Cortex AC Series Bidirectional Programmable AC Power Supply User Manual

Contents

1 Contact Information

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2 Warranty and Safety Information

2.1 Limited After-sales Warranty

Xi'an ActionPower Electric Co., Ltd. provides a 12-month warranty from the date of delivery for all Cortex AC Series products it manufactures and sells, ensuring free repair for any faults or damage occurring under normal use.

During the warranty period, the company shall not be liable for free repairs in any of the following situations. Repairs performed under such circumstances will be charged based on the actual repair condition:

Products are not directly sold by the company or by the company's officially authorized distributors.

Failures or damage caused by force majeure, or attributable to the user's failure to comply with the User Manual or due to user negligence, such as improper operation or other handling.

Failures or damage resulting from unauthorized disassembly, repair, modification, or addition of accessories without the company's consent.

During the warranty period, in the event of a product failure or damage, the user shall be responsible for delivering the product to the company, with associated costs borne by the user. After repair, the costs for returning the product to the user (mainland China only) or a designated location (mainland China only) shall be borne by the company.

This warranty does not include any other express or implied warranties.

2.2 Safety

Do not install, replace substitute parts, or perform any unauthorized modifications yourself. For repairs, please return this Product to our company's service department to ensure its safety features.

Please refer to the specific warnings or cautions in the User Manual to avoid personal injury or Product damage.

2.3 Safety Rules

To prevent electric shock, it is strictly prohibited for personnel not authorized by our company to disassemble this Product.

This Product must not be used in life support systems or any other equipment with safety requirements.

We assume no liability for any direct or indirect financial losses that may occur from using this Product.

2.4 Meaning of Safety Symbols

Warning:

Warning statements indicate conditions or actions that may endanger the life safety of the Operator.

Caution:

Caution statements indicate conditions that may cause damage to this Product or to other equipment connected to this Product.

2.5 Safety Information

This section contains important information that must be read before attempting to install and start the Cortex AC Series Products, and is intended for use by experienced Operators. Experienced Operators must understand and recognize the importance of personal safety and other safety issues. This section mainly includes:

Safety Precautions;

Warning;

Caution;

Installation Preparation;

Installation Instructions;

Be sure to familiarize yourself with the safety symbols shown on this page. These symbols are used throughout this User Manual and indicate important information and issues that affect the safety of the end user or Operator.

Note: Before installation and operation, please read the User Manual of this Product in detail.

Symbols	Definitions
⏚	Protective Grounding Mark (equivalent to the 'PE' symbol)
○	Disconnect Power
3~	Three-Phase AC
~	Alternating Current (AC)
|	On (Power On)
⎓	Direct Current (DC)
≂	AC/DC (AC and DC)

 **Warning: High Voltage / Electric Shock Hazard.**

 **Note: When you see this warning symbol, be sure to consult this manual to become familiar with the nature of potential hazards and the measures to avoid them.**

2.6 Safety Precautions

During all stages of operation, maintenance, and servicing of this Product, the following general Safety Precautions must be observed. Failure to observe these precautions or specific warnings elsewhere in this manual constitutes a violation of the safety standards in design, manufacture, and intended use of the Product. Xi'an ActionPower Electric Co., Ltd. assumes no responsibility or liability for any claims arising from the customer's failure to comply with these requirements.

 **Precaution Instructions**

Application Scenario: Indoor;

Overvoltage Category: III;

Protection Level: IP20;

Power Supply System: TT or TN;

Output: Maximum additional transient overvoltage = 1500V, applicable only to models with an output of 1,500V;

It is prohibited to connect the output to the main power supply. If necessary, the output should be isolated from the main power supply via a transformer, with the primary winding of the transformer separated from the secondary winding by basic insulation.

 **Warning: Class I Equipment.**

This Product is Class I Safety Equipment (with Protective Earth Terminal). If used in a manner not specified in the User Manual, the protective function of this Product may be impaired.

 **Warning: Environmental Conditions.**

This Product is suitable only for installation in environments with Pollution Degree 2, altitude not exceeding 2000 m, Overvoltage Category OVC III, avoiding direct sunlight, and not for use in indoor environments with dust, flammable or explosive gases, or strong magnetic fields. Its operating temperature range is 0–50°C, with relative humidity less than 80%.

 **Note: Before applying power.**

Verify that the AC Input specifications listed on the nameplate match the voltage, frequency, and other parameters of the available utility circuit.

 **Safety Precautions: Grounding.**

This product is Class I Safety Equipment (equipped with a Protective Earth Terminal). To reduce the risk of electric shock, the product's enclosure Ground Terminal must be connected to an electrically safe ground. This product must be connected to the AC Power Supply using a properly rated three-phase cable with protective earth (L1-L2-L3-PE).

Disconnecting the protective (ground) conductor or the Protective Earth Terminal may lead to a potential electric shock hazard and could result in personal injury.

This product is equipped with a line filter to reduce electromagnetic interference and must be properly grounded to minimize electric shock hazard. Operating at a line voltage or frequency higher than those specified on the model nameplate may result in leakage current exceeding 5.0 mApeak.

 **Warning: Do not operate in explosive environments.**

Do not operate this product in environments containing flammable or explosive gases.

 **Warning: Isolation Device.**

The AC input connection must include an isolation device (external switch or circuit breaker) as part of the installation. The isolation device must be located in an accessible, appropriate position and must be labeled as the isolation device for this product. The isolation device must disconnect all conductors

simultaneously.

External overcurrent protection devices, such as fuses or circuit breakers, must be provided.

The breaking capacity of the overcurrent protection device must be matched to the rated current of the equipment.

At least basic insulation is required between components with opposite supply polarity on the power source side of the overcurrent protection device.

Overcurrent protection devices must not be installed in the protective conductor. For multiphase equipment, the neutral line shall not be fitted with a fuse or single-pole circuit breaker, and installation must comply with IEC 19517-2009 requirements.

After disconnecting the mains power, always use the DC range of a digital voltmeter (DMM) as follows: Figure 1 Check for any residual direct current voltage between each line terminal and the grounding stud to verify that the voltage is at a safe level (<5 Vdc) before touching the equipment, terminal blocks, or any pins.

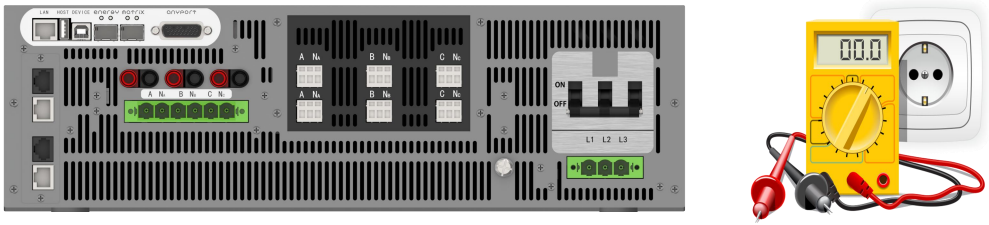


Figure 1 Schematic Diagram of Residual Voltage Check of AC Input Filter After Disconnecting AC Power

Warning: Do not replace components or make modifications.

To avoid introducing additional hazards, do not install substitute components or make any unauthorized modifications to this Product. The Product should be returned to the Sales and Service Department of Xi'an ActionPower Electric Co., Ltd. for service and maintenance to ensure it is properly maintained.

If a Product is damaged or defective, it should be taken out of operation and labeled with a notice such as "Fault/To Be Repaired" to prevent accidental use until it has been repaired by qualified service personnel.

Note: Instrument placement.

Do not place the instrument in any location that impedes easy access to the Isolation Device, or in any way that makes operating the Isolation Device difficult.

Note: Please keep the surface of the Product clean and dry.

Note: Do not place heavy objects on the Product enclosure.

Note: Avoid severe impacts or improper handling that may cause damage to the machine.

Note: Do not obstruct the ventilation openings on the side, front, or rear panels.

Warning: To prevent fire, only use the fuse specified for this Product.

Note: Maintenance and cleaning.

Do not perform maintenance or cleaning on this Product while it is energized, as this may result in electric shock. Use a soft cloth moistened with mild detergent and water; do not spray cleaning agents directly. Do not use chemical or abrasive cleaning products such as benzene, toluene, xylene, or acetone.

Non-professional personnel are not permitted to perform maintenance or cleaning on this Product, as this may result in personal injury or Product damage.

10 minutes

Warning: Disconnect power for 10 minutes before opening the enclosure for operation or maintenance.

This Product contains internal Electrolytic Capacitors, which require an extended discharge time after power is disconnected. Therefore, professional personnel must discharge the Electrolytic Capacitors after power is disconnected, or wait until 10 minutes have elapsed and the voltage has dropped to a safe level before commencing operation or maintenance, to prevent electric shock due to residual voltage.

Note: Operation by non-professional personnel is strictly prohibited.

3 Product Overview

This chapter primarily describes the general operating characteristics of the Cortex AC Series Bidirectional Programmable AC Power Supply.

3.1 Basic Description

The Cortex AC Series Bidirectional Programmable AC Power Supply sets the benchmark for the next generation of AC power supplies, offering exceptionally high power density by delivering a rated Output Power of 22 kVA within a 3U enclosure. The entire series is configured with a matrix-based parallel functionality, allowing for parallel scaling up to a maximum of 220 kVA to provide increased Output Power and meet diverse testing requirements. An independent high-Accuracy measurement system and superior industry Load compatibility elevate Output parameters to a new standard, enabling application testing to be more accurate and convenient.

Cortex AC Series Products feature four-quadrant operation capability to satisfy general grid simulation regulatory tests. The proprietary RLC Mode meets all grid adaptability, Island, and off-grid operation testing needs for green energy industries, including photovoltaic grid-tied inverters, energy storage systems (ESS/PCS), microgrids, on-board chargers (OBC/BOBC), uninterruptible power supplies (UPS), and similar Products.

Features include a small-signal bandwidth of up to 10 kHz, analog output capability, ultra-low latency, and specialized optimization for hardware-in-the-loop (PHIL) simulation applications.

Cortex AC Series Products provide precise, stable, and clean AC or direct current output, operable either via the front panel display screen or remotely through LAN, USB, and analog interfaces, enabling standard tests, automated testing, and access to additional functions.

Cortex AC Series Products are equipped with five built-in programming functions—List, Wave, Step, Pulse, and Advanced—as well as harmonic and interharmonics parameter setting functions, supporting steady-state outputs such as sine wave, pulse wave, triangle wave, leading-edge half-wave, trailing-edge half-wave, 30 built-in harmonics, and custom waveforms. Equipped with waveform point editing functionality, supporting import and export via external USB storage devices.

3.2 Product Features

The following features apply to all Cortex AC Series Products.

Integrated source/load design with full power feedback and four-quadrant load capability.

Small signal bandwidth up to $10kHz$, large signal bandwidth $2000Hz$, optimized for Power Hardware-in-the-Loop (PHIL) applications.

High power density, up to 3U $20kVA$, configurable in standard 19-inch rack with $200kVA$;

Three-phase operation: linkage, independent, or parallel, $0-450V_{@L-N}$ output capability.

High accuracy in output and measurement, $0.01\% \pm 0.05\%\ F.S$ voltage accuracy, $0.1\% \pm 0.1\%\ F.S$ current accuracy.

Fundamental output frequency range $0.001-200Hz$;

Harmonic expansion up to 100th order @ $40Hz-70Hz$;

Constant power curve output, no need to set high or low voltage ranges.

Provides up to 12 RLC network topology simulation functions.

USB and Ethernet interfaces compatible with SCPI and Modbus communication protocols.

Leveraging the advanced power conversion technology of the Cortex AC Series Products, when the Product output is connected to an energy-regenerative Load, such as motors or inverters, it can operate in Four-Quadrant Operation without requiring an additional discharge circuit.

3.3 Functional Block Diagram

The Cortex AC Series Products utilize all high-frequency components, achieving performance specifications at an entirely new level. Figure 2 This diagram illustrates the internal functional schematic of the Cortex AC Series Products.

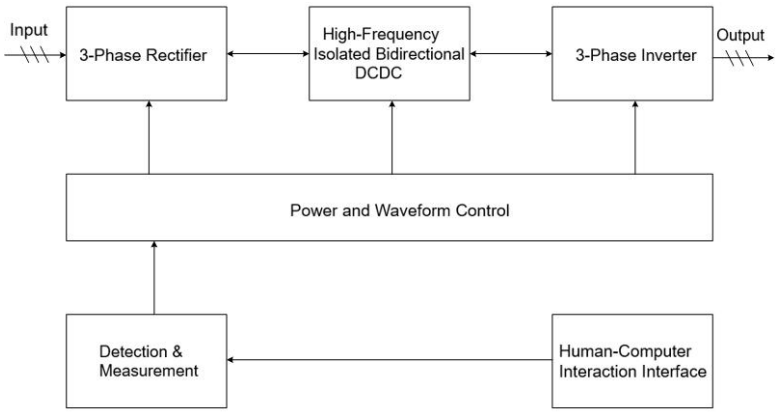


Figure 2 Functional Block Diagram of the Cortex AC Series Bidirectional Programmable AC Power Supply

3.4 Measurement and Data

Operating and setting parameters such as voltage, current, and Frequency of the Cortex AC Series Products can be read and configured via the Display Screen or communication port.

The Cortex AC Series Products feature an internal high-Accuracy synchronous measurement system, which is factory-calibrated and compliant with specifications. It meets the requirements for general applications without the need for additional instrumentation. For detailed data and Accuracy, refer to section4.2.

3.5 Accessories

Each Cortex AC Series Product that passes factory inspection includes the accessoriesTable 1listed in the table. If one or more accessories are incorrect or missing, please contact the manufacturer's after-sales service.

Table 1 Attachment Name and Quantity Table

Model	Accessory Name	Quantity/Unit
CA06-450 CA7.5-450 CA09-450 CA12-450 CA15-450 CA20-450 CA22-450	3-pin Input Connector	1/pc
	6-position Output Connector	1/pc
	Analog Programming Converter Box	1/pc
	Input Cable	1/set
	Installation Kit	1/set
	Parallel Operation Kit	1/set

4 Technical Specifications

The relevant performance specifications in this chapter apply to an ambient temperature of 0–50℃ and an altitude not exceeding 2000 meters.

4.1 Product Model

The Cortex AC Series Products offer seven models, with a power range of $6kW$~$22kW$, for detailed product models, see Table 2.

Table 2 Cortex AC Series Product Model Table

Product Model	Number of Output Phases	Rated Power (W)	Maximum Voltage (_)	Three-Phase Maximum Current (A_)	Single-Phase Maximum Current (A_)	Maximum Voltage (V _DC)	Maximum Current (A _DC)	Outline
CA06-450	Three-Phase	6	450	30	90	636	90	3U
CA7.5-450	Three-Phase	7.5	450	30	90	636	90	3U
CA09-450	Three-Phase	9	450	35	105	636	105	3U
CA12-450	Three-Phase	12	450	35	105	636	105	3U
CA15-450	Three-Phase	15	450	35	105	636	105	3U
CA20-450	Three-Phase	20	450	35	105	636	105	3U
CA22-450	Three-Phase	22	450	35	105	636	105	3U

4.2 Technical Specifications

Table 3 A summary of data under Ambient Temperature of 25°C ±5°C, rated input, and resistive load conditions is provided, suitable for general model selection reference. For additional influencing factors, please refer to sections 4.4–4.13.

Table 3 Technical Specifications Overview Table

Product Model	CA06-450	CA7.5-450	CA09-450	CA12-450	CA15-450	CA20-450	CA22-450
Output Mode	AC, DC, AC + DC, DC + AC						
Mode of Operation	Bidirectional Regenerative Source						
Number of Output Phases	Three-Phase, Single Phase, Split Phase						
Maximum Power (*kW*)	6	7.5	9	12	15	20	22
AC Output							
Voltage							
Range (V _ rms)	L-N/0-450， L-L/0-779@0.001-200.00Hz						
Setting Resolution (V)	0.01						
Accuracy*1	±(0.01%+0.05% F.S.)						
Waveform Types	Sine wave, triangle wave, pulse wave, clipped wave, half wave, multipulse wave, 30 sets of DST, custom waveforms						
DC Component ( )*2	<20						
Voltage Distortion*3	<0.3%@50Hz/60Hz						
	<1%@0.001-200Hz						
Load Regulation	±0.05% F.S.						
Source Regulation	±0.01% F.S. @10% variation						
Remote Compensation	Adaptive						
Voltage Slew Rate	AC>3.0V/μs						
Frequency							
Range ( )	DC， 0.001–200.0						
Setting Resolution ( )*4	0.001						
Accuracy	±0.01%						
Phase							
Range	A = 0°, B = 240°, C = 120° (default); Programmable range: 0°–359.9°						
Setting Resolution	±0.1°						
Accuracy*5	±0.1°@0.001-200Hz						
Harmonic							
Number of Cycles	100 cycles @ 40-70Hz fundamental frequency						
	25 cycles @ 70-200Hz fundamental frequency						
Content*6	40%						
Amplitude Error	±5% of setting value or 0.1% of fundamental value						
Phase Angle Range	0°-359.9°						
Current							
Single Phase RMS (*A_rms*)	90	90	105	105	105	105	105
Single Phase Peak (*A_peak*)	270	270	315	315	315	315	315
Three-Phase RMS (*A_rms*)	30	30	35	35	35	35	35
Three-Phase Peak (*A_peak*)	90	90	105	105	105	105	105
Setting Resolution (*A*)	0.01						
Crest Factor*7	1-6						
Accuracy*8	±(0.1%+0.1% F.S.)@15-200Hz						
Transient							
Programming							
Mode	List, Wave, Step, Pulse, Advanced, Harmonic, Interharmonics						
Minimum programming time step	100us						
Number of programmable waveforms	50						
Synchronization Source / Trigger Source	Internal, External						
Data Source	Edit, Import, Export						
Analog Programming	RMS, Peak, Instantaneous (Power Amplifier Mode)						
Standard							
AC IEC61000	4-11、4-13、4-14、4-27、4-28、3-2、3-3、3-11、3-12						
DCt IEC61000	4-17、4-29						
Internal Resistance Mode							

R Range(Ω)[*9]	0-10						
L Range( )	0-2						
Setting Resolution	0.001						
Accuracy	0.1%+0.2% F.S.						
RLC Load							
Resistance							
Range (Ω)	0.001-1000						
Setting Resolution (Ω)	0.001						
Accuracy	±0.1% F.S.						
Inductance							
Range (*mH*)	1-5000						
Setting Resolution (*mH*)	0.001						
Accuracy	±0.1% F.S.						
Capacitance							
Range (*μF*)	1-5000						
Setting Resolution (*μF*)	0.001						
Accuracy	±0.1% F.S.						
DC Output							
Voltage							
Range (V)	±636						
Setting Resolution (V)	0.01						
Output Accuracy[*10]	±(0.01%+0.05% F.S.)						
Output Ripple (V _ rms)[*11]	<0.35@(DC-300kHz)						
Load Regulation	±0.05%F.S.						
Source Regulation	±0.01% F.S. @10% variation						
Output Slew Rate	DC>3.0V/μs						
Current							
Range (A)	90	90	105	105	105	105	105
Setting Resolution (*A*)	0.01						
Accuracy	±(0.1%+0.1% F.S.)						
Measurement Parameters							
AC Voltage							
Range (V _ rms)	L-N/0-600						
Resolution (_)	0.01						
Accuracy	±(0.01%+0.05% F.S.)						
Frequency							
Range ( )	15-500						
Resolution ( )	0.001						
Accuracy	±0.01%						
AC Current							
Range (A)	140						
Resolution	0.01						
Accuracy	±(0.1%+0.2% F.S.)						
Peak Current							
Range (A)	200						
Resolution ( )	0.01						
Accuracy	±2% F.S.						
Crest Factor							
Range	1.00-6.00						
Resolution	0.001						
Accuracy	±2% F.S.						
Active Power							
Range ( )	20						
Resolution ( )	1						
Accuracy[*12]	±0.2% F.S.						
Apparent Power							
Range ( )	20						
Resolution ( )	1						
Accuracy[*12]	±0.2% F.S.						
Power Factor							
Range	0.000-1.000						
Resolution	0.001						
DC Voltage							
Range (V)	±1000						
Resolution ( )	0.01						
Accuracy	0.1%F.S.						
DC Current							
Range (A)	±200						
Resolution ( )	0.01						
Accuracy	±(0.1%+0.2%F.S.)						
Input							
Wiring Method	Three-Phase Four-Wire, ABC+PE						
Frequency (Hz)	47 - 63						
Rated Input Voltage Range (V)[*13]	380 - 440						
Per Phase Current (*A_Max*)	12	15	18	22	30	35	38
Input Peak Current (A)	< 1.5 times rated						
Power Factor	> 0.99						
Efficiency[*14]	> 0.91						

Interface	
General Interface	Type-B、USB、LAN
Multifunctional Interface	"Anyport." For detailed definition, refer to the User Manual.
Environment	
Operating Range (℃)	0-50
Storage Range (℃)	-20-70
Humidity	≤80%
Dimensions and Weight	
Dimensions (Width × Height × Depth)	435×132×680mm (780mm With Breaker)
Weight	35kg
Protection	
Protection	RMS Overcurrent Trip
	Peak Overcurrent Trip
	Overpower Trip
	Overcapacity Trip
	Overvoltage (Set 1%-105%) Trip
	Overtemperature Trip
	Grid Input Overvoltage or Undervoltage Trip

Note:

*1: In the parameter table, all references to F.S. related to AC Output Voltage indicate the maximum AC voltage of 450V. All listed performance parameters are measured at an RMS Output Voltage above 15V unless otherwise specified;

*2: The DC component is tested with the Output Voltage set to 220VAC and Frequency at 50Hz under no-load conditions;

*3: Output voltage distortion is measured with the Output Voltage set to 250VAC and a Purely Resistive Load up to Rated Power;

*4: The resolution is 0.001 or 0.01% of the current setting value, whichever is greater.

*5: Phase accuracy is measured with the three-phase Output Voltage set to 220V, the three-phase phase set to the default value, and tested under no-load conditions.

*6: The maximum value of Individual Harmonic Content is 40%.

*7: Crest Factor refers to the ratio of peak current to RMS value. The typical value for a standard sine wave is 1.414. The maximum allowable value is 6; however, the peak value must not exceed the maximum current of a single unit. This does not refer to the Crest Factor under rated conditions.

*8: All references to F.S. for AC current parameters in the parameter table refer to the maximum peak current for the corresponding model.

*9: Output impedance refers to the impedance of the voltage source under steady-state output conditions.

*10: In the parameter table, F.S. related to DC Output Voltage refers to the maximum output DC voltage of 636 V.

*11: Output ripple voltage is measured with the output DC Voltage set to 500 V, output unloaded, and the oscilloscope set to AC coupling with a 20 MHz bandwidth limit.

*12: F.S. referenced in the accuracy of Active Power and Apparent Power refers to the maximum measurable power value of the respective model.

*13: The input operating voltage range is 304 Vac – 480 Vac.

