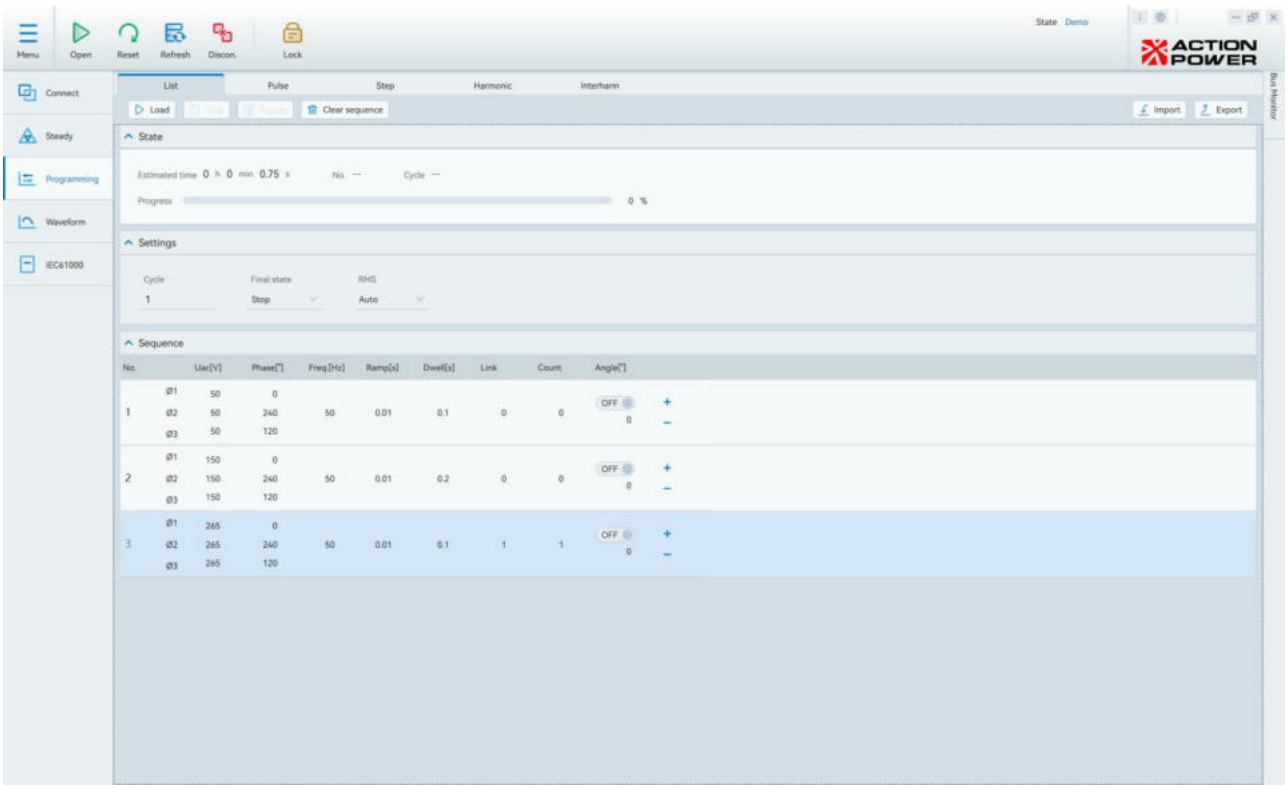


Figure 6.2.2 Schematic of Transient List Configuration

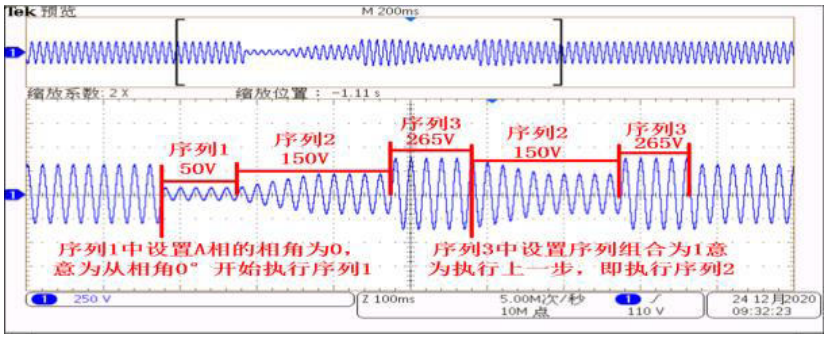


Figure 6.2.3 Actual waveform diagram of transient list

6.2.2 Transient Pulse Interface

6.2.2.1 Interface Description

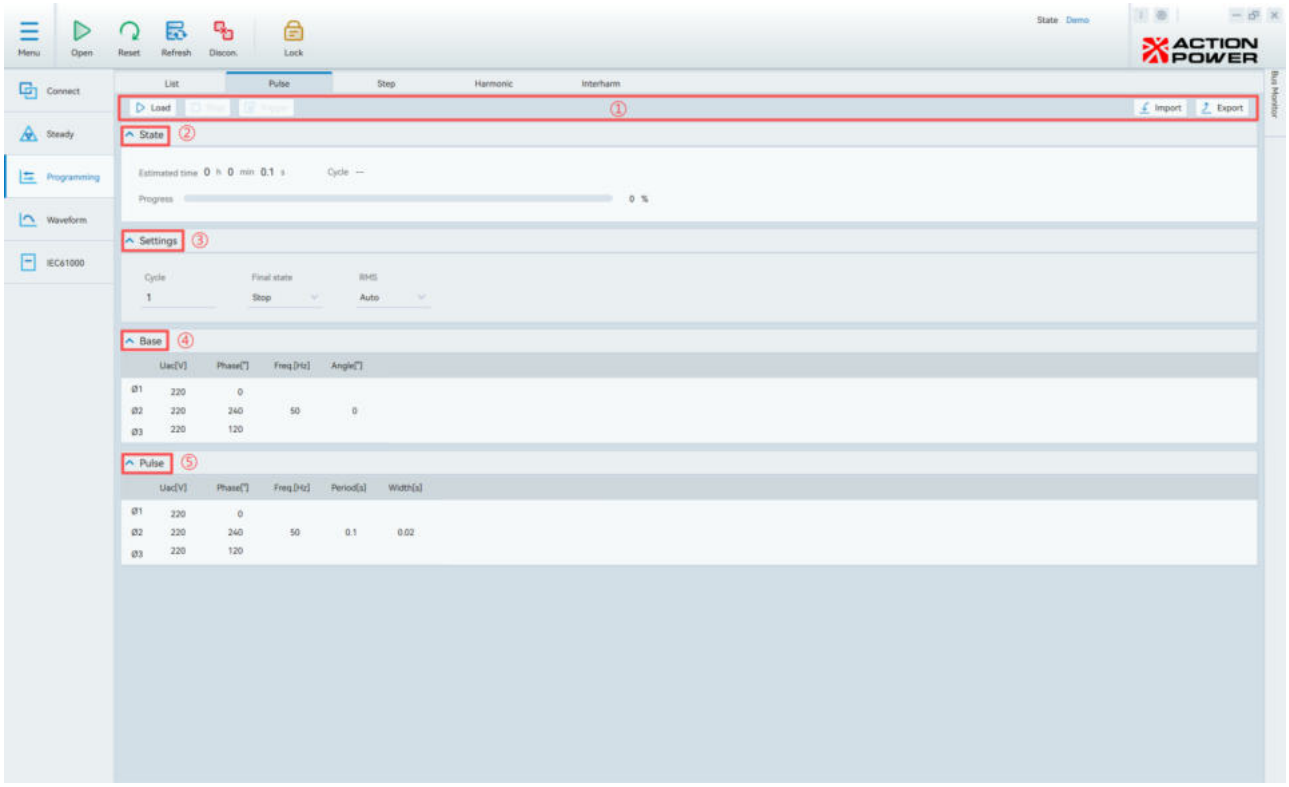


Figure 6.2.4 Transient Pulse Interface

Transient Pulse supports fundamental waveform superimposed with pulse waveforms;

Prerequisites: Successful device connection or demo mode

1. Function Area: The Start button transmits fundamental pulse information and settings to the device; the End button concludes the current experiment; the Trigger button initiates the experiment.

2. Status Area: Displays current experiment status information;

【Estimated Time】: Total experiment duration calculated based on set loop count and pulse period;

[Cycle]: Current cycle number being executed;

[Progress]: Current progress of the experiment.

3. Settings Area:

【Cycle】: Total number of transient pulse cycles, range 0–1000 (0 indicates infinite looping)

【Final State】: Device state selection after transient pulse completion. "Hold" maintains the last sequence output state; "Exit" returns to steady-state condition upon completion.

【RMS】: Setting for the output voltage RMS value during transient pulse. See Table 6.1 for details.

4. Base Zone:

【Uac】: Target AC voltage values for each phase in the current mode interface.

【Phase】: Target AC phase values for each phase in the current mode interface;

【Freq】: Target frequency value for the current mode interface;

【Angle】: Starting phase angle for "Fundamental" mode.

5. Pulse Zone:

【Period】: Target value for the total execution time in "Pulse" and "Fundamental" modes;

【Width】: Target value for the duration in "Pulse" mode

6.2.2.2 Operation Instructions

- In the settings area, configure the number of cycles, select the termination condition, and set the valid value mode.
- Configure fundamental wave and pulse information
- Click the Start button to activate the device
- Click the Start button to load experimental data. Once initiated, other programmed interfaces will display the ongoing experiment
- Click the Trigger button to initiate the experiment. The status bar in the status area displays the current experiment type: Transient Pulse
- After the experiment completes, click the End button to terminate it.
- Clicking the Import button opens a file selection dialog. Select the desired file (.puls), then click "Open" to import. Clicking Cancel returns to the previous screen. The Import button is disabled while the device is running.
- Clicking the Export button opens the Export File dialog. Modify the filename in the bottom input field. Click Save to export the file; clicking Cancel cancels the export.
- Example: Select AC for the coupling mode, set the output phase to three-phase synchronous operation, configure the transient pulse as shown in Figure 6.2.5, and the corresponding waveform is shown in Figure 6.2.6.

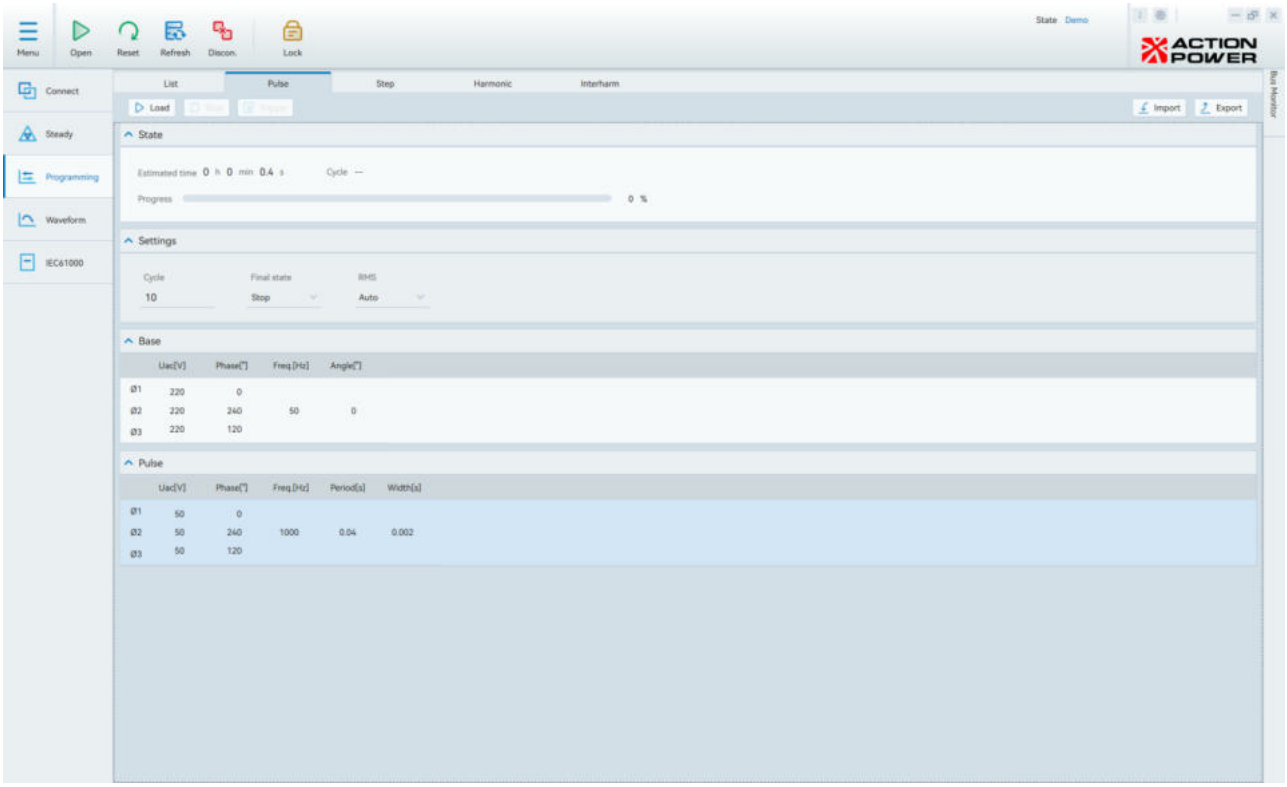


Figure 6.2.5 Schematic Diagram of Transient Pulse Configuration

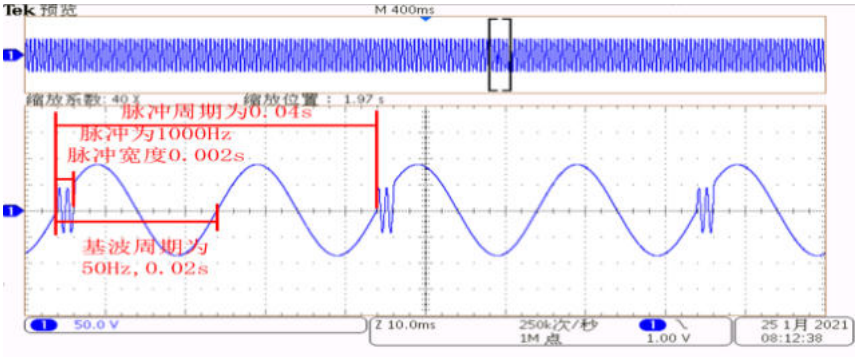


Figure 6.2.6 Transient Pulse Waveform Diagram

6.2.3 Transient Step Interface

6.2.3.1 Interface Description

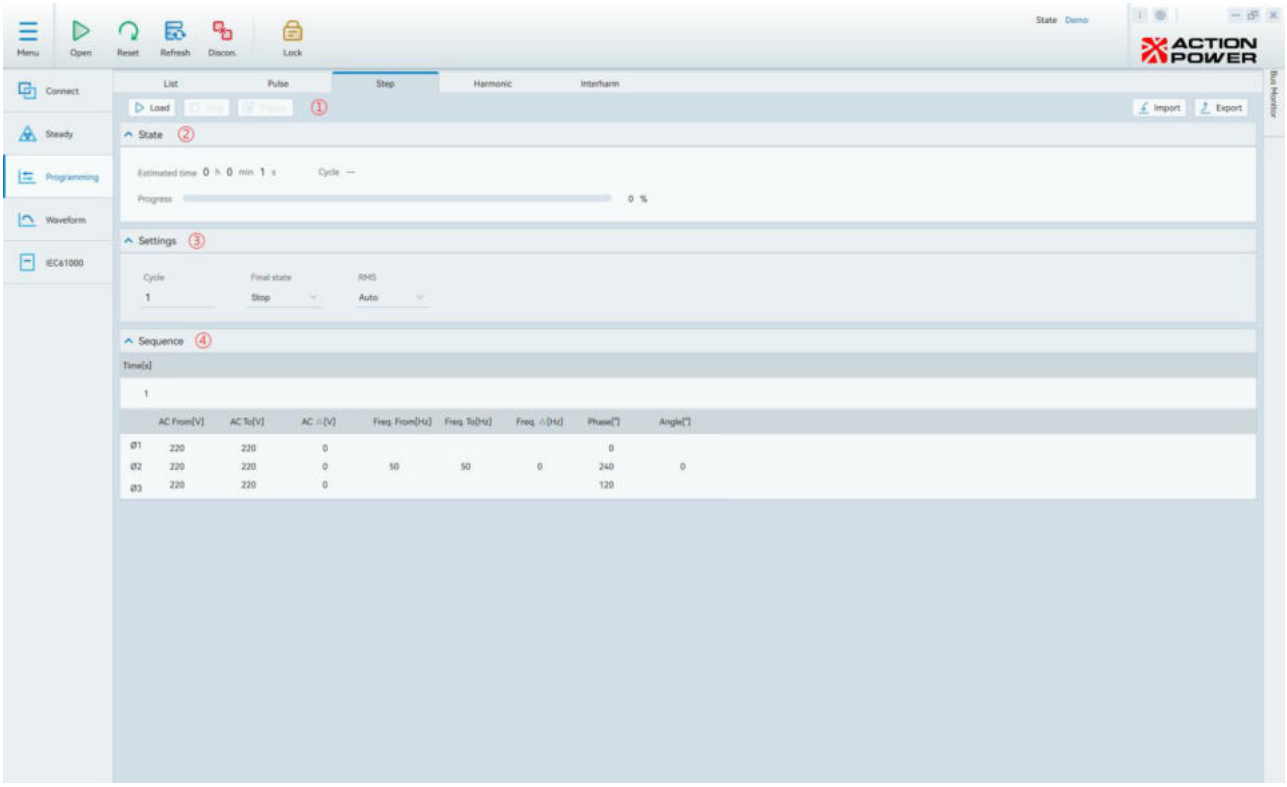


Figure 6.2.7 Transient Step Interface

Transient Step supports programming with equidistant step size variations;

Prerequisites: Successful device connection or demo mode

1. Function Area: The Start button transmits the sequence and settings to the device; the End button concludes the current experiment; the Trigger button initiates the current experiment;

2. State Area: Displays current experiment status information;

【Estimated Time】: Total experiment duration calculated based on set loop count and sequence;

[Cycle]: Current cycle number being executed;

[Progress]: Current progress of the experiment.

3. Settings Area:

【Cycle】: Total number of transient step cycles, range 0–1000 (0 indicates infinite looping)

【Final State】: Device state selection after transient step completion. "Hold" maintains the last sequence output state; "Exit" returns to steady-state condition upon completion.

【RMS】: Setting for the output voltage RMS value during transient step. See Table 6.1 for details.

4. Sequence Area:

【AC From】: Initial target value for AC voltage execution;

【AC To】: Target value for AC voltage execution at completion;

【Time】: Duration of each step;

【AC △】： Incremental target value for AC voltage execution;

【Freq From】: Initial target value for AC voltage execution;

【Freq To】: Target value for the end of AC voltage execution;

【Freq △】: Incremental target value for AC voltage execution;

【Phase】: Target relative phase angle for each phase in the current mode interface;

【Angle】: The absolute phase angle target value for AC voltage execution at the start

6.2.3.2 Operation Instructions

- In the settings area, configure the number of cycles, select the termination condition, and set the effective value mode.
- Configure sequence information
- Click the Start button to activate the device
- Click the Start button to load test data. Once initiated, other programmed interfaces will display the ongoing test
- Click the Trigger button to initiate the experiment. The status bar in the status area displays the current experiment type as Transient Step
- After the experiment completes, click the End button to terminate it.
- Clicking the Import button opens a file selection dialog. Select the desired file (.step), then click "Open" to import. Clicking Cancel returns to the previous screen. The Import button is disabled while the device is running.
- Clicking the Export button opens the Export File dialog. Modify the filename in the bottom input field. Click Save to export the file; clicking Cancel cancels the export.
- Example: Select AC for the coupling mode and three-phase synchronous output. The transient STEP configuration is shown in Figure 6.2.8, with the corresponding waveform in Figure 6.2.9.

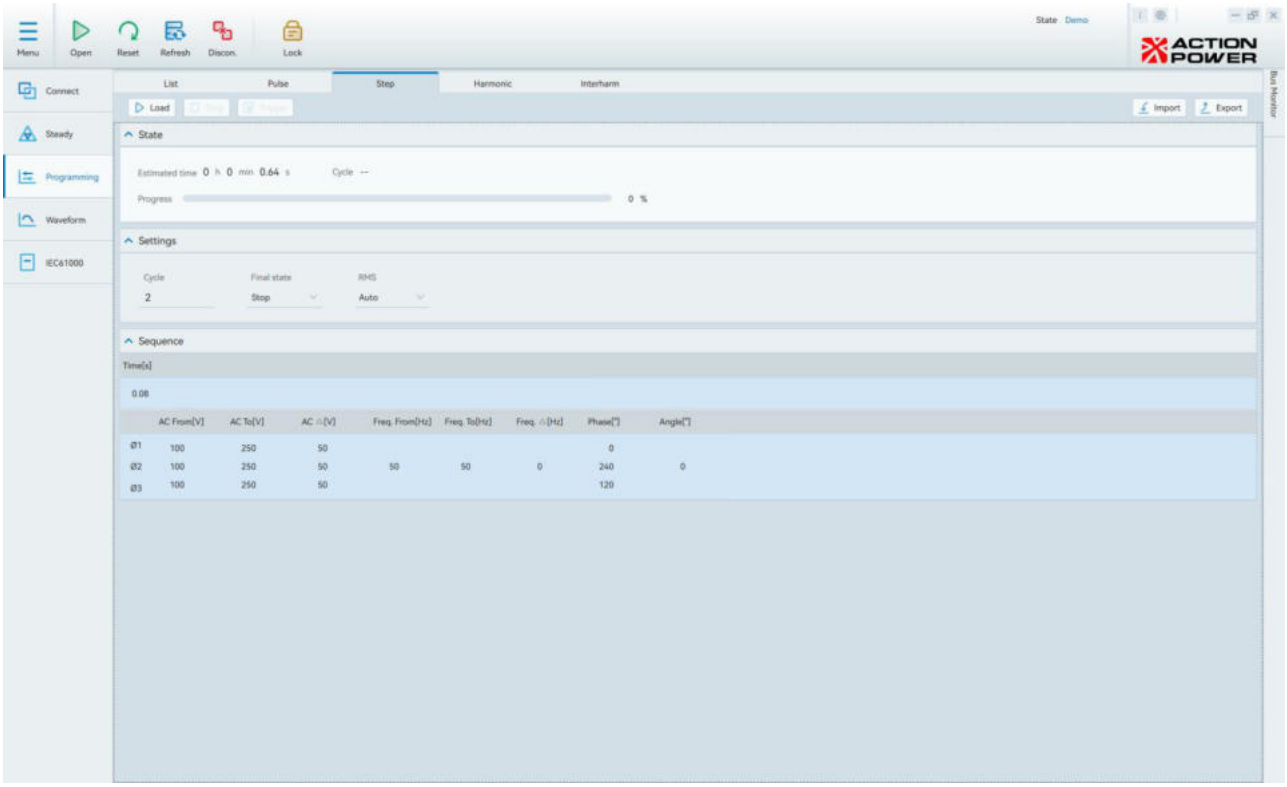


Figure 6.2.8 Transient Step Configuration Diagram

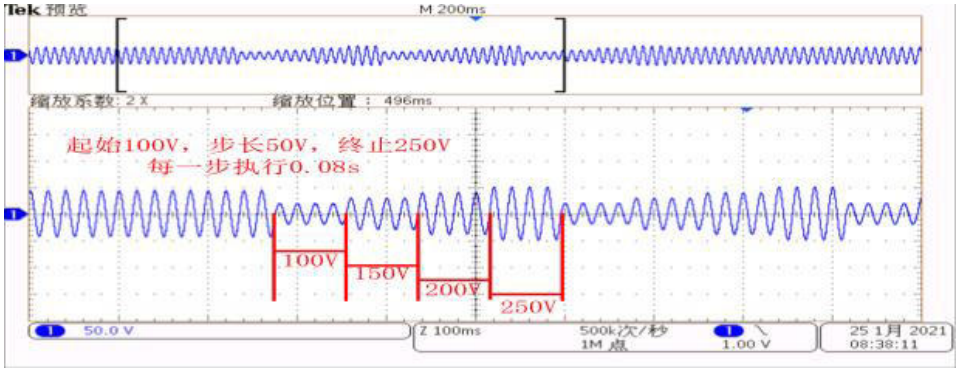


Figure 6.2.9 Transient Step Waveform Diagram

6.2.4 Harmonics Interface

6.2.4.1 Interface Description

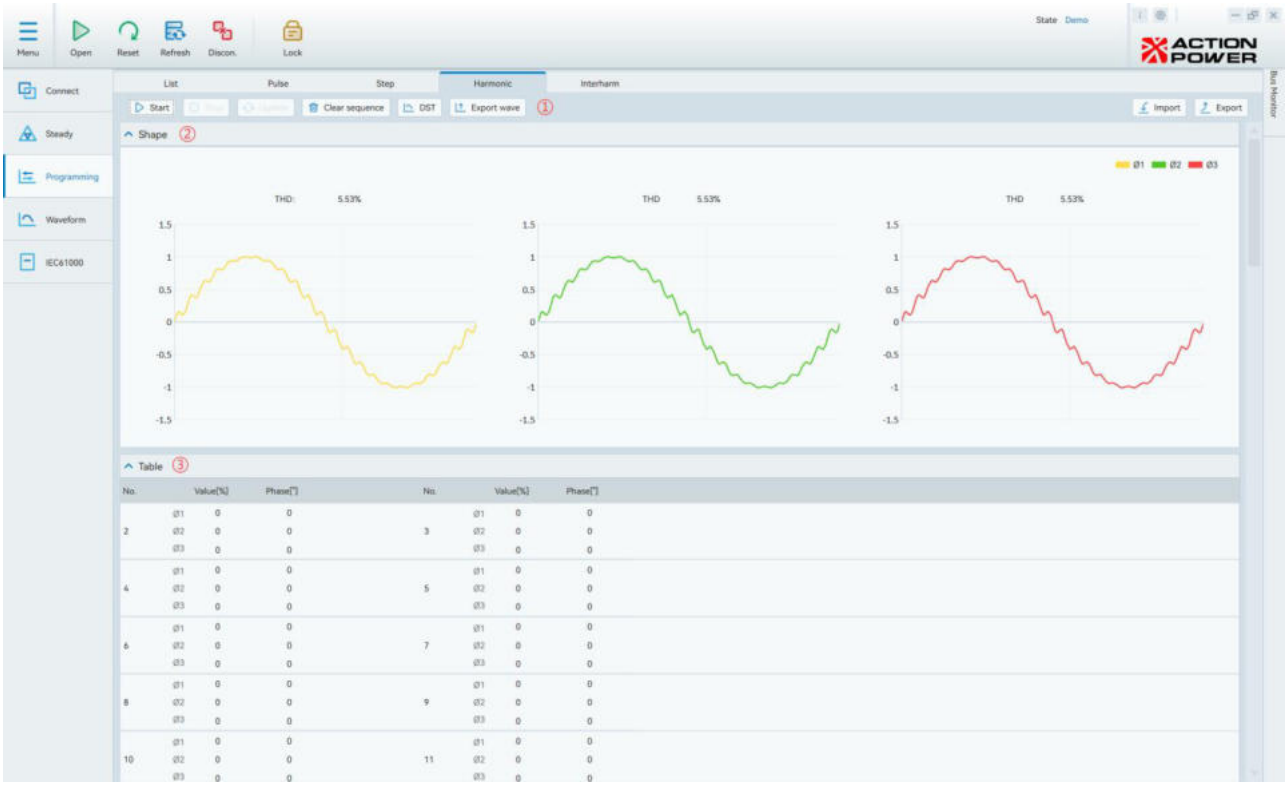


Figure 6.2.10 Harmonic Programming Interface

Prerequisites: Device connection successful or demonstration mode with coupling type set to AC or AC/DC

1. Function Area: The Start button transmits experimental data and configuration parameters to initiate the experiment; the End button concludes the current experiment. Update Button: Updates experimental data and triggers the experiment; Clear Data Button: Resets harmonic content and phase data for all cycles to zero; DST Button: Imports 30 sets of preloaded harmonic data; Export Waveform Button: Exports the current harmonic preview waveform data for use in the waveform function; Import/Export Button: Exports programming data as a configuration file for importing into the device.

2. Shape Area: Displays a real-time schematic of the device's output waveform with superimposed harmonics.

3. Table Area:

【Value】: Corresponding harmonic content by order, ranging from 0.00% to 40.00%. Total harmonic content upper limit is 50.00%.

【Phase】: Corresponding phase angle, range 0.0°~359.9°

6.2.4.2 Operation Instructions

➢ Click the DST button to select one of the 30 built-in harmonics and choose the phase to overlay.

- Preview the waveform diagram with the selected harmonic superimposed in the waveform area.
- Adjust the content and phase as needed in the list
- Click the Start button to activate the device
- Click the Start button to load experimental data and trigger the experiment. The status bar in the status area displays the current experimental type (harmonic). After starting, other programmed interfaces open to show the experiment in progress.
- To change the selected built-in harmonic during the experiment, click the DST button to reselect the harmonic, choose the phase to overlay, and finally click the Update button to send the experimental data.
- During the experiment, manually adjust content and phase in the list area. After modifications, click the Update button to send the experimental data and trigger the experiment
- After the experiment completes, click the End button to terminate it.
- Clicking the Import button opens a file selection dialog. Select the desired file (.harm), then click "Open" to import. Clicking Cancel returns to the previous screen. The Import button is disabled after device startup.
- Clicking the Export button opens the export dialog. Modify the filename in the bottom input field, then click Save to export the file. Clicking Cancel cancels the export.
- Import/Export buttons are disabled after the experiment begins.