*14: Power factor and efficiency specifications are tested at a Three-Phase input voltage of 380 V, output set to 220 V, with a Purely Resistive Load at rated Output Power.

4.3 Dimensions

All Cortex AC Series Products utilize a standard 19-inch chassis design. For detailed dimensions, refer to Figure 3, which can be integrated into standard rack systems or used on a desktop.

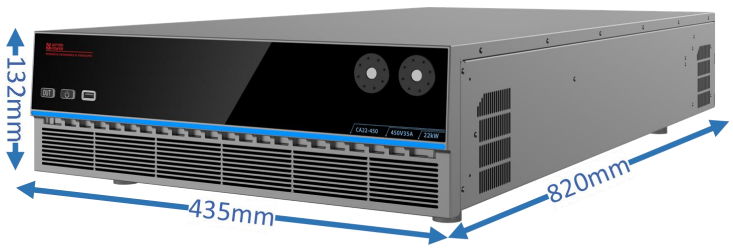


Figure 3 Cortex AC Series Bidirectional Programmable AC Power Supply Outline Drawing

4.4 Output Voltage and Current Curve

Traditional AC power supplies feature two voltage output ranges to provide either high voltage or high current. The Cortex AC Series is engineered with a unique single voltage range that operates along a constant power curve. For the constant output power curve, refer toFigure 4. Taking the CA20-450 as an example, at L-N/190 Vac@35 A , rated power can be output, and this operating range can be extended to L-N/450 Vac@15 A The output remains uninterrupted. In contrast, other power supplies may interrupt output and cause EUT shutdown when switching between high and low voltage ranges, making them unsuitable for testing AC products with wide voltage input requirements.

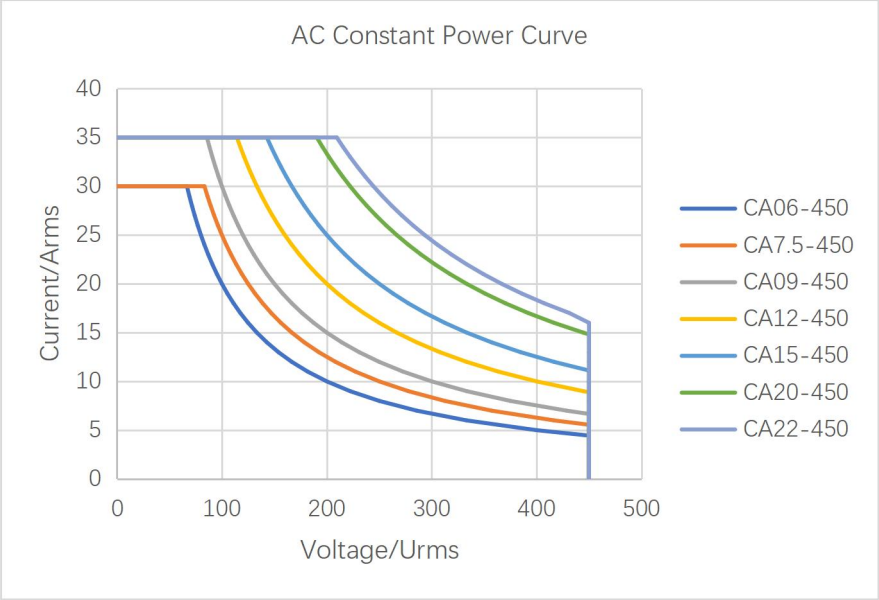


Figure 4 Output Voltage and Output Current Characteristics of Cortex AC Series Products in AC Constant Power Mode

Note:

The Output Voltage Range is determined by multiple limiting conditions. For instance, under different Output Frequency settings, Output Voltage and Output Power are affected to varying degrees. For details, refer to section 4.4-4.7.

This feature is also applicable in Direct Current Output Mode. For standard programmable AC power supplies, the Output Current in Direct Current Mode is typically half of the AC RMS value. Thanks to advanced power conversion technology, the Cortex AC Series Products, when operating in Direct Current Mode, provide a maximum Output Current average value equal to the AC RMS value and support Four-Quadrant Operation. Figure 5 The four-quadrant relationship between voltage and current in Direct Current Mode is illustrated.

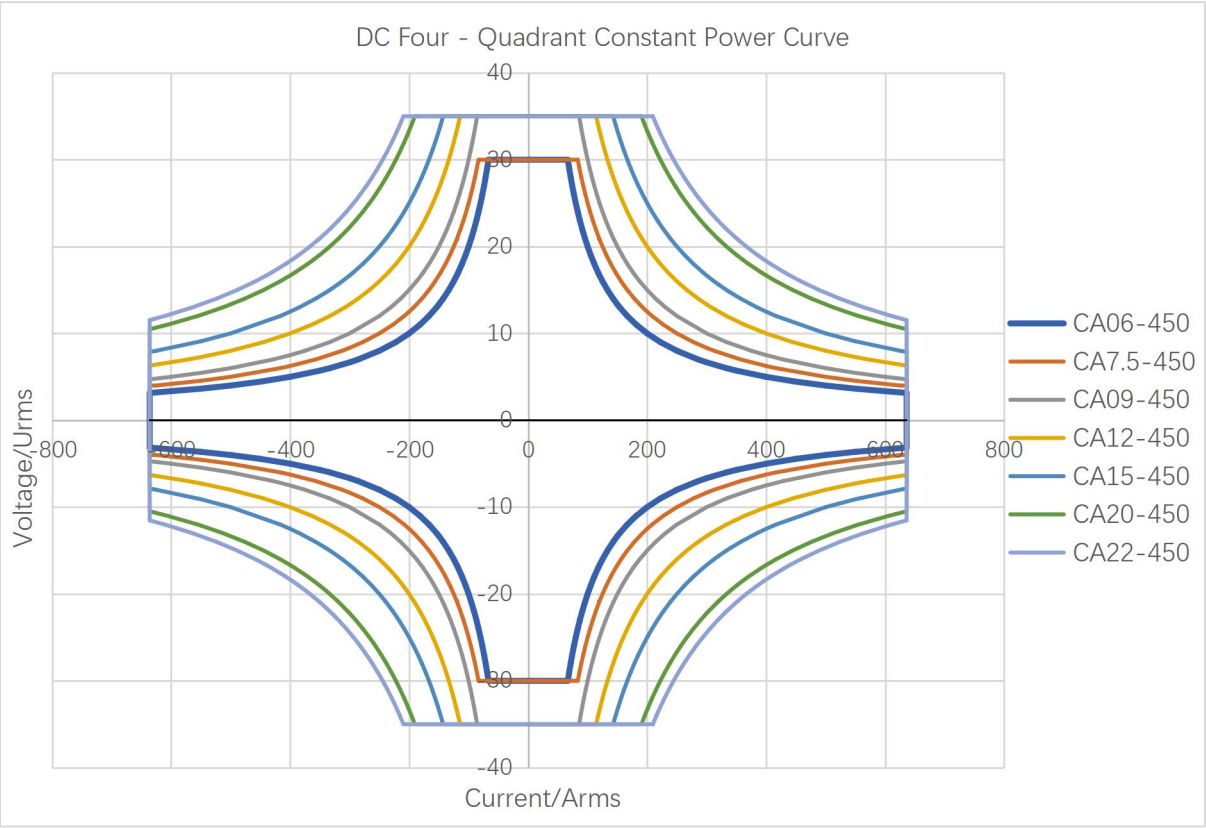


Figure 5 Output Voltage and Output Current Curves in Constant Power DC Mode of Cortex AC Series Products

In DC output mode, the Cortex AC Series Products can provide up to three independent outputs, enabling simple connections to achieve positive, ground, and negative three-wire DC output, such as generating ±270 V output for aerospace test systems. The system fully accommodates 100% unbalanced loads. Parallel configuration can also be used to achieve a single output with three times the current.

4.5 Output Voltage THD and Power

During steady-state output, variations in resistive load power will affect the Output Voltage THD index. The Cortex AC Series Products exhibit superior THD performance under light load conditions. As the load power increases, the THD will also increase, but will not exceed the nominal value specified in the specifications.

4.6 Output Voltage THD vs. Frequency Curve

The Cortex AC Series Products demonstrate superior Output Voltage THD performance across the entire frequency range, meeting most testing requirements. However, due to limiting parameters, the output THD increases as the Output Frequency rises. Refer to the output relationship curve. Figure 6.

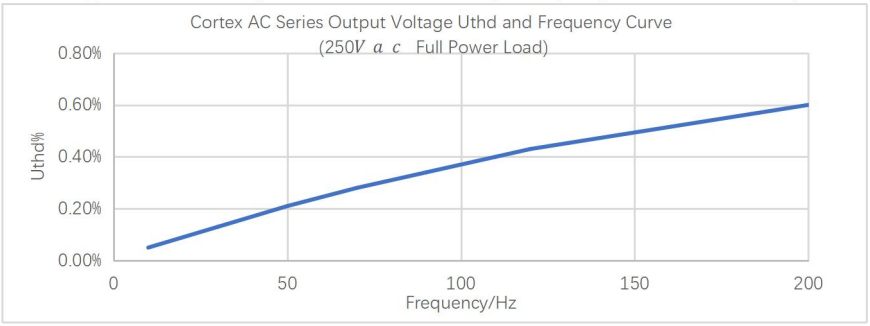


Figure 6 Output Frequency vs. Output Voltage THD Curve

4.7 Output Voltage Accuracy vs. Frequency

The Cortex AC Series Products employ high-speed, high-accuracy asynchronous sampling technology to maintain high voltage accuracy across a wide output range. When the Output Voltage exceeds 10V, the accuracy of the Output Voltage remains within the value specified in the specification table.

4.8 Individual Harmonic Content versus Number of Superpositions Curve

The Cortex AC Series Products offer a wide harmonic generation capability. Under fundamental frequencies of 40 Hz ~70 Hz, harmonic orders up to 100 are achievable; at 200 Hz, harmonic orders up to 25 are achievable. The relationship between Individual Harmonic Content and Number of Superpositions under 40 Hz-70 Hz conditions is shown in Figure 7. The relationship between Individual Harmonic Content and Number of Superpositions under 70 Hz ~200 Hz conditions is

shown in Figure 8.

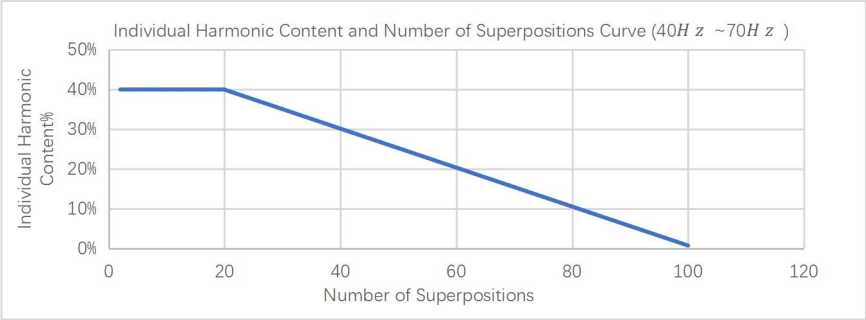


Figure 7 Individual Harmonic Content versus Number of Superpositions Curve (40 Hz ~70 Hz)

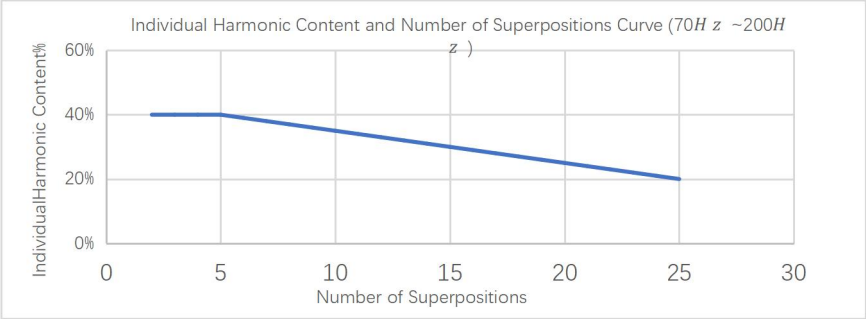


Figure 8 Individual Harmonic Content and Number of Superpositions Curve (70 Hz ~200 Hz)

4.9 Output Overcurrent Protection Delay Curve

The Cortex AC Series Products are equipped with a comprehensive internal protection system, particularly for various types of load protection. Users may adjust these protections as required; however, maximum limit values are preset for each parameter. To effectively prevent the malfunction of protective devices when the Cortex AC Series Products are connected to impact loads, the overcurrent protection delay time can be adjusted over a wide range. For the maximum setting area, see Figure 9. For related setting operations, refer to Section 8.9.

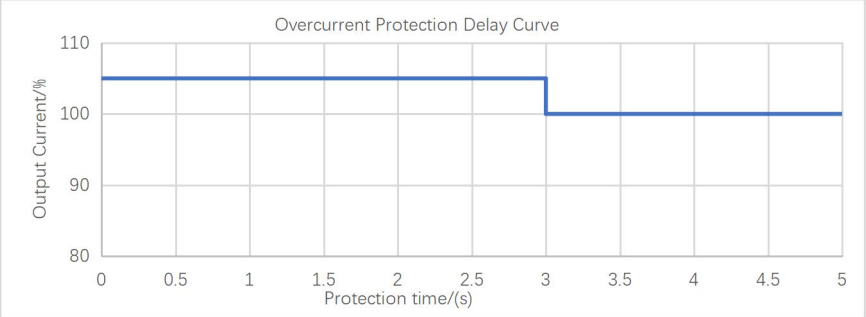


Figure 9 Overcurrent Protection Delay Curve

4.10 Environmental Conditions

To ensure that the Cortex AC Series Products maintain optimal performance and service life, the operating environment must not exceed the following limits. See Environmental Conditions.Table 4。

Table 4 Cortex AC Series Products Environmental Conditions Table

Operating Environment	
Cooling Method	Intelligent variable-speed fan cooling
Audio noise	Standard: 55 dB
	Full power: <80 dB
Operating Temperature	0℃-50℃
Storage Temperature	-20℃-70℃
Humidity	≤80%, non-condensing
Altitude	Not to exceed 2000 m

4.11 Output Derating vs. Ambient Temperature Curve

A typical electronics development laboratory or production line is capable of maintaining a favorable temperature environment. Under such Environmental Conditions, the Cortex AC Series Products can ensure optimal performance specifications. When the ambient temperature rises, the output power of the Cortex AC Series Products will decrease until over-temperature protection is activated. For the output power derating versus temperature curve, see Figure 10。

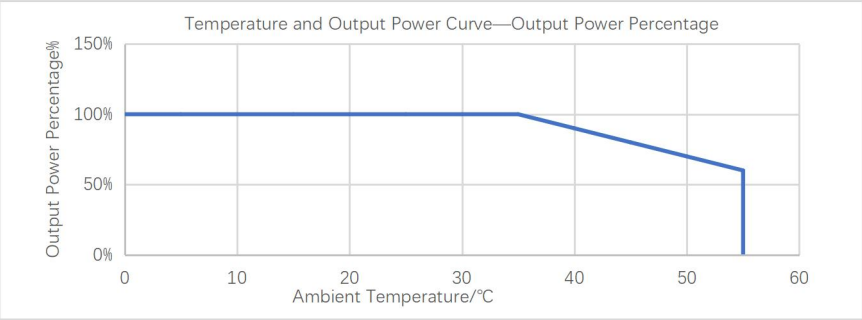


Figure 10 Output Power Derating versus Temperature Curve

4.12 Audio Noise and Ambient Temperature

During operation, the Cortex AC Series Products generate audio noise from both the fan and the fundamental frequency sources. Only fan noise is considered during audio noise testing. The Cortex AC Series Products are equipped with intelligent speed-controlled fans, which effectively reduce audio noise at lower ambient temperatures.

4.13 Audio Noise versus Output Power Curve

During operation, the Cortex AC Series Products generate audio noise from both the fan and the fundamental frequency sources. Only fan noise is considered during audio noise testing. The Cortex AC Series Products are equipped with intelligent variable-speed fans, which can effectively reduce audio noise at lower output power. As output power increases, fan noise also increases. The relationship between the two is shown in the following curve: Figure 11。

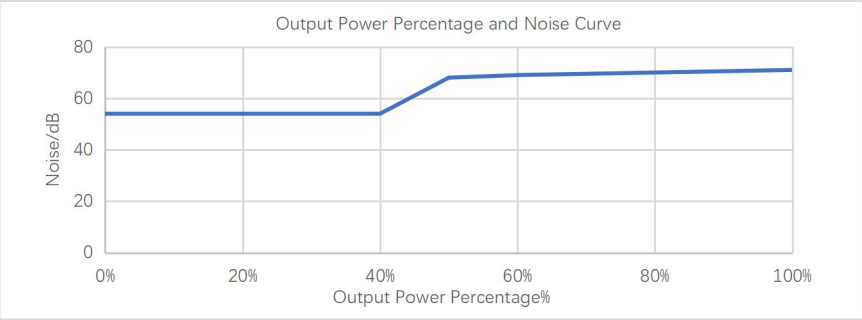


Figure 11 Output Power vs. Noise Curve

4.14 Audio Noise vs. Output Frequency

The Cortex AC Series Products are capable of outputting a 200 Hz fundamental wave and up to the 100th harmonic at 40 Hz-70Hz , and up to the 25th harmonic at 200 Hz harmonics. Under these conditions, the power supply may produce audio noise perceptible to the human ear. Due to individual differences, perception under identical conditions may vary. It is recommended that sensitive individuals take protective measures to safeguard their hearing.

4.15 Safety Standards

Compliance Standards	
Safety Standards	EN 61010-1:2010/A1:2019
EMC Limit Value	EN IEC 61326-1:2021
EMC Immunity	EN IEC 61326-1:2021
Product Category	Class A

5 Unpacking and Installation

5.1 Inspection

Before unpacking, please carefully check that the packaging is intact. If there are any anomalies or if you believe that the product may be damaged, please contact the Xi'an ActionPower Electric Co., Ltd. after-sales service immediately.

After unpacking, please carefully inspect the product appearance and verify the quantity of accessories against the packing list. If there are any anomalies, please contact the Xi'an ActionPower Electric Co., Ltd. after-sales service immediately.

All Cortex AC Series Products require three-phase AC input and are equipped with a pluggable terminal block module.

5.2 Packaging and Handling Instructions

For information on the packaging of Cortex AC Series Products, refer to Figure 12. In accordance with safety regulations, the weight of this Product series exceeds 18 kg (approximately 35 kg). Before unpacking, the package must be placed on a suitable flat surface. After opening the package, two people are required to remove the Product from the packaging—one person lifting from each long side. Place the Product in an appropriate location that can support its weight.

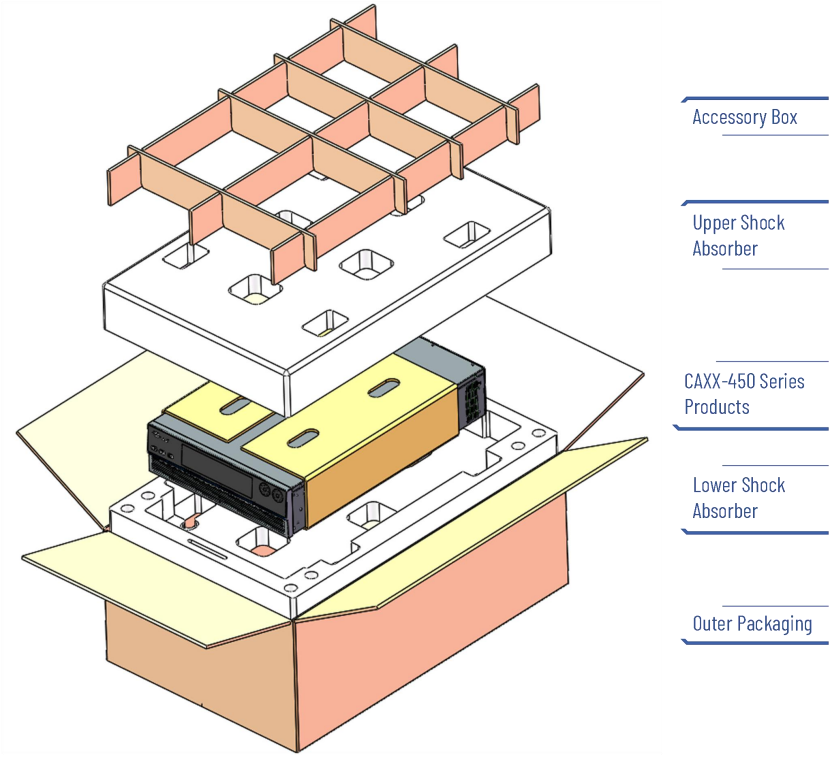


Figure 12 Cortex AC Series Products Packaging Disassembly Diagram

When moving the Product during laboratory use, two persons must lift or carry it. Do not attempt to lift the Product alone, nor use the two handles on the Front Panel by yourself to move the Product. For proper handling, refer to the following diagram: Figure 13.

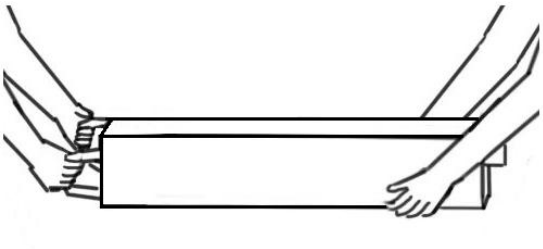


Figure 13 Handling Diagram

5.3 Placement Instructions

The only correct placement method for the Cortex AC Series Products is shown in Figure 14 center ① position; no other placement methods are permitted, and floor-standing installation is not allowed.

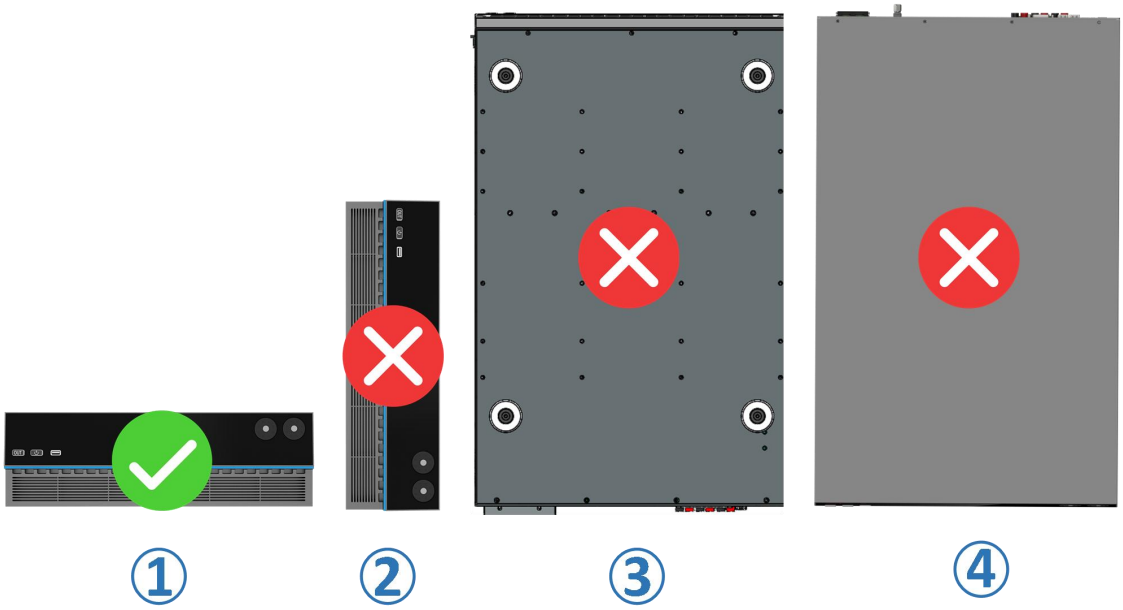


Figure 14 Product Placement Diagram

5.4 Rack Ear Installation

When the Cortex AC Series Products need to be installed in a standard cabinet, please refer toFigure 15Install the rack ears included in the 'Installation Kit.'

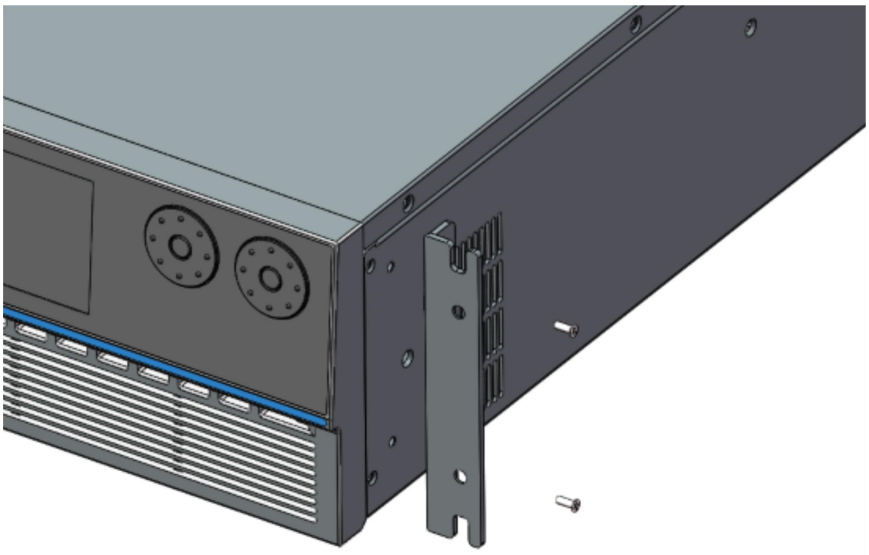


Figure 15 Rack Ear Installation Diagram

5.5 Handle Installation

When the Cortex AC Series Products need to be moved in and out of the cabinet, please refer to Figure 16 Install the handles included in the 'Installation Kit.'

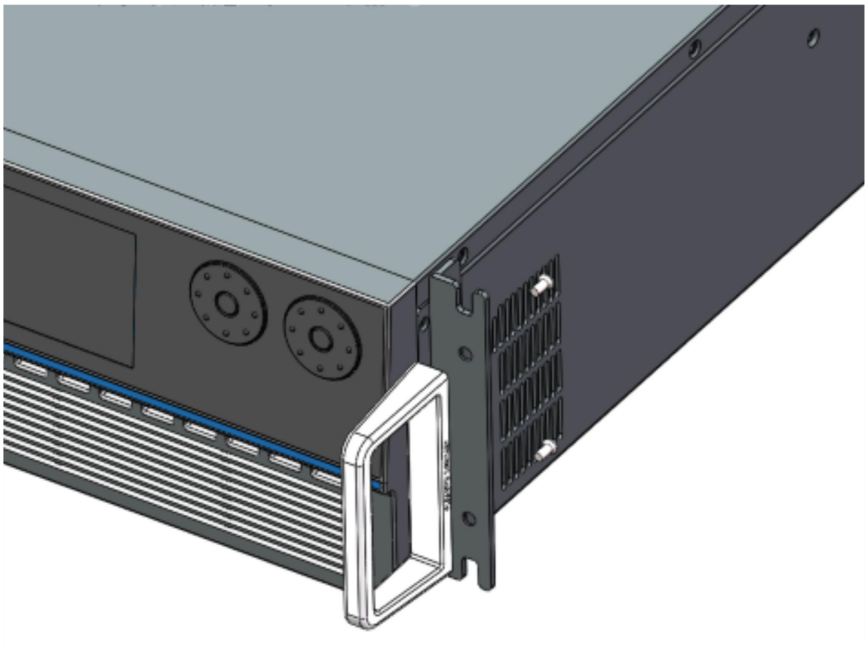


Figure 16 Handle Installation Diagram

5.6 Foot Pad Installation

The Cortex AC Series Products are equipped with Foot Pads by default. If the Product needs to be elevated, please refer to Figure 17 Replace the tall foot pads included in the installation kit.

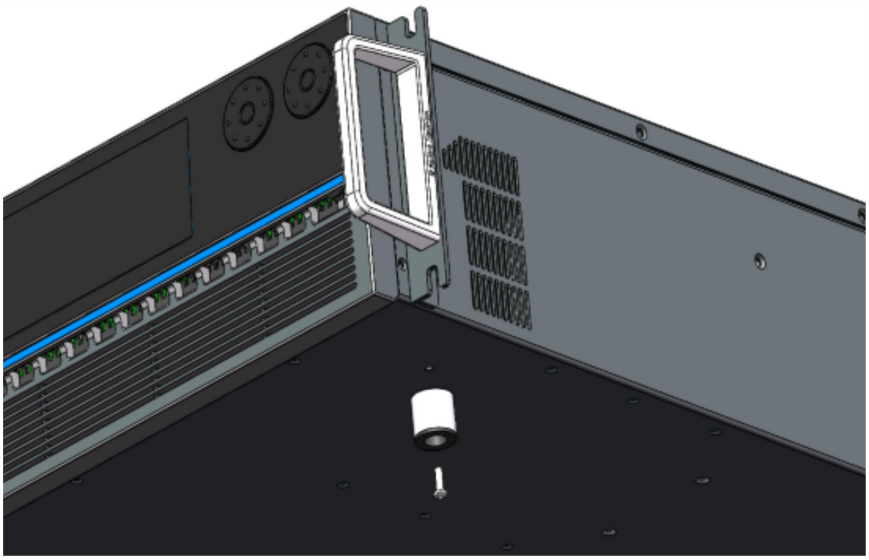


Figure 17 Illustration of Foot Pad Installation

5.7 Check AC Input

Cortex AC Series Products support a wide voltage and frequency range. Before connecting the AC power supply to a Cortex AC Series Product, you must check the type label on the device to verify that its AC input configuration matches the local grid. If the AC input voltage, phase, and frequency do not match, do not connect the power supply to this product.

5.8 AC Input Connection

The product's AC input connection must include an isolation device (external switch or circuit breaker). As part of the installation, the isolation device must be placed in an accessible location and must be clearly labeled as the product's isolation device. The isolation device must simultaneously disconnect all conductors.

External overcurrent protection devices, such as fuses or circuit breakers, must be provided.

The breaking capacity of the overcurrent protection device must be matched to the rated current of the equipment.

At least basic insulation is required between components with opposite supply polarity on the power source side of the overcurrent protection device.

Overcurrent protection devices must not be installed in the protective conductor. The neutral line of multiphase products shall not be fitted with a fuse or single-pole circuit breaker, and must be installed in accordance with the requirements of GB19517-2009. For each model of the Cortex AC Series Products, please follow Table 5 Select the appropriate cable.

Table 5 AC Input Wire Gauge Table

Product Model	Rated Power ( )	Rated Input Voltage (_)	Rated Input Current (A_)	Recommended Distribution Current (_)	Recommended Wire Gauge (^2)
CA06-450	6	380	12	30	4
CA7.5-450	7.5	380	15	30	4
CA09-450	9	380	18	30	4
CA12-450	12	380	22	30	4
CA15-450	15	380	30	50	6
CA20-450	20	380	35	50	6
CA22-450	22	380	38	50	6

AC input connections must be made at the AC Input Connector. Phase markings for AC input are indicated on the rear panel. Four-wire power connection is required (L1, L2, L3, and grounding). Cortex AC Series Products are self-adaptive to the phase of the AC input voltage. Unless otherwise specified, it is not necessary to differentiate the correspondence of the three-phase phases. Refer to the Wiring Diagram.Figure 18.

Note: The input connector screws must be securely tightened during installation.

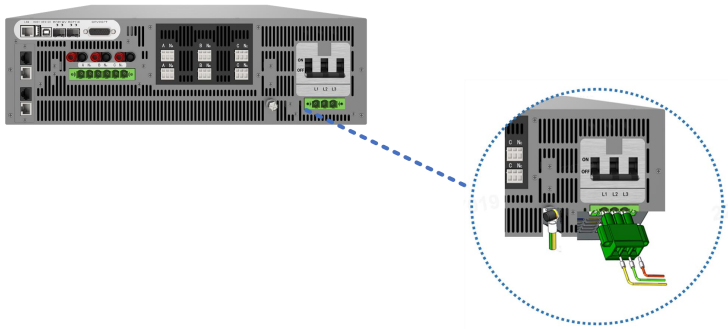


Figure 18 AC Input Connection Diagram

Electric Shock Hazard: Cortex AC Series Products must never be operated without proper grounding under any circumstances.

This product:

Must be grounded through the AC Input.

Must always use cables with effective grounding.

Must comply with applicable national standards for electrical system grounding.

The Ground Terminal is the screw fastening port at the lower right corner of the AC Input Connector; refer to Figure 18。

5.9 Load Connection

Hazardous Output: The product output is at a hazardous voltage level. The output is electrically isolated from the AC input; therefore, the output must always be regarded as hazardous. In all cases, when AC input is connected to the product, the Operator must disconnect the input to the Cortex AC Series Products before connecting or disconnecting the Output Connector.

All products can be configured for Single Phase output or Three-Phase output. Whether operating in Single Phase or Three-Phase mode, the external voltage sensing connector maintains a Three-Phase connection. Through system configuration, Cortex AC Series Products will automatically detect the channel and set the appropriate configuration.

5.9.1 Output Wiring and Recommended Wire Gauge

The connection from the Output Terminal Block of Cortex AC Series Products to the Load should use the supplied matching Output Connector. This connector is safe and its contact capacity is matched to the power supply output; it must be used when connecting load wires.

Note: The output connector screws must be securely tightened during installation.

The load output cable should be derated according to the current; for 40 Hz –70 Hz, it is recommended to refer to the relevant guidelines. Table 6 When selecting the appropriate wire gauge, the rated insulation voltage of the load cable should also be considered. Due to the skin effect, as the Output Frequency increases, losses in the same conductor will also increase; if the Frequency exceeds 120 Hz in operation, it is recommended to use output wires in accordance with standard derating guidelines.

Table 6 Output Wire Diameter/Wire Gauge Table @ 40 Hz-70 Hz

Product Model	Rated Power ( )	Rated Output Voltage (V _ RMS)	Rated Output Current (A _ RMS)	Recommended Distribution Current (_)	Recommended Wire Gauge (^2)
CA06-450	6	450	30	50	6
CA7.5-450	7.5	450	30	50	6
CA09-450	9	450	35	50	6
CA12-450	12	450	35	50	6
CA15-450	15	450	35	50	6
CA20-450	20	450	35	50	6
CA22-450	22	450	35	50	6

5.9.2 Three-Phase Y-Type Load Connection

In the Cortex AC Series Products, the output three-phase six-wire configuration is mutually independent. For Y-Type Load connections, refer to Figure 19. Short-circuit NA, NB, and NC to form a single neutral point. This neutral point serves as the reference for all phases. The Cortex AC Series Products are equipped with an Independent Detection System; adjustment of the detection system is not required.

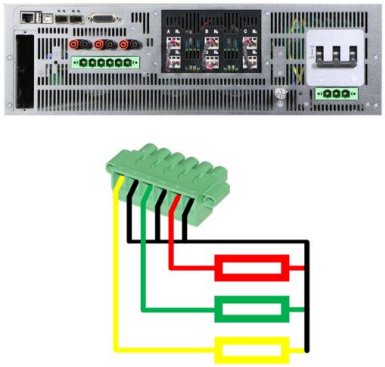


Figure 19 Y-Type Load Connection Diagram

As the AC Output Frequency increases, the Load Terminal Voltage will decrease significantly. To obtain more precise voltage at the load port, please refer to Section 7.10 Adjust the remote compensation cable as described in this section.

5.9.3 Three-Phase Delta Load Connection

The three-phase six-wire outputs of the Cortex AC Series Products are mutually independent. For connections to a Delta load, refer to Figure 20. The Cortex AC Series Products are equipped with an Independent Detection System; adjustment of the detection system is not required.

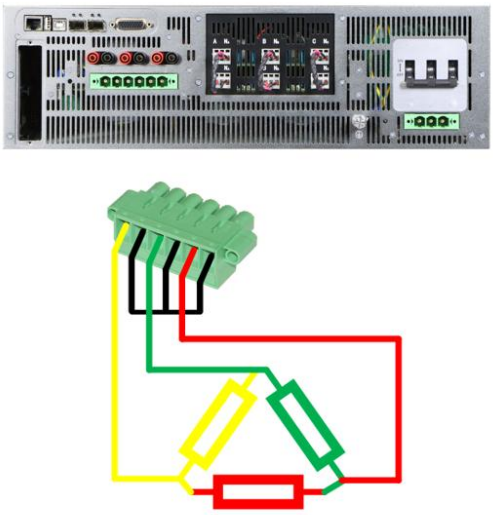


Figure 20 Delta Load Connection Diagram

5.9.4 Output Neutral Point Grounding

If the power supply's output neutral terminal is not grounded, the output midpoint is considered floating. The power supply allows its output to float with respect to earth ground. The neutral point may be grounded through the load. Alternatively, the output midpoint can be connected via a conductor to the ground terminal on the rear panel of the power supply to obtain a stable earth potential; for wiring instructions, refer to Figure 21。

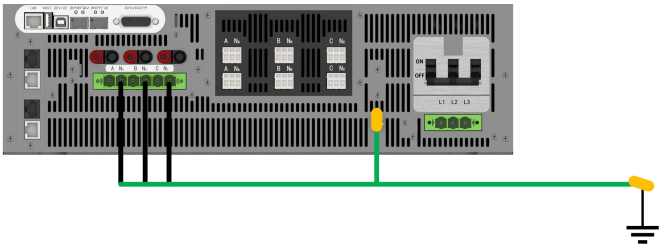


Figure 21 Output Midpoint Grounding Diagram

5.9.5 Single Phase/DC Load Connection

Although the PRE20's internal space is very compact, both a parallel switch and a Load Switch have been provided. The parallel switch is associated with Single Phase Mode and can automatically parallel all three phases to the A phase output, reducing operational complexity and resolving issues caused by failure to remove external jumper wires. The Load Switch is associated with the OUT function, achieving isolation between the output and the load, thereby enhancing safety during R&D testing and production line ATE conversion of the Device Under Test.

The Cortex AC Series Products provide mutually independent three-phase six-wire outputs. Any individual phase can be used, or the three phases can be connected in parallel to form a single phase/Direct Current, thus expanding the output capacity to the rated value. The Cortex AC Series Products are designed with an Independent Detection System. There is no need to adjust the detection system or configure the current detection ratio.

The output terminal block of the Cortex AC Series Products supports a maximum RMS current of 50 A _ per port. For currents less than 50 A _ , refer to the wiring method in Figure 22。 When the current is ≥50 A_ , external short-circuiting is required. Refer to the wiring method in Figure 23.

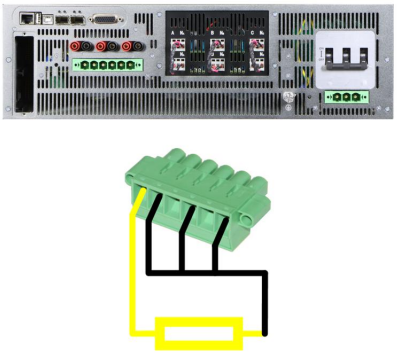


Figure 22 Wiring Diagram for Single Phase/DC Load with Current <50A_

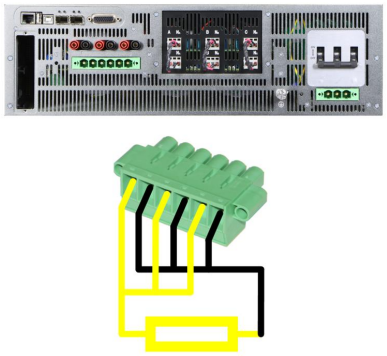


Figure 23 Wiring Diagram for Single Phase/DC Load with Current ≥50A_

Note: 1. The N line must be short-circuited in all wiring configurations.

2. After proper wiring according to the diagram, switch from Three-Phase Mode to Single Phase Mode. For detailed operation, see section8.2.

5.10 Energy Matrix Interface Installation

When connecting Cortex AC Series Products in parallel, each output must be separately short-circuited and connected using optical fiber for communication. When this product is used in parallel, two Energy Matrix Interfaces are required. Taking three Cortex AC Series Products as an example, refer to the optical fiber connection method in Figure 24. When connecting, insert the optical fiber cable into the optical module, secure the optical module, and then insert the optical module into the Product's Energy Matrix Interface.

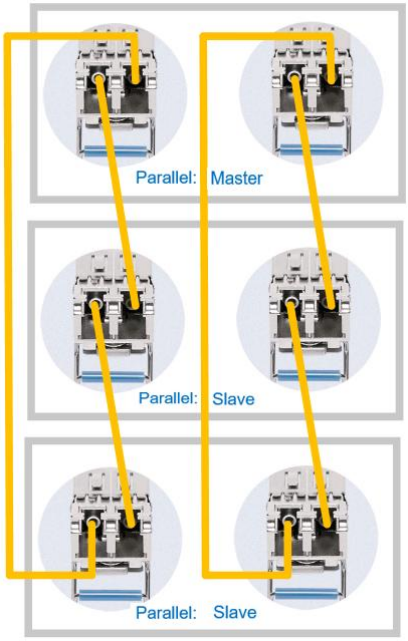


Figure 24 Parallel Optical Fiber Connection Diagram

Note: When inserting the optical module, the Circuit Breaker on the Rear Panel must be turned off.

5.11 Anyport Interface Installation

Anyport is a multifunctional interface. To use this interface, connect it using an analog programming converter. Before connecting or disconnecting the Anyport Interface, the power input must be disconnected. For the Anyport installation method, see Figure 25.

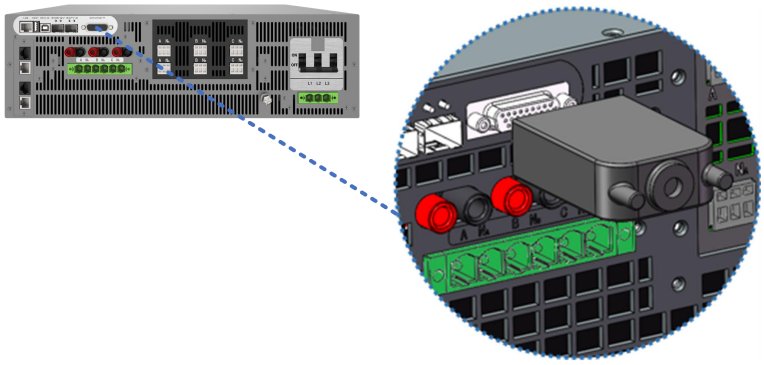


Figure 25 Anyport Installation Diagram

5.12 Desktop Use

When placing the Product on a workbench or desktop, ensure that the maximum rated load of the workbench or desktop exceeds the actual weight of the Product.

The bottom of the Cortex AC Series Products is equipped with instrument pads, which prevent slippage and protect the desktop during tabletop use. However, do not forcibly push the Product when moving it, to prevent the rubber components of the instrument pads from detaching and potentially damaging the desktop.

5.13 Rack Installation

The Cortex AC Series Products can be installed in a standard 19-inch rack. Customers or system integrators wishing to install one or more Cortex AC Series Products in their system may directly order the dedicated Cortex ACrack. The rack is equipped with input and Output Wiring terminals, and reserves space for L-shaped support installation, enabling zero-gap stacking with other devices or test equipment. Xi'an ActionPower Electric Co., Ltd. can provide relevant technical support.

5.14 Ventilation

The Cortex AC Series Products utilize a design with air intake at the Front Panel and air exhaust at the Rear Panel. To ensure proper operation, there must be no obstructions within 30 cm of the Rear Panel during installation, so as to prevent blockage of exhaust airflow and to avoid triggering overheat protection.

5.15 Noise Level

When the Product is operating at rated full power or near rated full power in high-temperature environments, the fan speed will reach its maximum. At a distance of 1 meter from the Front Panel, the noise level of the power supply may exceed 70 dB. Installers shall implement measures to reduce the noise level at the Operator's workstation to a safe level. Such measures include installing noise reduction baffles or providing protective earplugs. Operators should wear hearing protection when exposed to these noise levels.

5.16 Liquid Protection

Cortex AC Series Products do not offer protection against liquid spillage. Do not install the product in areas where chemicals or liquids may be spilled.

5.17 Cleaning

The Cortex AC Series Products are not designed for user-performed cleaning and do not include cleaning accessories. They may be used for extended periods under the recommended environmental conditions. If cleaning is necessary, please contact the manufacturer's after-sales service.

5.18 Abnormal Condition Handling

In the unlikely event of product failure, or if the power supply cannot be powered on even when connected to the correct AC supply, affix a warning label to the power supply to indicate that maintenance or repair is required. Contact Xi'an ActionPower Electric Co., Ltd. or its authorized representative to arrange for service.

6 Front Panel

6.1 Front Panel Layout

The Cortex AC Series Products are designed with an integrated front panel, allocating operational features according to usage frequency and user habits. Control buttons are positioned at the lower left, while rotary controls are situated at the upper right, significantly enhancing operational efficiency and accuracy. The functional partitioning of the controls also accommodates both left-handed and right-handed users, ensuring ease of use for all operators.

The functional partitioning of the front panel is as follows: Figure 26 including Display Screen, Manufacturer Logo, external storage interface, Power/Reset Button, Output Button, Left Shuttle Knob, Left Shuttle Button, Right Shuttle Knob, and Right Shuttle Button.

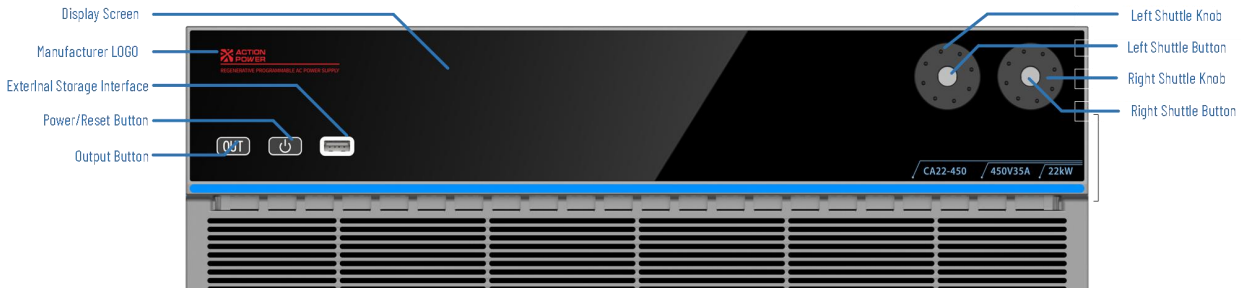


Figure 26 Front Panel Functional Layout Diagram

6.1.1 Display Screen

The Cortex AC Series Products are equipped with an 8.8-inch LCD touch Display Screen, featuring a 1920*480 resolution and 16-bit RGB ultra-wide aspect ratio, allowing for the display of additional information. Users can operate and control the unit via the touch Display Screen and physical buttons.