6.2.5 Interharmonic Interface

6.2.5.1 Interface Description

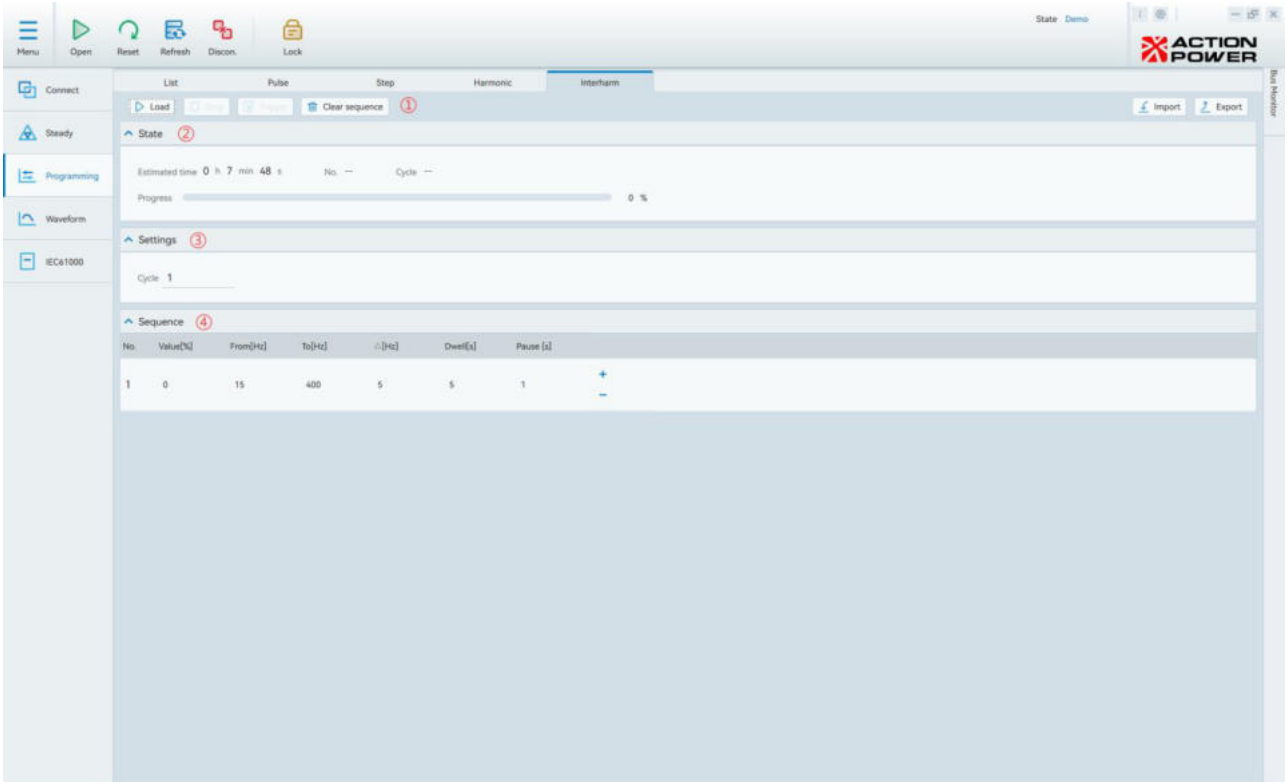


Figure 6.2.11 Interharmonic Programming Interface

Interharmonic programming enables custom frequency harmonic superposition with equal content per step.

Prerequisites: Successful device connection or demonstration mode with coupling type set to AC or AC/DC.

1. Function Area: The Start button transmits the sequence and settings to the device; the End button concludes the current experiment; the Trigger button initiates the experiment; the Clear Sequence button removes all entries except the first one.

2. State Area: Displays current experiment status information;

【Estimated Time】: Total experiment duration calculated based on set loop count and sequence;

[No.]: Current cycle being executed;

[Cycle]: Indicates the current sequence being executed;

[Progress]: Current progress of the experiment.

3. Settings Area:

【Cycle】: Number of cycles for the set harmonic sequence, range 0~1000 (0 indicates infinite looping)

4. Sequence Area:

【Value】: Target interharmonic content value;

【From】: Target start frequency for interharmonic execution;

【To】: Target end frequency for interharmonic execution;

【△】: Target incremental frequency step size for interharmonic execution.

【Dwell】: Target duration for a single step execution;

【Pause】: Target steady-state operating time interval between two harmonic frequency steps;

6.2.5.2 Operation Instructions

- Configure the number of cycles in the settings area
- Configure sequences in the sequence area; up to 100 sequences can be added
- Click the Start button to activate the device
- Click the Start button to load experimental data. Once initiated, other programmed interfaces will display the ongoing experiment
- Click the Trigger button to initiate the experiment. The Status bar in the Status area displays the current experiment type: harmonics
- After the experiment completes, click the End button to finish the experiment
- Clicking the Import button opens a file selection dialog. Select the desired file (.inte), then click "Open" to import it. Clicking Cancel returns to the previous screen. The Import button is disabled while the device is running.
- Clicking the Export button opens the export dialog. Modify the filename in the bottom input field, then click Save to export the file. Clicking Cancel cancels the export.
- After clicking the Start button, the Import and Export buttons become unavailable.
- Example: Select AC for the coupling mode, set the output phase count to three-phase synchronous operation, configure

interharmonics as shown in Figure 6.2.12, and the corresponding waveform is depicted in Figure 6.2.13

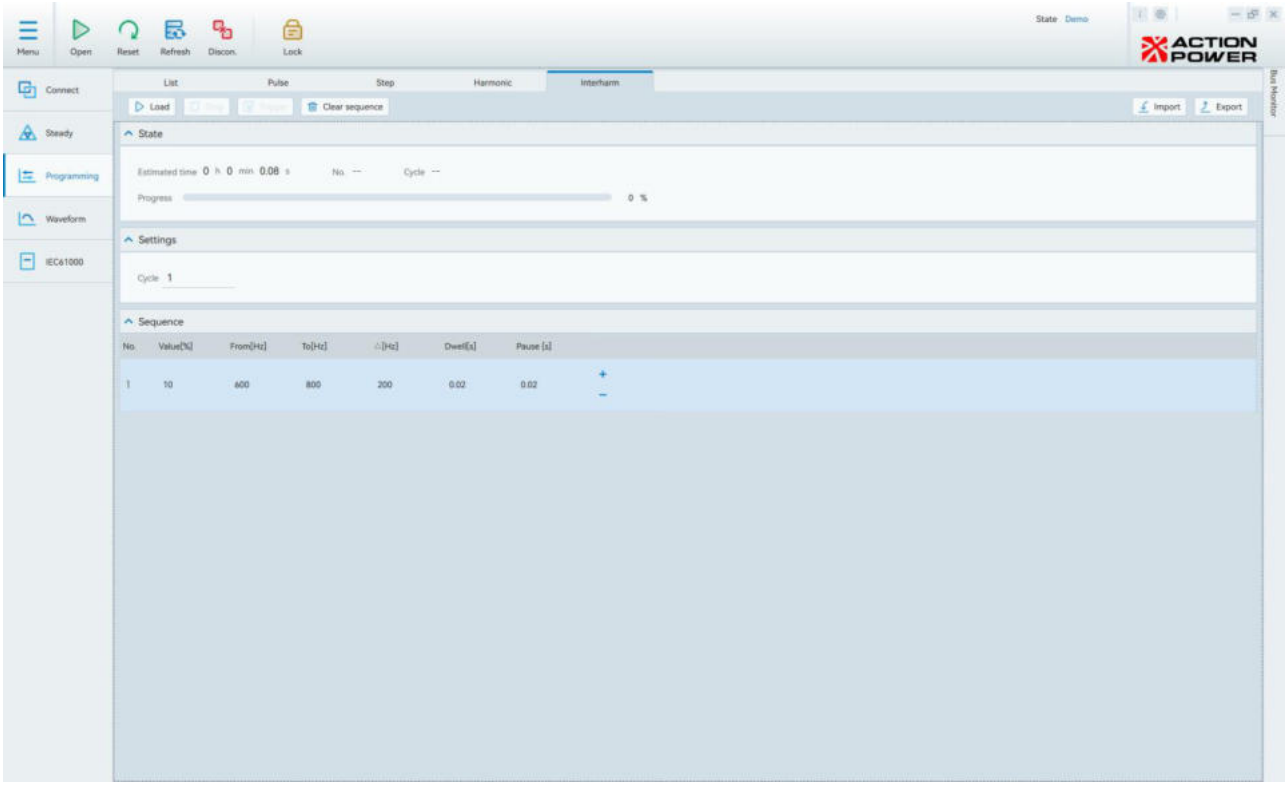


Figure 6.2.12 Interharmonic Configuration Diagram

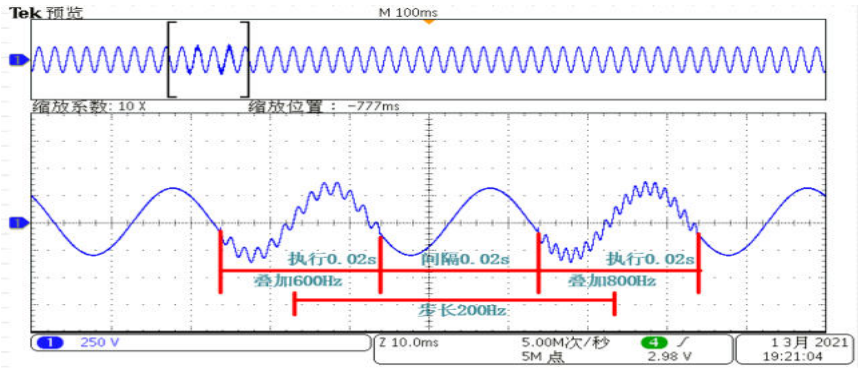


Figure 6.2.13 Actual Interharmonic Programming Waveform

6.3 Waveform Interface

6.3.1 Waveform Editing Interface

6.3.1.1 Interface Description

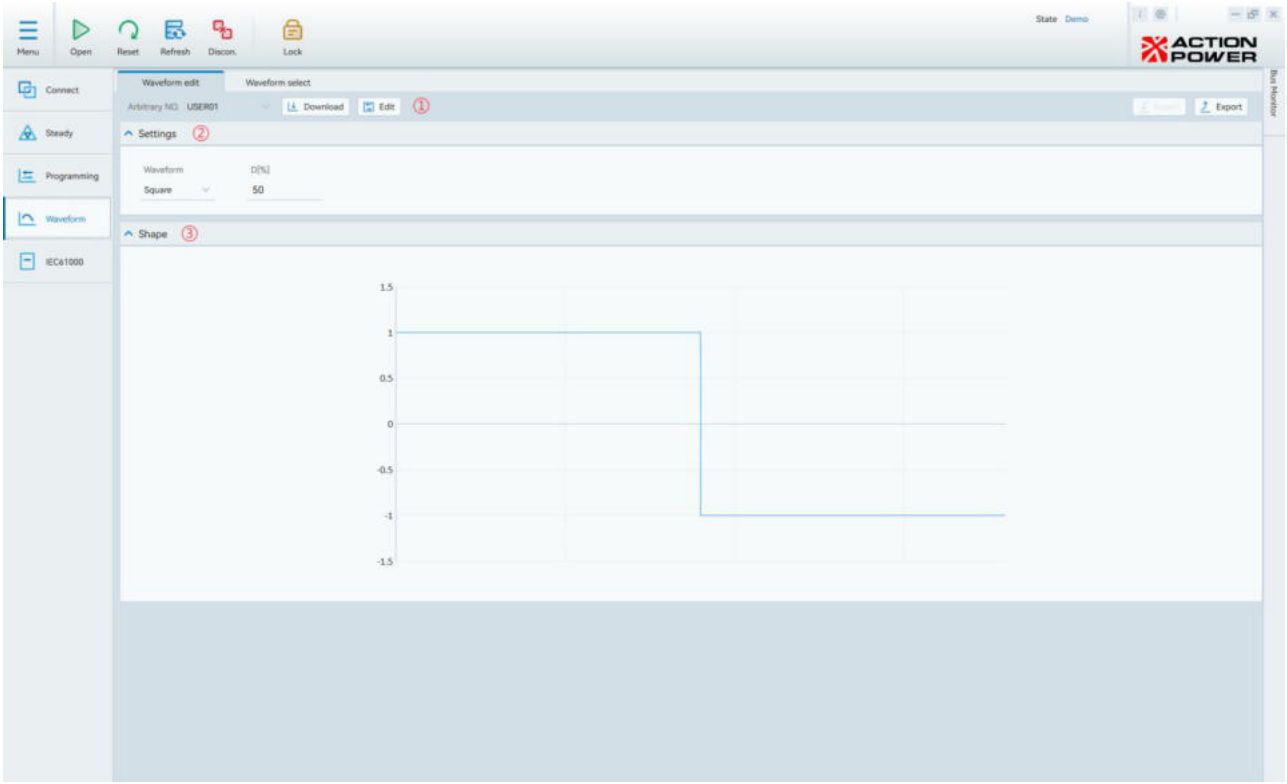


Figure 6.3.1 Waveform Editing Interface

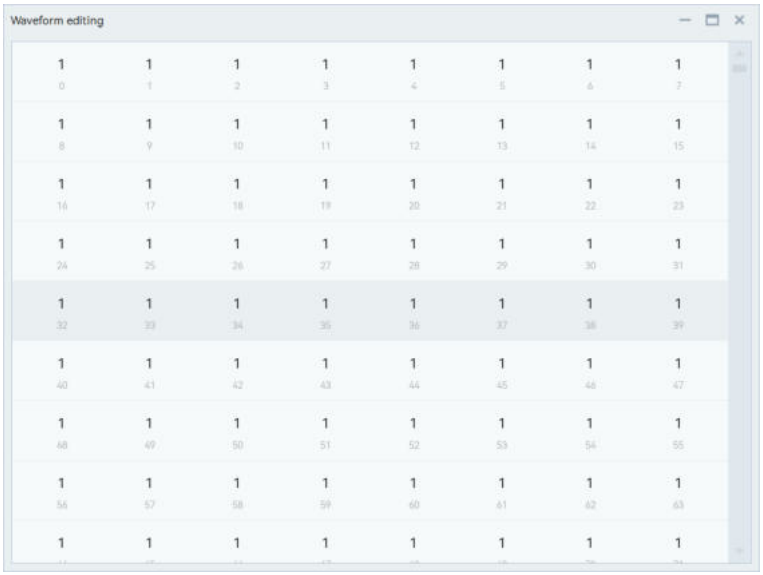


Figure 6.3.2 Waveform Editing Interface

Prerequisites: Successful device connection or demo mode

1. Function Area: Download Waveform: Downloads custom waveforms to the device; cannot download after device startup. Edit Waveform: Click the Edit Waveform button to open the waveform editing interface (as shown in Figure 6.3.2). Edit waveforms within this interface; edited waveforms can be viewed in the waveform section of the editing interface.

2. Settings Area: Waveform Type: Select the waveform type.

3. Shape Area: Preview the custom waveform.

6.3.1.2 Operation Instructions

- Select the custom waveform number to edit in the function area.
- In the Configuration Area, select the waveform type. Note: When selecting any waveform, the Import button becomes available. Click the Import button to import the desired waveform.
- Click the Edit Waveform button Edit the waveform in the waveform editing page
- Preview the waveform in the Waveform Preview Area
- Click the Download Waveform button to download the waveform to the device
- Clicking the Import button opens a file selection dialog. Select the desired file (.wave or .csv), then click "Open" to import. Clicking Cancel returns you to the previous screen.
- Clicking the Export button opens the Export File dialog. Modify the filename in the bottom input field. Click Save to export the file; clicking Cancel cancels the export.
- When the waveform type is set to Sine Wave or Arbitrary Wave in the configuration, the percentage cannot be configured.
- The Import button is only enabled when the waveform type is set to Arbitrary Waveform. For other waveform types, the Import button remains disabled.
- After device startup, clicking the Download Waveform button displays a prompt stating "Experiment in progress; download not permitted."

6.3.2 Waveform Selection Interface

6.3.2.1 Interface Description

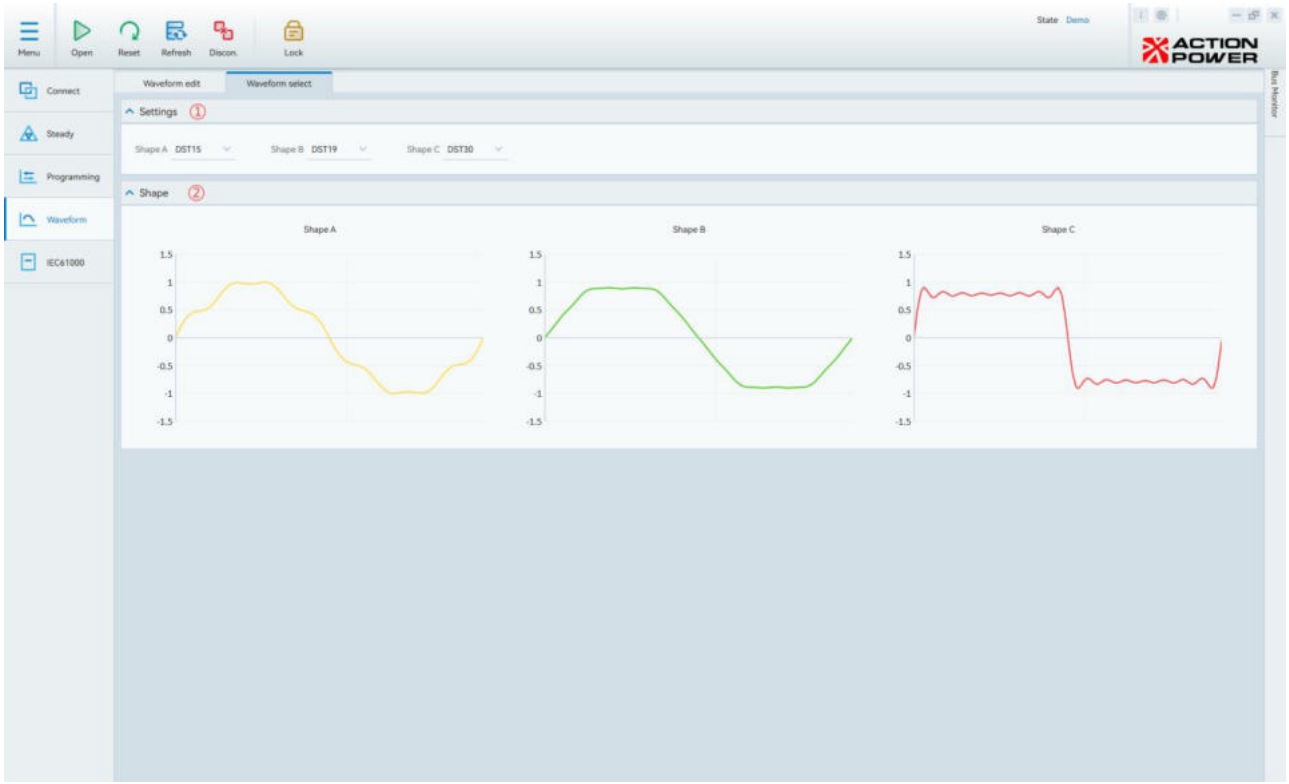


Figure 6.3.3 Waveform Selection Interface

Prerequisites: Device connection successful and device not running or in demo mode

1. Settings Area: Retrieve waveforms stored internally in the device for Waveforms A, B, and C respectively.

2. Shape Area: Preview waveform data retrieved from the device's internal storage

6.3.2.2 Operation Instructions

- Select the desired built-in waveform number for Waveform A, B, and C respectively.
- View the actual waveforms corresponding to Waveforms A, B, and C in the Waveform Preview Area
- After device startup, the waveform selection interface displays a masking overlay prohibiting operation, indicating the device is running.
- Select waveforms ABC during steady-state or programming to output the retrieved waveform. See Figure 6.3.4 for an example

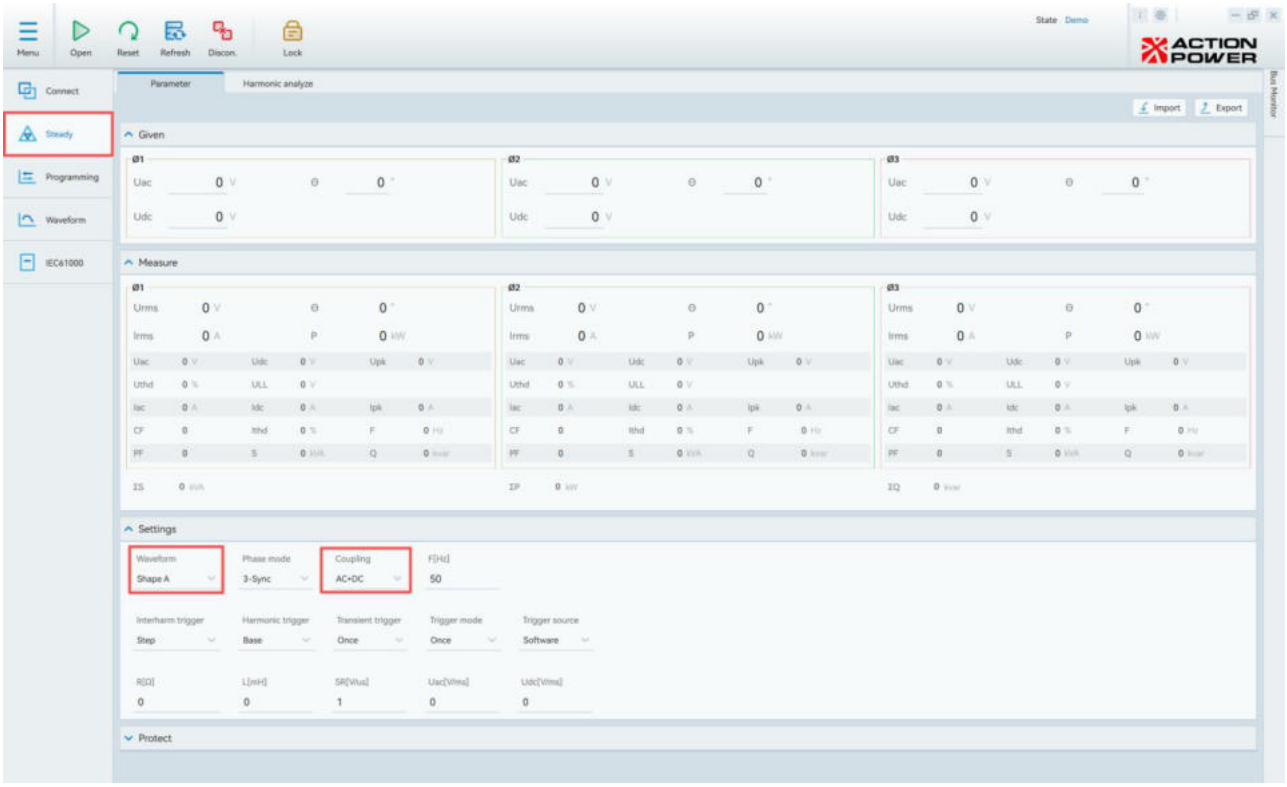


Figure 6.3.4 Steady-state output waveform using Waveform A

6.4 IEC 61000 Interface

The IEC 61000 series standards are a set of International Electrotechnical Commission (IEC) specifications for electromagnetic compatibility (EMC). These standards define requirements that various electrical equipment must meet in electromagnetic environments to ensure proper operation amidst interference sources and susceptible devices. The IEC 61000 series serves as essential foundational guidance for electrical equipment manufacturers, developers, and users, covering EMC for diverse devices and systems.

In this chapter, we simulate seven experiments to model usage scenarios under different conditions, testing the immunity of the device under test (DUT) to interference.

4-11 Immunity Test for Voltage Dips, Short Interruptions, and Voltage Variations at AC Power Input Ports: Tests the immunity of electrical and electronic equipment connected to low-voltage power supply networks against voltage dips, short interruptions, and voltage variations. Applicable to electrical and electronic equipment with a rated input current not exceeding 16A per phase connected to 50Hz or 60Hz AC networks.

4-13 AC Harmonic and Interharmonic Immunity Test: Evaluates the immunity of electrical and electronic equipment with a rated current per phase ≤16A in low-voltage power systems (50Hz) to harmonics and interharmonics with disturbance frequencies up to 2kHz.

4-14 Voltage Fluctuation Immunity Test: Tests the immunity of electrical and electronic equipment to disturbances in its electromagnetic environment, considering only sensing phenomena. This includes immunity for equipment connected to public and industrial power supply networks.

4-17 DC Ripple Immunity Test: Tests the immunity of electrical and electronic equipment to ripple at the DC power input port. Applicable to low-voltage DC power ports of equipment supplied by external rectifier systems or charging batteries.

4-27 Three-Phase Voltage Unbalance Immunity Test: Tests the immunity of electrical and electronic devices to unbalanced supply voltages, involving only conducted phenomena. Includes immunity of devices connected to public or industrial networks.

Applicable to electrical and electronic devices with 50Hz three-phase supply and rated line current per phase below 16A.

4-28 Power Frequency Variation Immunity Test: Tests the immunity of electrical and electronic equipment to power frequency variations, involving only conducted phenomena. This includes immunity for equipment connected to public or industrial networks. Applicable to electrical and electronic equipment connected to a 50Hz power distribution network with a rated current per phase not exceeding 16A.

4-29 DC power input port voltage dips, short interruptions, and voltage variations immunity test: Tests the immunity of DC electrical and electronic equipment to voltage dips, short interruptions, and voltage variations. Applicable to low-voltage DC power input ports of equipment supplied by external DC networks.

6.4.1 4-11 AC Power Input Port Voltage Dips, Short Interruptions, and Voltage Variations Immunity Test

6.4.1.1 Interface Description

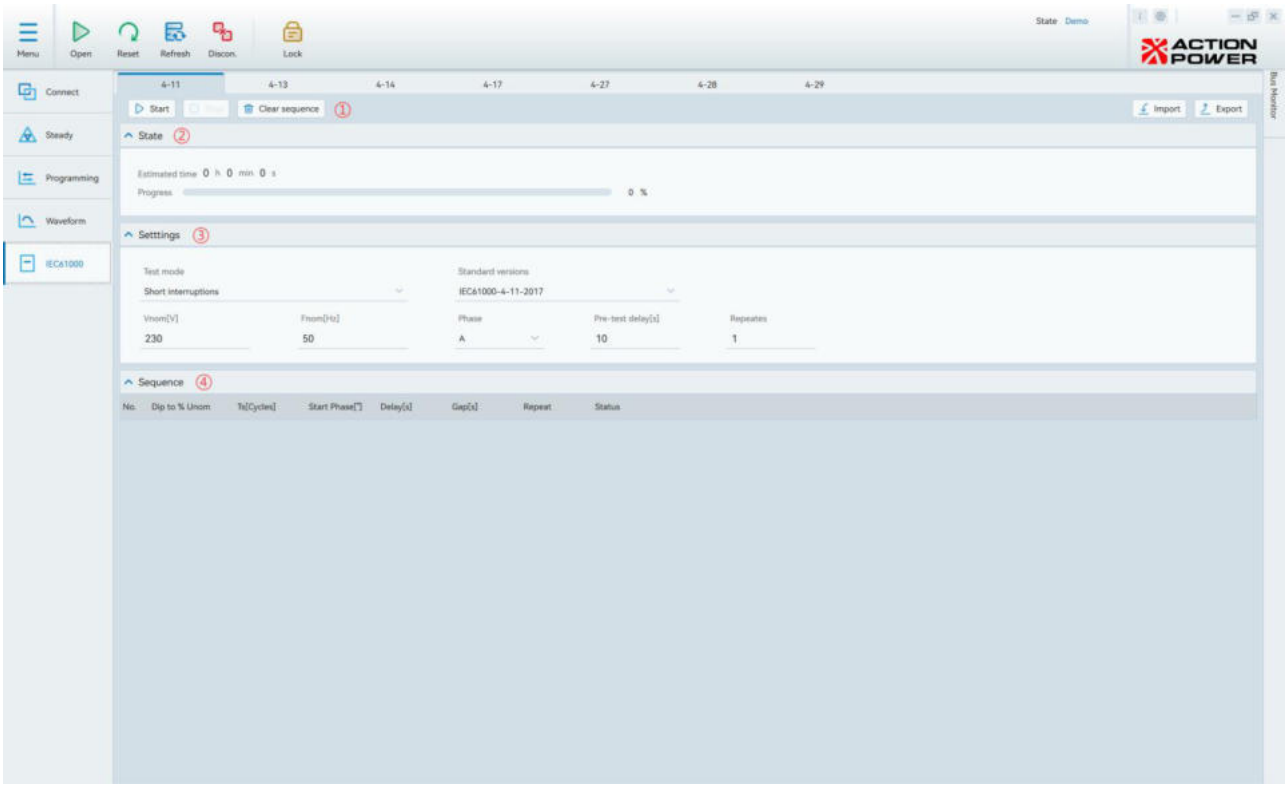


Figure 6.4.1 Interface for 4-11

Prerequisites: Connected device successful or demonstration mode

1. Function Area: The Start button transmits test data and configuration parameters to initiate the test; the End button concludes the current test; the Clear Sequence button erases programmed data.

2. State Area: Displays current experiment status information;

【Estimated Time】: Total experiment duration calculated based on settings and sequence;

[Progress]: Current execution progress of the experiment.

3. Settings Area:

【Test **Mode**】: Experiment type, selectable from voltage dip, short interruption, and voltage variation.

【Standard Version】: Standard version

【Vnom】: Steady-state voltage

【Fnom】: Steady-state frequency

【Phase】: Test phase

【Pre-test delay】: Pre-test duration

【Cycle】： Cycle Count

4. Sequence Area:

Short-term interruption Voltage dip:

【Dip to % Unom】: Percentage of voltage dip magnitude;

【Ts(Cycles)】: Voltage dip duration (displayed in ms; time = Cycles × (1/fundamental frequency), where fundamental frequency is the frequency set in basic parameters, typically 50Hz/60Hz);

【Start Phase】: Starting phase;

【Delay】: Steady-state recovery hold time;

【Gap】: Next step preparation time;

【Repeat】： Experiment execution cycle;

【Status】: Controls whether to execute the current sequence

Voltage Change

【Var to % Unom】: Percentage of voltage variation relative to nominal value;

【FallTime】: Decay time of the transition

【HoldTime】: Hold time of the change

【RiseTime】: Variable rise time

【Delay】： Delay time before each step;

6.4.1.2 Operation Instructions

- Click the Import button to select the configuration file corresponding to the experiment to be performed
- Modify settings and sequence parameters as needed
- Click the Start button to begin the experiment. Once started, other program interfaces will display the experiment in progress
- Clicking the Export button opens the export dialog. Modify the filename in the bottom input field. Click Save to export the file; click Cancel to cancel exporting
- During the experiment, click the End button to terminate it
- 4-11 Programming mode: Three-phase AC only. Other modes cannot initiate programming.

- The foundational data for programming sequences must be imported from configuration files; initial data cannot be manually added.
- Once programming begins, settings and sequence data cannot be modified, nor can further imports or exports be performed.