6.1.2 Manufacturer Logo

The Manufacturer Logo indicates the Product status. When the Cortex AC Series Products are powered on, the LOGO will illuminate red. The upper left corner displays the company logo, the right side shows the product series name PRE, and the bottom indicates the full product name, PROGRAMMABLE POWER SUPPLY, that is, Bidirectional Programmable Power Supply.

6.1.3 External Storage Interface

This interface is intended for connecting external USB storage devices, allowing the storage and exchange of information between internal and external USB storage devices of the Cortex AC Series Products.

6.1.4 Power/Reset Button

The Power/Reset Button is used to power on, power off, and reset the Cortex AC Series Products, and is equipped with a tri-color indicator light. When the button indicator light is yellow, it indicates standby mode; when green, normal operation; and when red, protection mode.

6.1.5 Output Button

The Output Button is used to connect or disconnect the Output Terminal. When the button indicator light is off, the Output Terminal cannot be operated. When the indicator light is green, the Output Terminal is disconnected; when red, the Output Terminal is connected.

6.1.6 Left/Right Shuttle Buttons and Knobs

The backlight of the Left/Right Shuttle Buttons is off by default. Pressing a shuttle button turns on its backlight and enables the corresponding shuttle knob. If there is no operation for 5 seconds, the shuttle button backlight will automatically turn off, and the corresponding shuttle knob will become inactive.

The left/right shuttle knobs are used to set the values on the right side of the Main Interface of the Display Screen. The Left Shuttle Knob sets the Output Voltage, while the right shuttle knob sets the Frequency. Users can use the shuttle knobs instead of the on-screen numeric keypad to set the required values. Rotating the left or right shuttle knob clockwise increases the value, while rotating it counterclockwise decreases the value. The step size is 1.

6.2 Power/Reset Button Related Operations

The Power/Reset Button can be used to perform Power On, Shutdown, and Reset functions.

6.2.1 Power On/Shutdown

The power-on procedure for Cortex AC Series Products is as follows:

Step 1: Push the Rear Panel AC Circuit Breaker upward to the ON position; see Figure 27 Status 1.

Step 2: Wait until the Manufacturer Logo on the Front Panel is illuminated and the Power/Reset Button Indicator Light turns yellow. At this point, the system is in standby power-on mode; see Figure 27 Status 2.

Step 3: Press and hold the Power/Reset Button until the indicator light turns green; seeFigure 27Status 3. This completes the product power-on procedure.

Figure 27 Power-On Process Diagram

The shutdown procedure for Cortex AC Series Products is as follows:

Step 1: Disconnect the Output Terminal; see Figure 28 Status 1.

Step 2: Press and hold the Power/Reset Button until the indicator light changes from green to yellow; see Figure 28 Status 2.

Step 3: Push the Rear Panel AC Circuit Breaker downward to the OFF position; seeFigure 28State 3 indicates the completion of product shutdown.

Although the Cortex AC Series Products are regenerative devices equipped with anti-islanding functionality, in emergency situations when energy is being fed back to the grid, shutdown can still be performed by directly disconnecting the AC Terminal Circuit Breaker. However, under normal circumstances, it is recommended to follow the standard shutdown procedures as outlined above.

Figure 28 Shutdown Process Diagram

6.2.2 Automatic Power-On

The Cortex AC Series Products feature Automatic Power-On functionality, which simplifies the power-on procedure and enhances user convenience.

To enable Automatic Power-On, the product's start-up mode must be set to automatic. For details, see section8.14.

6.2.3 Reset

The reset procedure for the Cortex AC Series Products is as follows:

Step 1: The Power/Reset Button indicator light turns red and the Status Display Area displays the protection status. SeeFigure 29Status 1.

Step 2: Briefly press the Power/Reset Button. The Output Button Indicator will begin to flash. When both the Power/Reset Button Indicator and the Output Button Indicator turn green, and the Status Display Area changes from protection state to standby state, the reset operation is complete. See Figure 29 State 2.

Figure 29 Reset Procedure Diagram

6.3 Output Button Related Operations

The Output Button is used to connect or disconnect the Output Terminal. When the button indicator light is off, the Output Terminal cannot be operated. When the indicator light is green, the Output Terminal is disconnected; when red, the Output Terminal is connected.

6.3.1 Manual Output

The output operation for Cortex AC Series Products is as follows:

Step 1: The power supply is in standby state. See Figure 30 Status 1.

Step 2: Press the Output Button. The Output Relay will engage, and the Output Button Indicator will change from green to red. SeeFigure 30 State 2. At this time, the product's Output Terminal is connected.

Step 3: Press the Output Button again. The Output Relay will disengage, and the Output Button Indicator will change from red to green. See Figure 30 State 3: At this time, the product Output Terminal is disconnected.

Figure 30 Output Connection Status Diagram

6.3.2 Automatic Output

Cortex AC Series Products are equipped with Automatic Output functionality. When the product's operating mode is set to automatic, see Section 8.14, after Power On, the product will automatically output according to the last saved parameter settings.

6.3.3 Output On/Off Delay

Cortex AC Series Products are equipped with output connection delay and disconnection delay functions.

When setting the product's connection delay time, refer to Section 8.14, in standby mode, after pressing the Output Button, the Output Button Indicator will change from green to yellow. See Figure 31 State 2: After the preset connection delay time expires, the Output Relay will engage and the Output Button Indicator will change from yellow to red. See Figure 31 State 3: At this time, the Product's Output Terminal is connected.

Figure 31 Output Activation Delay Status Diagram

When setting the Product's disconnection delay time, refer to Section 8.14, in the output state, after pressing the Output Button, the Output Button Indicator changes from red to yellow. See Figure 32 State 2: After the set disconnection delay time has elapsed, the Output Relay disconnects and the Output Button Indicator changes from yellow to green. See Figure 32 State 3: At this time, the Product's Output Terminal is disconnected.

Figure 32 Output Disconnection Delay Status Diagram

6.3.4 Operating Sequence

6.3.4.1 Output Activation Sequence

To extend the service life of the internal relay, refer to the Output Activation Sequence in Figure 33.

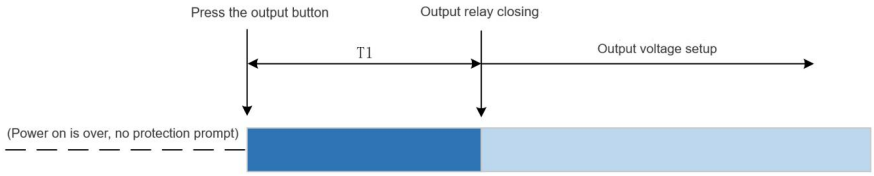


Figure 33 Output Activation Sequence Diagram

Figure 33 Here, T1 refers to the time from pressing the Output Button to the actuation of the Output Relay. This duration is affected by factors such as activation delay parameters and response delay, with a minimum of 100 ms.

6.3.4.2 Output Disconnection Sequence

Refer to the Output Disconnection Sequence Figure 34.

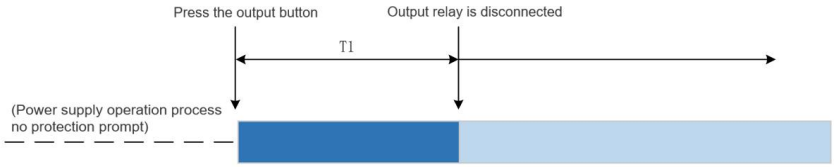


Figure 34 Output Disconnection Sequence Diagram

Figure 34 T1 represents the time from pressing the Output Button to the disconnection of the Output Relay. This time is affected by various factors, such as shutdown slew rate, shutdown phase angle, and disconnection delay parameters. The Output Voltage is reduced to zero before the Output Relay disconnects.

7 Rear Panel

The rear panel of the Cortex AC Series Products provides concise and standardized interfaces. This chapter describes the rear panel layout and important considerations for use.

7.1 Rear Panel Layout

The rear panel includes the Anyport Interface, Energy Matrix Interface, USB Communication Interface, LAN Interface, Log Storage Interface, Output Measurement Interface, Output Connector, Optional Interface, Remote Compensation Interface, Input Connector, PE Connector, and AC Input Circuit Breaker. See Figure 35.

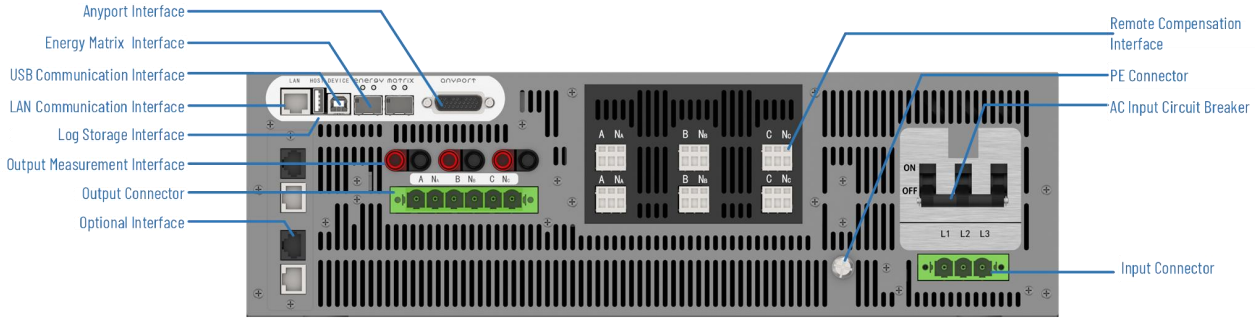


Figure 35 Rear Panel Functional Partition Diagram

7.2 Anyport Interface

Anyport is a multifunctional interface that provides four types: Digital Input, Digital Output, Analog Input, and Analog Output. Users may configure this interface with corresponding functions to operate and monitor the operational status of this Product.

The 6-channel Digital Input interface and 6-channel Digital Output interface can each be individually configured to meet various control requirements. For the functions of the Digital Input and Digital Output interfaces, see Figure 36.

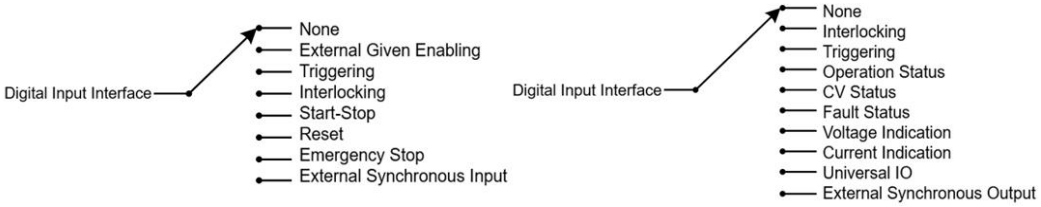


Figure 36 Anyport Digital Input and Digital Output Interface Functional Diagram

The functions of the analog interfaces are fixed, and can be configured to control voltage, current, power, internal resistance, and analog operations. For detailed functional information, see Table 7.

Table 7 Anyport Interface Function Table

Interface Type	Pin Position	Signal Level	Function Description
Digital Input	Pin10	3V~27V	The six pins correspond to six input interfaces. Each channel can be configured for external preset enable, trigger, interlock, start/stop, reset, emergency stop, and external synchronization input functions. For the Digital Input Interface functional diagram, see Figure 37.
	Pin11		
	Pin19		
	Pin20		
	Pin21		
	Pin22		
Digital Output	Pin1	3V~27V	Each of the six pins corresponds to an output channel, each of which can be configured for interlock, trigger, general I/O, voltage indication, current indication, and external synchronization output functions. Each channel can also be configured to monitor the product's operating status, CV status, and protection status. The interface defaults to OC (open collector). During use, the current limit value should be set within the range of 3 to 10 mA. Refer to the digital output interface diagram. Figure 38.
	Pin2		
	Pin3		
	Pin4		
	Pin14		
	Pin15		
Analog Input	Pin9	-5V~5V/ -10V~10V	This pin can be configured for tracking amplitude, tracking RMS value, or real-time tracking function of Φ1. The measurement range can be configured in the "Anyport-Analog" interface. For details, see section 8.15.2.
	Pin8		This pin can be configured for tracking amplitude, tracking RMS value, or real-time tracking function of Φ2. The measurement range can be configured in the "Anyport-Analog" interface. For details, see section8.15.2.
	Pin7		This pin can be configured for Φ3 tracking amplitude, tracking RMS value, or real-time tracking function. The range can also be set via the 'Anyport-Analog' interface. For details, see Section8.15.2.
	Pin6		This pin can be configured for the tracking Output Frequency function. For details, see Section8.15.2.
Analog Output	Pin24	5V	This pin provides a 5V voltage reference output. Users may apply appropriate voltage division to this pin and connect it as needed, based on product settings.
	Pin25	-5V~5V	Both pins can indicate the RMS value of voltage and current for each phase, Active Power, apparent power, reactive power, as well as total Active Power, total apparent power, and total reactive power. The range can be set via the 'Anyport-Analog' interface. For details, see Section8.15.2The parameter value of the Analog Output is proportional to the actual output parameter value.
	Pin26		
Grounding Terminal	Pin5		These seven pins serve as the negative terminals for the Digital Input, Digital Output, Analog Input, and Analog Output interfaces and are commonly grounded.
	Pin12		
	Pin13		
	Pin16		

Interface Type	Pin Position	Signal Level	Function Description
	Pin17		
	Pin18		
	Pin23		

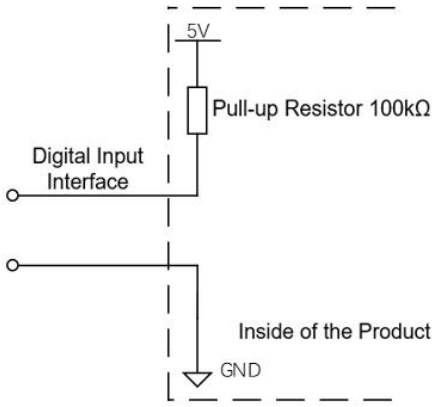


Figure 37 High-Level Signal Diagram of Anyport Digital Input Interface

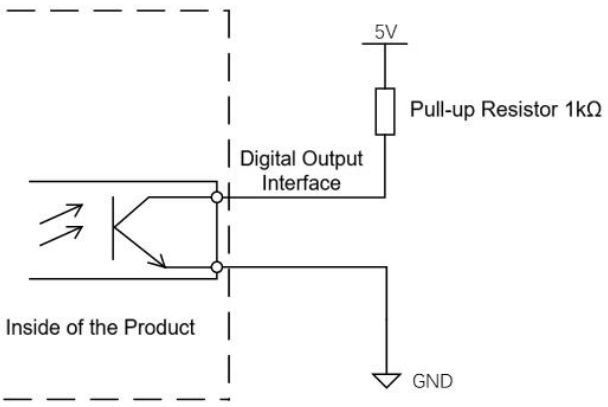


Figure 38 External High-Level Signal Diagram of Anyport Digital Output Interface

7.3 Energy Matrix Interface

The Energy Matrix Interface is a parallel operation function unique to this Product, allowing up to 10 units to be connected in parallel and expanded to a total capacity of 220 kW. In a typical parallel system, current sharing becomes unbalanced after capacity expansion through parallel operation. The maximum system output capability will be less than the product of the single-unit capacity and the number of units in parallel. This issue becomes increasingly evident as the number of parallel units increases. The Energy Matrix Interface of this Product provides current sharing accuracy of less than 0.02%, with virtually no capacity loss.

7.4 USB Interface

The USB Interface is used for remote control and features a Type-B connector, supporting both USB 2.0 and USB 1.1. It includes both USBTMC and USB488 protocols, with a transmission rate of up to 480 Mbps. To ensure communication reliability, the cable length must not exceed 2 meters. Both SCPI and Modbus-RTU protocol command sets are supported. For further details, please refer to the PRE20 Series Bidirectional Programmable AC Power Supply Programming Guide.

Note: The USB and LAN Interfaces can simultaneously receive query commands; however, only one may be selected to receive control commands.

7.5 LAN Interface

The LAN Interface is used for remote control. It adopts a standard RJ45 connector with port number 502. Supports both SCPI and Modbus-TCP protocol command sets. For details, refer to the PRE20 Series Bidirectional Programmable AC Power Supply Programming Guide.

Note: The USB and LAN Interfaces can simultaneously receive query commands; however, only one may be selected to receive control commands.

7.6 Log Storage Interface

The Log Storage Interface allows connection to an external USB storage device for importing or exporting log interface contents. For specific instructions, refer to section8.12.2.

7.7 Output Measurement Interface

The Cortex AC Series Products are designed with standard 4mm banana sockets to accommodate various types of measuring instruments, enabling rapid measurement of the output terminal voltage.

Note: Under no circumstances shall the Output Measurement Interface be used for load operations; it is strictly for output monitoring only.

7.8 Output Connector

The output connector serves as the output terminal of the Cortex AC Series Products. Under all circumstances, when AC input is connected to the product, the operator must disconnect the product's input before connecting or disconnecting the wiring of the output connector.

7.9 Optional interface

The optional interface can extend the functions of the Cortex AC Series Products for use in various industries. Users may refer to the Magic-Box/Magic-Bus manual to select the required expansion components. The optional interface features two card slots, both of which can automatically recognize Magic-Box and Magic-Bus functional components. However, only one Magic-Box and one Magic-Bus can be installed; installation of two Magic-Boxes or two Magic-Buses with different functions cannot be recognized.

7.10 Remote compensation interface

The remote compensation interface of the Cortex AC Series Products provides remote voltage compensation capability and can directly compensate for the voltage drop on the line from the output terminal to the external load. The values displayed on the display screen are calculated from samples taken at the compensation interface. Therefore, the remote compensation cable must always be connected to the output terminal or the user load terminal.

As the AC Output Frequency or Output Power increases, the Load Terminal Voltage may decrease. For more accurate voltage measurement at the load terminal, please use a remote compensation cable. Users may connect the cable as required. For connection instructions, refer to Figure 39.

Connect one end of the compensation cable to the 'sampling terminal' and the other end to the 'user load terminal' according to the corresponding phase sequence. The remote compensation function is enabled automatically.

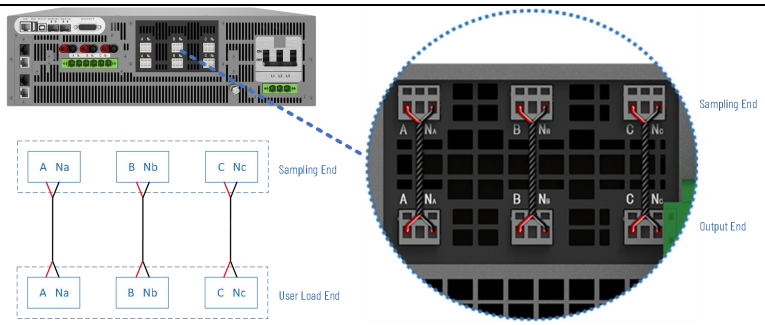


Figure 39 Remote compensation connection diagram

The requirements for user-connected remote compensation cables are as follows:

For compensation cables shorter than 5 m, it is recommended to use a cross-sectional area of 0.5 mm^2.

The compensation cable should be twisted pair.

In parallel mode, the compensation cable only needs to be connected to the master product.

The dielectric strength of the compensation cable must be at least the rated direct current voltage of 636 V.

7.11 Input Connector

The Input Connector is the AC Input terminal of the Cortex AC Series Products. It can be directly connected to the power grid. Ensure that the input circuit breaker is switched to OFF before making the connection.

7.12 PE Connector

The PE Connector is the Grounding terminal for the Cortex AC Series Products. To ensure personal and product safety, the PE Connector must always be connected to earth ground.

7.13 AC Terminal Circuit Breaker

The AC Terminal Circuit Breaker is an essential switch connecting the Cortex AC Series Products to the grid, providing overload and short circuit protection. Set the AC Terminal Circuit Breaker to ON to power on, and to OFF to power off. When the product is not in use, always ensure that the circuit breaker is set to OFF.

8 Display Screen Functions and Operation

All parameter settings and functional applications of the Cortex AC Series Products can be performed via the front panel Display Screen. The Display Screen interface is divided into 16 sections, as shown in Figure 40. Within each functional interface, you can swipe left, right, up, or down to view related content.

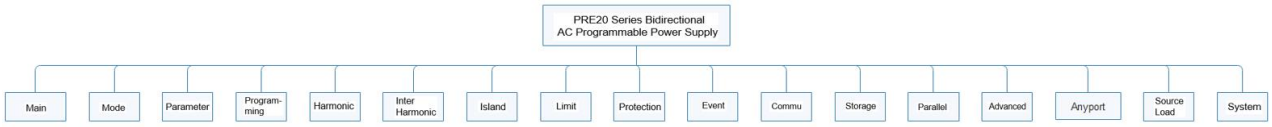


Figure 40 Function Tree Diagram

8.1 Main Interface

The Main Interface is shown in Figure 41, and is divided into the following five areas: Home button, menu button, Status Display Area, Output Display Area, Dropdown Quick Access Area, and Output Setting Area. Different areas offer distinct functions, enabling users to quickly access required information within these interfaces.

Figure 41 Main Interface Diagram

8.1.1 Status Display Area

For the Status Display Area at the top of the Display Screen, see Figure 42, which indicates the operating status and mode of the Cortex AC Series Products. For details, see Table 8.

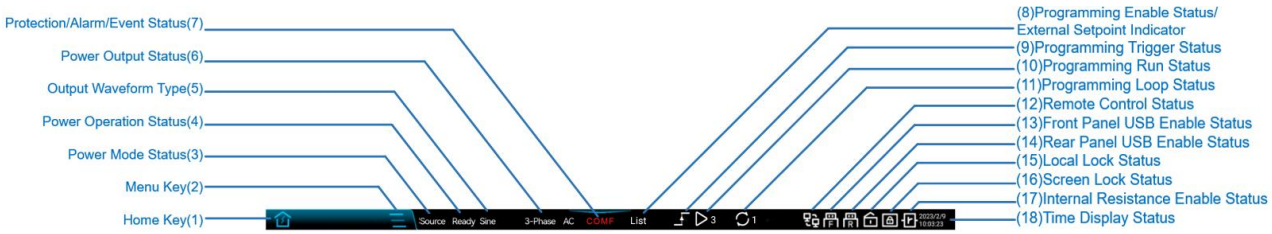


Figure 42 Status Display Area Diagram

Table 8 Status Display Area Function Table

Status Area	Display Content	Definition and Application
(1) Home Key		Click the Home key to return to the Main Interface.
(2) Menu Key		Click the Menu key to display the menu bar on the right side of the interface.
(3) Power Mode Status	Source	When bidirectional power flow is required, set the product to operate in Source Mode. For operating instructions, see Section 8.16.
	Load	When external power absorption is required, set the product to operate in Load Mode. For operating instructions, see Section 8.16.
(4) Power Operation Status	Standby	The Output Terminal of this Product is disconnected. When the Output Terminal is not in use, the Product can be placed in Standby mode. For operating instructions, see section 6.3.
	Operation	The Output Terminal of this Product is connected. When the Output Terminal is required, the Product can be set to Operation mode. For operating instructions, see section 6.3.
	Protection	The Product has entered the protection state. At this time, the Output Terminal is disconnected and a Reset operation is required to return to Standby mode. For operating instructions, see section 6.2.2. To protect the Product and user equipment and ensure operation within a safe Range, protection parameters may be set. See section 8.9.
	Reset	Product Reset can return the system to Standby mode. In the event of protection, alarm, or event, if it is necessary to return to Standby mode, the user may press the Power/Reset Button or use the Anyport external input Reset signal to perform the Reset operation. For operating instructions, see section 8.15.1.
	Emergency Stop	This product performs an emergency stop to disconnect the output. When it is necessary to disconnect the output in an emergency, you may press the Output Button or use the Anyport external input emergency stop signal. For operation details, refer to section 8.15.1.
(5) Output Waveform Type	Sine Wave	The waveform type can be selected under 'Waveform Selection.' For details, refer to Figure 54.
(6) Power Output Status	Three-Phase AC	Displays the current output phase number and coupling mode.
(7) Protection Status	LVP	Load undervoltage protection. In Load Mode, the Output Terminal voltage is lower than the value set in section 0'Protection' interface.
	OVP	Overvoltage protection. Indicates that the Output Voltage exceeds the value set in section 8.9'Protection' interface.
	OCP	Overcurrent protection. Indicates that the Output Current exceeds the value set in section 8.9'Protection' interface.
	OPP	Overpower protection. Indicates that the Output Power exceeds the value set in section 8.9'Protection' interface.
	LFP	Under-frequency protection. Indicates that the Output Frequency is below the specified value in 8.9'Protection' interface.
	OFP	Over-frequency protection. Indicates that the Output Frequency is above the specified value in 8.9'Protection' interface.
	CHAF	Interlock protection. Receives external interlock signals via 'Anyport'; see section 8.15.
	SLAF	Slave unit protection. When operating in parallel mode, if any slave unit enters protection, this will be displayed on the master unit interface.
	INSF	Internal protection. Indicates internal module protection.
	POWF	Power supply protection. Indicates abnormal external power supply.

Status Area	Display Content	Definition and Application
	PARF	Parallel communication protection. Indicates abnormal fiber optic cable connection.
	COMF	Communication timeout protection. Indicates abnormal internal communication within the product.
	OPT	Air outlet over-temperature protection.
	SENF	Telemetry protection. Indicates abnormal feedback cable.
	COCP	Port overcurrent protection.
	FOCP	Preset overcurrent protection.
(7) Alarm Status	EMST	Emergency stop alarm. Receives external emergency stop signals via 'Anyport'. See section 8.15.
	IPAF	IP conflict alarm. Indicates an IP address conflict of the Product.
	SPDL	AC source programming data exceeds Range alarm. Indicates that during programming operation, when the set data exceeds the value specified in section 8.7on 'Limit Value', the unit will operate according to the Limit Value and trigger an alarm.
	LVL	Cut-off voltage alarm. In Load Mode operation, an alarm is triggered if the external input voltage falls below the AC cut-off voltage.
	WAIT	Parallel WAIT alarm. Indicates that the condition for parallel operation is not met.
	PARA	Parallel redundancy alarm. Indicates that the parallel system is operating in a parallel redundancy state.
	TMCE	USBTMC queue empty alarm. The USBTMC query queue is empty.
	CFIL	Peak current over-limit warning in Load Mode.
	IHAL	Interharmonics content over-limit warning.
	LREL	AC Load RLC/PQ calculation setpoint over-limit warning.
	WLUF	Port voltage waiting warning. In Load Mode, waiting for the port voltage to be ready.
	LHOF	Load Harmonic programming frequency over-limit warning.
(7) Event Status	Event X	Displays user events that have been triggered, e.g., Event 1.
(8) Programming Enable Status/External Setpoint Indicator	List	This status is displayed after List Mode has been loaded in the programming interface.
	Wave	This status is displayed after Wave Mode has been loaded in the programming interface.
	Step	This status is displayed after Step Mode has been loaded in the programming interface.
	Pulse	This status is displayed after Pulse Mode has been loaded in the programming interface.
	Advanced	This status is displayed once the Advanced Mode in the programming interface has finished loading.
	Harmonic	This status is displayed once the Harmonic has finished loading.
	Interharmonics	This status is displayed once the Interharmonics has finished loading.
	Island	This status is displayed once Island mode has been enabled.
	Ext.Ref	This status is displayed when any port of the Anyport Digital Input is externally enabled and, simultaneously, any port of the Analog Input is enabled.
(9) Programming Trigger Status		This icon will illuminate when the programming mode is triggered.
(10) Programming Run Status		Displays the sequence number currently being executed in programming.
(11) Programming Loop Status		Displays the current number of loops being executed in programming.
(12) Remote Control Status		This icon will illuminate when remote control is enabled.
(13) Front Panel USB Trigger Status		When the Product detects a USB storage device on the Front Panel, this icon will illuminate.
(14) Rear Panel USB Trigger Status		When the Product detects a USB storage device on the Rear Panel, this icon will illuminate.
(15) Local Lock Status		When Local Lock is enabled, this icon will illuminate.
(16) Screen Lock Status		When Screen Lock is enabled, this icon will illuminate.
(17) Internal Resistance Enable Status		When Internal Resistance is enabled, this icon will illuminate.
(18) Time Status	2022/9/3 13:02:09	Displays the current time (year-month-day-hour-minute-second).

8.1.2 Home/Menu Key

Press the menu key on the Main Interface to display the menu interface on the right side of the Main Interface. See Figure 43 Slide up or down in the menu interface to view all menu items. Press the Home key on any interface to return to the Main Interface.

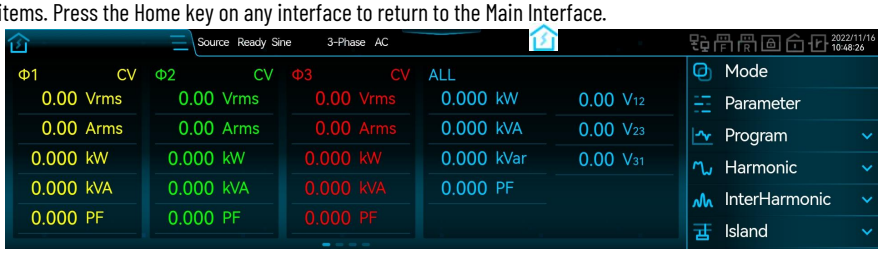


Figure 43 Menu Interface Diagram

Select any menu item in the menu bar. For example, click 'Mode' to enter the Mode Setting Interface. See Figure 44 Click the menu key to close the menu bar on the right side of the screen and display the Output Setting Area. The Mode Setting Interface on the left side of the screen will remain unchanged. See Figure 45 At this time, you can configure relevant parameters for both Mode and Output simultaneously.

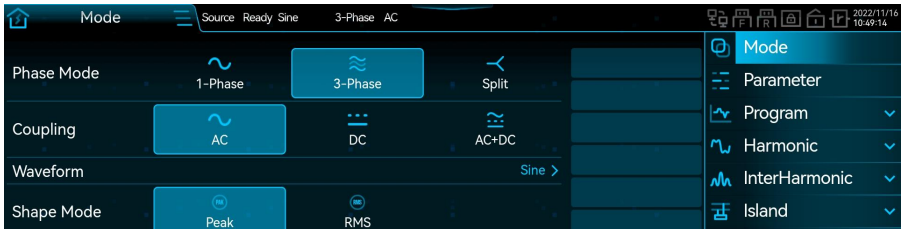


Figure 44 Mode Setting Interface Diagram

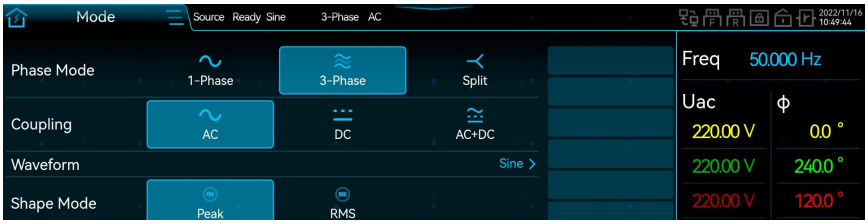


Figure 45 Mode Setting Interface and Output Setting Area Diagram

8.1.3 Output Display Area

The Output Display Area is where the Product's output parameters are presented. It is divided into four pages: Output Basic Parameter Display Page, Output Detailed Parameter Display Page, Voltage/Current Distortion Rate Numerical Display Page, and Voltage/Current Distortion Rate Bar Graph Display Page. Swipe left or right within this area to view the corresponding content.

8.1.3.1 Output Basic Parameter Display Page

See the Output Basic Parameter Display Page Figure 46 See the definitions of each parameter in Table 9.

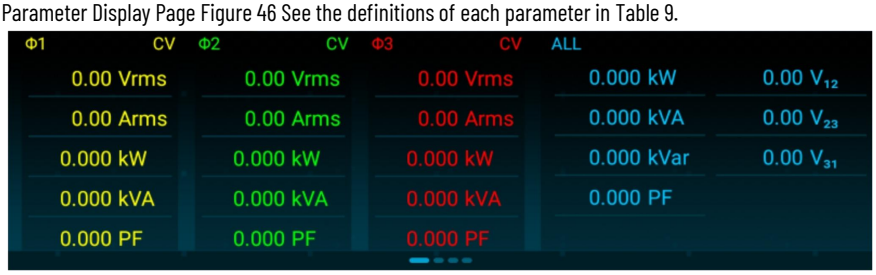


Figure 46 Output Basic Parameter Display Page Diagram

Table 9 Output Basic Parameter Definitions Table

Parameter Item	Definitions
Vrms	Output Voltage RMS Value
Arms	Output Current RMS Value
kW	Active Power
kW	Apparent Power
PF	Power Factor
kvar	Reactive Power
V_{12}、V_{23}、V_{31}	Line Voltage

8.1.3.2 Output Detailed Parameter Display Page

See the Output Detailed Parameter Display Page Figure 47See the definitions of each parameter in Table 10.

Figure 47 Output Detailed Parameter Display Page Diagram

Table 10 Output Detailed Parameter Definitions Table

Parameter Item	Definitions
%Uthd	Total Harmonic Distortion of Voltage, calculated as THD-F.
Vac	AC Voltage
Vdc	Direct Current Voltage
Vpk	Peak Voltage
%Ithd	Total current distortion rate, calculated as THD-F.
Aac	AC Current
Adc	Direct Current
Apk	Peak Current
Arush	Inrush Current
CF	Current Crest Factor
Hz	Output Frequency

8.1.3.3 Voltage/Current Distortion Rate Numerical Display Page

Refer to the voltage/current distortion rate numerical display page atFigure 48. This page displays the odd and even harmonic content in the output voltage/current.

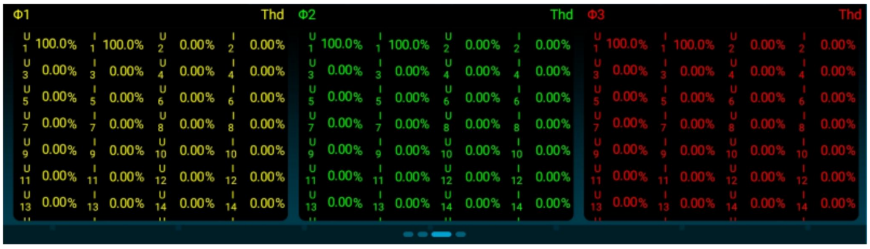


Figure 48 Voltage/Current Distortion Rate Numerical Display Page Diagram

8.1.3.4 Voltage/Current Distortion Rate Bar Graph Display Page

Refer to the voltage/current distortion rate bar graph display page at Figure 49. This page displays a bar graph of the 2nd to 50th harmonic content in the output voltage/current.

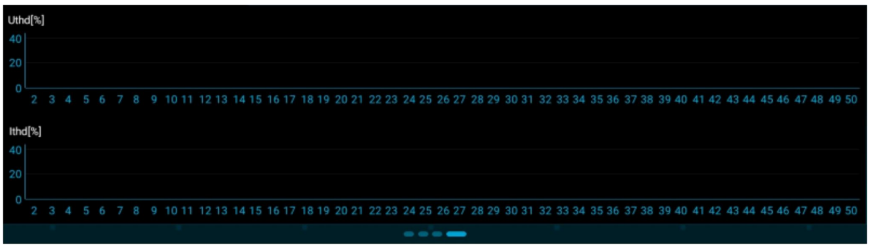


Figure 49 Voltage/Current Distortion Rate Bar Graph Display Page Diagram

8.1.4 Dropdown Quick Access Area

The Dropdown Quick Access Area provides several basic operations to enhance user efficiency. The same functions can also be accessed through the corresponding menu items. At present, the options in the Dropdown Quick Access Area do not support adjustment or modification.

Users may press the central button at the top of the screen "  " to open the Dropdown Quick Access Area, and press the button at the top right "  " to close the Dropdown Quick Access Area. The predefined functions are detailed in Figure 50 and Table 11.

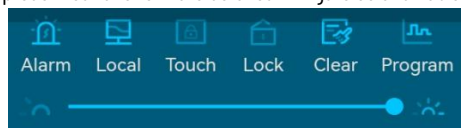


Figure 50 Dropdown Quick Access Area Diagram

Table 11 Dropdown Quick Access Area Function Table

Button	Description and Operation
Alarm Sound	When an audible prompt for protection, alarm, or event signals is required, press this button. The product screen will display the corresponding status and simultaneously emit an alarm sound.
Local Control/LAN/USB	Press this button to quickly switch the communication port.
Screen Lock	When it is necessary to prevent inadvertent operation or to lock the screen, press this button. Press this button again to release the screen lock function.
Local Lock	To prevent remote commands from modifying control authority, click this button. The Product can only assign control authority via the Display Screen.
Clear Event	Clear all occurred events and status.
List	Quickly navigate to the programming interface or the corresponding function interface.

8.1.5 Output Setting Area

The Output Setting Area allows you to set the Output Voltage and Frequency. Click on the value, then enter the desired parameter using the numeric keypad on the right. See Figure 51 and Figure 52, or use the left/right rotary knob for adjustment. For details, refer to Section 6.1.6.

Figure 51 Output Setting Area Figure 1

Figure 52 Output Setting Area Figure 2

8.2 Mode

In the menu bar, click Mode to enter the Mode Settings interface. The Mode Settings interface allows you to select the output phase number, coupling method, output waveform, and waveform percentage for Cortex AC Series Products. During operation, Three-Phase and split-phase settings, as well as the waveform, can be modified. For the settings interface, see Figure 53.

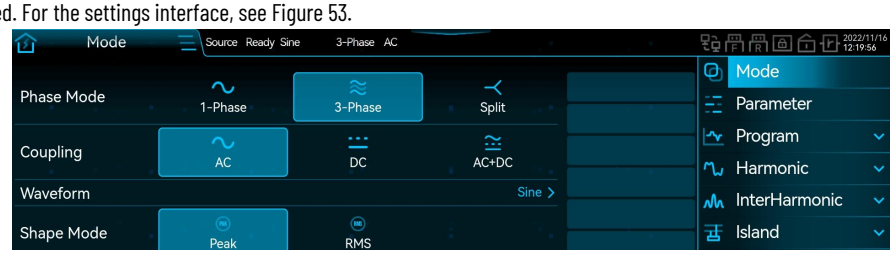


Figure 53 Mode Setting Interface Diagram

Click the arrow to the right of 'Select Waveform' to enter the waveform selection interface. See Figure 54, which not only provides the common sine wave, pulse wave, triangle wave, clipped wave, and pulse wave, but also 30 types of Harmonic, and supports up to 100 user-defined waveforms. Peak or RMS Mode can be selected as required.

The definitions of the percentage parameters for pulse wave, triangle wave, clipped wave, leading half-wave, and trailing half-wave can be found in Table 12.

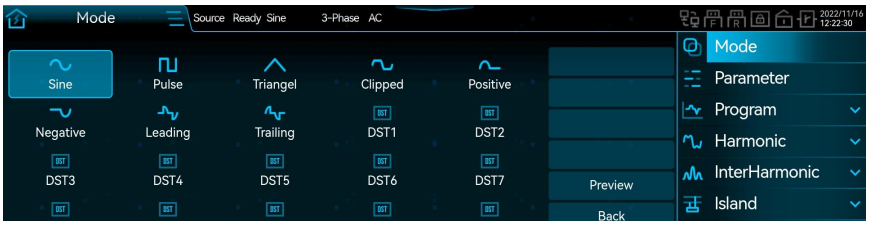


Figure 54 Waveform Selection Interface Diagram

Table 12 Table of Percentage Definitions for Different Waveforms

Waveform Name	Unit	Percentage Definition	Model	Resolution	Initial Value	Setting Range
Pulse Wave	/	Duty Cycle D	ALL	0.01	50	0~100
Triangle Wave	/	Symmetry S	ALL	0.01	50	0~100
Clipping	/	Percentage C	ALL	0.01	0	0~50
Leading Half-Wave	/	Conduction Angle Percentage L	ALL	0.01	0	0~100
Trailing Half-Wave	/	Turn-off Angle Percentage T	ALL	0.01	50	0~100

8.3 Parameter

Click on 'Parameter' in the menu bar to enter the parameter setting interface. The parameter setting interface includes the configuration of product output parameters and functional settings.

Product output parameter settings include AC/DC output voltage, phase, and frequency. Functional configuration includes AC limit value, DC limit value, and internal resistance. Slope, response speed, slew rate, angle, inrush current, and external synchronization delay can also be set.

Figure 55 Parameter Setting Interface Diagram

See the AC Limit Value Enable Interface Figure 56.

Figure 56 AC Limit Value Enable Interface Diagram

See the DC Limit Value Enable Interface Figure 57.

Figure 57 DC Limit Value Enable Interface Diagram

See the Internal Resistance Enable Interface Figure 58.

Figure 58 Internal Resistance Enable Interface Diagram

See the Transient Angle Enable Interface Figure 59.

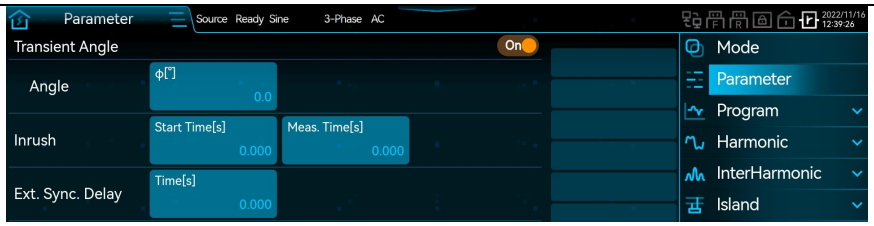


Figure 59 Transient Angle Enable Interface Diagram

For detailed functions of each parameter, see Table 13.

Table 13 Parameter Detailed Function Table

Parameter Item	Unit	Definition and Application	Model	Resolution	Initial Value	Setting Range
AC Voltage	V	AC voltage setting for product output.	ALL	0.01	220	0~450
Direct Current Voltage	V	Direct Current voltage setting for product output.	ALL	0.01	0	-636~636
Phase	°	Phase angle setting for three-phase AC voltage output of the product.	ALL	0.1	0	0~359.9
Frequency	Hz	Frequency setting for AC voltage output of the product.	ALL	0.001	50	0.001~200
AC Limit Value Enable Switch	\	This enable button is only effective when the coupling mode is set to AC. After being enabled, the maximum AC output current and maximum apparent power of the Product are limited to the set values.	ALL	\	\	\
Current	A	When the output phase configuration is Three-Phase or Split-Phase, this represents the maximum AC output current per phase. When the output phase configuration is Single Phase, this represents the total maximum AC output current.	CA06-450	0.01	Three-Phase/Split-Phase: 30 Single Phase: 90	Three-Phase/Split-Phase: 0-30 Single Phase: 0-90
			CA7.5-450			
			CA09-450		Three-Phase/Split-Phase: 35 Single Phase: 105	Three-Phase/Split-Phase: 0-35 Single Phase: 0-105
			CA12-450			
			CA15-450			
			CA20-450			
			CA22-450			
Apparent Power	kVA	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 total maximum apparent power.	CA06-450	0.001	Three-Phase/Split-Phase: 2 Single Phase: 6	Three-Phase/Split-Phase: 0-2 Single Phase: 0-6
			CA7.5-450		Three/Phase: 2.5 Single Phase: 7.5	Three/Phase: 0-2.5 Single Phase: 0-7.5
			CA09-450		Three/Phase: 3 Single Phase: 9	Three/Phase: 0-3 Single Phase: 0-9
			CA12-450		Three/Phase: 4 Single Phase: 12	Three/Phase: 0-4 Single Phase: 0-12
			CA15-450		Three/Phase: 5 Single Phase: 15	Three/Phase: 0-5 Single Phase: 0-15
			CA20-450		Three/Phase: 6.667 Single Phase: 20	Three-/Split-Phase: 0~6.667 Single Phase: 0~20
			CA22-450		Three-/Split-Phase: 7.333 Single Phase: 22	Three-/Split-Phase: 0~7.333 Single Phase: 0~22
Direct Current Limit Value Enable Switch	\	This enable button is only effective when the coupling mode is set to Direct Current. When enabled, the maximum positive and negative direct current output and the maximum positive and negative active power output of the Product are limited to the set values.	ALL	\	\	\
Positive Current	A	When the number of output phases is three-phase or split-phase, this indicates the maximum positive direct current output for each phase. When the output phase is single phase, this indicates the total maximum positive direct current output.	CA06-450	0.01	Three-Phase/Split-Phase: 30 Single Phase: 90	Three-Phase/Split-Phase: 0-30 Single Phase: 0-90
			CA7.5-450			
			CA09-450		Three-Phase/Split-Phase: 35 Single Phase: 105	Three-Phase/Split-Phase: 0-35 Single Phase: 0-105
			CA12-450			
			CA15-450			
			CA20-450			
			CA22-450			
Negative Current	A	When the number of output phases is three-phase or split-phase, this indicates the minimum negative direct current output for each phase. When the output phase is single phase, this indicates the total minimum negative direct current output.	CA06-450	0.01	Three-Phase/Split-Phase: -30 Single Phase: -90	Three-Phase/Split-Phase: -30 to 0 Single Phase: -90 to 0
			CA7.5-450			
			CA09-450		Three-Phase/Split-Phase: -35 Single Phase: -105	Three-Phase/Split-Phase: -35 to 0 Single Phase: -105 to 0
			CA12-450			
			CA15-450			
			CA20-450			
			CA22-450			
Forward Active Power	kW	When the number of output phases is three-phase or split-phase, this indicates the maximum forward active power per phase. For single-phase output, this indicates the maximum total forward active power.	CA06-450	0.01	Three-Phase/Split-Phase: 2 Single Phase: 6	Three-Phase/Split-Phase: 0-2 Single Phase: 0-6
			CA7.5-450		Three/Phase: 2.5 Single Phase: 7.5	Three/Phase: 0-2.5 Single Phase: 0-7.5
			CA09-450		Three/Phase: 3 Single Phase: 9	Three/Phase: 0-3 Single Phase: 0-9
			CA12-450		Three/Phase: 4 Single Phase: 12	Three/Phase: 0-4 Single Phase: 0-12
			CA15-450		Three/Phase: 5 Single Phase: 15	Three/Phase: 0-5 Single Phase: 0-15