6.4.2 4-13 AC Harmonic and Interharmonic Immunity Test

6.4.2.1 Interface Description

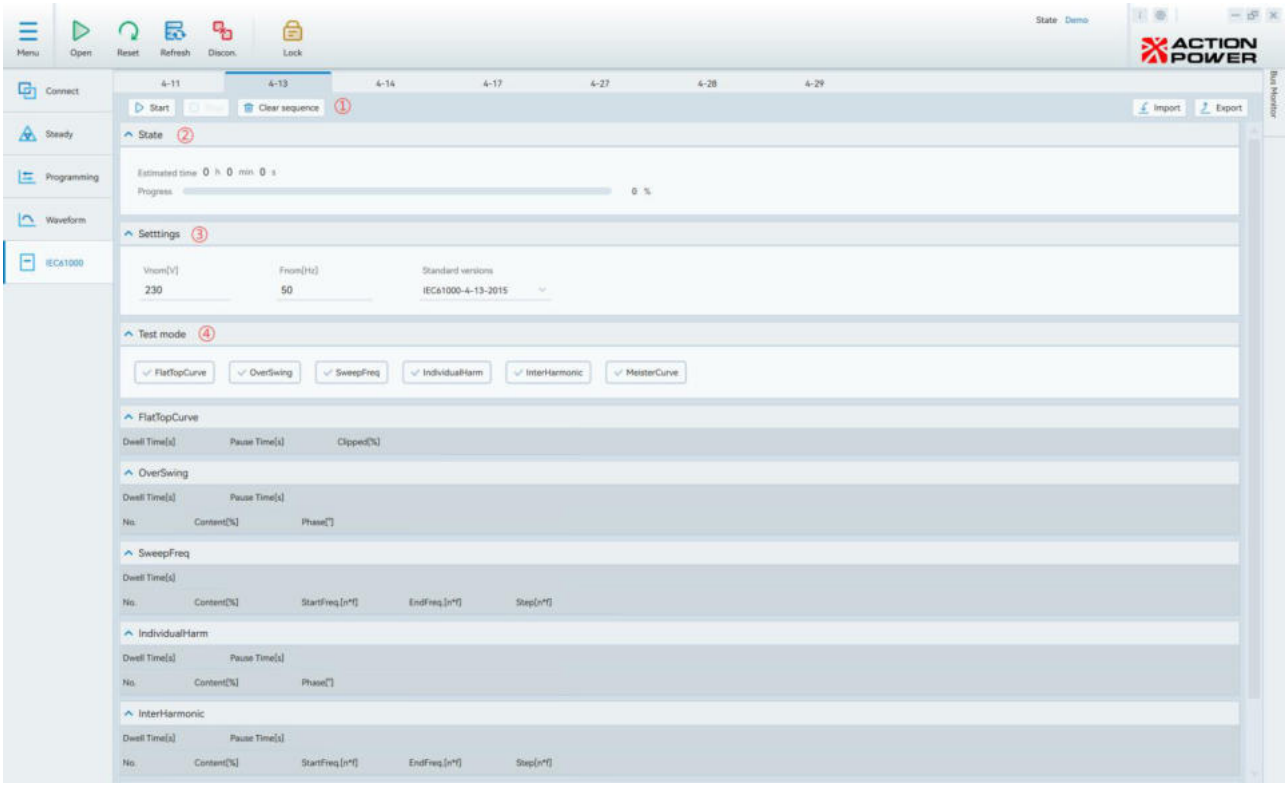


Figure 6.4.2 4-13 Interface

Prerequisites: Successful device connection or demonstration mode

1. Function Area: The Start button transmits experimental data and configuration parameters to initiate the experiment; the End button concludes the current experiment; the Clear Sequence button erases programmed data.

2. Status Area: Displays current experiment status information;

【Time】: Total experiment duration calculated based on settings and test items;

[Progress]: Current execution progress of the experiment.

3. Settings Area:

【Standard Version】: Standard version

【Vnom】: Steady-state voltage

【Fnom】: Steady-state frequency

4. Test Items:

From left to right: Clipping Test, Peak Wave Test, Sweep Frequency Test, Harmonic Test, Interharmonic Test, Meister Curve Test

Clipping Test:

【Dwell Time】: Duration;

【Pause Time】: Interval duration;

【Clipped】: Clipping percentage;

Spike Wave Experiment:

【Dwell Time】: Duration;

【Pause Time】: Interval time;

【Content】： Content;

【Phase】： Phase;

Sweep Frequency Experiment:

【Dwell Time】: Execution time per step;

【Content】： Content;

【StartFreq】: Starting frequency (multiple of fundamental frequency)

【EndFreq】: End frequency;

【Step】: Frequency step size;

Harmonic Experiment:

【Dwell Time】: Duration;

【Pause Time】: Interval time;

【No.】2nd–40th harmonics

【Content】： Content;

【Phase】: Phase;

Interharmonic Experiment:

【Dwell Time】: Execution time per step;

【Pause Time】: Interval time;

【Content】： Content;

【StartFreq】: Starting frequency (multiple of fundamental frequency)

【EndFreq】: End frequency;

【Step】： Frequency step;

Meister Curve Experiment:

【Dwell Time】: Execution time per step;

【Pause Time】: Interval duration;

【Content】： Content level;

【StartFreq】: Starting frequency (multiple of fundamental frequency)

【EndFreq】: End frequency;

【Step】： Frequency step;

6.4.2.2 Operation Instructions

- Click the Import button to select the configuration file corresponding to the experiment to be performed
- Modify settings and test item parameters as needed
- Click the Start button to begin the experiment. Once started, other program interfaces will display the experiment in progress
- Clicking the Export button opens the export dialog. Modify the filename in the bottom input field. Click Save to export the file; click Cancel to cancel exporting
- During the experiment, click the "End" button to terminate it
- 4-13 Programming Modes: Coupling mode must be AC+DC. Output phase configuration: Single-phase, three-phase, or three-phase interlocked are all supported.
- Basic programming sequence data must be imported from configuration files; initial data cannot be manually added.
- Once programming begins, settings and test item data cannot be modified, nor can import/export operations be performed.

6.4.3 4-14 Voltage Fluctuation Immunity Test

6.4.3.1 Interface Description

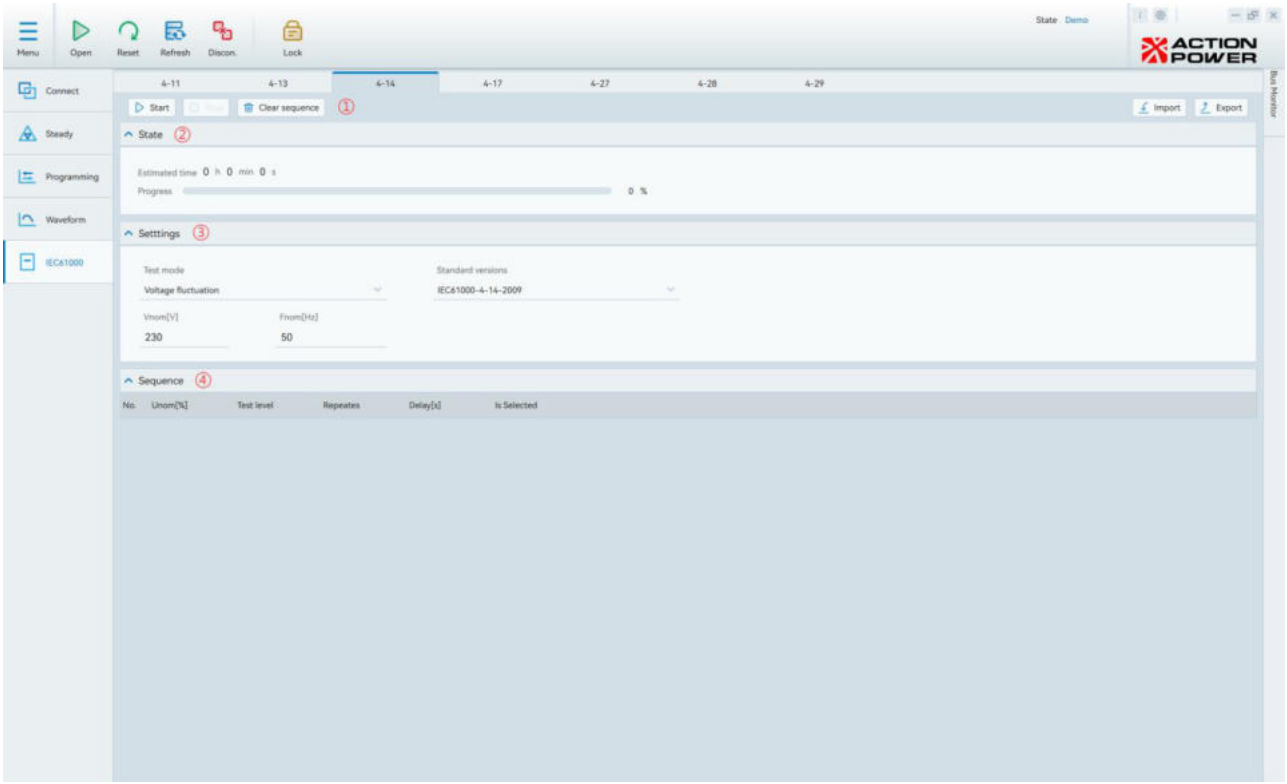


Figure 6.4.3 4-14 Interface

Prerequisites: Successful device connection or demonstration mode

1. Function Area: The Start button transmits test data and configuration parameters to initiate the test; the End button concludes the current test; the Clear Sequence button erases programmed data.

2. States Area: Displays current experiment status information;

【Time】: Total experiment duration calculated based on settings and sequence;

[Progress]: Current execution progress of the experiment.

3. Settings Area:

[Test **Mode]**: Experiment type, selectable options include voltage fluctuation

【Standard Version】: Standard version

【Vnom】: Steady-state voltage

【Fnom】: Steady-state frequency

4. Sequence Area:

【Unom[%]】： Rated voltage percentage;

【Test Level】: Variation Level;

【Cycle】： Number of cycles executed;

【Delay】： Interval time between two tests;

【Is Selected】: Controls whether to execute the current sequence

6.4.3.2 Operation Instructions

- Click the Import button to select the configuration file corresponding to the experiment to be executed
- Modify settings and sequence parameters as needed
- Click the Start button to begin the experiment. Once started, other program interfaces will display the experiment in progress
- Clicking the Export button opens the export dialog. Modify the filename in the bottom input field. Click Save to export the file; click Cancel to cancel exporting
- During the experiment, click the End button to terminate it.
- 4-14 Programming Mode: Coupling method must comply with AC. Output phase configuration: Single-phase, three-phase, or three-phase interlocked are all supported.
- Basic programming sequence data must be imported from configuration files; initial data cannot be manually added.
- Once programming begins, settings and sequence data cannot be modified, nor can import/export operations be performed.

6.4.4 4-17 DC Ripple Immunity Test

6.4.4.1 Interface Description

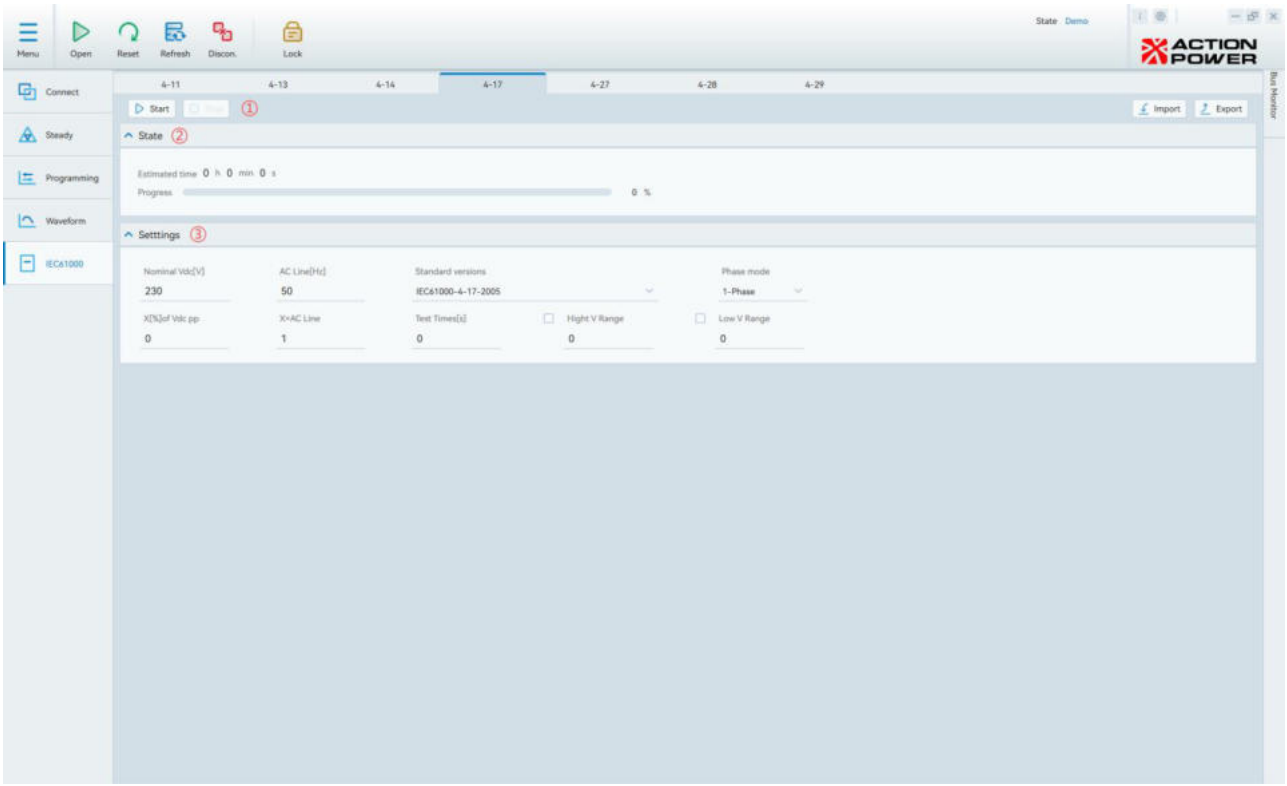


Figure 6.4.4 Interface for 4-17

Prerequisites: Successful device connection or demonstration mode

1. Function Area: The Start button transmits experimental data and configuration parameters to initiate the experiment; the End button concludes the current experiment.

2. State Area: Displays current experiment status information;

【Estimated Time】: Total experiment duration;

[Progress]: Current progress of the experiment.

3. Settings Area:

【Nominal **Vdc**】: DC voltage

【AC Line】: AC frequency

【Standard Version】: Standard version

【X[%] of Vdc pp】: Percentage of ripple amplitude relative to DC

【X x AC Line】： Frequency Multiplier

【Test Time】: Test duration

【High V Range】: Maximum voltage range

【Low V Range】: Minimum Value

6.4.4.2 Operating Instructions

- Click the Import button to select the configuration file corresponding to the experiment to be performed
- Modify the settings parameters as needed
- Click the Start button to begin the experiment. Once started, other program interfaces will display the experiment in progress
- Clicking the Export button opens the export dialog. Modify the filename in the bottom input field. Click Save to export the file; click Cancel to cancel exporting
- During the experiment, click the "End" button to terminate it
- 4-17 Programming Modes: Coupling mode must be AC+DC. Output phase configuration: Single-phase, three-phase, or three-phase interlocked are all supported.
- Once programming begins, settings cannot be modified, and import/export operations are disabled.

6.4.5 4-27 Three-Phase Voltage Unbalance Immunity Experiment

6.4.5.1 Interface Description

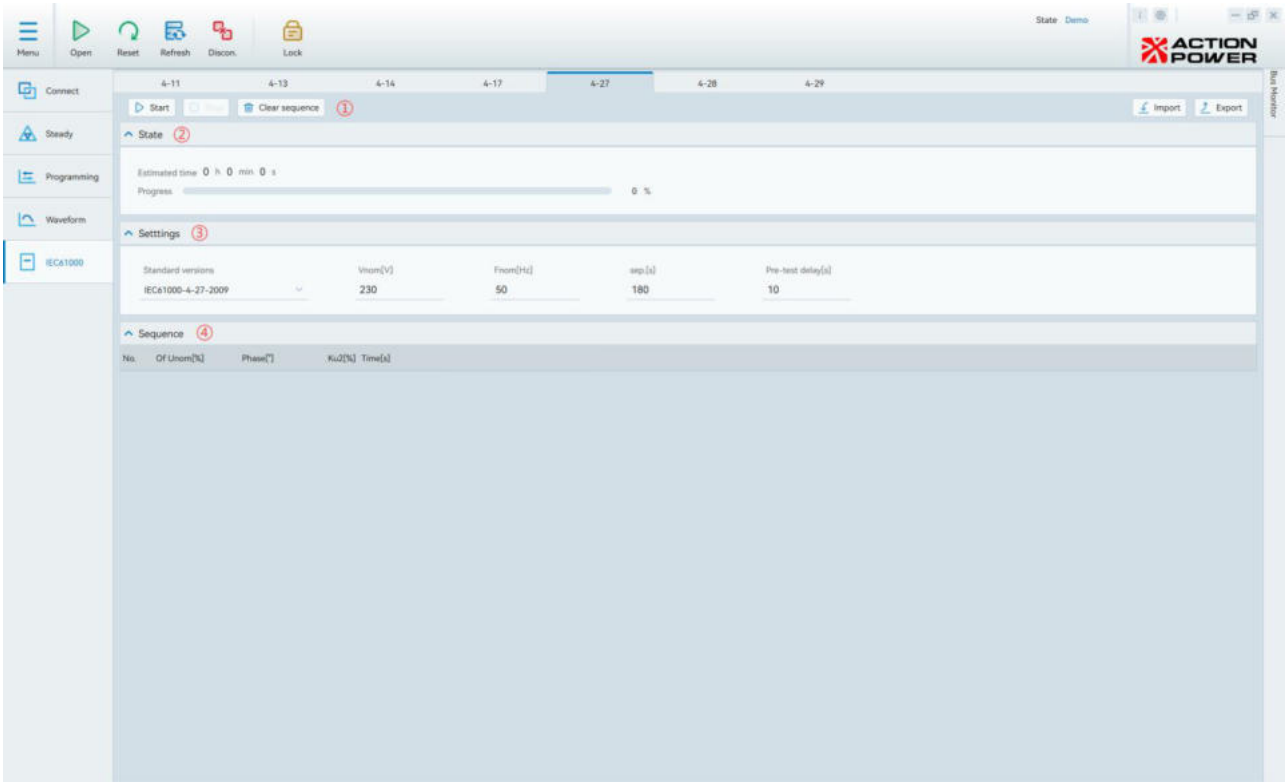


Figure 6.4.5 4-27 Interface

Prerequisites: Successful device connection or demonstration mode

1. Function Area: The Start button transmits test data and configuration parameters to initiate the test; the End button concludes the current test; the Clear Sequence button erases programmed data.

2. State Area: Displays current experiment status information;

【Estimated Time】: Total experiment duration calculated based on settings and sequence;

[Progress]: Current execution progress of the experiment.

3. Settings Area:

【Standard Version】: Standard version

【Vnom】: Steady-state voltage

【Fnom】: Steady-state frequency

【Sequence **delay**】: Sequence interval time

【Pre-test delay】: Test preparation phase execution time

4. Sequence Area:

【Of Unom[%]】： Three-phase amplitude percentage;

【Degree】: Three-phase phase angle;

【Ku2】: Calculated unbalance factor;

【Time】: Current sequence execution time;

6.4.5.2 Operation Instructions

- Click the Import button to select the configuration file corresponding to the experiment to be executed
- Modify settings and sequence parameters as needed
- Click the Start button to begin the experiment. Once started, other program interfaces will display the experiment in progress
- Clicking the Export button opens the export dialog. Modify the filename in the bottom input field. Click Save to export the file; click Cancel to cancel exporting
- During the experiment, click the "End" button to terminate it
- 4-27 Programming Mode: Coupling method must be AC. Output phase count: Three-phase.
- The foundational data for programming sequences must be imported from configuration files; initial data cannot be manually added.
- Once programming begins, settings cannot be modified, and no further import/export operations are permitted.

6.4.6 4-28 Power Frequency Variation Immunity Test

6.4.6.1 Interface Description

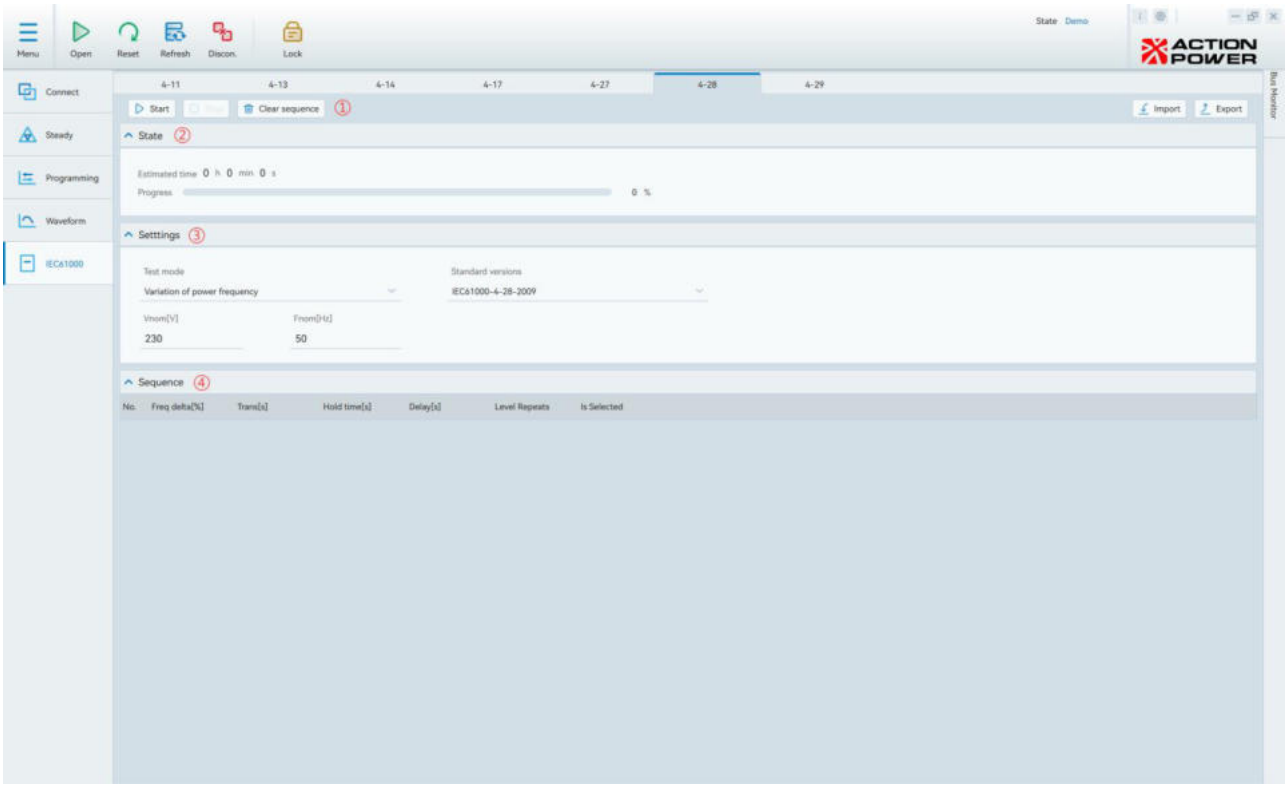


Figure 6.4.6 4-28 Interface

Prerequisites: Successful device connection or demonstration mode

1. Function Area: The Start button transmits test data and configuration parameters to initiate the test; the End button concludes the current test; the Clear Sequence button erases programmed data.

2. State Area: Displays current test status information;

【Estimated Time】: Total experiment duration calculated based on settings and sequence;

[Progress]: Current execution progress of the experiment.

3. Settings Area:

【Test Mode】: Experiment type

【Standard Version】: Standard version

【Vnom】: Steady-state voltage

【Fnom】: Steady-state frequency

4. Sequence Area:

【Freq delta】: Frequency change percentage;

【Trans】： Transition time;

【Hold Time】: Hold duration;

【Delay】： Time to return to normal value execution;

【Level Repeats】: Number of execution cycles

6.4.6.2 Operation Instructions

- Click the Import button to select the configuration file corresponding to the experiment to be executed
- Modify settings and sequence parameters as needed
- Click the Start button to begin the experiment. Once started, other programming interfaces will display the experiment in progress
- Clicking the Export button opens the export dialog. Modify the filename in the bottom input field. Click Save to export the file; click Cancel to cancel exporting
- During the experiment, click the "End" button to terminate it
- 4-28 Programming Modes: Coupling mode must be AC. Output phase configuration: Single-phase, three-phase, or three-phase interlocked are all supported.
- The foundational data for programming sequences must be imported from configuration files; initial data cannot be manually added.
- Once programming begins, settings cannot be modified, and no further import/export operations are permitted.

6.4.7 4-29 DC Power Input Port Voltage Dip, Short Interruption, and Voltage Variation Immunity Test

6.4.7.1 Interface Description

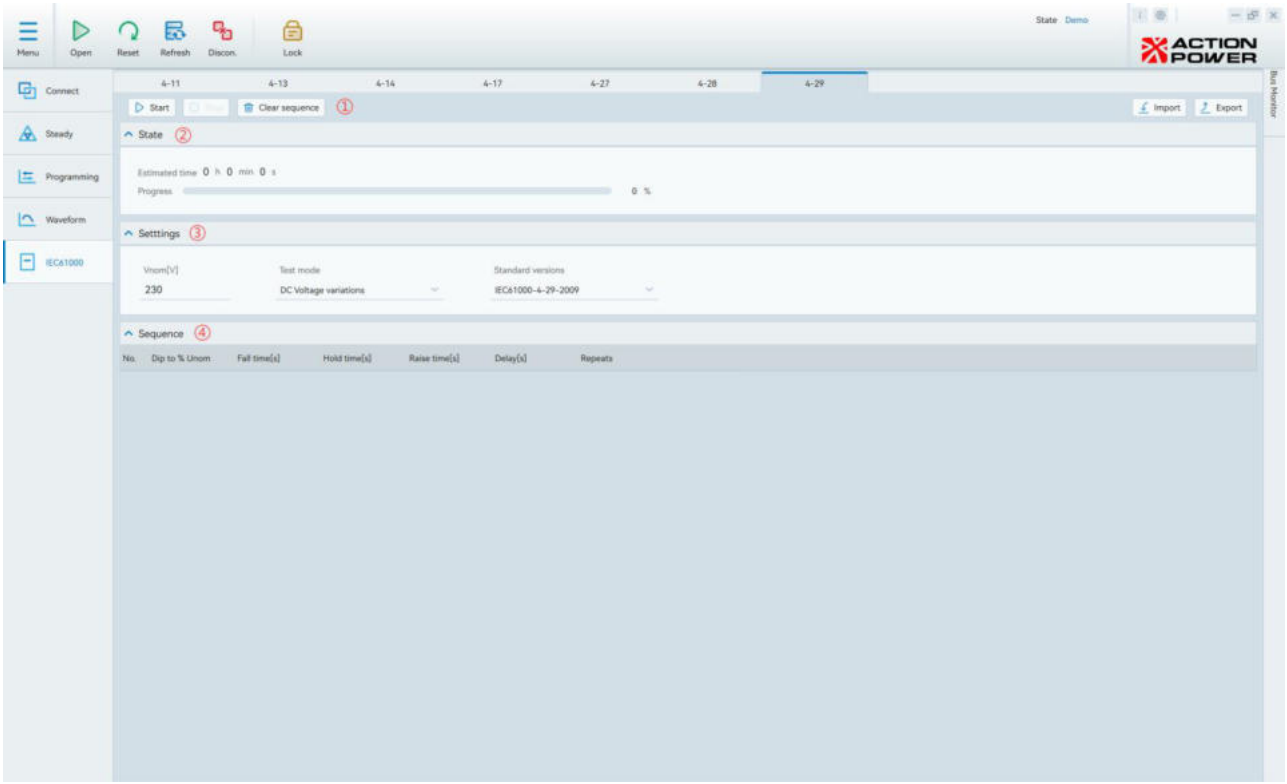


Figure 6.4.7 4-29 Interface

Prerequisites: Successful device connection or demo mode

1. Function Area: The Start button transmits test data and configuration parameters to initiate the test; the End button concludes the current test; the Clear Sequence button erases programmed data.

2. State Area: Displays current test status information;

【Time】: Total experiment duration calculated based on settings and sequence;

[Progress]: Current execution progress of the experiment.

3. Settings Area:

【Vnom】: Steady-state voltage

【Test Mode】: Test Type

【Standard Version】: Standard Version

4. Sequence Area:

Voltage Dip and Short Interruption:

【Dip to % Unom】: Percentage of voltage short-term interruption;

【Hold Time】: Duration of interruption;

【Delay】： Recovery hold time;

【Repeats】: Number of cycles;

Voltage Variation:

【Dip to % Unom】: Voltage change percentage;

【Fall Time】: Duration of change;

【Hold Time】: Duration of interruption;

【Raise Time】: Time to return to steady state;

【Delay】： Steady-state hold time;

【Repeats】: Number of cycles

6.4.7.2 Operation Instructions

- Click the Import button to select the configuration file corresponding to the experiment to be performed
- Modify settings and sequence parameters as needed
- Click the Start button to begin the experiment. Once started, other program interfaces will display the experiment in progress
- Clicking the Export button opens the export dialog. Modify the filename in the bottom input field. Click Save to export the file; click Cancel to cancel exporting
- During the experiment, click the "End" button to terminate it
- 4-29 Programming Modes: Coupling mode must satisfy DC. Output phase configuration: Single-phase, three-phase, or three-phase interlocked are all supported.
- Basic programming sequence data must be imported from configuration files; initial data cannot be manually added.
- Once programming begins, settings cannot be modified, and no further import/export operations are permitted.

7 CORTEX-AC and NEXUS-AC devices

7.1 Mode Interface

7.1.1 Interface Description

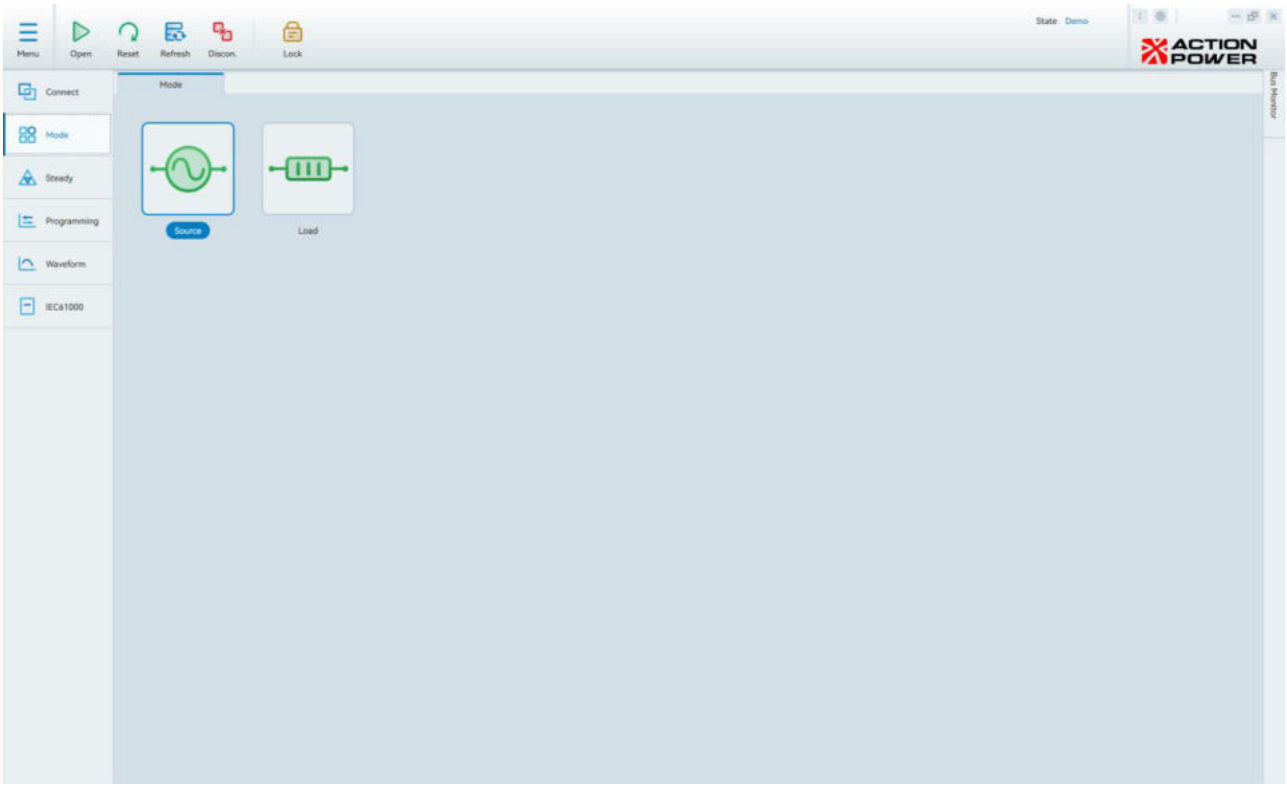


Figure 7.1.1 Mode Selection Interface

Figure 7.1.2 Load Mode Switching Prompt

Figure 7.1.3 Mode Interface Disabled During Device Startup

The Mode Selection Interface allows switching between CORTEX-AC and NEXUS-AC series operating modes. You can set the device's mode status to Source Mode or Load Mode, and the power mode status display will update accordingly.

Prerequisites: Successful connection to the device or demonstration mode; device not powered on

7.1.2 Operation Instructions

1. After connecting to the device, switching the mode to Load Mode will display the prompt shown in Figure 7.1.2.
2. After switching the mode selection, the interface will automatically transition to the steady-state interface.
3. The mode switching interface is unavailable during device operation, as shown in Figure 7.1.3.

7.2 Steady-State Interface

7.2.1 Steady-State Parameters

7.2.1.1 Interface Description

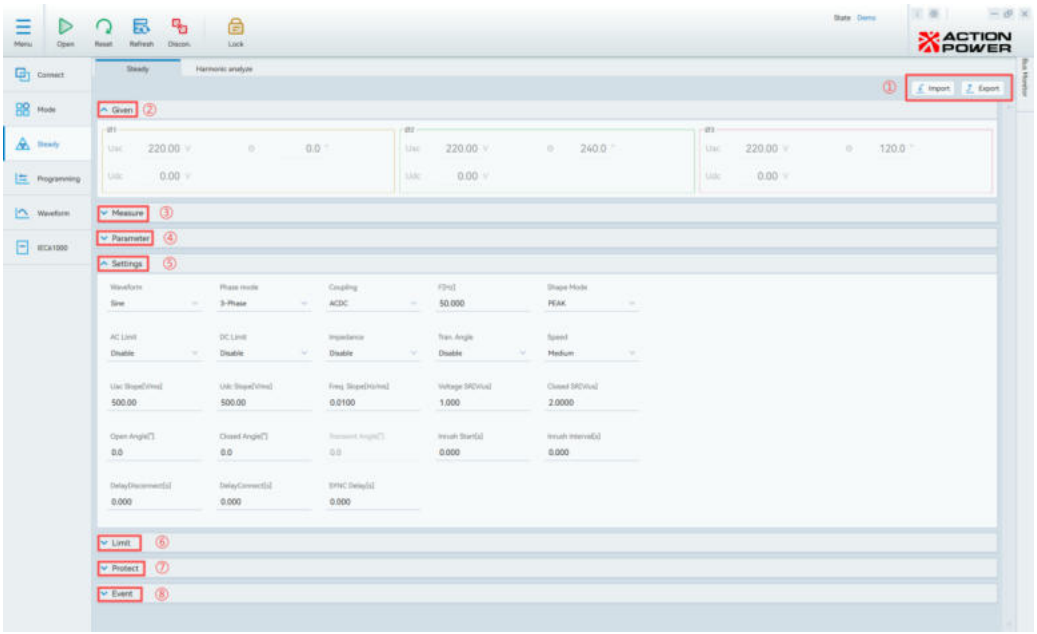


Figure 7.2.1 Source Mode Steady-State Parameters Window (AC+DC)

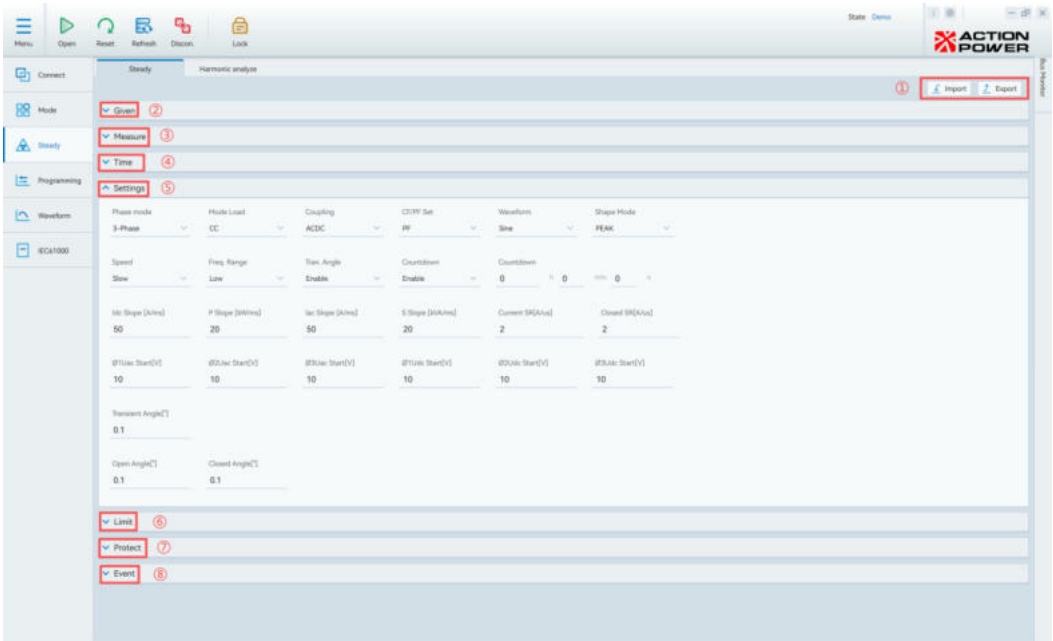


Figure 7.2.2 Load Mode Steady-State Parameters Window (AC+DC)

Different modes and different coupling methods correspond to different steady-state interfaces. Figure 7.2.1 shows the steady-state interface for three-phase ACDC coupling in source mode, while Figure 7.2.2 shows the steady-state interface for three-phase ACDC coupling in load mode.

Prerequisites: Successful device connection or demonstration mode

1. Function Area: Import/export current steady-state parameters

2. Input Area:

【Uac】: RMS value of the AC voltage component;

【Udc】: RMS value of the DC voltage component

【θ】: Initial phase angle

【Iac】: Output AC current;

【Idc】: Output DC current

【CF】: Crest factor

【PF】: Power factor

【S】: Apparent power

【P】: Active power

Basic Parameters of RLC Mode:

【R】: Load Resistance

【L】: Load Inductance

【RL】: Inductive reactance

【C】: Load capacitance

【RC】: Capacitive internal resistance

Basic Parameters of PQ Mode:

【P】: Active power

【QL】: Inductive reactive power

【QC】: Capacitive reactive power

3. Measurement Area: Real-time display of current device output measurements

【Urms】: Root mean square value of the DC component of voltage divided by the square root of the sum of the squares of the AC component's effective values;

【Irms】: Square root of the sum of the square of the AC component's RMS value and the DC component's RMS value;

【P】: Active power

【Upk】: Absolute value of voltage peak

【U12】: Line voltage UAB

【U23】: Line voltage UBC

【U31】: Line voltage UCA

【Uthd】: Total voltage harmonic distortion

【Freq】: Frequency

【Iac】: RMS value of AC current component

【Idc】: DC Component RMS Current

【Ipk】: Absolute value of current peak

【CF】: Current Peak Factor

【Ithd】: Total Harmonic Distortion of Current

【Irh】: Inrush current

【PF】: Power factor

【S】: Apparent power

【Q】: Reactive Power

【∑S】: Total apparent power

【∑P】: Total active power

【∑Q】: Total reactive power

【∑PF】: Total power factor

4. Parameter or time zone

【Iac】: Alternating current

【S】: When the output phase configuration is three-phase or split-phase, this represents the maximum apparent power per phase. When the output phase configuration is single-phase, this represents the maximum total apparent power.

【R】: Built-in resistor

【L】: Built-in inductance. Calculate inductance using X=2πfL.

【Time】: Run time; when load timing enable is set in the configuration, Time indicates the operational countdown.

【Transfer】: Transfer time

5. Settings Area:

【Shape Mode】: PEAK: Peak value; RMS: Root Mean Square value.

【AC Limit】: This enable button is only active when the coupling mode is set to AC. When enabled, the maximum AC current and maximum apparent power output by the product are limited to the set values.

【DC Limit】: This enable button is only active when the coupling mode is set to DC. When enabled, the maximum positive/negative DC current and maximum positive/negative active power output by the product are limited to the set values.

【Impedance】: When enabled, a set impedance is added to the product's output terminals, causing the output voltage to decrease.

【Tran.Angle】: When enabled, the output will synchronously change according to the set transient angle when voltage or frequency is altered.

【Speed】: The system's response bandwidth. Users can select different response speeds to adapt to the device under test.

【Uac Slope】: A parameter describing the steady-state output voltage, defined as the ratio of the output voltage RMS increment to time.

【Freq Slope】: A parameter describing the output frequency in steady state, defined as the ratio of the output frequency increment to time.

【Voltage SR】: A parameter describing the output voltage transient. A higher value reduces the time required to reach the set voltage.

【Closed SR】: The instantaneous voltage drop per microsecond at the output terminal after disconnection. Setting the shutdown slew rate controls the voltage decay time.

【Open Angle】: The output begins at the preset angle.

【Closed Angle】: The output terminates at the preset angle.

【Inrush Start】: Time from product output initiation to inrush current measurement commencement.

【Inrush Interval】: The duration for measuring inrush current.

【DelayDisconnect】: When a disconnect delay is set, pressing the output button during active output causes the output relay to disconnect after the specified delay, thereby terminating the output.

【Delay connect】: When a turn-on delay is set, in standby mode, pressing the output button causes the output relay to energize after the set turn-on delay time, connecting the product's output terminals.

【SYNC Delay】: Delay time for external phase synchronization input. Enables multi-phase synchronized output across multiple devices.

【Trigger Output】: DC voltage slope

【Load Timing】: After enabling load timing, set the operational duration for load mode. A countdown timer displays within the time zone (position 4 in the diagram).

6. Limit Zone:

【Uac Lower Limit】: The minimum value that can be set for the AC voltage in the output setting area. To prevent damage to the device under test due to an excessively low output AC voltage caused by incorrect operation, the user can set the AC voltage lower limit within a safe range here.

【Uac Upper Limit】: The maximum value that can be set for the AC voltage in the output setting area. Users should set the AC voltage upper limit within a safe range here to prevent damage to the device under test caused by excessively high output AC voltage due to misoperation.

【Udc Lower Limit】: The minimum value that can be set for DC voltage in the output configuration area. Users should set the DC voltage lower limit within a safe range here to prevent damage to the device under test caused by excessively low output DC voltage due to misoperation.

【Udc Upper Limit】: The maximum value that can be set for DC voltage in the output configuration area. To prevent damage to the device under test caused by excessive DC voltage due to incorrect operation, users can set the DC voltage upper limit within a safe range here.

【Iac Limit Lower Limit】: Represents the minimum value of the output AC current for each phase. This setting is effective when the coupling mode is AC. When the output phase configuration is three-phase or split-phase, the actual value equals the set value. When the output phase configuration is single-phase, the actual value is three times the set value. Users should avoid damaging the device under test due to erroneous operation causing excessively low output AC current. Here, the AC current lower limit can be set within a safe range.

【Iac Current Limit Upper Bound】: Represents the maximum output AC current for each phase, applicable when the coupling mode is AC. For three-phase or split-phase outputs, the actual value equals the set value. For single-phase outputs, the actual value is three times the set value. Users should set the AC current upper limit within a safe range here to prevent damage to the

device under test caused by excessively high output AC current due to misoperation.

【Idc Limit Lower Limit】: Represents the minimum value of the DC output current for each phase, effective when the coupling mode is DC. When the output phase configuration is three-phase or split-phase, the actual value equals the set value. When the output phase configuration is single-phase, the actual value is three times the set value. Users needing to prevent damage to the device under test due to excessively low DC output current caused by misoperation can set the DC current lower limit within a safe range here.

【Idc Limit Upper Bound】: Represents the maximum DC output current for each phase, effective when the coupling mode is DC. For three-phase or split-phase outputs, the actual value equals the set value. For single-phase outputs, the actual value is three times the set value. Users should set the DC current upper limit within a safe range here to prevent damage to the device under test caused by excessively high DC output current due to misoperation.

【Active Power Limit Lower Limit】: Represents the minimum active power value for each phase, effective when the coupling mode is DC. For three-phase or split-phase outputs, the actual value equals the set value. For single-phase outputs, the actual value is three times the set value. Users should set the active power lower limit within a safe range here to prevent damage to the device under test caused by excessively low source power due to misoperation.

【Upper Limit of Active Power】: Represents the maximum active power per phase, applicable when the coupling mode is DC. For three-phase or split-phase outputs, the actual value equals the set value. For single-phase outputs, the actual value is three times the set value. Users should set the upper limit of active power within a safe range here to prevent damage to the device under test caused by excessive source power due to misoperation.

【Apparent Power Limit Lower Bound】: Represents the minimum apparent power per phase, applicable when the coupling mode is AC or AC+DC. For three-phase or split-phase outputs, the actual value equals the set value. For single-phase outputs, the actual value is three times the set value. Users needing to prevent damage to the device under test due to excessively low source power from misoperation can set the apparent power lower bound within a safe range here.

【Upper Limit of Apparent Power】: Represents the maximum apparent power for each phase, applicable when the coupling mode is AC or AC+DC. For three-phase or split-phase outputs, the actual value equals the set value. For single-phase outputs, the actual value is three times the set value. Users should set the upper limit of apparent power within a safe range here to prevent damage to the device under test caused by excessive apparent power due to misoperation.

7. Protection Zone:

【Fast Peak Overvoltage Threshold】: Critical threshold for fast peak overvoltage protection, effective only in load mode. This parameter should be set when the user requires protection against the maximum instantaneous voltage value at the output terminal.

【RMS Overvoltage Threshold】: RMS overvoltage protection threshold. Set this parameter when protecting against the maximum RMS voltage at the output terminal.

【AC Overvoltage Threshold】: Critical threshold for AC overvoltage protection. This parameter can be set when users need to protect against the maximum AC voltage at the output terminal.

【DC Forward Overvoltage Threshold】: DC forward overvoltage protection threshold. This parameter can be set when users need to protect the maximum forward DC voltage at the output terminal.

【DC Reverse Overvoltage Threshold】: DC reverse overvoltage protection threshold. Set this parameter when protecting against the maximum reverse DC voltage at the output terminal.

【Load AC Undervoltage Threshold】: The critical threshold for load AC undervoltage protection, effective only in load mode. Set this parameter when users need to protect the minimum AC voltage at the output terminals.

【RMS Overcurrent Threshold】: Represents the RMS overcurrent protection threshold for each phase. When the output phase

configuration is three-phase or split-phase, it indicates the RMS overcurrent protection threshold for each phase. When the output phase configuration is single-phase, the actual value is three times the set value. This parameter can be set when the user needs to protect the maximum current at the output terminal.

【Active Power Threshold】: Total active power protection threshold. Set this parameter when users need to protect the maximum active power at the output terminals.

【Apparent Power Threshold】: Total apparent power protection threshold. Set this parameter when protecting the maximum apparent power at the output terminal.

【Overfrequency Threshold】: Critical value for overfrequency protection. Users can set this parameter to protect against maximum AC voltage frequency at the output terminal.

【Under-Frequency Threshold】: Under-frequency protection critical value. Users can set this parameter to protect the minimum frequency of the output AC voltage.

【Protection Duration】: If the output values of any parameter exceed their respective protection thresholds continuously within the set duration, protection is triggered.

8. Events:

【Event Source】: Displays voltage, current, frequency, power, and temperature for each phase. When monitoring voltage, current, power, or temperature status is required, select the corresponding trigger source to initiate events.

【Event Threshold】: Percentage of the trigger source's rated value. Users can set the trigger threshold to define event activation conditions.

【Event Time】: The duration from exceeding the trigger threshold until the event is triggered. Users can configure this parameter to control the event trigger speed.

【Event Action】: Log: When an event occurs, if the user needs to record the event in the log, select Log as the action mode. The product continues normal operation during logging. Alarm: When an event occurs, if the user needs to trigger an alarm and disconnect the output terminal, select Alarm as the action mode. After an alarm, the product disconnects the output terminal, and "Event X" flashes in the status display area. Warning: When an event occurs and the user requires a warning prompt, select "Warning" as the action mode. After a warning, the product continues normal operation, and "Event X" flashes in the status display area.

【Event Side】: Trigger events when voltage/current/power/temperature exceeds the trigger threshold upward. To trigger events when values exceed the threshold upward, set the threshold direction to "Upward." Trigger the event when voltage/current/power/temperature falls below the trigger threshold. If the user requires triggering when values drop below the threshold, set the threshold direction to "Down."

7.2.1.2 Operation Instructions

- First modify settings in the Settings area
- Then modify settings in the Designated Zone, Parameter Zone, Limit Zone, and Protection Zone. There is no specific order.
- Coupling mode and output phase number will be displayed in the Status Area mode field after configuration.
- The measurement area cannot be modified and is for displaying current output measurement values only
- Clicking the Import button opens a file selection dialog. Select the desired file (.meas), then click "Open" to import. Clicking Cancel returns to the previous screen.
- Clicking the Export button opens the Export File dialog. Modify the filename in the bottom input field, then click Save to export the file. Clicking Cancel cancels the export.

- Data import/export operations are disabled in Run mode. The Import/Export buttons will appear grayed out and unclickable.
- Example: Event configuration is shown in Figure 7.2.3. The trigger diagram is shown in Figure 7.2.4. When the Φ1 Urms trigger threshold reaches 100%, the corresponding parameter value is 636. This applies to all CORTEX-ACXX models. In the diagram, T1's duration is shorter than the trigger time, so Event 1 is not triggered. T2's duration equals the trigger time, so Event 1 triggers at 4 seconds.

Event

	NO.	Event source	Event threshold[%]	Event time[s]	Event action	Event side
☑	1	ϕ1 Urms	35	1.000	Warn	Above

Figure 7.2.3 Event Configuration Diagram

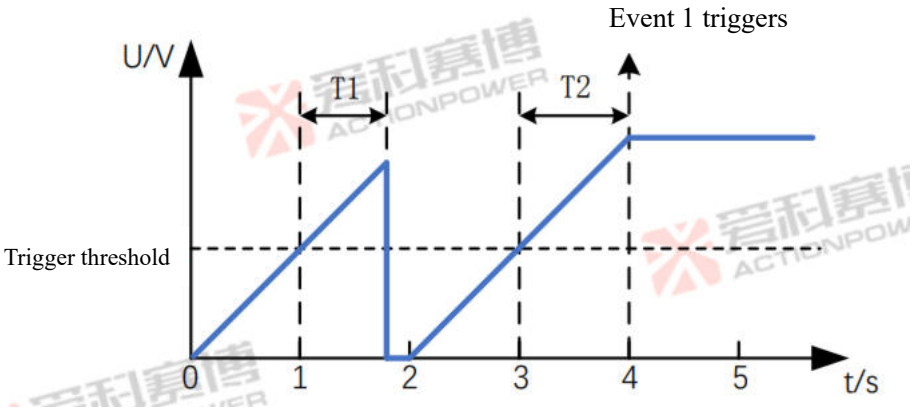


Figure 7.2.4 Event Trigger Diagram

7.2.2 Harmonic Analysis Interface

7.2.2.1 Interface Description

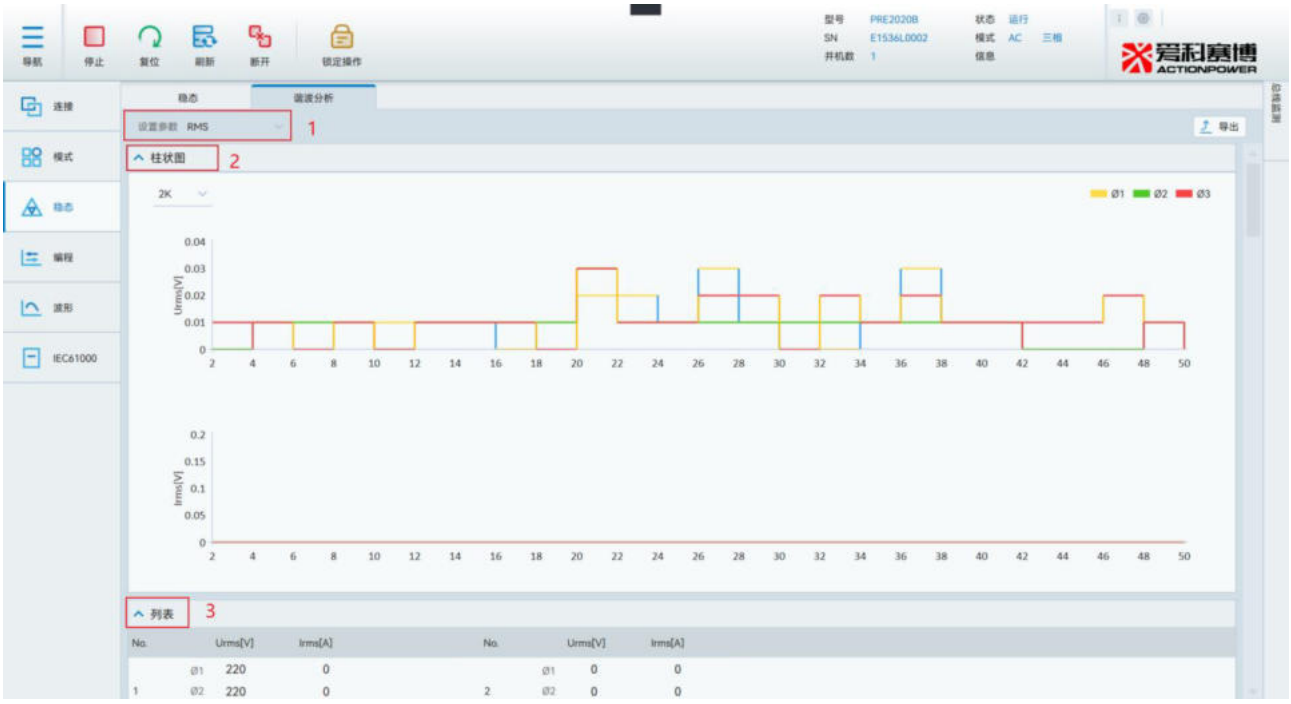


Figure 7.2.5 Harmonic Analysis Interface

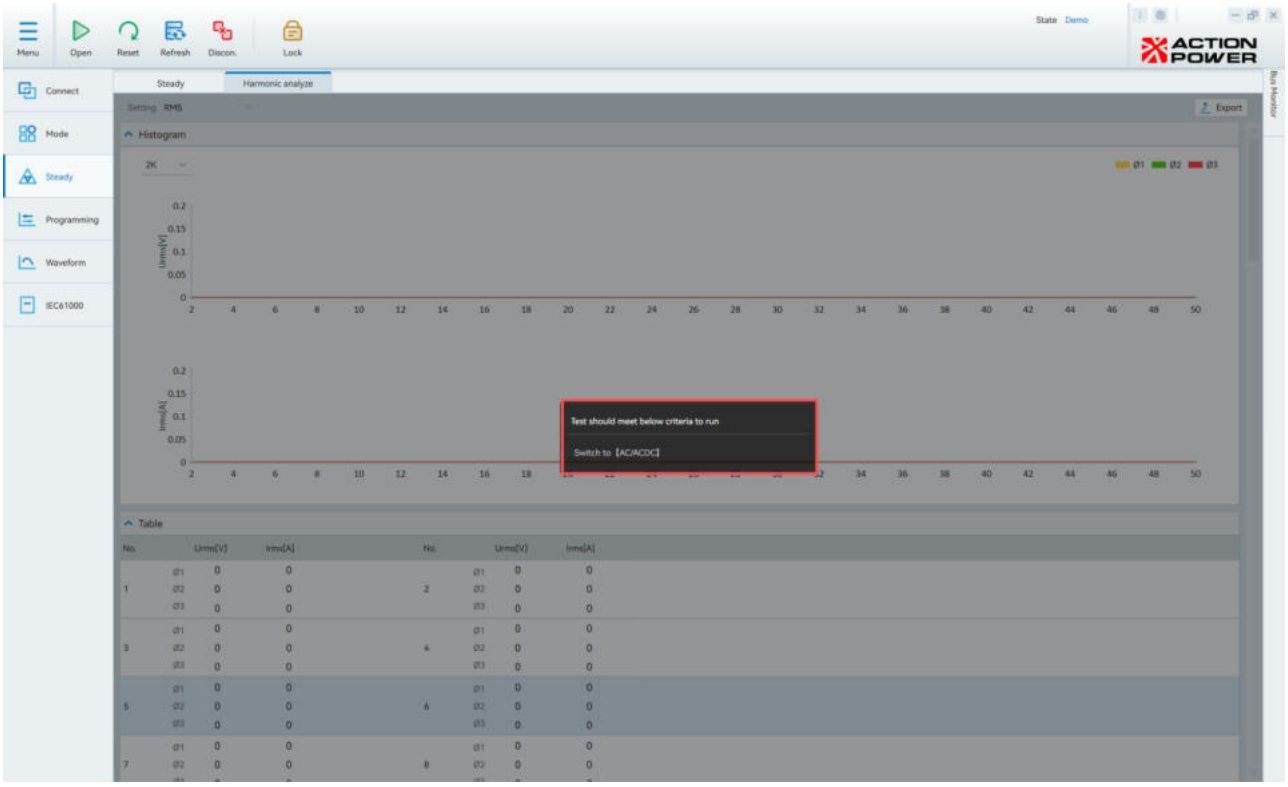


Figure 7.2.6 Harmonic Analysis Prompt

The Harmonic Analysis interface displays current harmonic content and RMS values. It is unavailable when the coupling mode is set to DC; adjust the coupling mode to AC or AC/DC instead. The prompt message is shown in Figure 7.2.6.

Prerequisites: Successful device connection with coupling mode set to AC, AC/DC, or Demo mode

1. Function Area: Settings Parameters: Select parameters to view. RMS: View effective value. THD: View harmonic content percentage. Export Button: Export current interface data.

2. Bar Chart Area: View parameter information via bar chart. The horizontal axis represents the nth harmonic.

3. List Area: Real-time display of harmonic content or RMS values for different frequencies based on parameters set in the Function Area. Note: The number of frequencies displayed in the harmonic analysis interface depends on the frequency range set in steady-state mode.

7.2.2.2 Operation Instructions

- First, set the parameters to view in the function area.
- View parameter information at different frequencies in the bar chart. Use the dropdown menu in the upper-left corner to adjust the displayed frequency range.
- View corresponding parameter information in real time in the list area.
- Clicking the Export button opens the Export File dialog. Modify the filename in the bottom-most field (*.analy), then click Save to export the file. Clicking Cancel cancels the export.
- Different frequencies correspond to different list area sequences and histogram horizontal axes, as detailed in the table below.

Frequency	Harmonic Order Display Range	Bar Chart X-Axis Display Range
40~100	100	50
100~200	10000/frequency	50
200~3200	10000/frequency	10000/frequency

7.3 Programming Interface

List programming involves creating a set of curves describing the relationship between time and voltage. Within each time interval, the voltage remains constant, making it suitable for simulating scenarios with sudden voltage changes.

Wave programming involves creating a series of curves describing the relationship between time points and voltage points (time, voltage). The key difference between Wave and List programming is that in List programming, the duration of each sequence represents the holding time for that sequence, whereas in Wave programming, the ramp time of each sequence defines the transition time for voltage changes between adjacent sequences.

Step programming describes the function of incrementing/decrementing the initial output value by a fixed step increment until reaching the final value. This feature is suitable for precisely measuring overvoltage/undervoltage protection thresholds, enabling users to quickly identify critical protection values.

Pulse programming enables the generation of fundamental waveforms superimposed with pulse waveforms.

Advanced programming enables sequence combinations and inner loops. Use Advanced programming to simulate complex operating conditions.

The Islanding Interface simulates anti-islanding testing functionality. When the product is in stable output mode, configure the corresponding RLC parameters or PQ parameters in the Islanding Editor interface to perform anti-islanding testing on the device under

test. This anti-islanding testing feature eliminates the need for external load devices, oscilloscopes, power analyzers, or other instruments, simplifying the test circuit, enhancing testing efficiency, and reducing testing costs.

The Flicker function is a programming mode designed to simulate sudden voltage changes.

AutoMatic programming enables customizable sequences in load CC, CP, and CR modes, facilitating adjustments to steady-state current, power factor, and internal resistance over a defined timeframe. It also supports sequence combinations and internal loops.