Parameter Item	Unit	Definition and Application	Model	Resolution	Initial Value	Setting Range
			CA20-450		Three/Phase: 6.667 Single Phase: 20	Three-/Split-Phase: 0~6.667 Single Phase: 0~20
			CA22-450		Three-/Split-Phase: 7.333 Single Phase: 22	Three-/Split-Phase: 0~7.333 Single Phase: 0~22
Reverse Active Power	kW	When the number of output phases is three-phase or split-phase, this indicates the minimum reverse active power per phase. For single-phase output, this indicates the minimum total reverse active power.	CA06-450	0.01	Three-Phase/Split-Phase: -2 Single Phase: -6	Three-Phase/Split-Phase: -2 to 0 Single Phase: -6 to 0
			CA7.5-450		Three/Split Phase: -2.5 Single Phase: -7.5	Three/Split Phase: -2.5 to 0 Single Phase: -7.5 to 0
			CA09-450		Three/Split Phase: -3 Single Phase: -9	Three/Split Phase: -3 to 0 Single Phase: -9 to 0
			CA12-450		Three/Split Phase: -4 Single Phase: -12	Three/Split Phase: -4 to 0 Single Phase: -12 to 0
			CA15-450		Three/Split Phase: -5 Single Phase: -15	Three/Split Phase: -5 to 0 Single Phase: -15 to 0
			CA20-450		Three/Split Phase: -6.667 Single Phase: -20	Three/Phase: -6.667~0 Single Phase: -20~0
			CA22-450		Three/Phase: -7.333 Single Phase: -22	Three/Phase: -7.333~0 Single Phase: -22~0
Internal Resistance Enable Switch	\	Once enabled, a specified impedance will be added to the Product Output Terminal, causing a reduction in Output Voltage.	ALL	\	\	\
R	Ω	Built-in resistor.	ALL	0.001	0	0~10
L	mH	Built-in inductive reactance. Inductive reactance is calculated as X = 2πfL.	ALL	0.001	0	0~2
Voltage Slope	V/ms	Describes the steady-state parameter of the Output Voltage, that is, the ratio of the incremental effective value of the Output Voltage to time.	ALL	0.01	500	0.01~3000
Frequency Slope	Hz/ms	Describes the steady-state parameter of the Output Frequency, that is, the ratio of the increment in Output Frequency to time.	ALL	0.0001	2000	0.0001~2000
Response Speed	\	System response bandwidth; users can select different response speeds to match the device under test.	ALL	\	Medium Speed	\
Voltage Slew Rate	V/μs	A parameter describing the output voltage transient; a larger value results in a shorter response time to the set voltage.	ALL	1	1	0.02~10
Shutdown Slew Rate	V/μs	After disconnecting the output, the instantaneous voltage drop per μs at the output terminal can be controlled by setting the shutdown slew rate.	ALL	0.001	2	0.002~10
Power On Angle	°	The output begins at the specified angle.	ALL	0.1	0	0~359.9
Shutdown Angle	°	The output ends at the specified angle.	ALL	0.1	0	0~359.9
Transient Angle Enable Switch	/	When enabled, any changes in voltage or frequency will cause the output to synchronize according to the set transient angle.	ALL	\	\	\
Angle	°	Transient angle.	ALL	0.1	0	0~359.9
Inrush Current Start Time	s	The time from product output to the start of inrush current measurement.	ALL	0.001	0	0~999.999
Inrush Current Measurement Time	s	Inrush current measurement time.	ALL	0.001	0	0~999.999
External synchronization delay time.	s	Delay time for external synchronization phase input. Supports multi-unit, multi-phase synchronized output.	ALL	0.001	0	0~999.999

Note: 1. The setting ranges listed in the table are for single-unit parameters. For parallel operation, the current and power settings should be multiplied by the number of units in parallel.

2. The parameter items R and L are connected in series.

8.4 Programming

The Cortex AC Series Products are designed with five programming modes. Required waveforms can be edited by flexibly configuring parameters. For programming functions, refer to Figure 60. All programming modes must be used while the product is outputting.

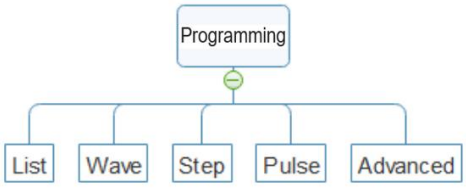


Figure 60 Programming Function Tree Diagram

8.4.1 List

The List includes both editing and configuration, see Figure 61.

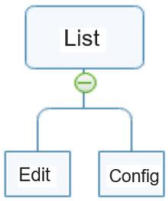


Figure 61 List Function Tree Diagram

Click Programming - List - Edit in the menu bar to enter the List programming interface. List programming parameters can be set as needed, see Figure 62 See the definitions of each parameter in Table 14.

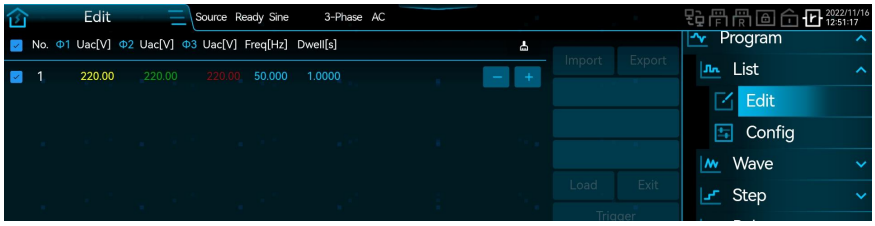


Figure 62 List Programming Interface Diagram

Table 14 List Programming Interface Parameter Definition Table

Parameter Item	Unit	Definitions	Model	Resolution	Setting Range
No.	/	Sequence number.	ALL	/	1~300
Uac[V]	V	RMS value of each phase AC voltage.	ALL	0.01	0~450
Freq[Hz]	Hz	Frequency of the Output Voltage.	ALL	0.001	0.001~200
Dwell[s]	s	Dwell time of the current sequence.	ALL	0.0001	0~999.9999
	/	Clear all current programming data and return to Figure 62the initial programming state.	ALL	/	/
"+"	/	Insert a new sequence after the current sequence, with parameter values identical to the current sequence.	ALL	/	/
"-"	/	Delete the current sequence.	ALL	/	/
Export	/	Export the current programming data as a file and store it.	ALL	/	/
Import	/	Import the stored data file into the programming interface.	ALL	/	/
Load	/	Lock the programming data and enter the trigger-ready state.	ALL	/	/
Exit	/	At any time during operation in programming Mode, click 'Exit' to terminate the current programming Mode.	ALL	/	/
Trigger	/	Switch from steady output state to programmed waveform output state.	ALL	/	/

Note: The expected output waveform is still subject to the Limit Value parameters. Inappropriate Limit Value settings may result in distortion of the expected output waveform.

List programming example:

1) Press the Front Panel Output Button to enable the Product to output steady-state voltage.
2) For list programming data, see Table 15.

Table 15 List Programming Data Example Table

Sequence Number / Parameter Item	No.1	No.2	No.3
Uac[V]	100	250	50
Freq[Hz]	50	50	50
Dwell[s]	0.1	0.1	0.1

For the list programming example diagram, see Figure 63.

Figure 63 List Programming Example Diagram 1

3) Click 'Load' in the lower right corner. At this point, both 'Exit' and 'Trigger' are highlighted; see Figure 64.

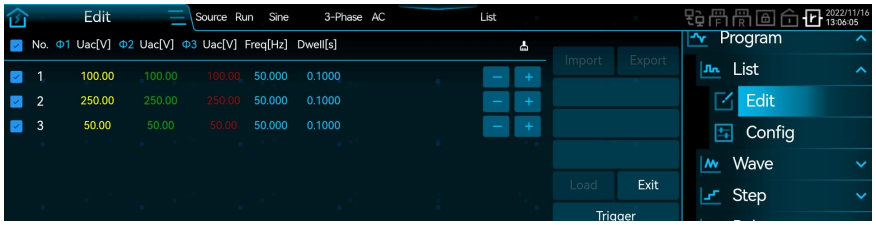


Figure 64 List Programming Example Diagram 2

Note: Programming data cannot be modified after loading. To modify, click 'Exit'.

4) Click 'Trigger' to display the programmed waveform on the oscilloscope (only the Φ1 waveform is shown here); see Figure 65.

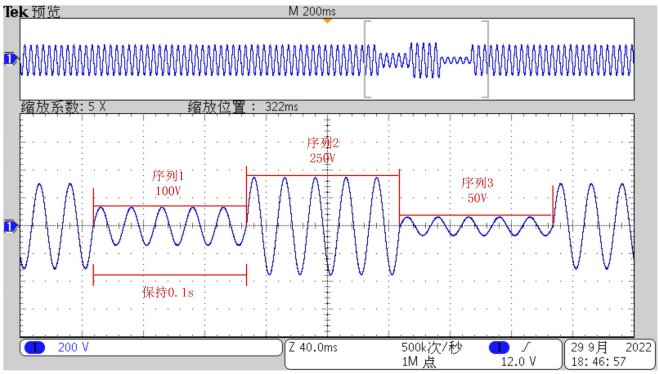


Figure 65 List Programming Waveform Example Diagram 1

Note: At any point during the operation of the programming mode, you may click "Exit" to end the current programming mode.

Click Programming - List - Configuration in the menu bar to enter the List Mode configuration interface, see Figure 66.

Figure 66 List Configuration Interface Diagram

In the configuration interface, you can modify the cycle count of the programmed waveform. For example, if the cycle count of the List programmed waveform is set to 2, the programmed waveform appears as shown in Figure 67.

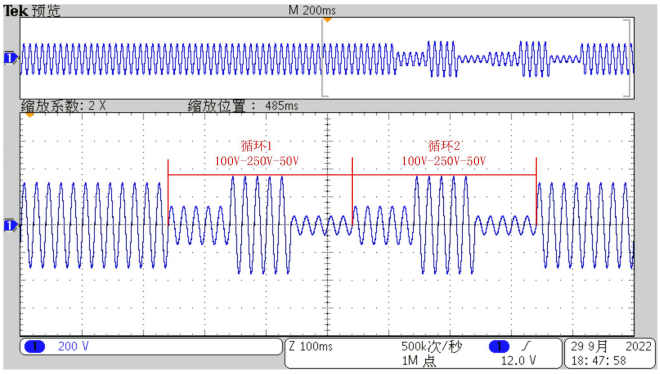


Figure 67 List Programming Waveform Example Diagram 2

For parameter definitions in the configuration interface, refer to Table 16.

Table 16 List Configuration Interface Parameter Definitions Table

Parameter Item	Unit	Definition and Application	Model	Resolution	Setting Range
Cycle Count	/	Sets the number of output cycles for the List programmed waveform. A cycle count of 0 indicates infinite looping.	ALL	/	0~9999999
End State	/	Steady State: After programming ends, the output waveform returns to steady state. Hold: After programming is complete, the output waveform remains at the final programmed sequence. Standby: After programming is complete, the output is disconnected, and the Output Button turns green.	ALL	/	/
Continuous Trigger	/	Once enabled, the same programming data can be triggered again by clicking 'Trigger' directly; it is not necessary to click 'Load'.	ALL	/	/
Trigger Mode	/	Automatic: Executes sequentially according to the programming order. Single: Each trigger executes only one sequence.	ALL	/	/
Trigger Input	/	Internal: Manually click 'Trigger' on the Display Screen or send a trigger command via the communication interface for internal triggering. External: Send a trigger signal via the Anyport Digital Input interface for external triggering. For details, see section8.15.1.	ALL	/	/
Trigger Delay	s	After pressing 'Trigger', the programmed sequence will begin execution following the configured trigger delay.	ALL	/	0~999.999
Trigger Output	/	After configuring the trigger function in the Anyport Digital Output interface, the Product will output a pulse indication signal at the Anyport Digital Output Terminal when outputting programmed waveforms. This operation requires the trigger function to be enabled in the Anyport Digital Output configuration interface. For details, refer to Section8.15.1. For a schematic diagram of the pulse output waveform, refer to Figure 68。 Single: The pulse indication signal is output only when program execution begins. Step: A pulse indication signal is output during the execution of each sequence. Loop: A pulse indication signal is output at the beginning of each loop.	ALL	/	/
RMS Mode	/	Auto: When the programmed waveforms of all sequences in the programming data are sine waves, clipped waves, built-in Harmonic, and custom waveforms—provided that the custom waveform Mode is set to RMS—RMS Mode is enabled automatically. The Output Voltage value is closed-loop regulated and automatically adjusted to match the set value. Otherwise, RMS Mode is disabled automatically and the Output Voltage value is open-loop. Enable: Forced closed-loop control. Disable: Forced open-loop control.	ALL	/	/

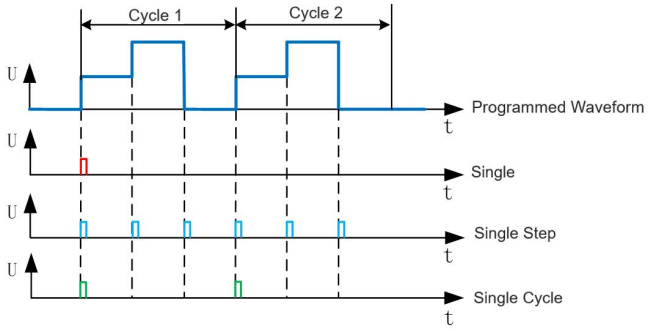


Figure 68 Trigger Output Schematic Diagram

Configured List programming waveform data can be stored in the internal memory of the Product or on an external USB storage device for convenient direct recall, thereby reducing repeated configuration by the user. For details, refer to section 8.12.5.

The specific procedure for saving List programming waveform data to internal storage is as follows:

1) Click Figure 63 the 'Export' button at the upper right corner in Figure 69 to enter the interface.

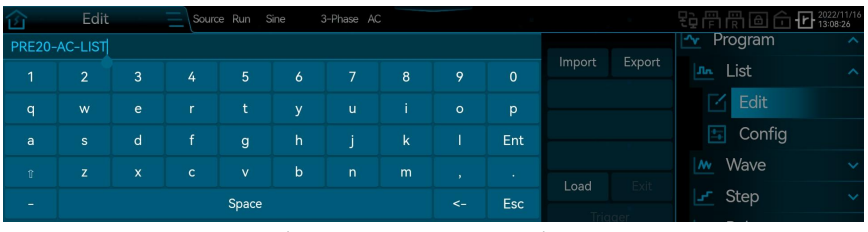


Figure 69 Waveform Export Interface Diagram

2) Enter the file name using the keypad and click 'Enter' to complete the save.

3) Return to the List programming interface, click 'Import', and in Figure 70 select the previously saved file (with the .list extension), click 'Confirm', and the saved waveform data will be imported into the List programming interface.

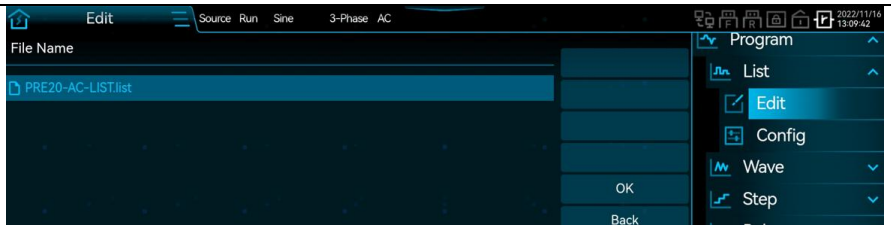


Figure 70 Waveform File Selection Interface

8.4.2 Wave

Wave includes both editing and configuration components; see Figure 71.

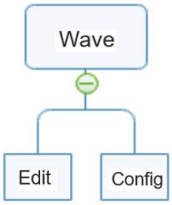


Figure 71 Wave Function Tree Diagram

Click Programming - Wave - Edit in the menu bar to enter the Wave Programming Interface. You can configure the Wave programming parameters independently; see Figure 72 See the definitions of each parameter in Table 17.

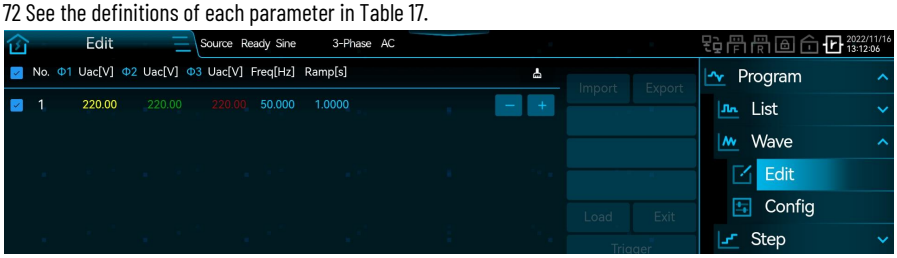


Figure 72 Wave Programming Interface Diagram

Table 17 Parameter Definitions Table for Wave Programming Interface

Parameter Item	Unit	Definitions	Model	Resolution	Setting Range
No.	/	Sequence number.	ALL	/	1~300
Uac[V]	V	RMS value of each phase AC voltage.	ALL	0.01	0~450
Freq[Hz]	Hz	Frequency of the Output Voltage.	ALL	0.001	0.001~200
Ramp[s]	s	Time required for the voltage transition between adjacent sequences.	ALL	0.0001	0~999.9999
	/	Clear all current programming data and return to Figure 72the initial programming state.	ALL	/	/
"+"	/	Insert a new sequence after the current sequence, with parameter values identical to the current sequence.	ALL	/	/
"-"	/	Delete the current sequence.	ALL	/	/
Export	/	Export the current programming data as a file and store it.	ALL	/	/
Import	/	Import the stored data file into the programming interface.	ALL	/	/
Load	/	Lock the programming data and enter the trigger-ready state.	ALL	/	/
Exit	/	At any time during operation in programming Mode, click 'Exit' to terminate the current programming Mode.	ALL	/	/
Trigger	/	Switch from steady output state to programmed waveform output state.	ALL	/	/

Note: The expected output waveform is still subject to the Limit Value parameters. Inappropriate Limit Value settings may result in distortion of the expected output waveform.

Wave Programming Example:

1) Press the Front Panel Output Button to enable the Product to output steady-state voltage.
2) For Wave programming data, refer toTable 18。

Table 18 Example Table of Wave Programming Data

Sequence Number / Parameter Item	No.1	No.2	No.3
Uac[V]	100	250	50
Freq[Hz]	50	50	50
Ramp[s]	0.1	0.1	0.1

For the Wave Programming Example Diagram, refer to Figure 73.

Figure 73 Wave Programming Example Diagram 1

3) Click 'Load' in the lower right corner. At this point, both 'Exit' and 'Trigger' are highlighted; see Figure 74.

Figure 74 Wave Programming Example Diagram 2

Note: Programming data cannot be modified after loading. To modify, click 'Exit'.

4) Click 'Trigger' to display the programmed waveform on the oscilloscope (only the Φ1 waveform is shown here); see Figure 75.

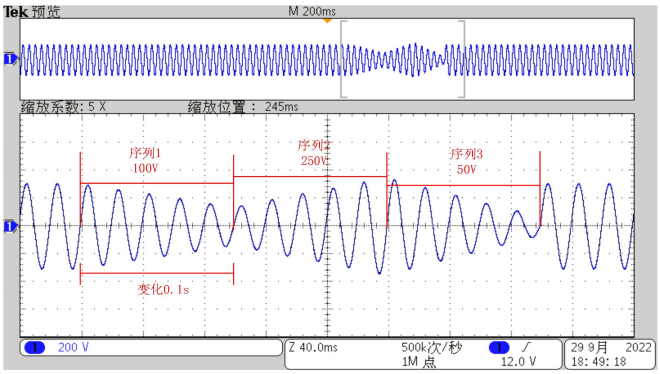


Figure 75 Wave Programming Waveform Example Diagram 1

Note: At any point during the operation of the programming mode, you may click "Exit" to end the current programming mode.

Click Programming - Wave - Configure in the menu bar to enter the Wave Mode Configuration Interface. The parameters and functions of the Wave Configuration Interface are consistent with those of the List Mode Configuration Interface; see Figure 66. If the number of cycles for the Wave programmed waveform is set to 2 in the configuration interface, the programmed waveform is shown in Figure 76.

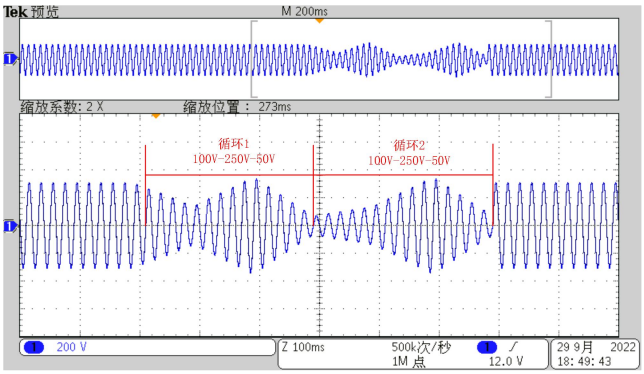


Figure 76 Wave Programming Waveform Example Diagram 2

The configured Wave programming waveform data can be stored either in the internal memory of the product or on an external USB storage device. This facilitates direct retrieval for subsequent use and reduces repetitive configuration by the user. For details, refer to section 8.12.5.

The specific method for storing Wave programming waveform data to the internal memory of the product can be referenced in the storage method for List programming.

8.4.3 Step

Step includes two parts: editing and configuration. See Figure 77.

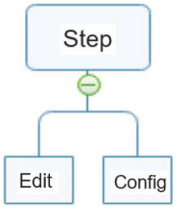


Figure 77 Step Function Tree Diagram

In the menu bar, click Programming - Step - Edit to enter the Step programming interface, where Step programming parameters can be set as needed. See Figure 78 See the definitions of each parameter in Table 19.