7.3.1 List Interface

7.3.1.1 Interface Description

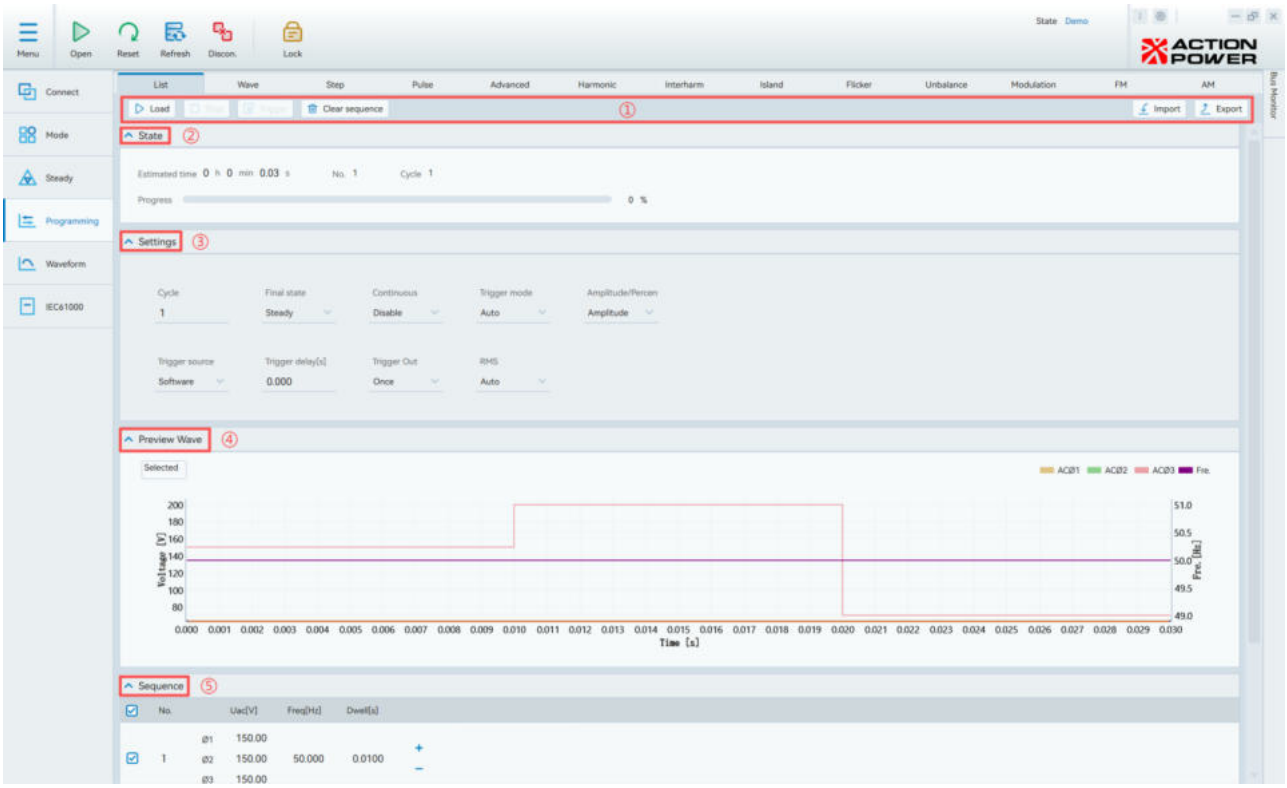


Figure 7.3.1.1 List Interface

Prerequisites: Source Mode: Device connection successful or Demo Mode; Load Mode: Device connection successful or Demo Mode with load mode set to CC or CP

1. Function Area: The Load button sends sequence and setting information to the device; the Exit button ends the current experiment; the Trigger button starts the current experiment; the Clear Sequence button clears all sequence entries except one.

2. State Area: Displays current experiment status information;

【Estimated Time】: Total experiment duration calculated based on set loop count and sequence length;

[No.]: The sequence number currently being executed;

[Cycle]: Current cycle number being executed;

[Progress]: Current progress of the experiment.

3. Settings Area:

【Cycle】: Sets the number of times the List programmed waveform will be cycled. A cycle count of 0 indicates infinite looping. Valid range: 0~9999999.

【Final State】： Steady State: After programming completes, the output waveform returns to steady state. Hold: After programming completes, the output waveform remains at the last programmed sequence. Standby: After programming completes, the output disconnects and the output button turns green.

【Continuous】: When enabled, re-triggering the same programming data requires no "Load" click—simply press "Trigger" directly.

【Trigger Mode】: Auto: Executes sequences sequentially per programming order. Single: Executes only one sequence per trigger.

【Trigger Souece】: Internal: Manually click "Trigger" on the display or send a trigger command via the communication interface for internal triggering. External: Send a trigger signal to the Anyport digital input interface for external triggering.

【Trigger delay】: After pressing "Trigger," execution of the programmed sequence begins after the set delay period.

【Trigger Out】: After enabling the trigger function in the Anyport digital output configuration interface, the product will emit a pulse indicator signal at the Anyport digital output port when outputting the programmed waveform. This operation requires enabling the trigger function in the Anyport digital output configuration interface. Single: Outputs a pulse indicator signal only when programming begins execution. Single Step: Emits a pulse indicator signal during the execution of each sequence. Single Cycle: Emits a pulse indicator signal at the start of each cycle.

【RMS】: See Table 7.1 for details.

RMS Mode	Description
Auto	When all programmed waveforms in the programming data are sine waves, clipped waves, built-in harmonics, or custom waveforms, and the custom waveform mode is set to RMS, RMS mode is automatically enabled. The output voltage value operates in closed-loop mode, automatically adjusting to match the setpoint. Otherwise, RMS mode is automatically disabled, and the output voltage operates in open-loop mode.
Enable	Forced closed-loop operation.
Disable	Force open-loop.

Table 7.1 RMS Mode Description Table

4. Waveform Preview Area

Previews the waveform generated by the current sequence configuration. Note: The load mode does not have a current region.

5. Sequence Area:

Source Mode:

【UAC】: RMS values of each phase's AC voltage.

【Freq】: Frequency of the output voltage.

【Dwell】: Hold time for the current sequence.

Load Mode:

【Iac】: RMS value of the AC component of the current.

【Idc】: RMS value of the DC component of the current

7.3.1.2 Operation Instructions

- Configure parameters in the settings area
- Configure sequences in the sequence area; up to 300 sequences can be added
- Click the Start button to activate the device
- Click the Load button to load the experiment data. After loading, other programming interfaces will open to display the ongoing experiment.
- Click the trigger button to start the experiment. The status bar in the status area displays the current experiment type: List.
- After the experiment completes, click the End button to conclude it.
- Clicking the Import button opens a file selection dialog. Select the file to import (.List), then click "Open" to import it. Clicking Cancel returns to the previous screen. The Import/Export buttons are disabled after device startup.
- Clicking the Export button opens the export dialog. Modify the filename in the bottom input field, then click Save to export the file. Clicking Cancel cancels the export.
- Example: In source mode, select AC coupling, set output phase to three-phase, configure List as shown in Figure 7.3.1.2, set loop count to 2. The corresponding waveform is shown in Figure 7.3.1.3

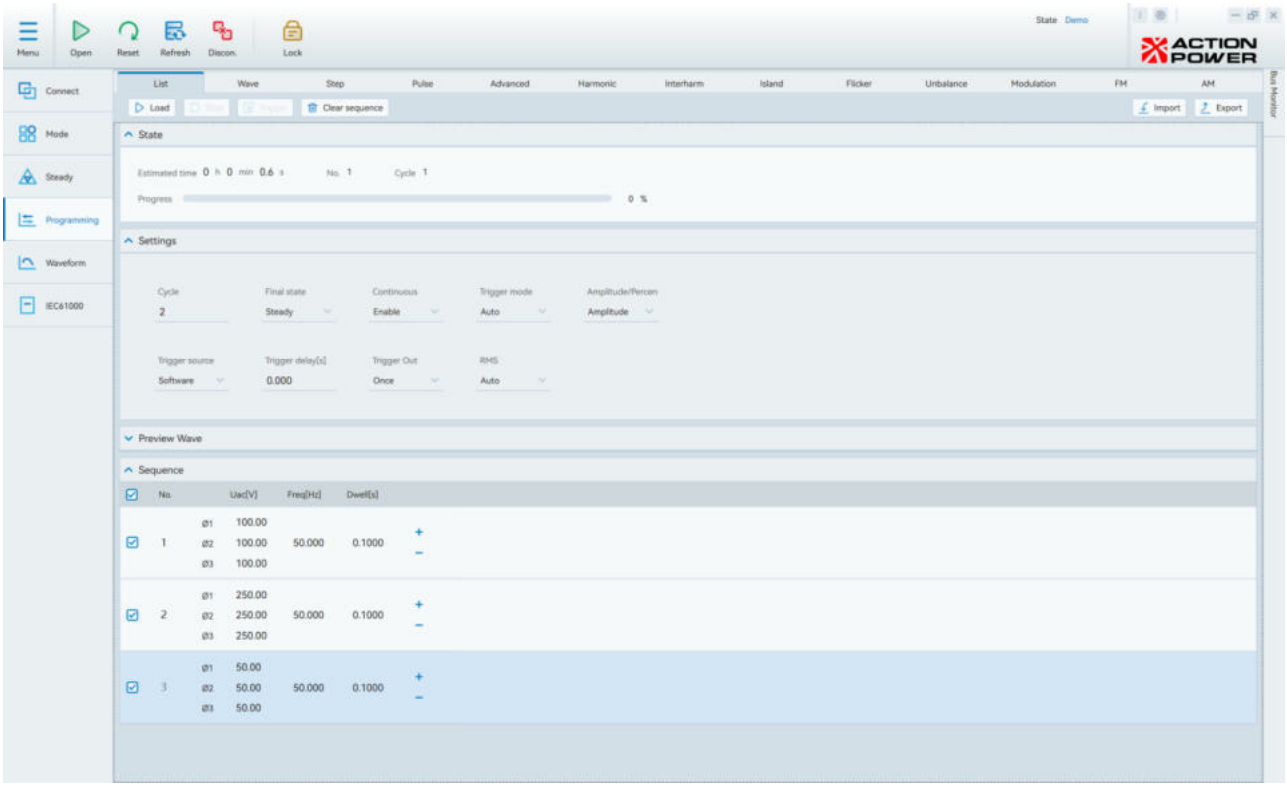


Figure 7.3.1.2 List Configuration Diagram

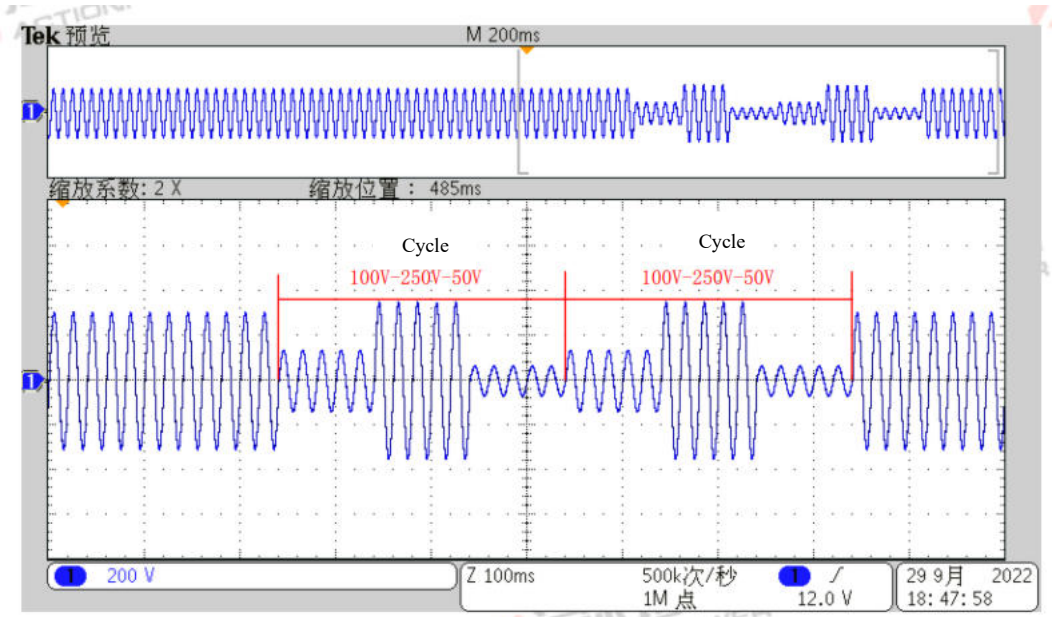


Figure 7.3.1.3 Actual List Waveform Diagram

7.3.2 Wave Interface

All operations in the Wave interface follow the same processing methodology as the List interface. The key distinction between Wave and List lies in the interpretation of sequence duration: in List, each sequence duration represents the hold time for the current sequence, whereas in Wave, the Ramp time for each sequence denotes the transition time between voltage values of adjacent

sequences.

Example: In source mode, with coupling mode set to AC and output phase count as three-phase, the Wave programming sequence configuration is shown in Figure 7.3.2.1. With a cycle count of 2, the corresponding waveform diagram is Figure 7.3.2.2.

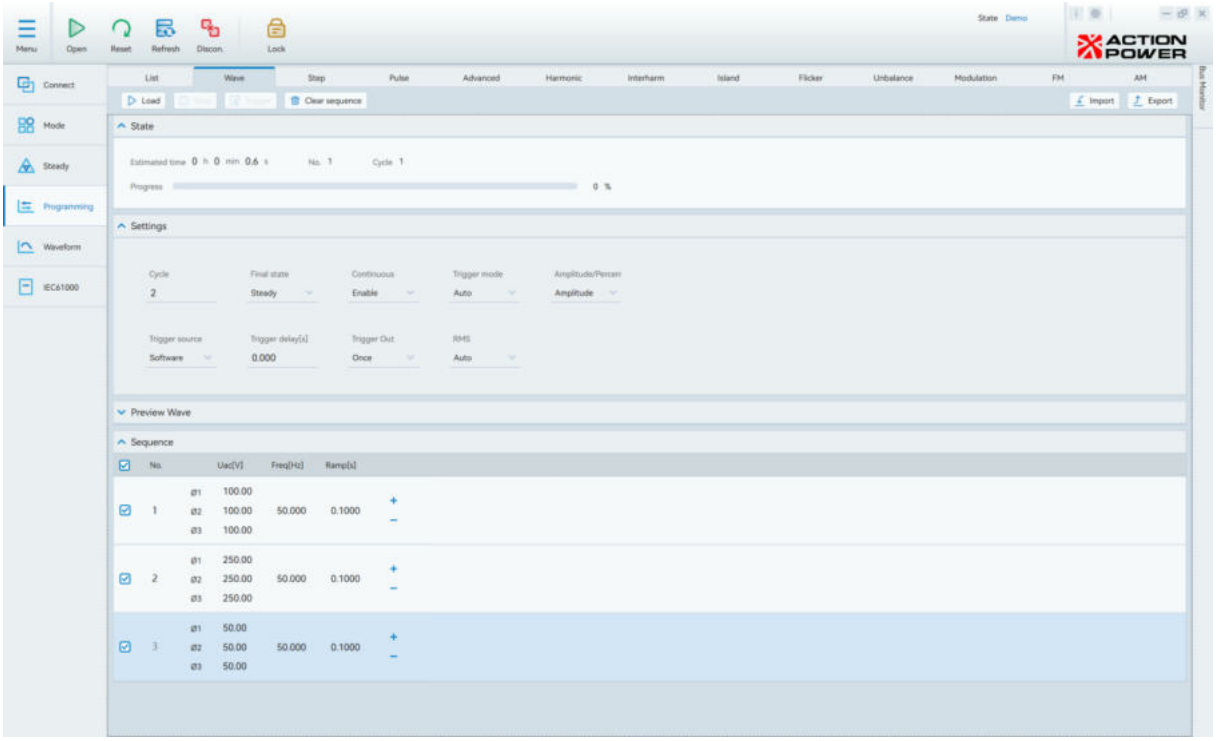


Figure 7.3.2.1 Wave Programming Sequence Configuration Example Diagram

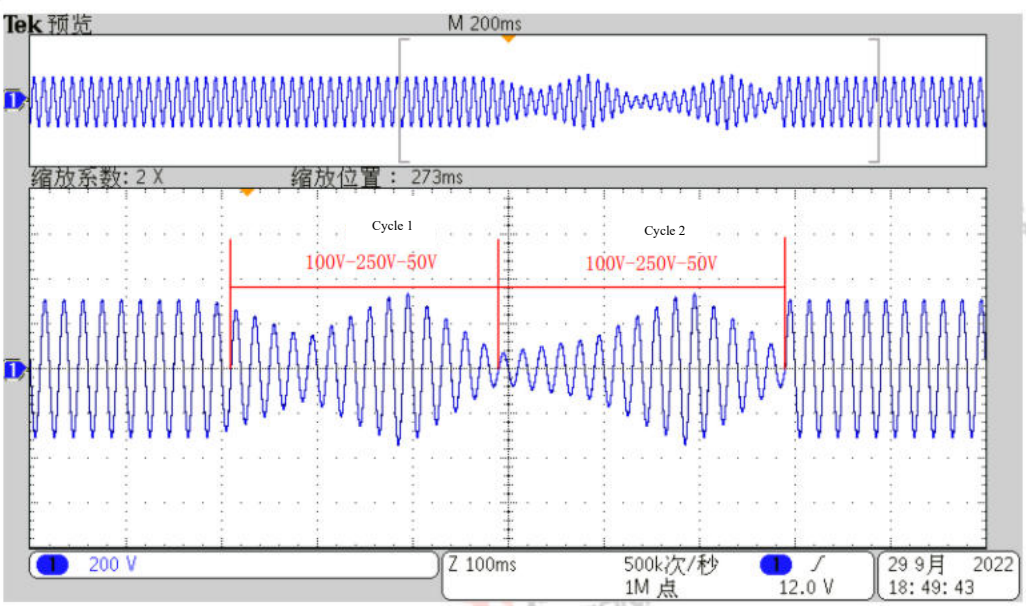


Figure 7.3.2.2 Waveform Diagram

7.3.3 Step Interface

7.3.3.1 Interface Description

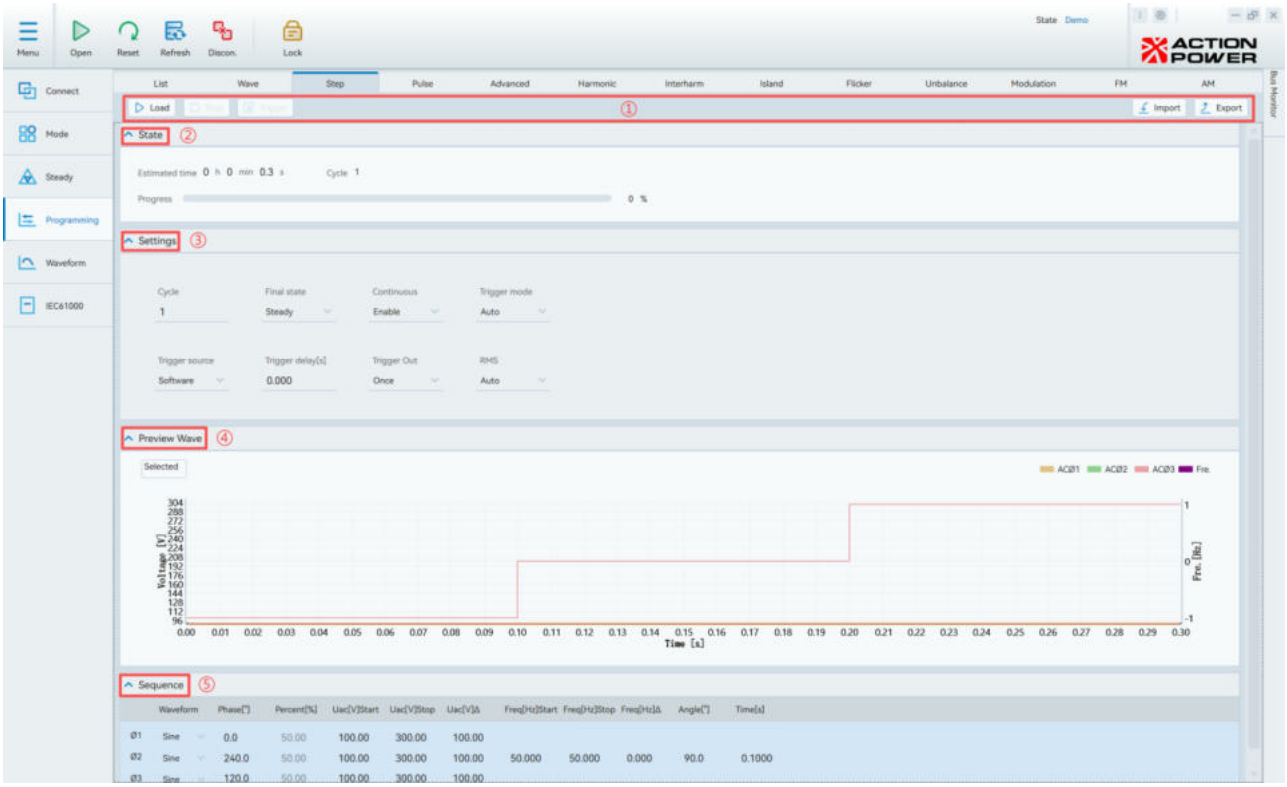


Figure 7.3.3.1 Step Interface

Prerequisites: Source Mode: Device connection successful or Demo Mode; Load Mode: Device connection successful or Demo Mode with load mode set to CC or CP

1. Function Area: The Load button sends the sequence and settings to the device; the Exit button ends the current experiment; the Trigger button starts the current experiment;

2. State Area: Displays current experiment status information;

【Estimated Time】: Total experiment duration calculated based on set loop count and sequence;

[Cycle]: Current cycle being executed;

[Progress]: Current progress of the experiment.

3. Settings Area:

Parameters correspond to those in the List interface parameter area

4. Preview Wave Area:

Previews the waveform generated by the current sequence configuration. Note: This area is not present in load mode.

5. Sequence Area:

Source Mode:

【Waveform】: Waveform.

【Phase[°]】: Phase.

【Percent[%]】： Percentage of waveform.

【Uac[V]Start】: Starting voltage RMS.

【Uac[V]End】: End voltage RMS.

【Uac[V]Δ】: Voltage change.

【Freq[Hz]Start】: Initial voltage frequency.

【Freq[Hz]End】: End voltage frequency.

【Freq[Hz]Δ】: Frequency change.

【Degree[°]】： Trigger angle.

【Time[s]】: Hold time for each step.

Load Mode:

【Iac[A]Start】: Initial current RMS value.

【Iac[A]End】: End current RMS value.

【Iac[A]Δ】: Current change.

7.3.3.2 Operation Instructions

- Configure parameters in the settings area
- Configure sequence information
- Click the Start button to activate the device
- Click the Load button to load experimental data. After loading, other programmed interfaces will open to display the ongoing experiment
- Click the Trigger button to start the experiment. The status bar in the status area displays the current experiment type: Step
- After the experiment completes, click the Exit button to end the experiment
- Clicking the Import button opens a file selection dialog. Select the desired file (.step), then click "Open" to import it. Clicking Cancel returns to the previous screen.
- Clicking the Export button opens the export dialog. Modify the filename in the bottom input field. Click Save to export the file; clicking Cancel cancels the export.
- Import/Export buttons are disabled after device startup.
- Example: In source mode, select AC as the coupling method and three-phase as the output phase count. The STEP

configuration is shown in Figure 7.3.3.2, with the corresponding waveform in Figure 7.3.3.3.

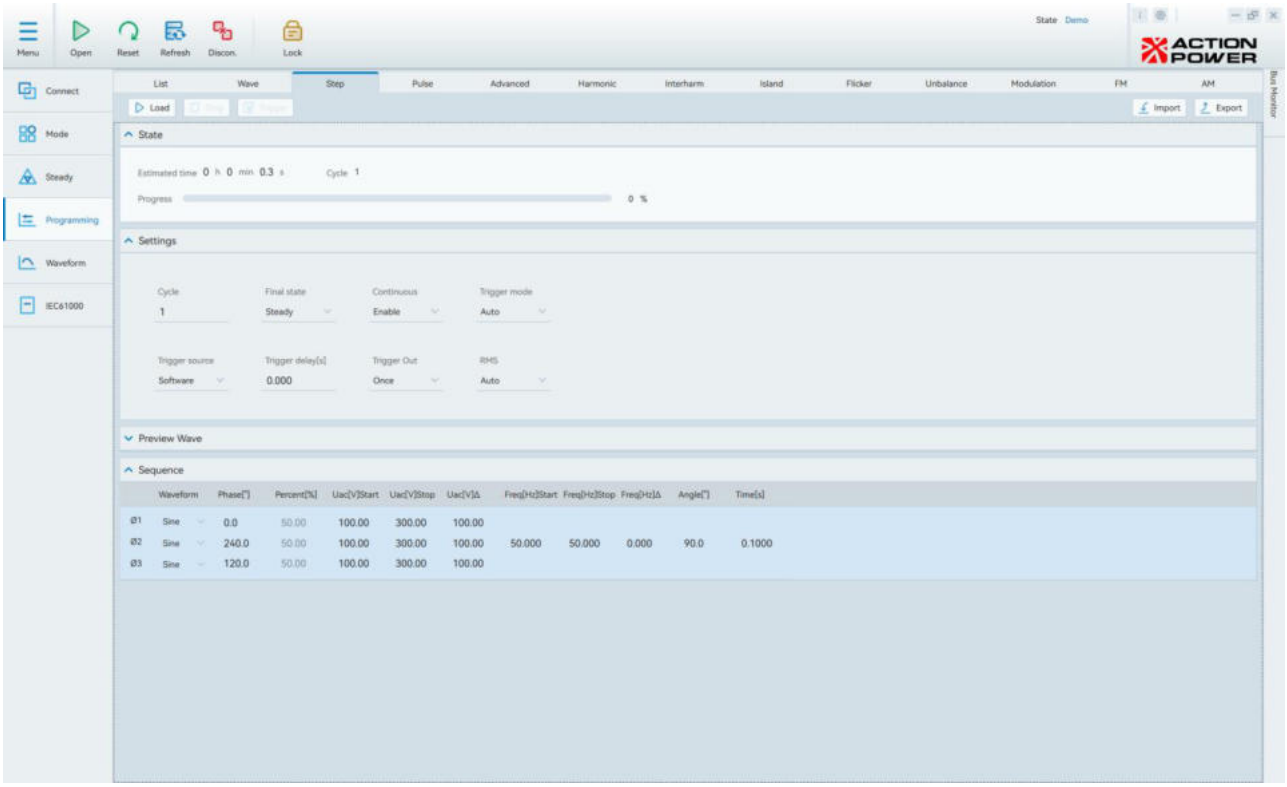
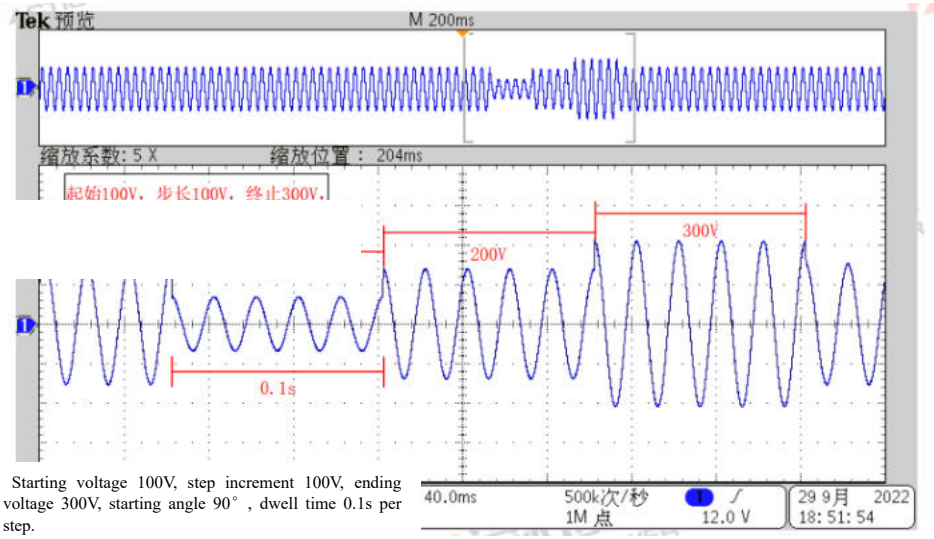


Figure 7.3.3.2 Step Configuration Diagram



Starting voltage 100V, step increment 100V, ending voltage 300V, starting angle 90° , dwell time 0.1s per step.

Figure 7.3.3.3 Step Waveform Diagram

7.3.4 Pulse Interface

7.3.4.1 Interface Description

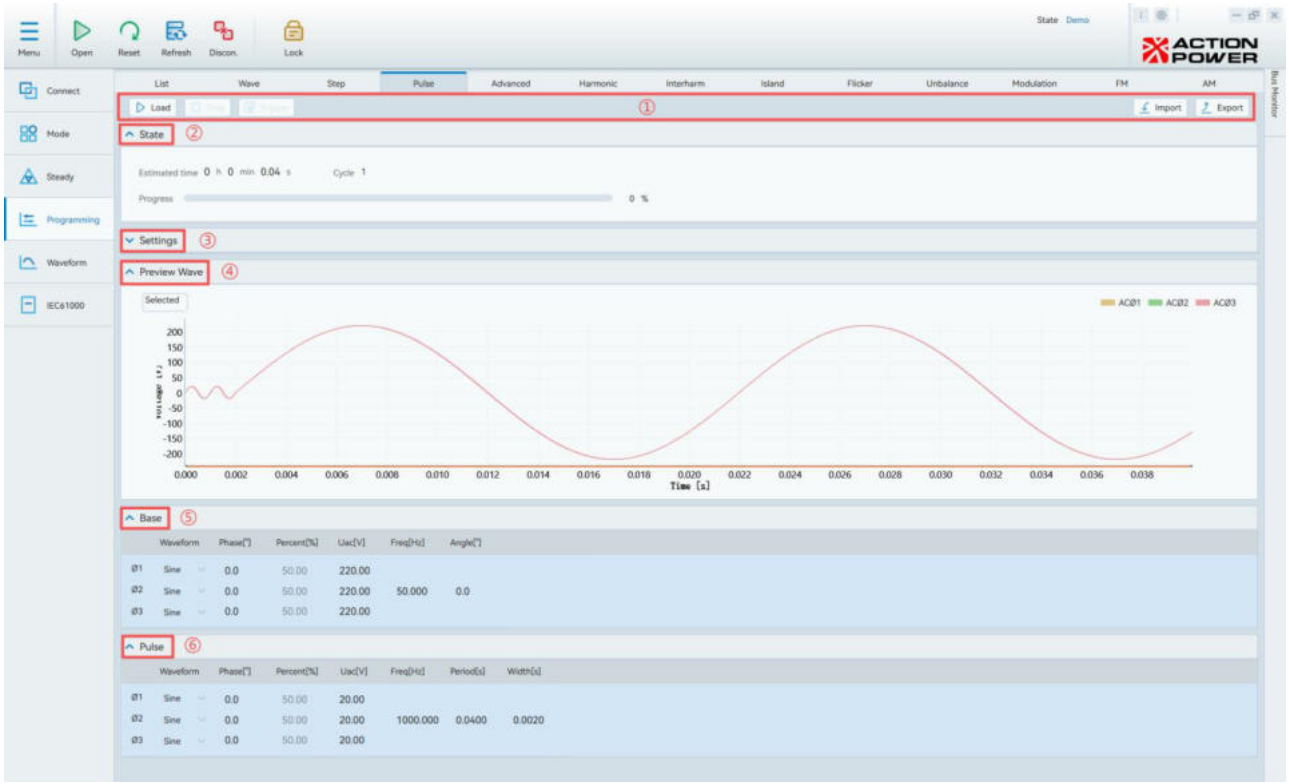


Figure 7.3.4.1 Pulse Interface

Prerequisites: Device connection successful or in demo mode and source mode

1. Function Area: The Load button sends fundamental pulse information and settings to the device; the End button concludes the current experiment; the Trigger button starts the current experiment.

2. State Area: Displays current experiment status information;

【Time】: Total experiment duration calculated based on the set number of cycles and pulse period;

[Execution Cycle]: Current cycle number being executed;

[Progress]: Current progress of the experiment.

3. Settings Area:

Parameters correspond to those in the List interface parameter area

4. Preview Wave Area:

Previews the waveform generated by the current sequence configuration.

5. Base Zone:

【Waveform】: Waveform.

【Phase[°]】: Phase.

【Percent[%]】: Waveform percentage.

【Uac[V]】: RMS value of each phase's AC voltage.

【Freq[Hz]】: Frequency of the output voltage.

【Width[s]】： Pulse width.

【Period[s]】： Fundamental period.

【Degree[°]】： Trigger angle.

7.3.4.2 Operation Instructions

- Configure parameters in the settings area
- Configure fundamental wave and pulse information
- Click the Start button to activate the device
- Click the Load button to load experimental data. After loading, other programming interfaces will open to display the ongoing experiment
- Click the Trigger button to start the experiment. The status bar in the status area displays the current experiment type: Pulse
- After the experiment completes, click the Exit button to end the experiment
- Clicking the Import button opens a file selection dialog. Select the desired file (.puls), then click "Open" to import it. Clicking Cancel returns to the previous screen.
- Clicking the Export button opens the export dialog. Modify the filename in the bottom input field. Click Save to export the file; clicking Cancel cancels the export.
- Import/Export buttons are disabled while the device is booting.
- Example: Select AC coupling mode, set output phase count to three phases, configure Pulse settings as shown in Figure 7.3.4.1, with corresponding waveform displayed in Figure 7.3.4.2

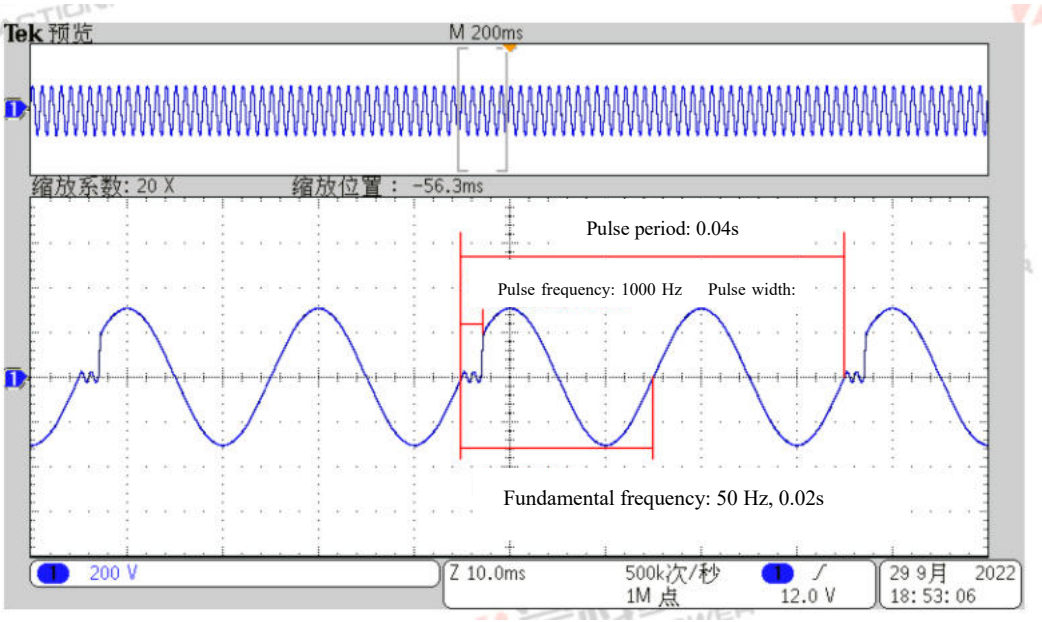


Figure 7.3.4.2 Transient Pulse Waveform Diagram

7.3.5 Advanced Interface

7.3.5.1 Interface Description

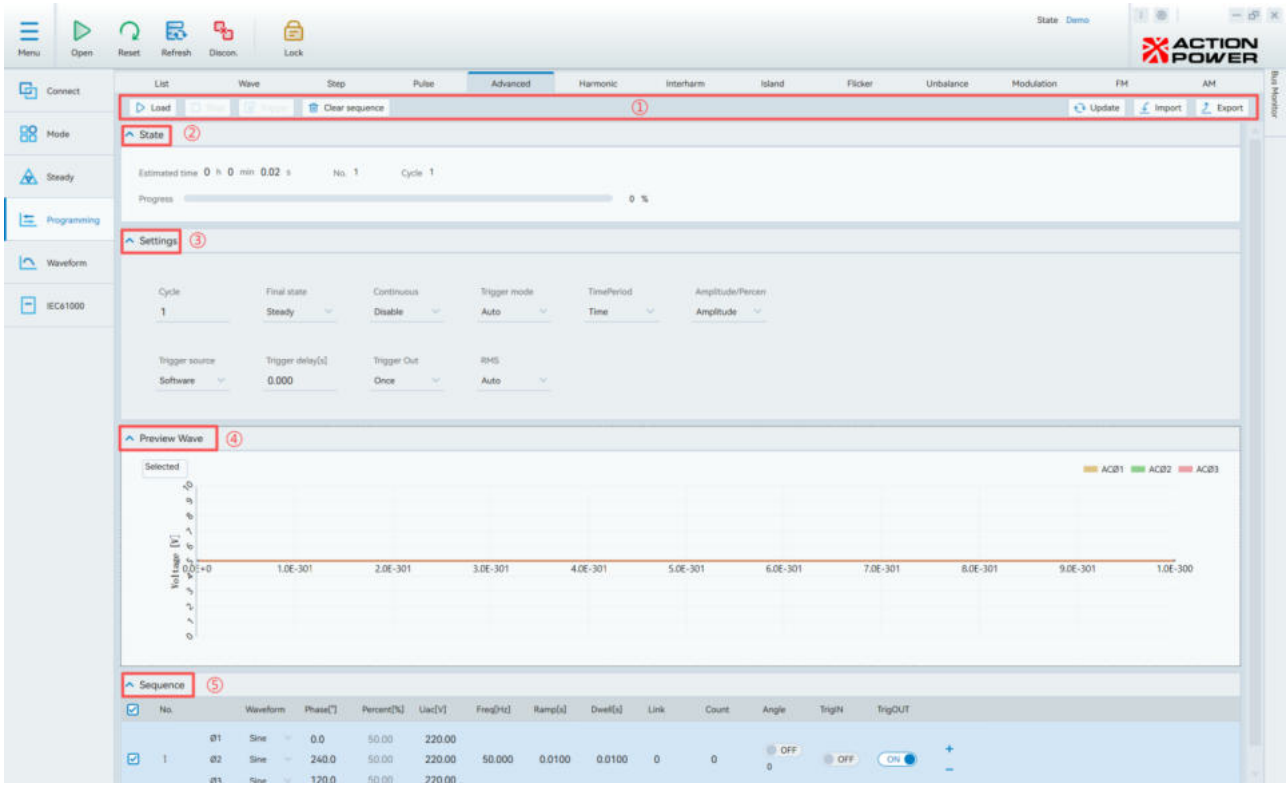


Figure 7.3.5.1 Advanced Interface

Prerequisites: Source Mode: Device connection successful or Demo Mode; Load Mode: Device connection successful or Demo Mode with load mode set to CC or CP

1. Function Area: The Load button sends the sequence and settings to the device; the Exit button ends the current experiment; the Trigger button starts the current experiment; the Clear Sequence button clears the sequence down to one entry; the Waveform Update button refreshes the waveform preview area

2. State Area: Displays current experiment status information;

【Estimated Time】: Total experiment duration calculated based on set loop count and sequence information;

[No.]: Indicates the current sequence being executed;

[Cycle]: Indicates the current loop being executed;

[Progress]: Current progress of the experiment.

3. Settings Area:

Parameters correspond to those in the List interface parameter area

【Time Period】: Select either time or cycle; total experiment duration varies based on configuration.

4. Preview Wave Area:

Previews the waveform generated by the current sequence configuration.

Waveform Selection: Choose the waveform to display

Note: Load mode does not have a current region.

5. Sequence Area:

Source Mode:

【Waveform】: Waveform.

【Phase[°]】: Phase.

【Percent[%]】： Percentage of waveform.

【Uac[V]】: RMS value of each phase AC voltage.

【Freq[Hz]】: Frequency of the output voltage.

【Ramp[s]】： Transition time between adjacent sequences.

【Dwell[s]】： Dwell time for the current sequence.

【Link】: After the current sequence completes, jump to the specified sequence. The rule is "Current Sequence Number - Link Value = Jump To Sequence Number". For example, if Sequence 3's Link is set to 2 (in which case Count must be set to a value ≥1, otherwise Link function fails), then after executing Sequence 3, it jumps to Sequence 1.

【Count】: Used in conjunction with Link to specify the number of cycles when jumping from the current sequence to the designated sequence. For example, if Link is set to 1 and Count is set to 2 for sequence 3, after sequence 3 completes, it jumps

to sequence 2, executes sequence 3 again, then jumps to sequence 2, completing two cycles.

【Degree[°]】: Starting angle, enabled when active.

【Trig In】: When disabled, sequences execute sequentially by number. When enabled, configure the trigger mode in the configuration area to "Auto" to execute enabled sequences via internal or external triggers.

【Trig Out】: When enabled, the trigger output in the configuration area must be set to single-step mode. A single-step pulse signal can be issued via the Anyport digital output interface.

Load Mode:

【Iac】: RMS value of AC current component

【Idc】: RMS value of DC current component

7.3.5.2 Operation Instructions

- Configure parameters in the settings area
- Configure sequence information; up to 300 sequences can be configured
- Click the waveform update button to refresh the waveform and view the preview image
- Click the Start button to activate the device
- Click the Load button to load experimental data. After loading, other programming interfaces will display that the experiment is in progress
- Click the Trigger button to start the experiment. The status bar in the status area displays the current experiment type: Advanced
- After the experiment completes, click the Exit button to end the experiment
- Clicking the Import button opens a file selection dialog. Select the desired file (.adva), then click "Open" to import it. Clicking Cancel returns to the previous screen.
- Clicking the Export button opens the export dialog. Modify the filename in the bottom input field. Click Save to export the file; clicking Cancel cancels the export.
- Import/Export buttons are disabled after device startup.
- Example: In source mode, select AC as the coupling method and three-phase as the output phase count. The Advanced configuration is shown in Figure 7.3.5.2, with the corresponding waveform displayed in Figure 7.3.5.3.

Sequence

	No.		Waveform	Phase[°]	Percent[%]	Uac[V]	Freq[Hz]	Ramp[s]	Dwell[s]	Link	Count	Angle	TrigIN	TrigOUT
☑	1	Ø1	Sine	0.0	50.00	50.00								
		Ø2	Sine	240.0	50.00	50.00	50.000	0.0001	0.0600	0	0	ON 60	OFF	ON
		Ø3	Sine	120.0	50.00	50.00								
☑	2	Ø1	Sine	0.0	50.00	150.00								
		Ø2	Sine	240.0	50.00	150.00	50.000	0.0001	0.0600	0	0	ON 90	OFF	ON
		Ø3	Sine	120.0	50.00	150.00								
☑	3	Ø1	Sine	0.0	50.00	300.00								
		Ø2	Sine	240.0	50.00	300.00	50.000	0.0600	0.0600	0	0	OFF 0	OFF	ON
		Ø3	Sine	120.0	50.00	300.00								

Figure 7.3.5.2 Advanced Sequence Configuration Diagram

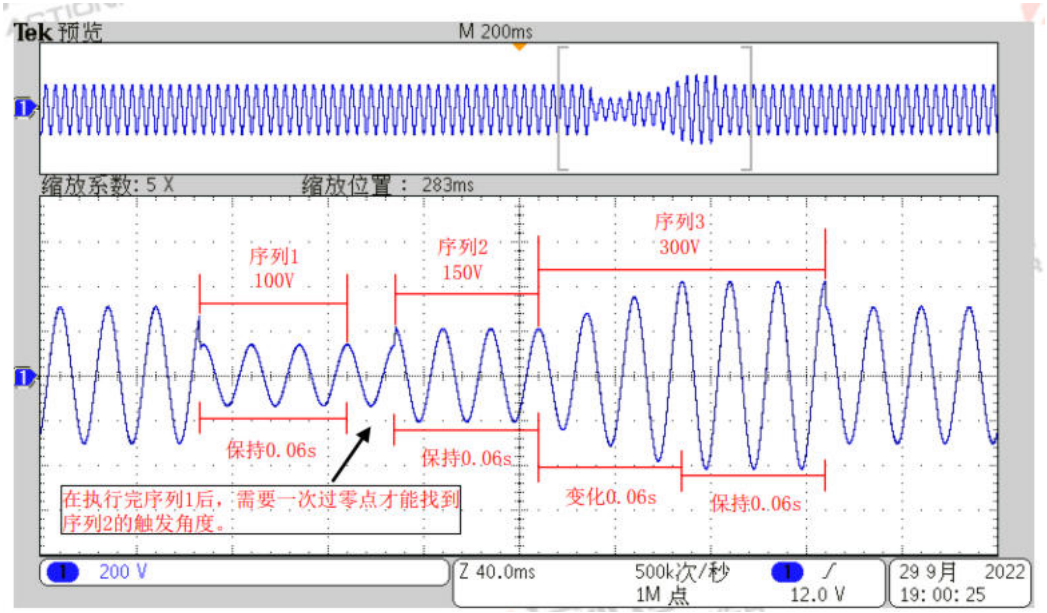


Figure 7.3.5.3 Advanced Waveform Diagram

With all other parameters unchanged, set both Link and Count for Sequence 3 to 1. Click "Load," then click "Trigger." The waveform displayed on the oscilloscope is shown in Figure 7.3.5.4.

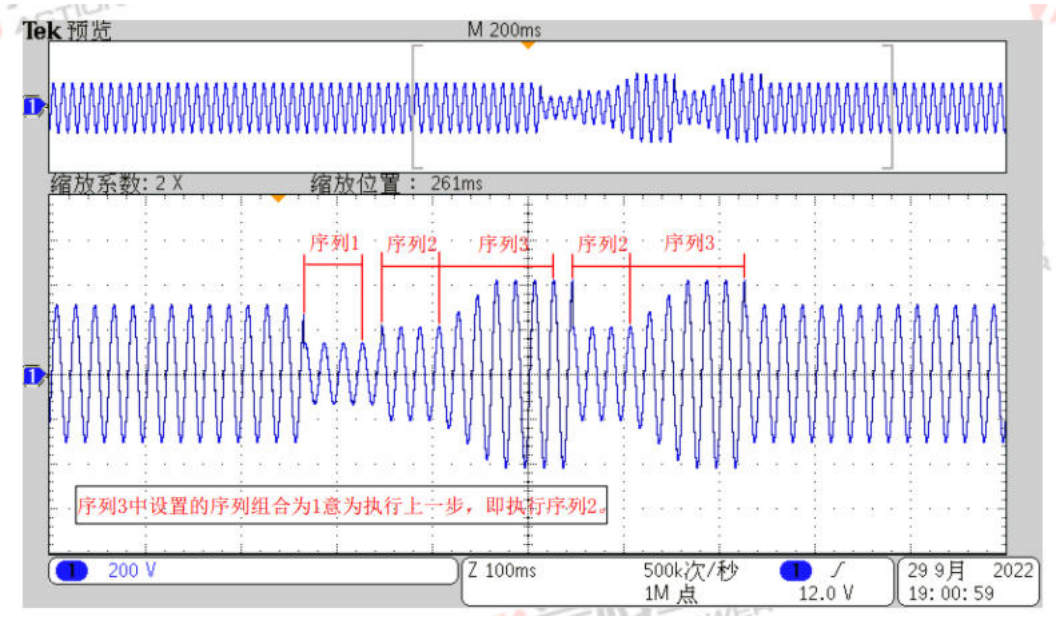


Figure 7.3.5.4 Advanced Sequence Combined Waveform Diagram

7.3.6 Harmonics Interface

7.3.6.1 Interface Description

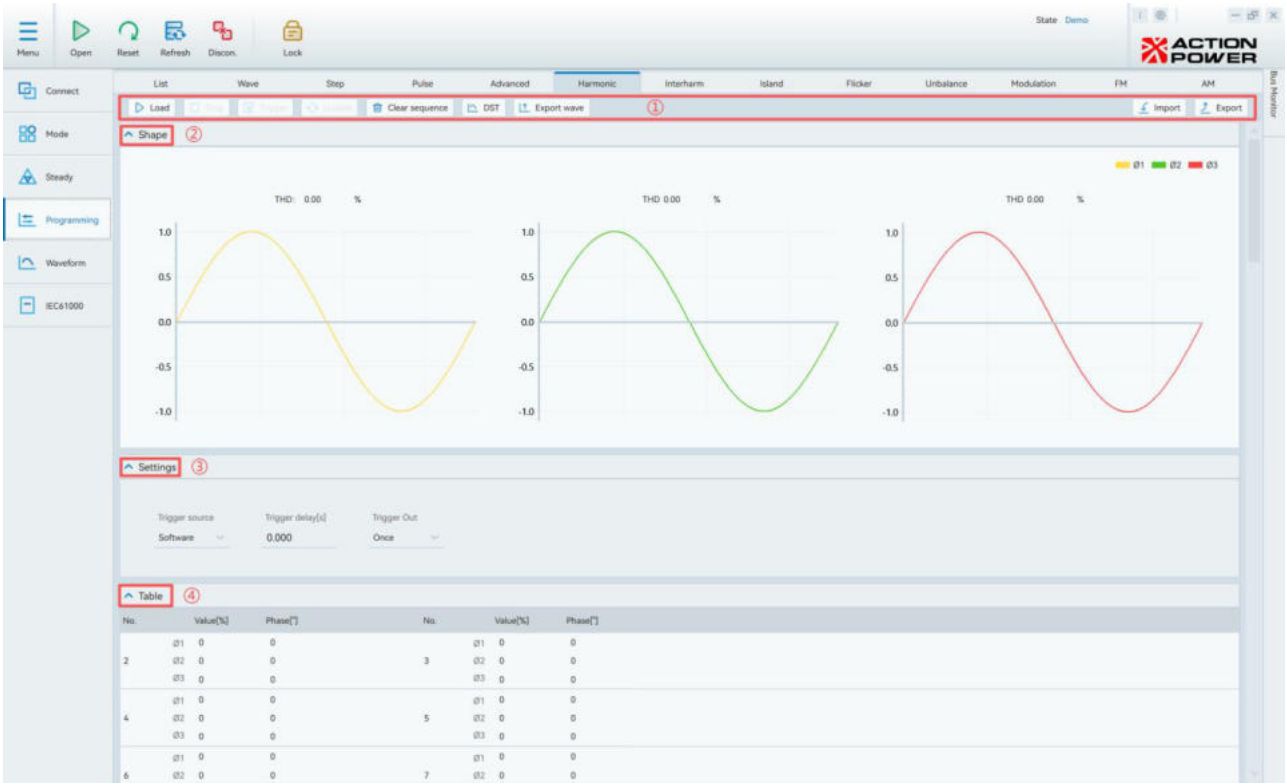


Figure 7.3.6.1 Harmonic Programming Interface

Prerequisites: Device connection successful or demonstration mode with coupling set to AC or AC/DC, and frequency configured between 40-400 Hz.

1. Function Area: Load button: Downloads experimental data and configuration parameters to initiate the experiment; Exit button: Terminates the current experiment; Update Button: Updates experimental data and triggers the experiment; Clear Data Button: Resets all harmonic content and phase data to zero; DST Button: Imports 30 sets of preloaded harmonic data; Export Waveform Button: Exports the current harmonic preview waveform data for use in the Waveform function; Import/Export Button: Exports programming data as a configuration file for import into the device.

2. Waveform Area: Displays a real-time schematic of the device's output waveform with superimposed harmonics.

3. Settings Area:

【Trigger source】: Internal: Manually click "Trigger" on the display to activate internal triggering. External: Send a trigger signal via the Anyport digital input interface to activate external triggering.

【Trigger Delay】: After pressing "Trigger," harmonics output after the set delay. Range: 0~999.999.

【Trigger Out】: Single: Emits a pulse indicator signal via Anyport digital output at the moment of harmonic output. Fundamental: After harmonic output, emits a pulse indicator signal via Anyport digital output at each zero-crossing point of the fundamental wave.

4. Table Area:

【NO.】: Harmonic order. Maximum editable value: 100th harmonic

【Value】: Harmonic content corresponding to the selected order.

【Phase】: Phase angle for the corresponding harmonic, range 0.0° to 359.9°.

7.3.6.2 Operation Instructions

- Click the DST button to select one of the 30 built-in harmonics and choose the phase to overlay.
- Preview the waveform diagram with the selected harmonic superimposed in the waveform area
- Adjust the content and phase as needed in the list
- Click the Start button to activate the device
- Click the Load button to load experimental data and trigger the experiment. The status bar in the status area displays the current experimental type (harmonic). After starting, other programmed interfaces open to show the experiment in progress.
- To change the selected built-in harmonic during the experiment, click the DST button to reselect the harmonic, choose the phase to overlay, and finally click the Update button to send the experimental data.
- During the experiment, manually adjust content and phase in the list area. After making changes, click the Update button to send the experimental data and trigger the experiment
- After the experiment completes, click the End button to terminate it.
- Different frequencies set in the steady-state interface allow editing different harmonic orders.
- Clicking the Import button opens a file selection dialog. Select the desired file (.harm), then click "Open" to import. Clicking

Cancel returns to the previous screen.

- Clicking the Export button opens the export dialog. Modify the filename in the bottom input field, then click Save to export the file. Clicking Cancel cancels the export.
- Import/Export buttons are disabled after device startup.

7.3.7 Interharmonic Interface

7.3.7.1 Interface Description

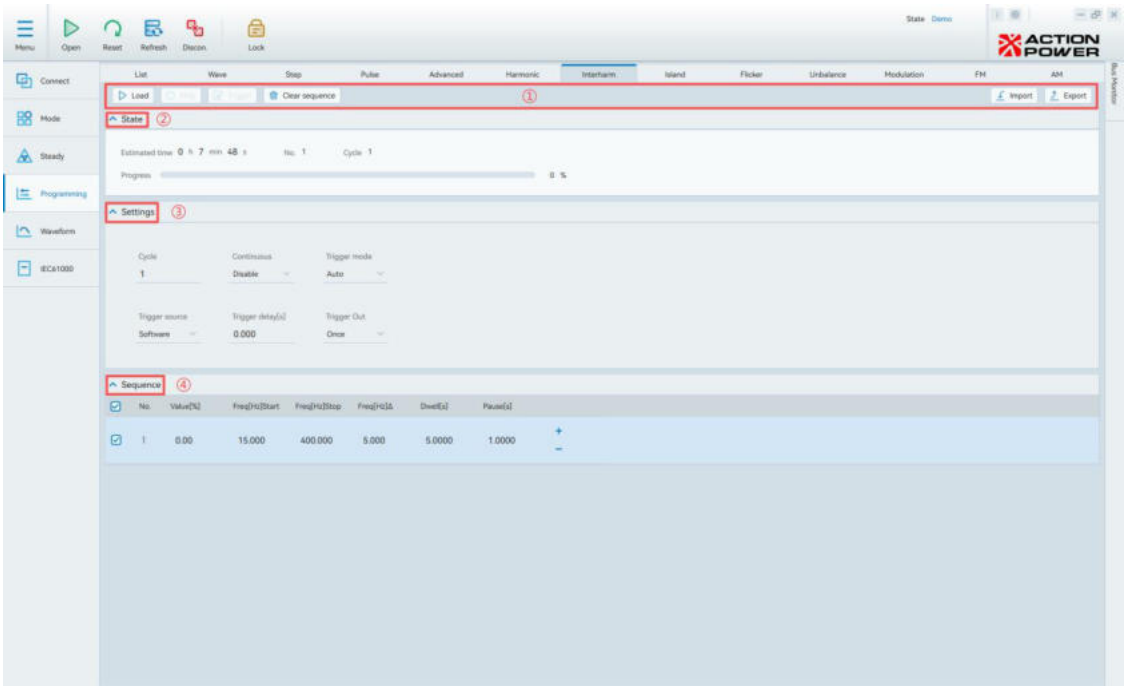


Figure 7.3.7.1 Interharmonic Programming Interface

Prerequisites: Successful device connection or demonstration mode with AC or AC/DC coupling.

1. Function Area: The Load button sends sequences and settings to the device; the Exit button ends the current experiment; the Trigger button starts the current experiment; the Clear Sequence button clears all sequence entries except one.

2. State Area: Displays current experiment status information;

【Estimated Time】: Total experiment duration calculated based on set loop count and sequence;

[No.]: Current cycle being executed;

[Cycle]: Indicates the current sequence being executed;

[Progress]: Current progress of the experiment.

3. Settings Area:

Refer to the List interface for configuration area

4. Sequence Area:

【No.】: Sequence number, supporting up to 300 steps.

【Value[%]】: Interharmonic content.

【Start[Hz]】: Starting frequency.

【End[Hz]】: End frequency.

【Δ[Hz]】: Frequency step size.

【Dwell[s]】: Execution time per frequency step.

【Pause[s]】: Interval time per frequency step.

7.3.7.2 Operation Instructions

- Configure parameters in the settings area
- Configure sequences in the sequence area; up to 300 sequences can be added
- Click the Start button to activate the device
- Click the Load button to load experimental data. After loading, other programming interfaces open to display the ongoing experiment
- Click the Trigger button to start the experiment. The Status bar in the Status area displays the current experiment type: harmonics
- After the experiment completes, click the Exit button to end the experiment
- Clicking the Import button opens a file selection dialog. Select the desired file (.inte), then click "Open" to import it. Clicking Cancel returns to the previous screen.
- Clicking the Export button opens the export dialog. Modify the filename in the bottom input field. Click Save to export the file; clicking Cancel cancels the export.
- Import/Export buttons are disabled after device startup
- Example: Select AC for the coupling mode, set the output phase count to three phases, configure interharmonics as shown in Figure 7.3.7.2, and the corresponding waveform is shown in Figure 7.3.7.3

Figure 7.3.7.2 Interharmonic Configuration Diagram

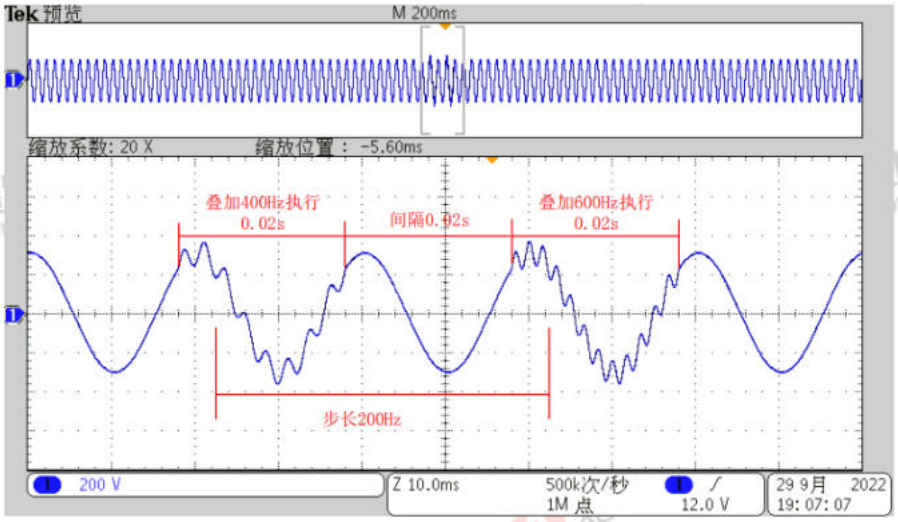


Figure 7.3.7.3 Actual Interharmonic Programming Waveform Diagram

7.3.8 Island Mode Interface

7.3.8.1 Interface Description

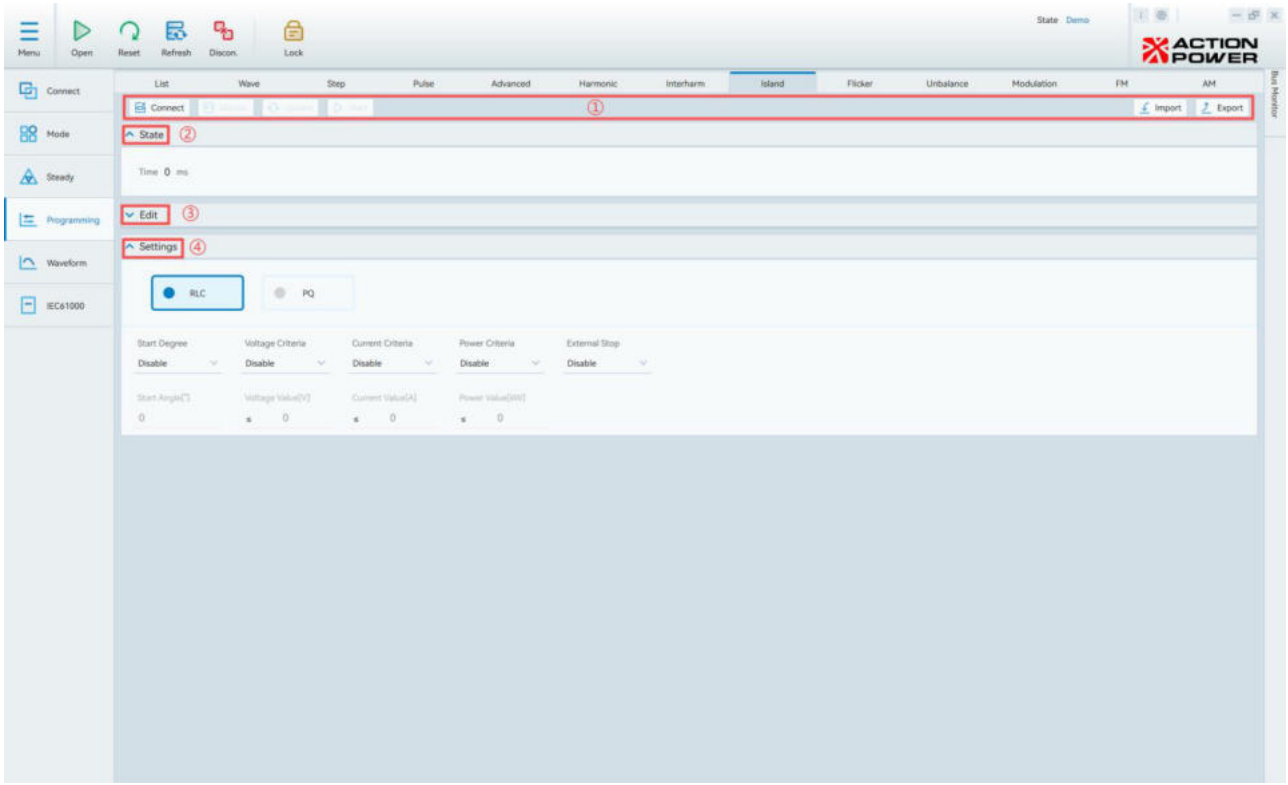


Figure 7.3.8.1 Islanding Interface

The CORTEX-ACXXS series products feature built-in anti-islanding test functionality. When the product is in stable output mode, set the corresponding RLC parameters or PQ parameters in the islanding test interface to perform anti-islanding testing on the device under test. This anti-islanding test function eliminates the need for external load devices, oscilloscopes, power analyzers, or other instruments, simplifying the test circuit, improving test efficiency, and reducing test costs.