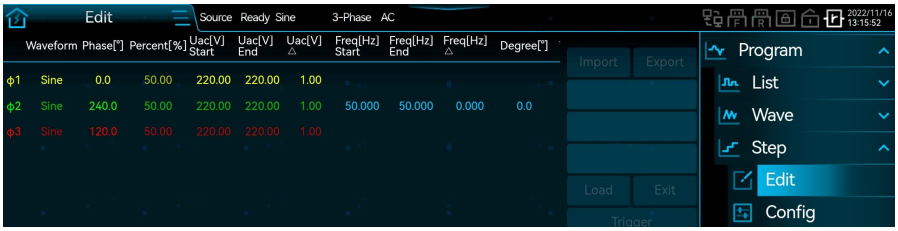


Figure 78 Step Programming Interface Diagram

Table 19 Step Programming Interface Parameter Definition Table

Parameter Item	Unit	Definitions	Model	Resolution	Setting Range
Waveform	/	Waveform.	ALL	/	/
Phase[°]	°	Phase.	ALL	0.1	0~359.9
Percent[%]	/	Waveform Percentage.	ALL	0.01	0~100
Uac[V]Start	V	Starting RMS Voltage.	ALL	0.01	0~450
Uac[V]End	V	End voltage RMS value.	ALL	0.01	0~450
Uac[V]Δ	V	Voltage deviation.	ALL	0.01	0~450
Freq[Hz]Start	Hz	Initial voltage frequency.	ALL	0.001	0.001~200
Freq[Hz]End	Hz	End voltage frequency.	ALL	0.001	0.001~200
Freq[Hz]Δ	Hz	Frequency deviation.	ALL	0.001	0.001~200
Degree[°]	°	Trigger angle.	ALL	0.1	0~359.9
Time[s]	s	Hold time for each step.	ALL	0.0001	0~999.9999
Export	/	Export the current programming data as a file and store it.	ALL	/	/
Import	/	Import the stored data file into the programming interface.	ALL	/	/
Load	/	Lock the programming data and enter the trigger-ready state.	ALL	/	/
Exit	/	At any time during operation in programming Mode, click 'Exit' to terminate the current programming Mode.	ALL	/	/
Trigger	/	Transition from a stable output state to a programmed waveform output state.	ALL	/	/

Note: The expected output waveform is still subject to the Limit Value parameters. Inappropriate Limit Value settings may result in distortion of the expected output waveform.

Step programming example:

1) Press the Front Panel Output Button to enable the Product to output steady-state voltage.
2) For step programming data, refer to Table 20.

Table 20 Step programming data example table

Parameter Item	Set value	Parameter Item	Set value
Uac[V]Start	100	Freq[Hz]End	50
Uac[V]End	300	Freq[Hz]Δ	0
Uac[V]Δ	100	Degree[°]	0
Freq[Hz]Start	50	Time[s]	0.1

For the step programming example diagram, refer to Figure 79.

Figure 79 Step programming example diagram 1

3) Click 'Load' in the lower right corner. At this point, both 'Exit' and 'Trigger' are highlighted; see Figure 80.

Figure 80 Step programming example diagram 2

Note: Programming data cannot be modified after loading. To modify, click 'Exit'.

4) Click 'Trigger' to display the programmed waveform on the oscilloscope (only the Φ1 waveform is shown here); see Figure 81.

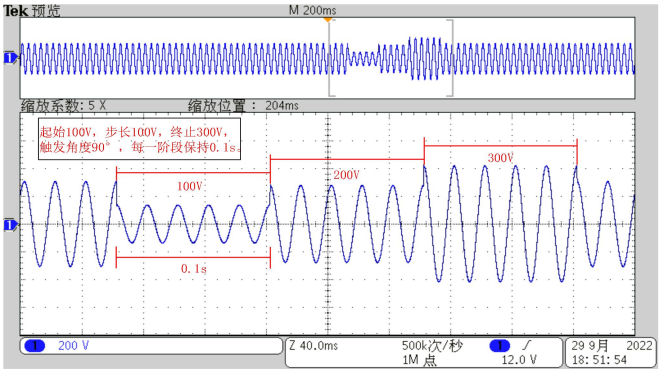


Figure 81 Step programming waveform example diagram 1

Keeping other parameters unchanged, set the trigger angle (Degree) to 90°. Click 'Load', then click 'Trigger'. The oscilloscope will display a waveform with a trigger angle of 90° (only the Φ1 waveform is shown here); refer to Figure 82.

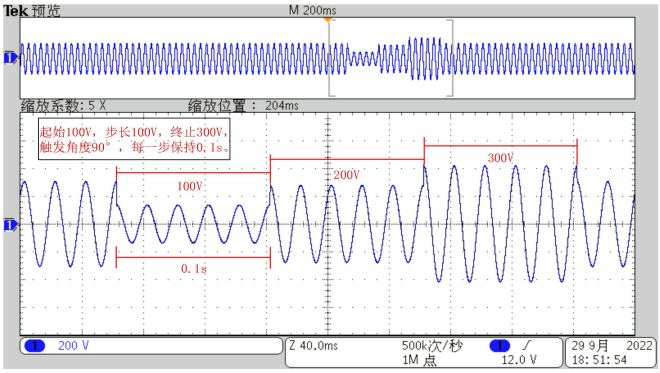


Figure 82 Step programming waveform example diagram 2

Note: At any point during the operation of the programming mode, you may click "Exit" to end the current programming mode.

Click Programming - Step - Configuration in the menu bar to access the Step Mode configuration interface. The parameters and functions in the Step configuration interface are identical to those in the List Mode configuration interface. See Figure 66. Set the loop count of the Step programming waveform to 2 in the configuration interface; the programmed waveform is shown in Figure 83.

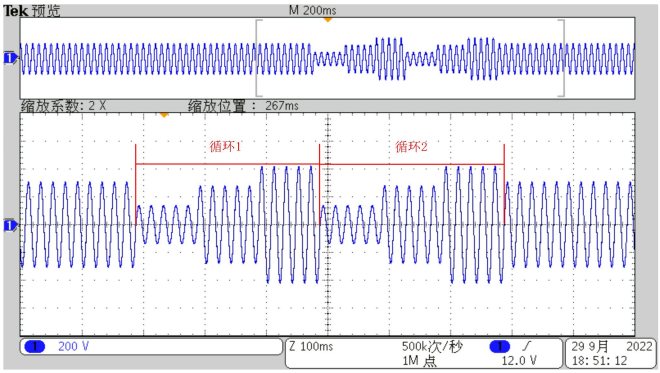


Figure 83 Step Programming Waveform Example Diagram 3

The configured Step programming waveform data can be stored either within the product or on an external USB storage device for direct retrieval in subsequent operations, thereby reducing redundant configuration by the user. For details, see section 8.12.5.

For specific instructions on storing Step programming waveform data within the product, refer to the List programming storage method.

8.4.4 Pulse

Pulse comprises two parts: editing and configuration. See Figure 84.

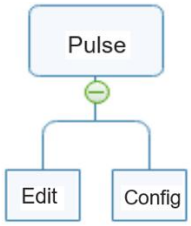


Figure 84 Pulse Function Tree Diagram

Click Programming - Pulse - Edit in the menu bar to enter the Pulse programming interface, where you can set the Pulse programming parameters as required. See Figure 85 See the definitions of each parameter in Table 21.

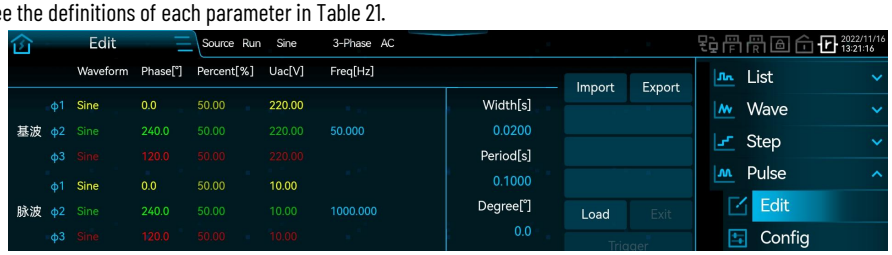


Figure 85 Pulse Programming Interface Diagram

Table 21 Pulse Programming Interface Parameter Description Table

Parameter Item	Unit	Definitions	Model	Resolution	Setting Range
Fundamental Wave	/	A steady-state waveform programmed by the user.	ALL	/	/
Pulse	/	Replaces a segment of the fundamental wave.	ALL	/	/
Waveform	/	Waveform.	ALL	/	/
Phase[°]	°	Phase.	ALL	0.1	0~359.9
Percent[%]	/	Waveform Percentage.	ALL	0.01	0~100
Uac[V]	V	RMS value of each phase AC voltage.	ALL	/	0~450
Freq[Hz]	Hz	Frequency of the Output Voltage.	ALL	0.001	Fundamental Wave: 0.001-200 Pulse: 0.001-2000
Width[s]	s	Pulse width.	ALL	0.0001	0~999.9999
Period[s]	s	Repeat period execution.	ALL	0.0001	0~999.9999
Degree[°]	°	Trigger angle.	ALL	0.1	0~359.9
Export	/	Export the current programming data as a file and store it.	ALL	/	/
Import	/	Import the stored data file into the programming interface.	ALL	/	/
Load	/	Lock the programming data and enter the trigger-ready state.	ALL	/	/
Exit	/	At any time during operation in programming Mode, click 'Exit' to terminate the current programming Mode.	ALL	/	/
Trigger	/	Switch from steady output state to programmed waveform output state.	ALL	/	/

Note: The expected output waveform is still subject to the Limit Value parameters. Inappropriate Limit Value settings may result in distortion of the expected output waveform.

Pulse Programming Example:

1) Press the Front Panel Output Button to enable the Product to output steady-state voltage.
2) For Pulse programming data, see Table 22.

Table 22 Pulse Programming Data Example Table

Category / Parameter Item	Fundamental Wave	Pulse	Other
Uac[V]	220	20	/
Freq[Hz]	50	1000	/
Width[s]	/	/	0.002
Period[s]	/	/	0.04
Degree[°]	/	/	0

Set the number of cycles to 3 in the Pulse-Configuration interface. For the Pulse programming example diagram, see Figure 86.

Figure 86 Pulse Programming Example Diagram 1

4) Click 'Load' in the lower right corner. At this point, both 'Exit' and 'Trigger' are highlighted; see Figure 87.

Figure 87 Pulse Programming Example Diagram 2

Note: Programming data cannot be modified after loading. To modify, click 'Exit'.

5) Click 'Trigger' to display the programmed waveform on the oscilloscope (only the Φ1 waveform is shown here); see Figure 88.

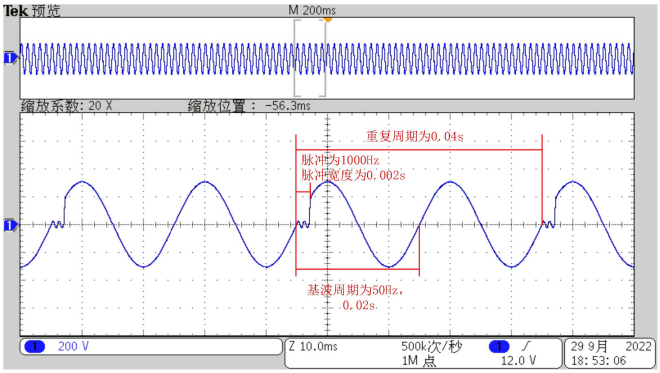


Figure 88 Pulse Programming Waveform Example Diagram

Note: At any point during the operation of the programming mode, you may click "Exit" to end the current programming mode.

Click Programming-Pulse-Configuration in the menu bar to enter the Pulse Mode Configuration interface. The parameters and functions of the Pulse configuration interface are consistent with those of the List Mode configuration interface; see Figure 66.

The configured Pulse programming waveform data can be stored internally within the product or externally on a USB storage device, enabling convenient future recall and reducing the need for repeated configuration. For details, see 8.12.5.

For specific instructions on storing Pulse programming waveform data internally, refer to the storage method for List programming.

8.4.5 Advanced

Advanced includes both Editing and Configuration sections; see Figure 89.

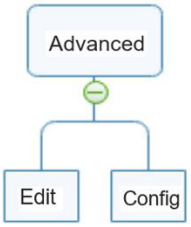


Figure 89 Advanced Function Tree Diagram

Click Programming-Advanced-Edit in the menu bar to enter the Advanced programming interface, allowing independent configuration of Advanced programming parameters. Swipe left or right within the interface to view the complete set of programming parameters; see Figure 90、 Figure 91 See the definitions of each parameter in Table 23.

Figure 90 Advanced Programming Interface Diagram 1

Figure 91 Advanced Programming Interface Diagram 2

Table 23 Parameter Definitions Table for Advanced Programming Interface Diagram

Parameter Item	Unit	Definitions	Model	Resolution	Setting Range
No.	/	Sequence number.	ALL	/	1~300
Waveform	/	Waveform.	ALL	/	/
Phase[°]	°	Phase.	ALL	0.1	0~359.9
Percent[%]	/	Waveform Percentage.	ALL	0.01	0~100
Uac[V]	V	RMS value of each phase AC voltage.	ALL	0.01	0~450
Freq[Hz]	Hz	Frequency of the Output Voltage.	ALL	0.001	0.001~200
Ramp[s]	s	Transition time between adjacent sequences.	ALL	0.0001	0~999.9999
Dwell[s]	s	Dwell time of the current sequence.	ALL	0.0001	0~999.9999
Link	/	After the current sequence is completed, the system jumps to the specified sequence according to the rule: 'Current Sequence Number - Link Value = Target Sequence Number.' For example, if the Link value for Sequence 3 is set to 2 (Count must be set to a value ≥ 1; otherwise, the Link function is invalid), after Sequence 3 is completed, the system jumps to Sequence 1.	ALL	/	0~300
Count	/	Used in conjunction with Link, this indicates the number of cycles for jumping from the current sequence to the specified sequence. For example, if the Link value for Sequence 3 is set to 1 and Count is set to 2, after completing Sequence 3, the system jumps to Sequence 2, then executes Sequence 3 in order, and then jumps again to Sequence 2, completing two cycles.	ALL	/0	0~9999999
Degree[°]	°	Starting angle, valid when enabled.	ALL	0.1	0~359.9
Trig In	/	When disabled, execute sequentially in order of serial number. After enabling, set the trigger Mode to Automatic in the 'Configuration' interface and use either internal or external triggering to execute the enabled sequence.	ALL	/	/
Trig Out	/	After enabling, set the trigger Output to Single Step in the 'Configuration' interface. A single-step pulse indication signal can be issued via the Anyport Digital Output interface. This operation requires enabling the Anyport Digital Output interface and selecting the trigger function. See Section8.15.1.	ALL	/	/
	/	Clear all current programming data and return to Figure 90and Figure 91the initial programming state.	ALL	/	/
"+"	/	Insert a new sequence after the current sequence, with parameter values identical to the current sequence.	ALL	/	/
"-"	/	Delete the current sequence.	ALL	/	/
Export	/	Export the current programming data as a file and store it.	ALL	/	/
Import	/	Import the stored data file into the programming interface.	ALL	/	/
Load	/	Lock the programming data and enter the trigger-ready state.	ALL	/	/
Exit	/	At any time during operation in programming Mode, click 'Exit' to terminate the current programming Mode.	ALL	/	/
Trigger	/	Switch from steady output state to programmed waveform output state.	ALL	/	/

Note: The expected output waveform is still subject to the Limit Value parameters. Inappropriate Limit Value settings may result in distortion of the expected output waveform.

Advanced programming example:

1) Press the Front Panel Output Button to enable the Product to output steady-state voltage.
2) For Pulse programming data, see Table 24.

Table 24 Advanced programming data example table

Sequence Number / Parameter Item	No.1	No.2	No.3
Uac[V]	100	150	300
Freq[Hz]	50	50	50
Ramp[s]	0	0	0.06
Dwell[s]	0.06	0.06	0.06
Link	0	0	0
Count	0	0	0
Degree[°]	Enable, 60	Enable, 90	Disable
Trig In	Disable	Disable	Disable
Trig Out	Enable	Enable	Enable

See Advanced programming example diagram Figure 92 to Figure 95.

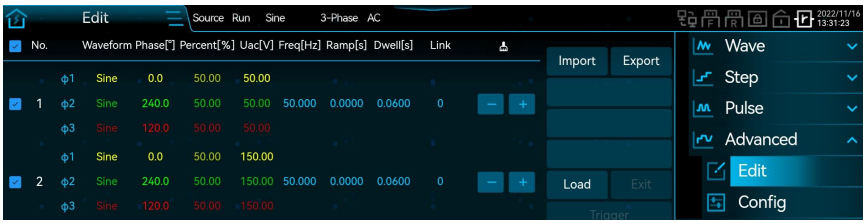


Figure 92 Advanced programming example Figure 1

Figure 93 Advanced programming example Figure 2

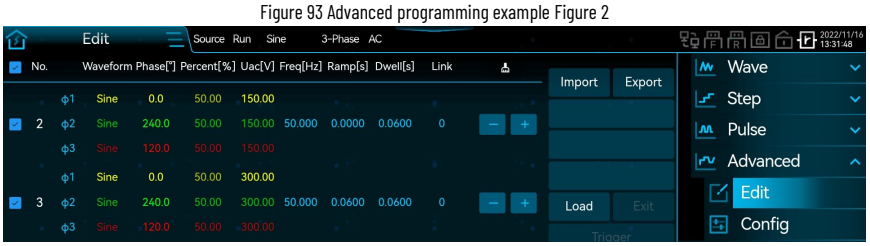


Figure 94 Advanced Programming Example Figure 3

Figure 95 Advanced Programming Example Figure 4

4) Click 'Load' in the lower right corner. At this point, both 'Exit' and 'Trigger' are highlighted; see Figure 96.

Figure 96 Advanced Programming Example Figure 5

Note: Programming data cannot be modified after loading. To modify, click 'Exit'.

5) Click 'Trigger' to display the programmed waveform on the oscilloscope (only the Φ1 waveform is shown here); see Figure 97.

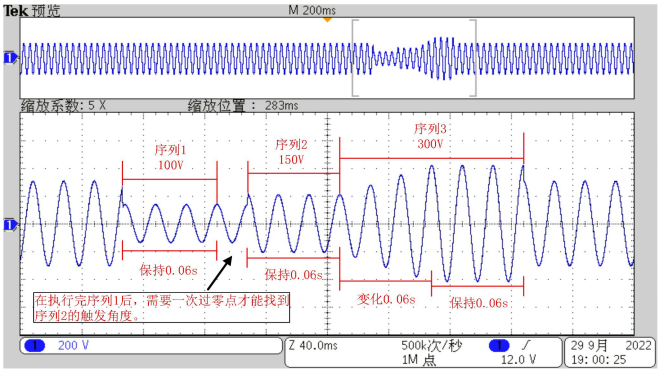


Figure 97 Advanced Programming Waveform Example Figure 1

Note: At any point during the operation of the programming mode, you may click "Exit" to end the current programming mode.

Keep all other parameters unchanged. Set both the Link and Count of Sequence 3 to 1. Click 'Load', then click 'Trigger'. The waveform displayed on the oscilloscope (only the Φ1 waveform is shown here) is as follows: Figure 98.

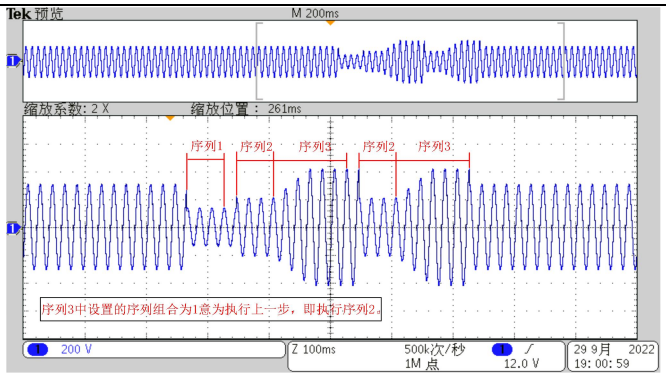


Figure 98 Advanced Programming Waveform Example Figure 2

Click Programming - Advanced - Configuration in the menu bar to enter the Advanced Mode configuration screen. The parameters and functions of the Advanced configuration screen are the same as those of the List Mode configuration screen. See: Figure 66.

The configured Advanced programming waveform data can be stored in the Product or on an external USB storage device for convenient direct recall, reducing repeated configuration operations. For details, see Section 8.12.5.

For the specific procedure of storing Advanced programming waveform data into the internal memory of the product, please refer to the storage method of List programming.

8.5 Harmonic

The Harmonic feature comprises two sections: editing and configuration. Refer to Figure 99.

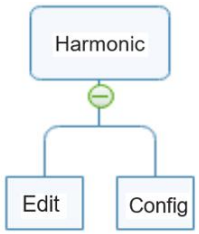


Figure 99 Harmonic Function Tree Diagram

Click Harmonic - Edit in the menu bar to access the harmonic parameter setting interface. You may configure harmonic parameters for output, or output any of the 30 built-in harmonics of the product. For waveform details, see "Appendix – Built-in Harmonic Examples". The harmonic parameter setting interface is shown in Figure 100, and parameter definitions are provided in Table 25.

Figure 100 Harmonic Parameter Setting Interface Diagram

Table 25 Harmonic Interface Parameter Definition Table

Parameter Item	Unit	Definitions	Model	Resolution	Setting Range
No.	/	Harmonic order. Up to 100 harmonics can be edited. For details, see 4.8.	ALL	/	/
Value[%]	/	Harmonic content.	ALL	0.01	Refer to 4.8Section
Phase[°]	°	Harmonic phase.	ALL	0.1	0~359.9
	/	Clear all current data and return to Figure 100 the initial programming state.	ALL	/	/
Export	/	Export the current harmonic parameters as a file and store them.	ALL	/	/
Import	/	Import the stored harmonic parameter file into the Harmonic settings interface.	ALL	/	/
DST	/	Includes 30 built-in Harmonics, which can be selected in the DST interface and imported to a specific phase or to Three-Phase. Refer to Figure 101 and Figure 102.	ALL	/	/
Preview	/	Preview the output waveform based on the currently set Harmonic parameters.	ALL	/	/
Export waveform	/	Store the configured Harmonic waveform to the Product's internal memory, and in Section 8.12.4import it into the custom waveform. This custom waveform can be used as a steady-state output waveform.	ALL	/	/
Load	/	Lock the Harmonic data and enter the trigger-ready state.	ALL	/	/
Exit	/	At any time during Harmonic Mode operation, you may click 'Exit' to terminate the current Mode.	ALL	/	/
Trigger	/	Transition from stable output state to Harmonic output state.	ALL	/	/
Update	/	After the user modifies the Harmonic parameters, simply click 'Update'. The Product will then output waveforms according to the current Harmonic parameter settings.	ALL	/	/

Note: The expected output waveform is still subject to the Limit Value parameters. Inappropriate Limit Value settings may result in distortion of the expected output waveform.

For the DST interface in Three-Phase output, see Figure 101.