Prerequisites: Successful device connection or demonstration mode with AC coupling

1. Function Area: - Engage button: Closes S2, connects island load, enters standby state. - Disconnect button: Opens S2, disconnects island load. - Start button: Opens S1, closes S2, initiates anti-islanding test. - Update button: Before clicking Start, modify island parameters. After editing, click Update to confirm changes.

2. Status Area:

【Island Duration】: Time elapsed from island start until stop conditions are met.

3. Editing Area:

RLC Mode Parameters:

【R】: Resistive load

【L】: Inductive Load

【C】: Capacitive load

PQ Mode Parameters:

【P】: Active Power

【Q L】: Inductive reactive power

【Q C】: Capacitive Reactive Power

Common Parameters:

【PR】: Active Power

【QL】: Inductive reactive power

【QC】: Capacitive Reactive Power

【Qf】: Power factor

【IR】: Resistive Current

【IL】： Inductive Current

【IC】: Capacitive Current

4. Settings Area:

【Start Degree】： After clicking "Start," the anti-islanding test will commence at the preset start angle.

【External Stop】: When an emergency stop signal is sent from the Anyport digital input interface, the islanding test ends and the product output automatically disconnects.

【Voltage Stop Threshold】: When the port voltage ≤ the set voltage threshold, the islanding test ends and the product output automatically disconnects.

【Current Stop Threshold】: When the port current ≤ the set current threshold, the islanding test ends and the product output automatically disconnects.

【Power Stop Threshold】: When the port power ≤ the set power threshold, the islanding test ends, and the product output

automatically disconnects.

7.3.8.2 Operation Instructions

- Configure parameters in the configuration area
- Edit parameters in the editing area
- Click the Start button to activate the device
- Click the Engage button to close S2, connect the load. After engagement, other programmed interfaces open to display the ongoing test
- If islanding parameters are modified, click the Update button to confirm changes
- Click the Start button to initiate the anti-islanding test. The status bar in the status area displays the current test type: Islanding
- After the experiment completes, click the Disconnect button to end the experiment
- Clicking the Import button opens a file selection dialog. Select the desired file (.isla), then click "Open" to import. Clicking Cancel returns to the previous screen.
- Clicking the Export button opens the Export File dialog. Modify the filename in the bottom input field. Click Save to export the file. Clicking Cancel cancels the export.
- Import/Export buttons are disabled after device startup.

7.3.9 Flicker

7.3.9.1 Interface Description

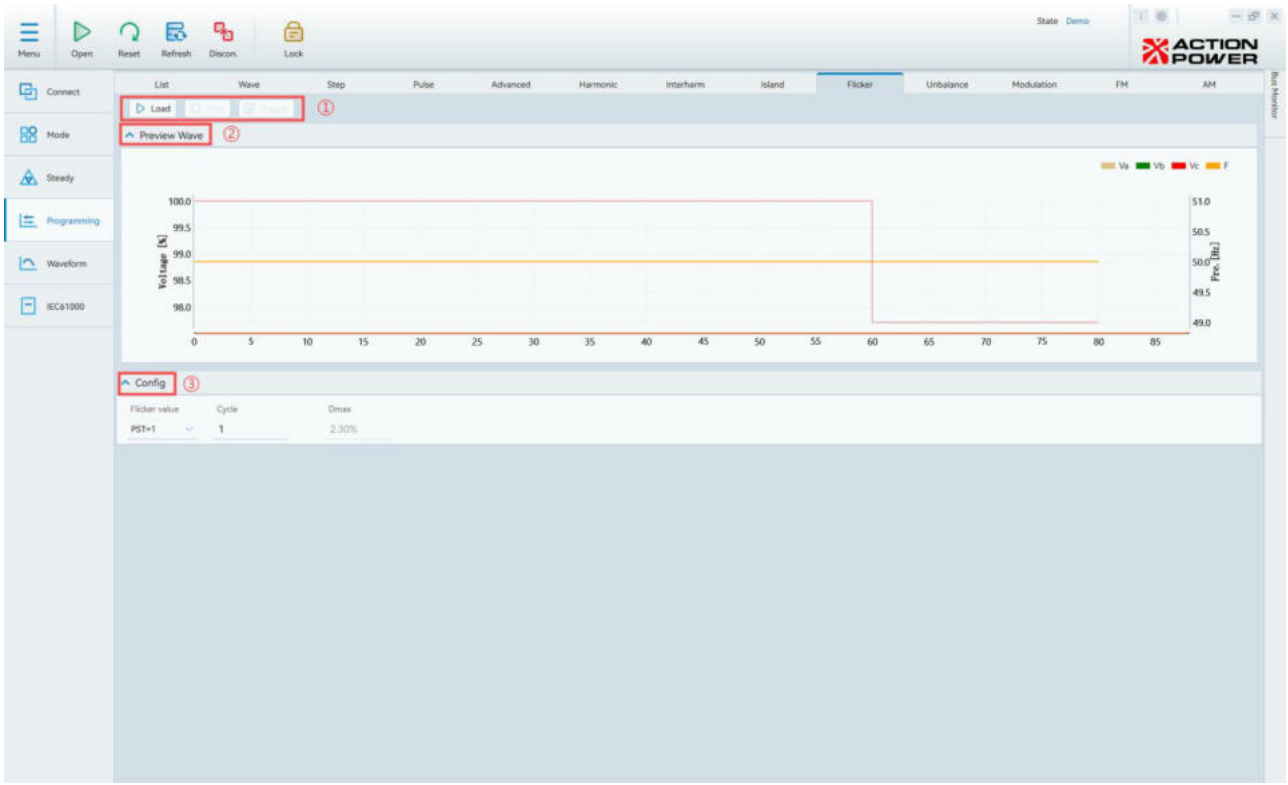


Figure 7.3.9.1 Flicker Interface

The Flicker function simulates sudden voltage changes through a programming method, offering 10 predefined programming configurations.

Prerequisites: Successful device connection or demo mode with AC coupling

1. Function Area: Load button to download programming configuration to the device; Trigger button to start the experiment; Exit button to end the experiment.

2. Waveform Preview Area:

Preview waveforms under different programming configurations.

3. Programming Configuration Area:

[Flicker Value]: 10 flicker values correspond to 10 built-in experimental parameter files for voltage transients in the host software

【Cycle】: Number of experimental cycles

【Dmax】: Maximum voltage change amplitude

7.3.9.2 Operating Instructions

- Select the flicker value and set the number of cycles
- View corresponding waveform preview information
- Click the Start button to activate the device
- Click the Load button to load experimental data. After loading, other programmed interfaces will open to display the ongoing experiment
- Click the trigger button to start the experiment. The status bar in the status area displays the current experiment type: Flicker
- After the experiment completes, click the exit button to end the experiment

7.3.10 Three-Phase Unbalance

7.3.10.1 Interface Description

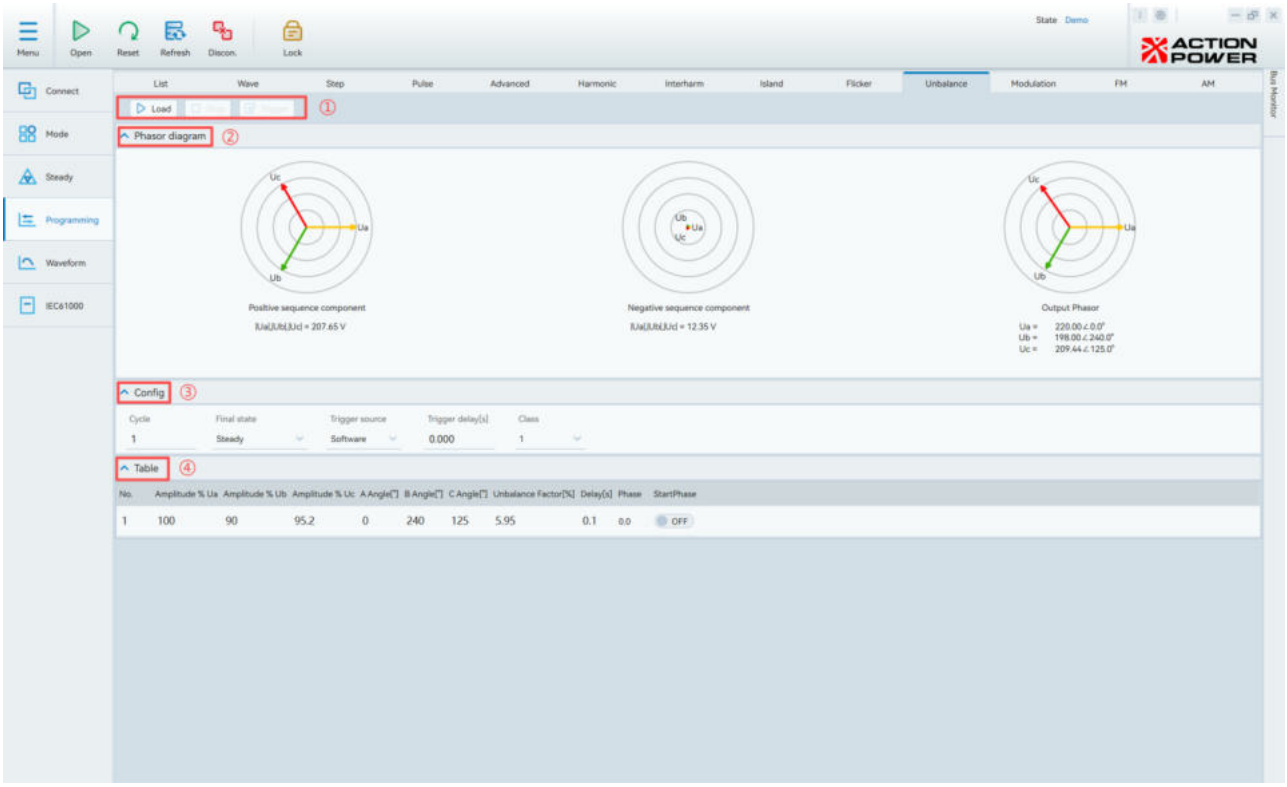


Figure 7.3.10.1 Three-Phase Unbalance Interface

Prerequisites: Successful device connection or demonstration mode, with coupling mode set to AC output and phase configuration set to separate phases.

1. Function Area: - Load Button: Downloads programming configuration and list information to the device. - Exit Button: Ends the current experiment. - Trigger Button: Starts the current experiment.

2. Phasor diagram Area:

3. Programming Configuration Area:

【Final State】： Steady State: Returns to steady state after the experiment ends; Hold: Maintains the final state after the experiment ends; Standby: Remains in standby mode after the experiment ends.

【Trigger Delay】： Experiment triggers after a specified time following button press.

【Class】: Four distinct types; only the Xth type list is editable.

4. List Area:

7.3.10.2 Operation Instructions

- Configure parameters in the programming configuration area.
- The list area is editable only when Class is set to X.
- Configure parameters in the list area
- Click the Start button to activate the device
- Click the Load button to load experimental data. After loading, other programming interfaces will display that the experiment is in progress
- Click the Trigger button to start the experiment. The status bar in the status area displays the current experiment type: Three-Phase Unbalance
- Click the Exit button to end the experiment after completion

7.3.11 Automatic

7.3.11.1 Interface Description

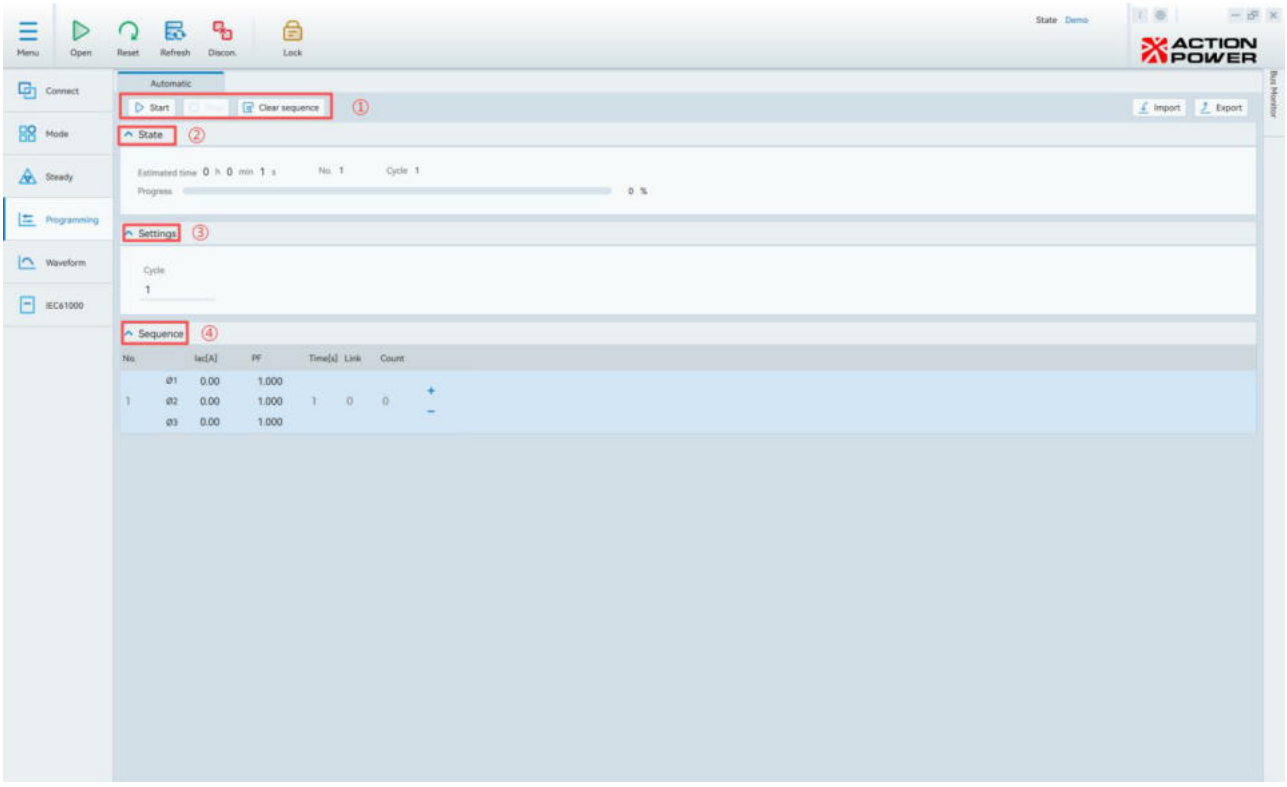


Figure 7.3.11.1 Automatic Interface

Prerequisites: Successful device connection or demonstration mode with mode set to Load and load mode set to CC, CP, or CR.

1. Function Area: The Start button transmits sequence and configuration data to the device and initiates the experiment; the End button concludes the experiment; the Clear Sequence button reduces the sequence to a single entry.

2. State Area: Displays the current experiment status information;

【Estimated Time】: Total experiment duration calculated based on the set number of cycles and sequence;

[No.]: The sequence number currently being executed;

[Cycle]: Current cycle number being executed;

[Progress]: Current progress of the experiment.

3. Settings Area:

【Cycle】: Number of cycles for the current experiment

4. Sequence Area:

【Iac】: Output AC current

【PF】: Power factor

【Time】: Duration of the current sequence

【Link】: After completing the current sequence, jump to the specified sequence. The rule is "Current Sequence Number - Link Value = Jump To Sequence Number". For example, if Link for Sequence 3 is set to 2 (Count must be set to a value ≥1; otherwise, Link function fails), after completing Sequence 3, jump to Sequence 1.

【Count】: Used in conjunction with Link to specify the number of cycles when jumping from the current sequence to the designated sequence. For example, if Link is set to 1 and Count is set to 2 for sequence 3, after sequence 3 completes, it jumps to sequence 2. It then executes sequence 3 again and jumps to sequence 2, completing two cycles.

7.3.11.2 Operation Instructions

- Set the loop count in the configuration area
- Configure sequences in the sequence area
- Click the Start button to activate the device
- Click the Start button to load experimental data and begin the experiment. The status bar in the status area displays the current experiment type as "Automatic." After starting, other programmed interfaces open to show the experiment in progress
- Click the End button to conclude the experiment after completion
- Clicking the Import button opens a file selection dialog. Select the desired file (.Auto), then click "Open" to import it. Clicking Cancel returns to the previous screen.
- Clicking the Export button opens the export dialog. Modify the filename in the bottom input field, then click Save to export the file. Clicking Cancel cancels the export.

7.4 Waveform Interface

7.4.1 Waveform Download

7.4.1.1 Interface Description

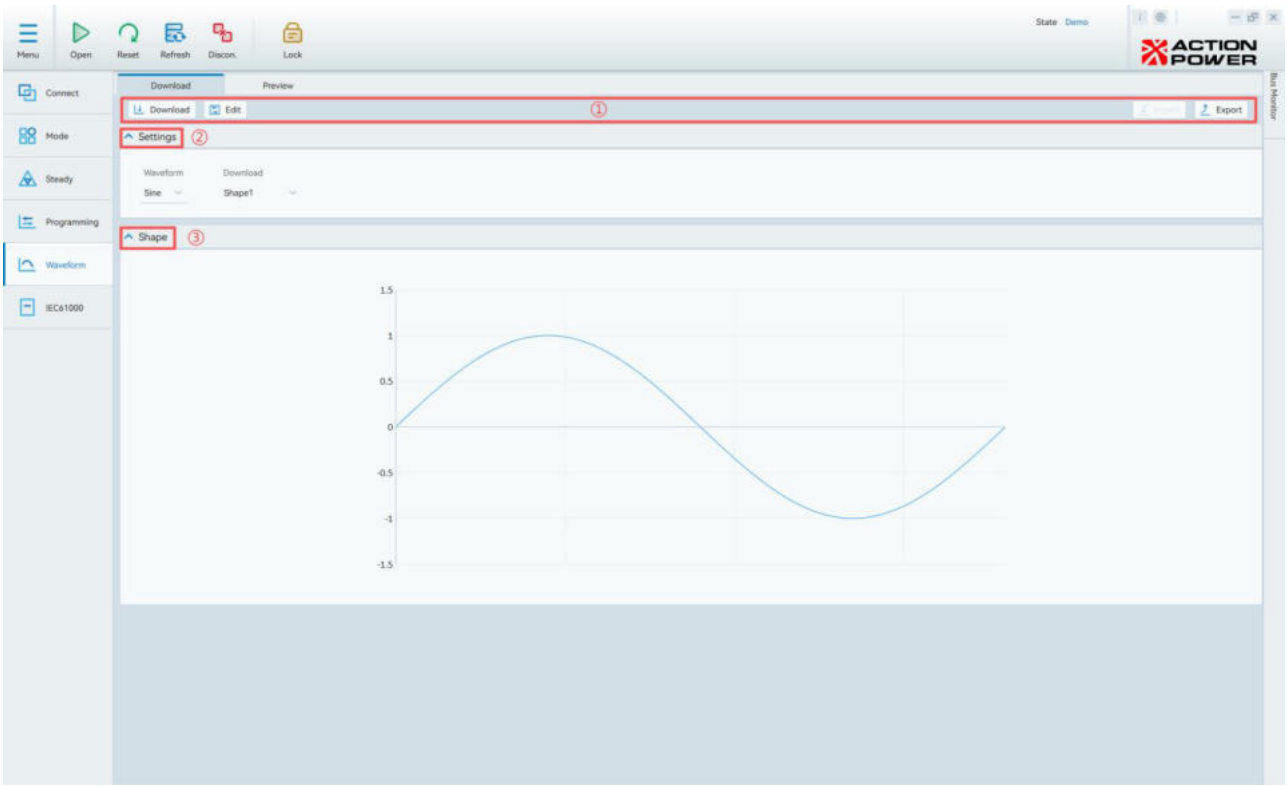


Figure 7.4.1.1 Waveform Download Interface

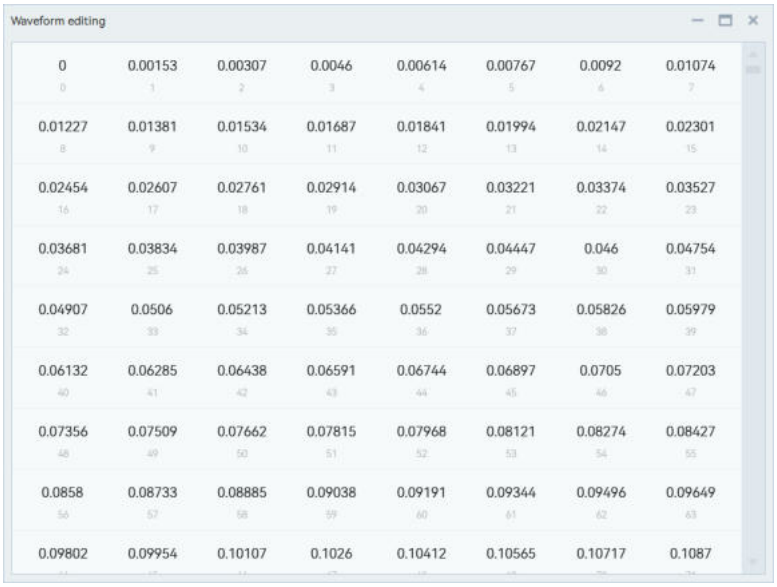


Figure 7.4.1.2 Waveform Editing Interface

Prerequisites: Successful connection to the device or demonstration mode

1. Function Area: Download Waveform: Download custom waveforms to the device; Edit Waveform: Click the Edit Waveform button to open the waveform editing interface (as shown in Figure 7.4.1.2). Edit waveforms within this interface. Edited waveforms can be viewed in the Waveform Download interface.

2. Settings Area:

Waveform Type: Select the waveform type.

Download Waveform: Select the waveform number to which the current waveform will be downloaded on the device.

3. Shape Area: Preview custom waveforms

7.4.1.2 Operation Instructions

- In the Configuration Area, select the waveform type and choose the waveform number to download the waveform to. Note: The Import button is only available when any waveform is selected. Click the Import button to import the desired waveform.
- Click the Edit Waveform button to edit the waveform in the waveform editing page
- Preview the waveform in the Waveform Preview Area
- Click the Download Waveform button to download the waveform to the device
- Clicking the Import button opens a file selection dialog. Select the desired file (.cust or .csv), then click "Open" to import. Clicking Cancel returns you to the previous screen.
- Clicking the Export button opens the Export File dialog. Modify the filename in the bottom input field. Click Save to export the file; clicking Cancel cancels the export.
- When the waveform type is set to Sine Wave or Arbitrary Wave in the configuration, the percentage cannot be configured.
- The Import button is only enabled when the waveform type is set to Arbitrary Waveform. For other waveform types, the Import button remains disabled.
- After device startup, the waveform download page displays a masking overlay indicating the device is operational and unavailable for interaction.
- Example: Downloading a clipped waveform to shape1 in the device, as shown in Figure 7.4.1.3

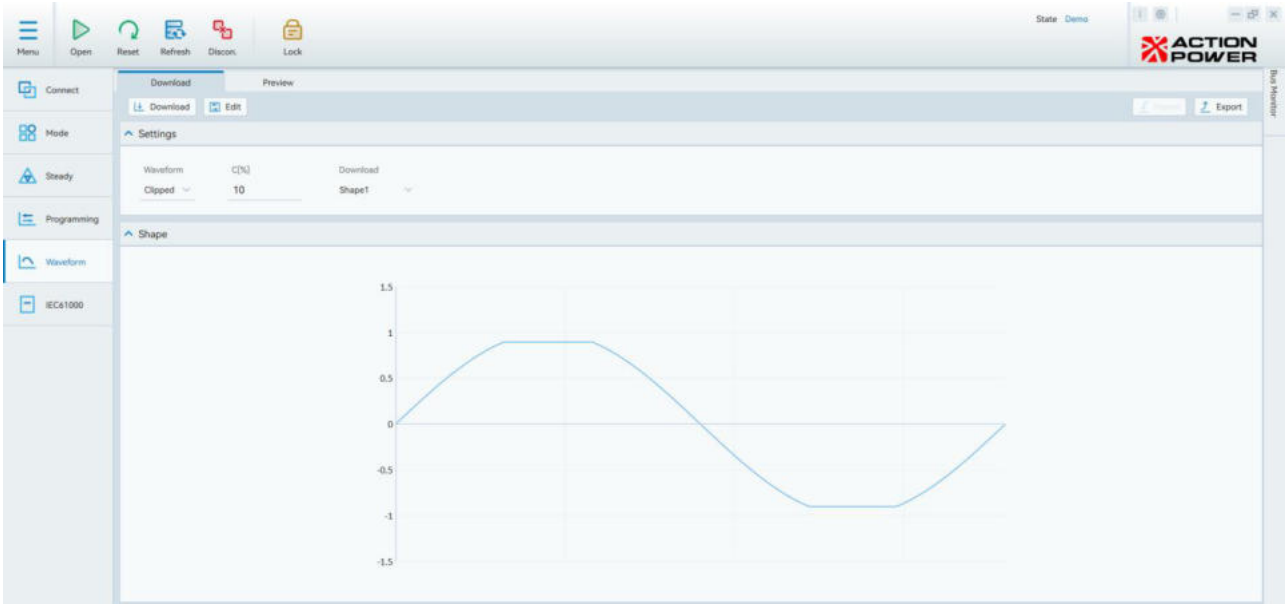


Figure 7.4.1.3 Waveform Download Completion

7.4.2 Waveform Preview

7.4.2.1 Interface Description

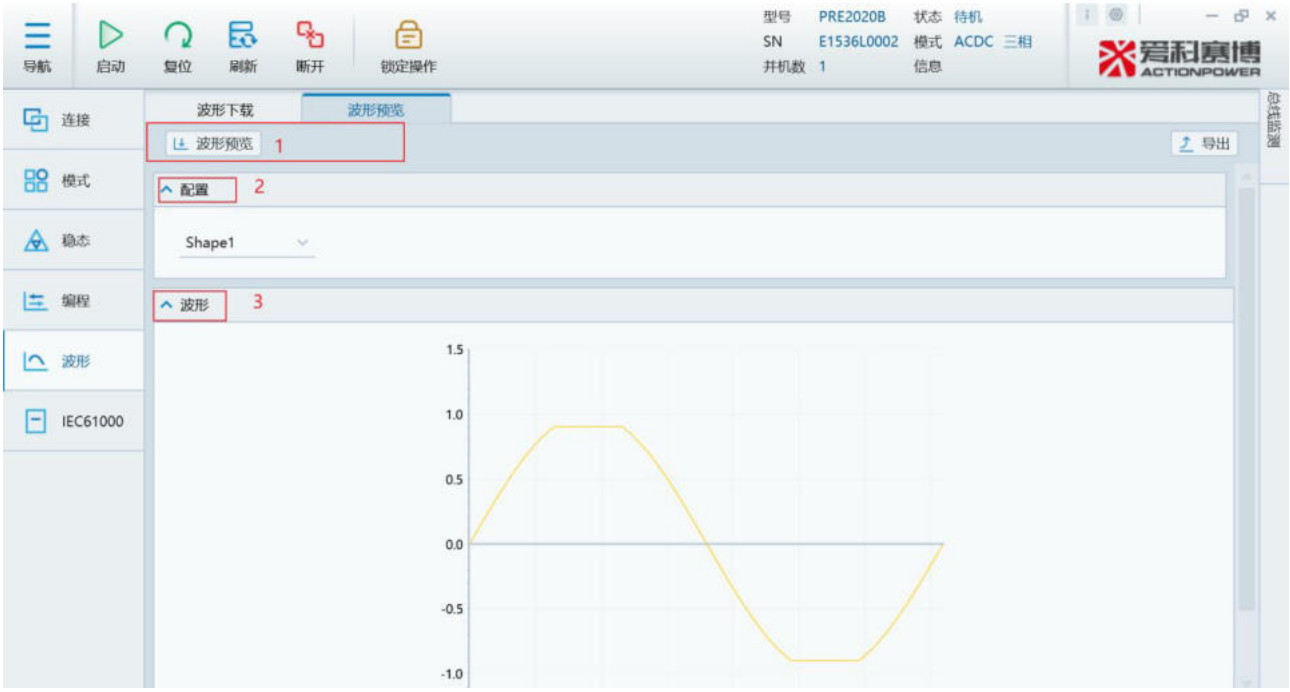


Figure 7.4.2.1 Waveform Preview Interface

Prerequisites: Successful device connection or demo mode

1. Function Area: Waveform Preview: Preview the waveform selected in the configuration; Export: Export the currently selected waveform

2. Configuration Area: Select which waveform to preview from the device

3. Waveform: Previews the selected waveform from the configuration; waveform data originates from the device

7.4.2.2 Operation Instructions

- Select which waveform to preview in the Configuration Area
- Click the Waveform Preview button to preview the waveform
- Preview the waveform in the waveform preview area
- Click the Export button to export the waveform
- After device startup, the waveform download page displays a masking overlay indicating the device is operational and unavailable for interaction
- In section 7.4.1, a clipping waveform was configured for shape1. Previewing shape1 in the waveform preview interface shows the previously downloaded clipping waveform.

7.5 IEC 61000 Interface

The IEC 61000 series standards are a set of International Electrotechnical Commission (IEC) specifications for electromagnetic compatibility (EMC). These standards define requirements that various electrical equipment must meet in electromagnetic

environments to ensure proper operation amidst interference sources and susceptible devices. The IEC 61000 series serves as essential foundational guidance for electrical equipment manufacturers, developers, and users, covering EMC for diverse devices and systems.

In this chapter, we simulate seven experiments to replicate usage scenarios under different conditions, testing the immunity of the device under test (DUT) to interference.

4-11 AC Power Input Port Voltage Dips, Short Interruptions, and Voltage Variations Immunity Test: Evaluates the immunity of electrical and electronic equipment connected to low-voltage power supply networks against voltage dips, short interruptions, and voltage variations. Applicable to electrical and electronic equipment with a rated input current not exceeding 16A per phase connected to 50Hz or 60Hz AC networks.

4-13 AC Harmonic and Interharmonic Immunity Test: Tests the immunity of electrical and electronic equipment connected to low-voltage power networks (50 Hz) with a rated current per phase ≤16 A to harmonics and interharmonics up to 2 kHz.

4-14 Voltage Fluctuation Immunity Test: Tests the immunity of electrical and electronic equipment to disturbances in its electromagnetic environment, considering only sensing phenomena. Includes immunity for equipment connected to public and industrial power supply networks.

4-17 DC Ripple Immunity Test: Tests the immunity of electrical and electronic equipment to ripple at the DC power input port. Applicable to low-voltage DC power ports of equipment supplied by external rectifier systems or charging batteries.

4-27 Three-Phase Voltage Unbalance Immunity Test: Tests the immunity of electrical and electronic devices to unbalanced supply voltages, considering only conducted phenomena. This includes immunity for devices connected to public or industrial networks and applies to electrical and electronic devices operating on 50Hz three-phase power with rated line currents of 16A or less per phase.

4-28 Power Frequency Variation Immunity Test: Tests the immunity of electrical and electronic equipment to power frequency variations, involving only conducted phenomena. This includes immunity for equipment connected to public or industrial networks and applies to electrical and electronic equipment connected to a 50Hz power distribution network with a rated current not exceeding 16A per phase.

4-29 DC Power Input Port Voltage Dip, Short Interruption, and Voltage Variation Immunity Test: Tests the immunity of DC electrical and electronic equipment to voltage dips, short interruptions, and voltage variations. Applicable to low-voltage DC power input ports of equipment supplied by external DC networks.

7.5.1 4-11 AC Power Input Port Voltage Dips, Short Interruptions, and Voltage Variations Immunity Test

7.5.1.1 Interface Description

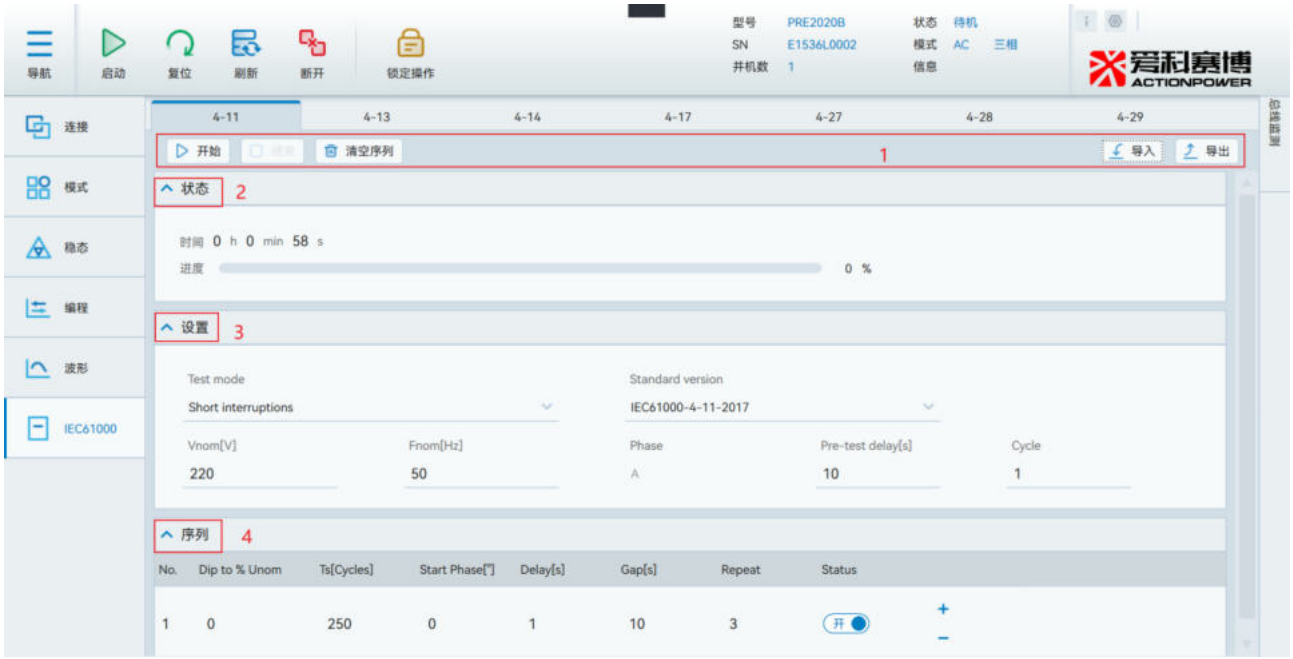


Figure 7.5.1 Interface for 4-11

Prerequisites: Connected device successful or demonstration mode

1. Function Area: The Start button transmits test data and configuration parameters to initiate the test; the End button concludes the current test; the Clear Sequence button erases programmed data.

2. Status Area: Displays current test status information;

【Time】: Total experiment duration calculated based on settings and sequence;

[Progress]: Current execution progress of the experiment.

3. Settings Area:

【Test **Mode**】: Experiment type, selectable from voltage dip, short interruption, and voltage variation.

【Standard Version】: Standard version

【Vnom】: Steady-state voltage

【Fnom】: Steady-state frequency

【Phase】: Test phase

【Pre-test delay】: Pre-test duration

【Cycle】： Cycle Count

4. Sequence Section:

Short-term interruption Voltage dip:

【Dip to % Unom】: Percentage of voltage dip magnitude;

【Ts(Cycles)】: Voltage dip duration (displayed in ms; time = Cycles × (1/fundamental frequency), where fundamental frequency is the frequency set in basic parameters, typically 50Hz/60Hz);

【Start Phase】: Starting phase;

【Delay】: Steady-state recovery hold time;

【Gap】: Next step preparation time;

【Repeat】： Experiment execution cycle;

【Status】: Controls whether to execute the current sequence

Voltage Change

【Var to % Unom】: Percentage change level;

【FallTime】: Decay time of the variation

【HoldTime】: Hold time of the variation

【RiseTime】: Rise time of the variation

【Delay】： Delay time before each step;

7.5.1.2 Operation Instructions

- Click the Import button to select the configuration file corresponding to the experiment to be performed
- Modify settings and sequence parameters as needed
- Click the Start button to begin the experiment. Once started, other programming interfaces will open to display the ongoing experiment
- Clicking the Export button opens the export dialog. Modify the filename in the bottom input field. Click Save to export the file; click Cancel to cancel exporting
- During the experiment, click the "End" button to terminate it
- 4-11 Programming mode: Three-phase AC only. Other modes cannot initiate programming.
- The foundational data for programming sequences must be imported from configuration files. Initial data cannot be manually added.
- Once programming begins, settings and sequence data cannot be modified, nor can import/export operations be performed.

7.5.2 4-13 AC Harmonic and Interharmonic Immunity Test

7.5.2.1 Interface Description

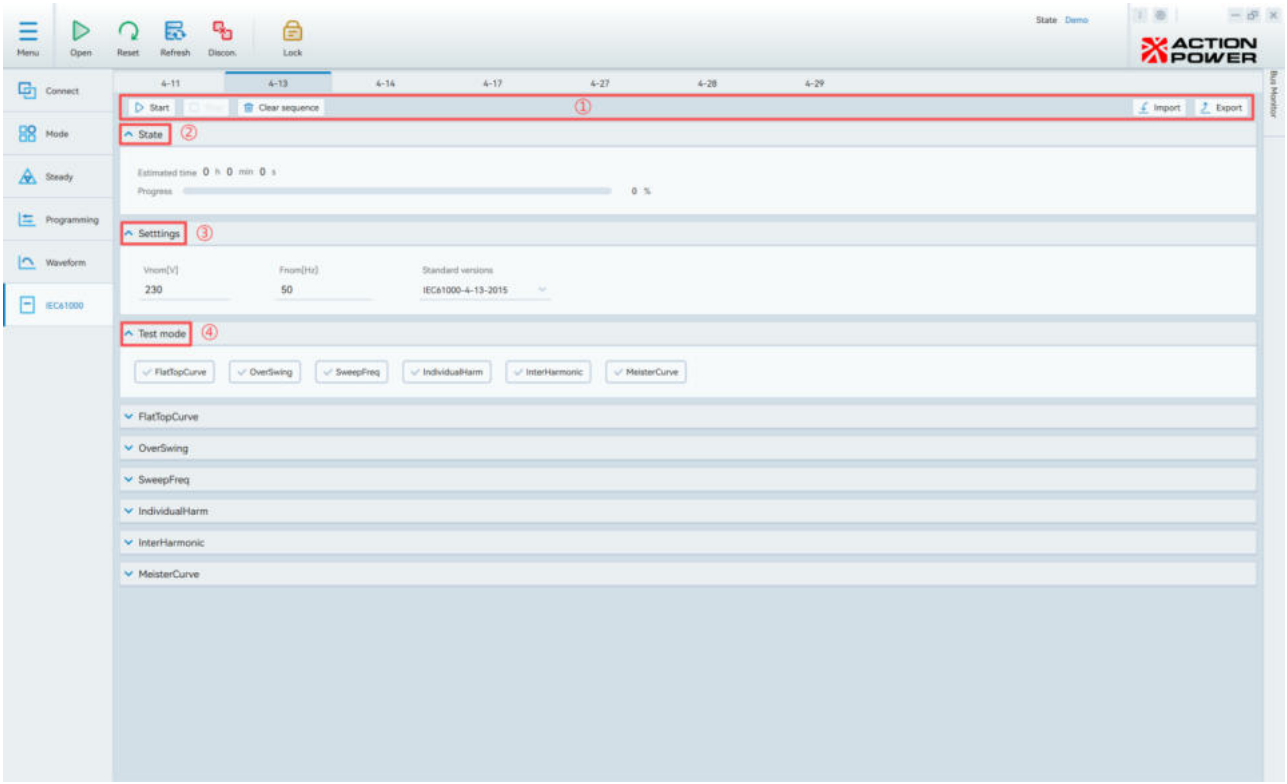


Figure 7.5.2 Interface for Section 4-13

Prerequisites: Successful device connection or demonstration mode

1. Function Area: The Start button transmits experimental data and configuration parameters to initiate the experiment; the End button concludes the current experiment; the Clear Sequence button erases programmed data.

2. State Area: Displays current experiment status information;

【Estimated Time】: Total experiment duration calculated based on settings and test items;

[Progress]: Current execution progress of the experiment.

3. Settings Area:

【Standard Version】: Standard version

【Vnom】: Steady-state voltage

【Fnom】: Steady-state frequency

4. Test Items:

From left to right: Clipping Test, Peak Wave Test, Sweep Frequency Test, Harmonic Test, Interharmonic Test, Meister Curve Test

Clip Test:

【Dwell Time】: Duration;

【Pause Time】: Interval duration;

【Clipped】: Clipping percentage;

Spike Wave Experiment:

【Dwell Time】: Duration;

【Pause Time】: Interval duration;

【Content】： Content;

【Phase】： Phase;

Sweep Frequency Experiment:

【Dwell Time】: Execution time per step;

【Content】： Content;

【StartFreq】: Starting frequency (multiple of fundamental frequency)

【EndFreq】: End frequency;

【Step】: Frequency step size;

Harmonic Experiment:

【Dwell Time】: Duration;

【Pause Time】: Interval time;

【No.】2nd–40th harmonics

【Content】： Content;

【Phase】: Phase;

Interharmonic Experiment:

【Dwell Time】: Execution time per step;

【Pause Time】: Interval duration;

【Content】： Content;

【StartFreq】: Starting frequency (multiple of fundamental frequency)

【EndFreq】: End frequency;

【Step】： Frequency step;

Meister Curve Experiment:

【Dwell Time】: Execution time per step;

【Pause Time】: Interval duration;

【Content】： Content;

【StartFreq】: Starting frequency (multiple of fundamental frequency)

【EndFreq】: End frequency;

【Step】： Frequency step;

7.5.2.2 Operation Instructions

- Click the Import button to select the configuration file corresponding to the experiment to be performed
- Modify settings and test item parameters as needed
- Click the Start button to begin the experiment. Once started, other program interfaces will display the experiment in progress
- Clicking the Export button opens the export dialog. Modify the filename in the bottom field, then click Save to export the file. Clicking Cancel cancels the export
- During the experiment, click the "End" button to terminate it
- 4-13 Programming Modes: Coupling mode must be AC+DC. Output phase configuration: Single-phase, three-phase, or three-phase interlocked are all supported.
- Basic programming sequence data must be imported from configuration files; initial data cannot be manually added.
- Once programming begins, settings and test item data cannot be modified, nor can import/export operations be performed.

7.5.3 4-14 Voltage Fluctuation Immunity Test

7.5.3.1 Interface Description

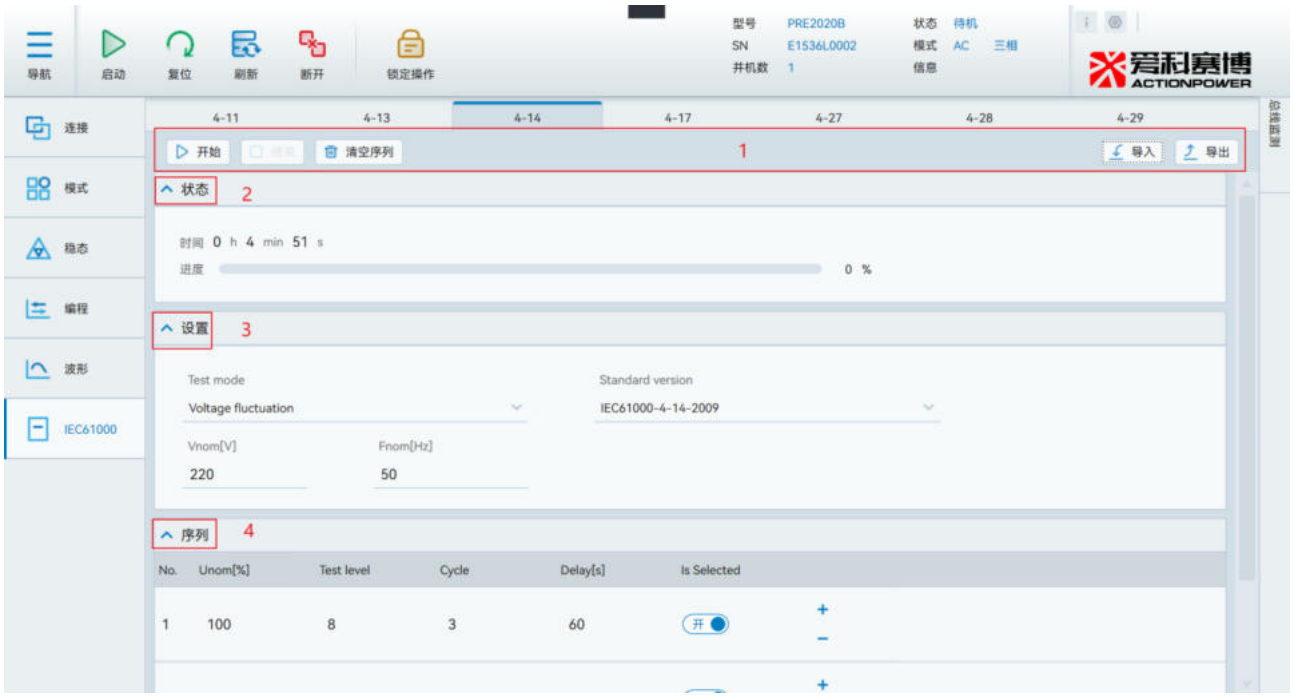


Figure 7.5.3 4-14 Interface

Prerequisites: Successful device connection or demo mode

1. Function Area: The Start button transmits test data and configuration parameters to initiate the test; the End button

concludes the current test; the Clear Sequence button erases programmed data.

2. Status Area: Displays current experiment status information;

【Estimated Time】: Total experiment duration calculated based on settings and sequence;

[Progress]: Current execution progress of the experiment.

3. Settings Area:

【Test Mode】: Experiment type, selectable options include voltage fluctuation

【Standard Version】: Standard version

【Vnom】: Steady-state voltage

【Fnom】: Steady-state frequency

4. Sequence Area:

【Unom[%]】: Rated voltage percentage;

【Test Level】: Variation Level;

【Cycle】: Number of cycles executed;

【Delay】: Interval time between two tests;

【Is Selected】: Controls whether to execute the current sequence

7.5.3.2 Operation Instructions

- Click the Import button to select the configuration file corresponding to the experiment to be executed
- Modify settings and sequence parameters as needed
- Click the Start button to begin the experiment. Once started, other program interfaces will display the experiment in progress
- Clicking the Export button opens the export dialog. Modify the filename in the bottom input field. Click Save to export the file; click Cancel to cancel exporting
- During the experiment, click the "End" button to terminate it
- 4-14 Programming Modes: Coupling mode must satisfy AC. Output phase configuration: Single-phase, three-phase, or three-phase interlocked are all supported.
- Basic programming sequence data must be imported from configuration files; initial data cannot be manually added.
- Once programming begins, settings and sequence data cannot be modified, nor can further import/export operations be performed.

7.5.4 4-17 DC Ripple Immunity Test

7.5.4.1 Interface Description

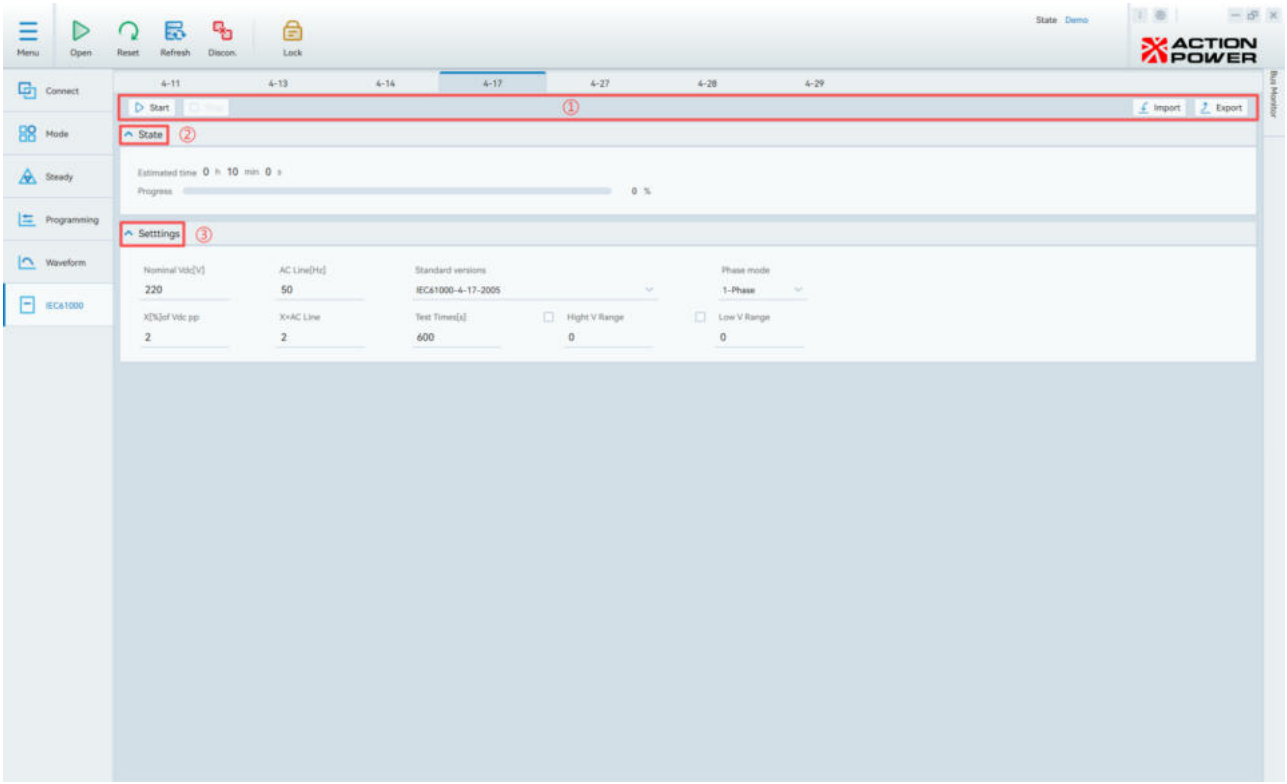


Figure 7.5.4 Interface for Section 4-17

Prerequisites: Successful device connection or demonstration mode

1. Function Area: The Start button transmits experimental data and configuration parameters to initiate the experiment; the End button concludes the current experiment.

2. State Area: Displays current experimental status information.

【Estimated Time】： Total experiment duration;

【Progress】： Current progress of the experiment execution.

3. Settings Area:

【Nominal **Vdc**】: DC voltage

【AC Line】： AC frequency

【Standard Version】: Standard version

【X[%] of Vdc pp】: Percentage of ripple amplitude relative to DC

【X x AC Line】： Frequency Multiplier

【Test Time】: Test duration

【High V Range】: Maximum voltage range

【Low V Range】: Minimum Value

7.5.4.2 Operating Instructions

- Click the Import button to select the configuration file corresponding to the experiment to be performed
- Modify the settings parameters as needed
- Click the Start button to begin the experiment. Once started, other programming interfaces will display the experiment in progress
- Clicking the Export button opens the export dialog. Modify the filename in the bottom input field. Click Save to export the file; click Cancel to cancel exporting
- During the experiment, click the "End" button to terminate it
- 4-17 Programming Modes: Coupling mode must be AC+DC. Output phase configuration: Single-phase, three-phase, or three-phase interlocked are all supported.
- Once programming begins, settings cannot be modified, and import/export operations are disabled.

7.5.5 4-27 Three-Phase Voltage Unbalance Immunity Test

7.5.5.1 Interface Description

Figure 7.5.5 4-27 Interface

Prerequisites: Successful device connection or demonstration mode

1. Function Area: The Start button sends experiment data and configuration parameters to initiate the experiment; the End button concludes the current experiment; the Clear Sequence button erases programmed data.

2. State Area: Displays current experiment status information;

【Estimated Time】: Total experiment duration calculated based on settings and sequence;

[Progress]: Current execution progress of the experiment.

3. Settings Area:

【Standard Version】: Standard version

【Vnom】: Steady-state voltage

【Fnom】: Steady-state frequency

【Sequence delay】: Sequence interval time

【Pre-test delay】: Test preparation phase execution time

4. Sequence Zone:

【Of Unom[%]】: Three-phase amplitude percentage;

【Degree】: Three-phase phase angle;

【Ku2】: Calculated unbalance factor;

【Time】: Current sequence execution time;

7.5.5.2 Operation Instructions

- Click the Import button to select the configuration file corresponding to the experiment to be executed
- Modify settings and sequence parameters as needed
- Click the Start button to begin the experiment. Once started, other program interfaces will display the experiment in progress
- Clicking the Export button opens the export dialog. Modify the filename in the bottom input field. Click Save to export the file; click Cancel to cancel exporting
- During the experiment, click the End button to terminate it.
- 4-27 Programming Mode: Coupling method must comply with AC. Output phase count: Three-phase.
- Basic programming sequence data must be imported from configuration files; initial data cannot be manually added.
- Once programming begins, setting data cannot be modified, nor can further import/export operations be performed.

7.5.6 4-28 Power Frequency Variation Immunity Test

7.5.6.1 Interface Description

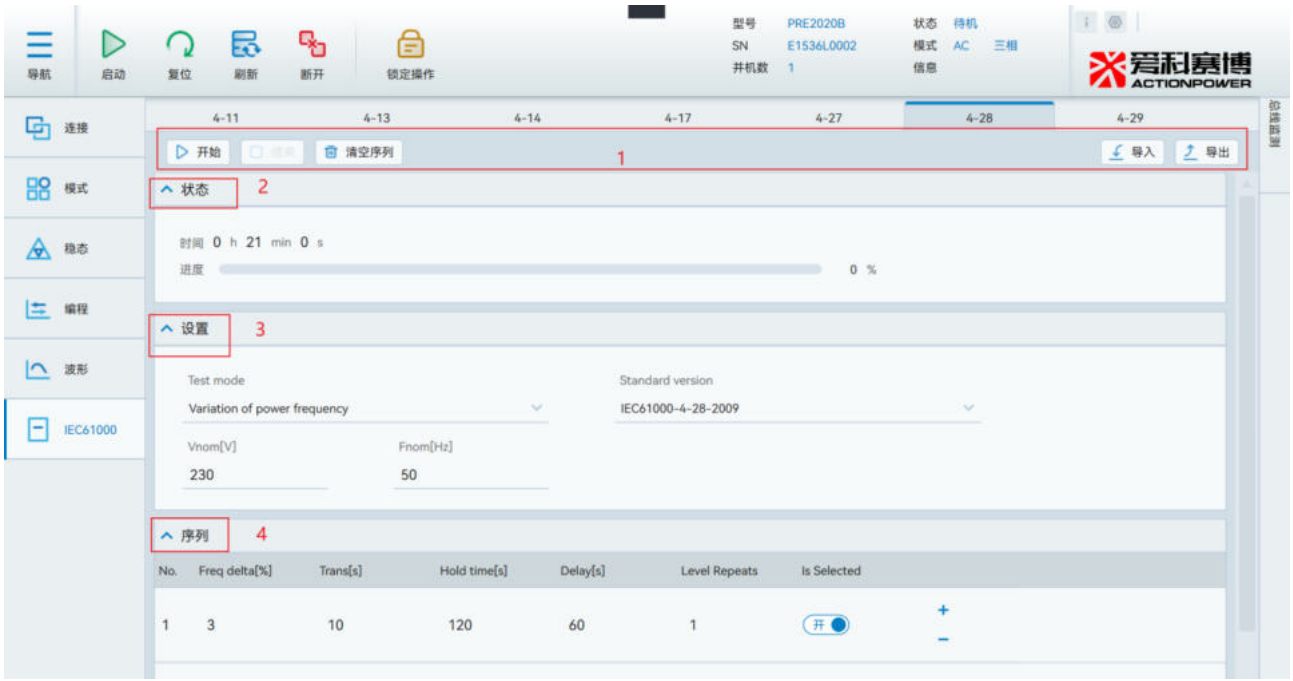


Figure 7.5.6 4-28 Interface

Prerequisites: Successful device connection or demo mode

1. Function Area: The Start button transmits test data and configuration parameters to initiate the test; the End button concludes the current test; the Clear Sequence button erases programmed data.

2. State Area: Displays current test status information;

【Estimated Time】: Total experiment duration calculated based on settings and sequence;

[Progress]: Current execution progress of the experiment.

3. Settings Area:

【Test Mode】: Experiment type

【Standard Version】: Standard version

【Vnom】: Steady-state voltage

【Fnom】: Steady-state frequency

4. Sequence Area:

【Freq delta】: Frequency change percentage;

【Trans】： Transition time;

【Hold Time】: Hold duration;

【Delay】： Time to return to normal value execution;

【Level Repeats】: Number of execution cycles

7.5.6.2 Operation Instructions

- Click the Import button to select the configuration file corresponding to the experiment to be executed
- Modify settings and sequence parameters as needed
- Click the Start button to begin the experiment. Once started, other programming interfaces will display the experiment in progress
- Clicking the Export button opens the export dialog. Modify the filename in the bottom input field. Click Save to export the file; click Cancel to cancel exporting
- During the experiment, click the End button to terminate it
- 4-28 Programming Modes: Coupling mode must satisfy AC. Output phase configuration: Single-phase, three-phase, or three-phase interlocked are all supported.
- The foundational data for programming sequences must be imported from configuration files; initial data cannot be manually added.
- Once programming begins, settings cannot be modified, and no further import/export operations are permitted.

7.5.7 4-29 DC Power Input Port Voltage Dip, Short Interruption, and Voltage Variation Immunity Test

7.5.7.1 Interface Description

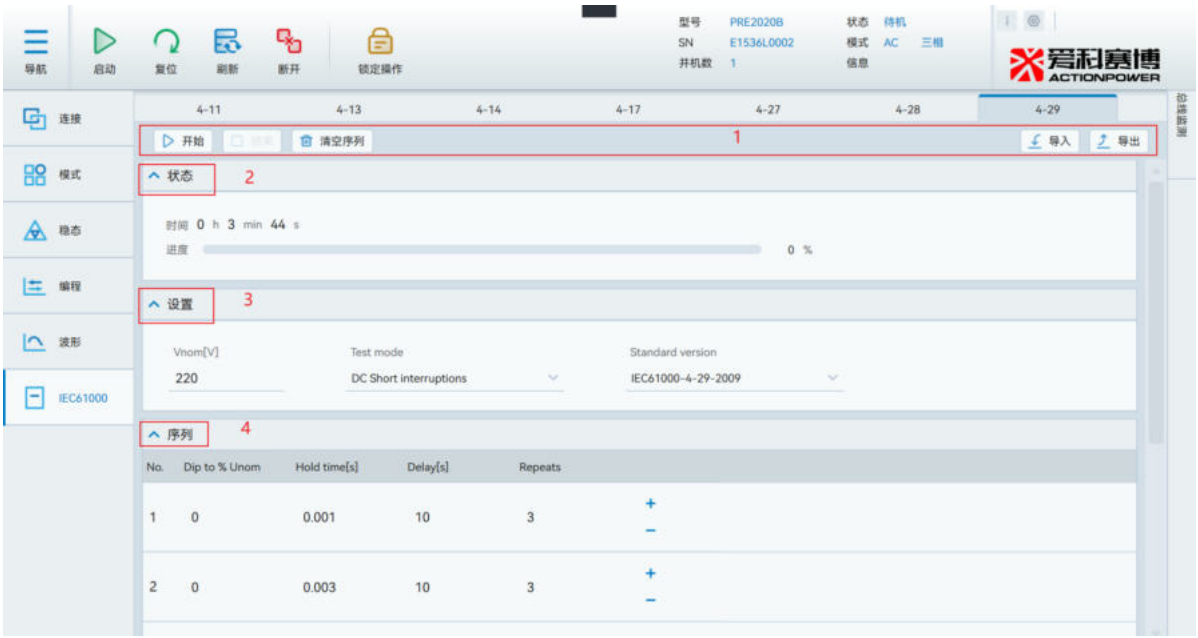


Figure 7.5.7 4-29 Interface

Prerequisites: Successful device connection or demo mode

1. Function Area: The Start button transmits test data and configuration parameters to initiate the test; the End button concludes the current test; the Clear Sequence button erases programmed data.

2. State Area: Displays current test status information;

【Estimated Time】: Total experiment duration calculated based on settings and sequence;

[Progress]: Current execution progress of the experiment.

3. Settings Area:

【Vnom】: Steady-state voltage

【Test Mode】: Experiment type

【Standard Version】: Standard Version

4. Sequence Area:

Voltage Dip and Short Interruption:

【Dip to % Unom】: Percentage of voltage interruption;

【Hold Time】: Duration of interruption;

【Delay】: Recovery hold time;

【Repeats】: Number of cycles;

Voltage Change:

【Dip to % Unom】: Voltage change percentage;

【Fall Time】: Duration of change;

【Hold Time】: Duration of interruption;

【Raise Time】: Time to return to steady state;

【Delay】: Steady-state hold time;

【Repeats】: Number of cycles

7.5.7.2 Operation Instructions

- Click the Import button to select the configuration file corresponding to the experiment to be performed
- Modify settings and sequence parameters as needed
- Click the Start button to begin the experiment. Once started, other program interfaces will display the experiment in progress
- Clicking the Export button opens the export dialog. Modify the filename in the bottom input field. Click Save to export the file; click Cancel to cancel exporting
- During the experiment, click the "End" button to terminate it
- 4-29 Programming Modes: Coupling mode must satisfy DC. Output phase configuration: Single-phase, three-phase, or three-phase interlocked are all supported.
- Basic programming sequence data must be imported from configuration files; initial data cannot be manually added.
- Once programming begins, settings cannot be modified, and no further import/export operations are permitted.