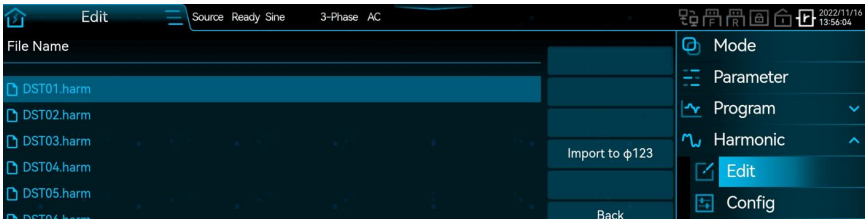


Figure 101 Three-Phase Mode DST Interface Diagram

For the DST interface in split-phase output, see Figure 102.

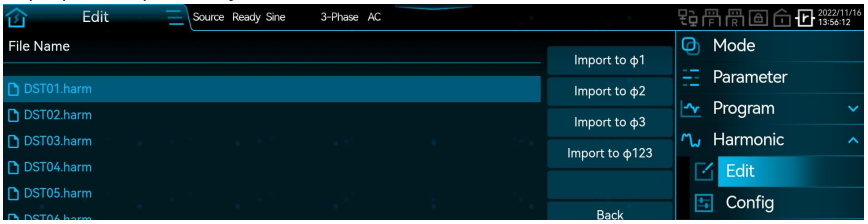


Figure 102 Split-Phase Mode DST Interface Diagram

Example of Harmonic Setting:

1) Press the Front Panel Output Button to enable the Product to output steady-state voltage.
2) Set the 3rd Harmonic content to 20%, and the 5th Harmonic content to 40%. See Figure 103.

Figure 103 Harmonic Parameter Setting Example Diagram 1

3) Click 'Load' in the lower right corner. At this point, both 'Exit' and 'Trigger' are highlighted; see Figure 104.

Figure 104 Harmonic Parameter Setting Example Diagram 2

4) Click 'Trigger' to display the programmed waveform on the oscilloscope (only the Φ1 waveform is shown here); see Figure 105.

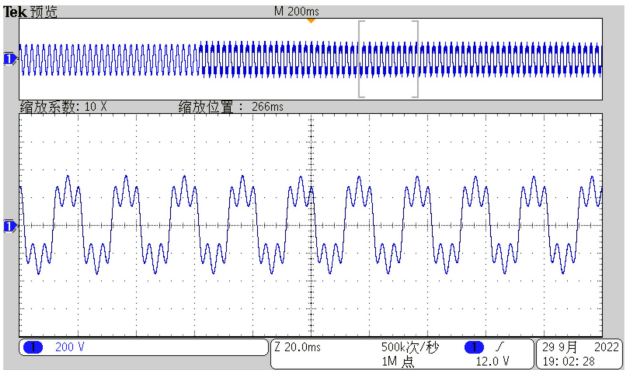


Figure 105 Harmonic Example Diagram

Note: 1. At any time during Harmonic operation, you may click 'Exit' to terminate the current Mode.

2. After clicking 'Trigger', 'Update' will be highlighted. Modify the Harmonic parameters and click 'Update'; the Product will output waveforms according to the current Harmonic parameter settings.

3. 'Export Waveform' Operation Method: Click 'Export Waveform' → enter the waveform name to be saved → click 'Enter' → click Φ1/ Φ2/ Φ3 to export, i.e., store the currently edited waveform in the Product's internal memory.

Click Harmonic - Configuration in the menu bar to enter the harmonic configuration interface, as shown inFigure 106See the definitions of each parameter in Table 26.

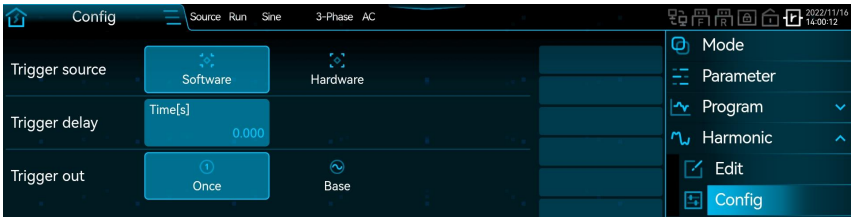


Figure 106 Harmonic Configuration Interface Diagram

Table 26 Harmonic Configuration Parameter Explanation Table

Parameter Item	Unit	Definition and Application	Model	Resolution	Setting Range
Trigger Input	/	Internal: Manually click 'Trigger' on the Display Screen to perform internal triggering. External: Send a trigger signal via the Anyport Digital Input interface for external triggering. For details, see section8.15.1.	ALL	/	/
Trigger Delay	s	After pressing 'Trigger', the harmonic will be output following the configured trigger delay.	ALL	0.001	0~999.999
Trigger Output	/	Single: Upon harmonic output, a pulse indication signal is generated via the Digital Output of Anyport. For details, see8.15.1. Fundamental: After harmonic output, at each zero-crossing of the fundamental wave, a pulse indication signal is generated via the Digital Output of Anyport.	ALL	/	/

The configured harmonic parameters can be stored either in the product's internal memory or on an external USB storage device, allowing direct recall for future use and reducing repetitive configuration by the user. For details, see Section 8.12.5.

For specific instructions on storing harmonic parameters in the product's internal memory, refer to the List programming storage method.

8.6 Interharmonics

Interharmonics include both editing and configuration sections; see Figure 107.

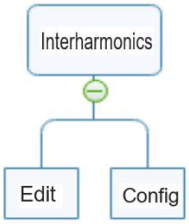


Figure 107 Interharmonics Function Tree Diagram

In the menu bar, click Interharmonics - Edit to access the Interharmonics Parameter Setting interface, where you can configure interharmonic parameters as required. For the Interharmonics Parameter Setting interface, see Figure 108 See the definitions of each parameter in Table 27.

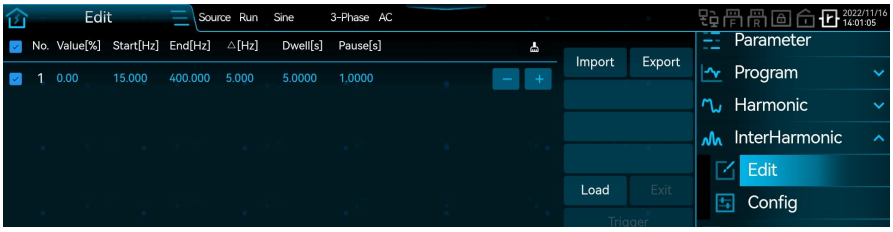


Figure 108 Interharmonics Parameter Setting Interface Diagram

Table 27 Interharmonics Interface Parameter Definitions Table

Parameter Item	Unit	Definitions	Model	Resolution	Setting Range
No.	/	Sequence number, supporting up to 300 steps.	ALL	/	/
Value[%]	/	Interharmonic content.	ALL	0.01	0~40
Start[Hz]	Hz	Starting frequency.	ALL	0.001	0.001~5000
End[Hz]	Hz	Ending frequency.	ALL	0.001	0.001~5000
Δ[Hz]	Hz	Frequency step.	ALL	0.001	0.001~5000
Dwell[s]	s	Execution time per frequency step.	ALL	0.0001	0~999.9999
Pause[s]	s	Interval time per frequency step.	ALL	0.0001	0~999.9999
	/	Clear all current data and return to Figure 108the initial programming state.	ALL	/	/
"+"	/	Insert a new sequence after the current sequence, with parameter values identical to the current sequence.	ALL	/	/
"-"	/	Delete the current sequence.	ALL	/	/
Export	/	Export the current interharmonic parameters as a file and save it.	ALL	/	/
Import	/	Import the saved interharmonic parameter file into the Interharmonics Parameter Setting interface.	ALL	/	/
Load	/	Lock the interharmonic data and enter the standby trigger state.	ALL	/	/
Exit	/	At any time during interharmonic operation, you may click 'Exit' to terminate the current Mode.	ALL	/	/
Trigger	/	Switch from steady output state to programmed waveform output state.	ALL	/	/

Note: The expected output waveform is still subject to the Limit Value parameters. Inappropriate Limit Value settings may result in distortion of the expected output waveform.

Example of interharmonic parameter setting:

1) Press the Front Panel Output Button to enable the Product to output steady-state voltage.
2) For interharmonic parameters, see Table 28; for an example diagram, see Figure 109.

Table 28 Interharmonic Parameter Example Table

Parameter Item	Set value	Parameter Item	Set value
Value[%]	20	Δ[Hz]	200
Start[Hz]	400	Dwell[s]	0.02
End[Hz]	600	Pause[s]	0.02

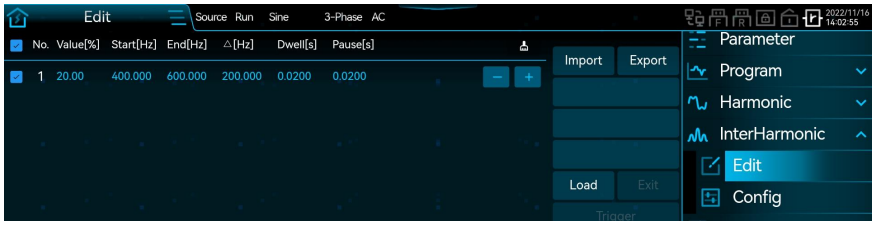


Figure 109 Interharmonic Parameter Setting Example Figure 1

3) Click 'Load' in the lower right corner. At this point, both 'Exit' and 'Trigger' are highlighted; see Figure 110.

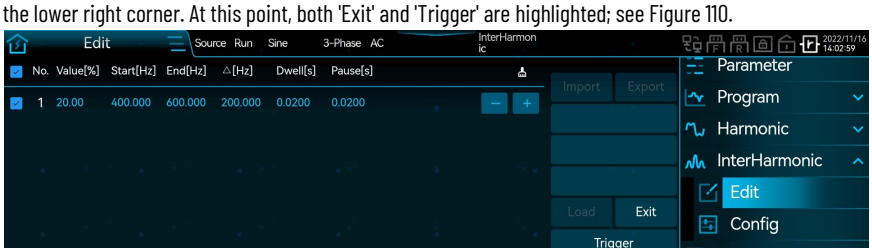


Figure 110 Interharmonic Parameter Setting Example Figure 2

Note: After loading, interharmonic parameters cannot be modified. To modify, click 'Exit'.

4) Click 'Trigger' to display the programmed waveform on the oscilloscope (only the Φ1 waveform is shown here); see Figure 111.

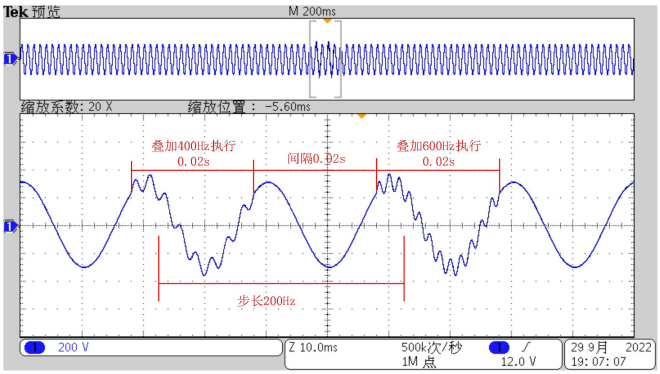


Figure 111 Interharmonics Example Diagram.

Note: At any time during interharmonics operation, you may click 'Exit' to terminate the current Mode.

Select Interharmonics - Configuration from the menu bar to access the Harmonic Configuration Interface; see Figure 112.

Figure 112 Interharmonics Configuration Interface Diagram.

For the functions and definitions of parameters in the Interharmonics Configuration Interface, refer to List and the Harmonic Configuration Interface.

The configured interharmonics parameters may be stored in the Product's internal memory or on an external USB storage device, allowing direct recall in future operations and reducing the need for repeated configuration by the user. For details, refer to section 8.12.5.

For detailed procedures on storing interharmonics parameters to the Product's internal memory, refer to the List programming storage method.

8.7 Island

The Cortex AC Series Products feature a built-in anti-islanding test function. When the Product is operating stably, set the corresponding RLC or PQ parameters in the Island editing interface to perform anti-islanding tests on the device under test. The anti-islanding test function does not require any external load equipment, oscilloscope, power analyzer, or similar instruments, thereby simplifying the test circuit, increasing testing efficiency, and reducing test costs.

The Island feature consists of two sections: Edit and Configuration. See Figure 113.

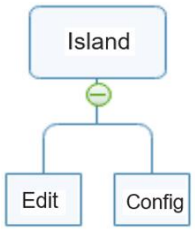


Figure 113 Island Function Tree Diagram

Click Island - Edit in the menu bar to enter the Island parameter setting interface. In this interface, scroll up or down to set the island load parameters. When the product is in standby, S1 is open; when the product is running, S1 is closed. The Island Load Mode is divided into RLC Mode and PQ Mode. For the RLC Mode parameter setting interface, see Figure 114, for the parameter definitions table, see Table 29, for the measurement parameter definitions table, see Table 30.

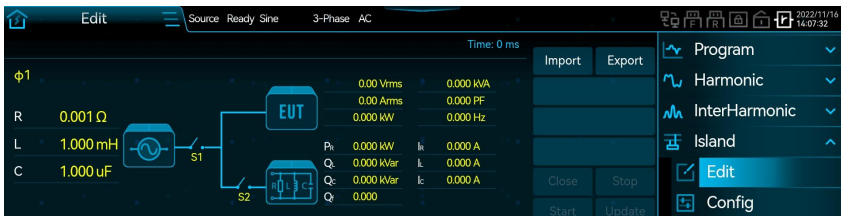


Figure 114 RLC Mode Parameter Setting Interface Diagram

Table 29 RLC Mode Interface Parameter Definition Table

Parameter Item	Unit	Definitions	Model	Resolution	Setting Range
R	Ω	Resistive load	ALL	0.001	0.001~1000
L	mH	Inductive Load	ALL	0.001	1~5000
C	μF	Capacitive Load	ALL	0.001	1~5000
Export	/	Export the current island interface parameters as a file and store them.	ALL	/	/
Import	/	Import the stored island parameter file into the island settings interface.	ALL	/	/
Engage	/	S2 closed; island load connected; entering standby state.	ALL	/	/
Disconnect	/	S2 open; island load disconnected.	ALL	/	/
Start	/	S1 open, S2 closed; initiate anti-islanding test.	ALL	/	/
Update	/	Before clicking Start, if island parameter modification is required, complete the modification and then click Update to confirm the changes.	ALL	/	/

Table 30 RLC Mode Interface Measurement Parameter Definition Table

Parameter Item	Unit	Definitions	Model	Resolution	Setting Range
P_R	kW	Active Power	ALL	0.001	/
Q_L	kVar	Inductive Reactive Power	ALL	0.001	/
Q_C	kVar	Capacitive Reactive Power	ALL	0.001	/
Qf	/	Quality Factor	ALL	0.001	/
I_R	A	Resistive Current	ALL	0.001	/
I_L	A	Inductive Current	ALL	0.001	/
I_C	A	Capacitive Current	ALL	0.001	/
Island Time	ms	The time from the beginning of island operation until the stop condition is met.	ALL	1	/

For the PQ Mode parameter setting interface, see Figure 115; for the parameter definition table, see Table 31

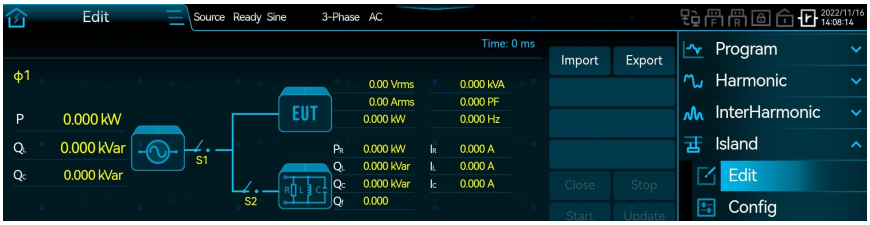


Figure 115 PQ Mode Parameter Setting Interface Diagram

Table 31 PQ Mode Interface Parameter Definition Table

Parameter Item	Unit	Definitions	Model	Resolution	Setting Range
P	kW	Active Power	CA06-450	0.001	Three-Phase/Split-Phase: 0-2 Single Phase: 0-6
			CA7.5-450		Three/Phase: 0-2.5 Single Phase: 0-7.5
			CA09-450		Three/Phase: 0-3 Single Phase: 0-9
			CA12-450		Three/Phase: 0-4 Single Phase: 0-12
			CA15-450		Three/Phase: 0-5 Single Phase: 0-15
			CA20-450		Three-/Split-Phase: 0~6.667 Single Phase: 0~20
			CA22-450		Three-/Split-Phase: 0~7.333 Single Phase: 0~22
Q_L	kVar	Inductive Reactive Power	CA06-450	0.001	Three-Phase/Split-Phase: 0-2 Single Phase: 0-6
			CA7.5-450		Three/Phase: 0-2.5 Single Phase: 0-7.5
			CA09-450		Three/Phase: 0-3 Single Phase: 0-9
			CA12-450		Three/Phase: 0-4 Single Phase: 0-12
			CA15-450		Three/Phase: 0-5 Single Phase: 0-15
			CA20-450		Three-/Split-Phase: 0~6.667 Single Phase: 0~20
			CA22-450		Three-/Split-Phase: 0~7.333 Single Phase: 0~22
Q_C	kVar	Capacitive Reactive Power	CA06-450	0.001	Three-Phase/Split-Phase: 0-2 Single Phase: 0-6
			CA7.5-450		Three/Phase: 0-2.5 Single Phase: 0-7.5
			CA09-450		Three/Phase: 0-3 Single Phase: 0-9
			CA12-450		Three/Phase: 0-4 Single Phase: 0-12
			CA15-450		Three/Phase: 0-5 Single Phase: 0-15
			CA20-450		Three-/Split-Phase: 0~6.667 Single Phase: 0~20
			CA22-450		Three-/Split-Phase: 0~7.333 Single Phase: 0~22

Note: The setting ranges listed in the table apply to a single unit. For parallel operation, multiply by the number of units.

Anti-islanding Test Example—RLC Mode:

1) Click 'Island – Edit' in the menu bar to enter the anti-islanding test function interface; see Figure 116.

Figure 116 Anti-islanding Test Function Interface Diagram

2) Load Mode Selection.

Click 'Island – Configuration' in the menu bar to enter the island configuration interface; see Figure 117, select RLC Mode or PQ Mode in the 'Mode' section of this interface:

When RLC Mode is selected: The anti-islanding test interface allows for the configuration of resistive load R, inductive load L, and capacitive load C;

When PQ Mode is selected: The anti-islanding test interface allows for the configuration of active power P, inductive reactive power Q L, and capacitive reactive power Q C.

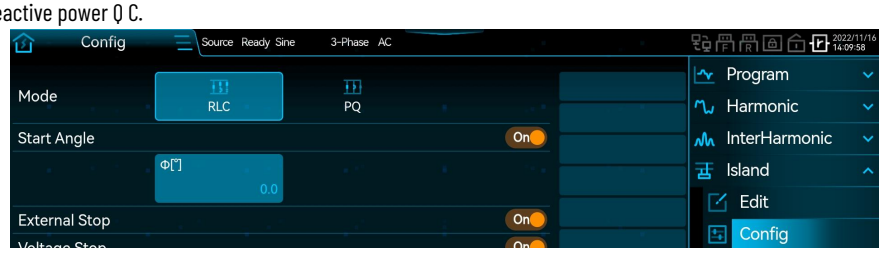


Figure 117 Load Mode and Initial Phase Angle Setting Interface Diagram

3) Return to the anti-islanding test function interface, set the corresponding RLC parameters, and press the front panel Output Button to enable the product to output a steady-state voltage. At this time, S1 is closed, the EUT (Equipment Under Test) is connected to the grid, and 'Engage' is highlighted. See Figure 118.

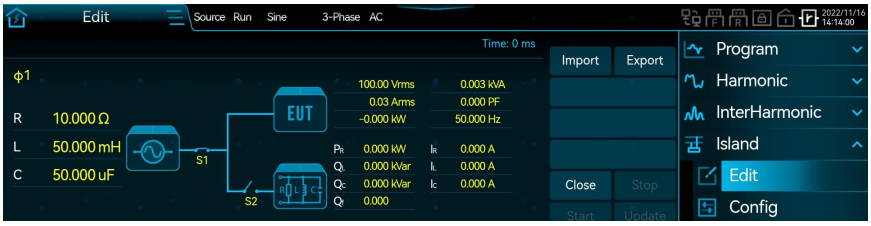


Figure 118 RLC Mode Anti-Islanding Test Interface Diagram 1

Note: At this time, you may import or export the configured parameters. Please refer to the List programming steps.

4) Click 'Engage'. S2 closes, and the RLC Load is connected. See Figure 119.

Figure 119 RLC Mode Anti-Island Test Interface Diagram 2.

Note: At this time, you may select 'Disconnect' or 'Start,' or modify the island parameters and update.

5) Click 'Start.' S1 opens, and the anti-island test is initiated. See Figure 120. The user may configure the anti-island test termination method in the 'Island - Configuration' interface. When the Product detects the completion of the anti-island test, S2 opens, and the anti-island protection time of the EUT (Equipment Under Test) will be displayed on the interface. See Figure 121.

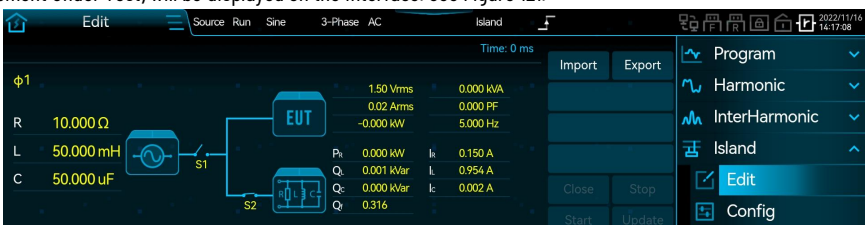


Figure 120 RLC Mode Anti-Island Test Interface Diagram 3.

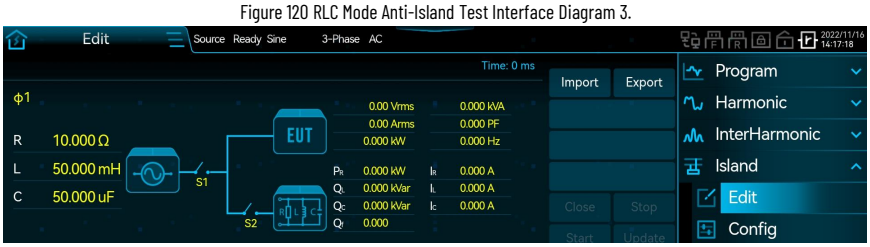


Figure 121 RLC Mode Anti-Islanding Test Interface Diagram 4

Click Island - Configuration in the menu bar to enter the Island Configuration Interface. See Figure 122, and parameter definitions are provided in Table 32.

Figure 122 Island Configuration Interface Diagram

Table 32 Parameter Definitions for the Island Configuration Interface

Parameter Item	Unit	Definition and Application	Model	Resolution	Setting Range
Mode	/	You can select either RLC Mode or PQ as the island load mode.	ALL	/	/
Starting Angle	°	After clicking 'Start', the anti-islanding test will commence at the specified starting angle.	ALL	0.1	0 ~ 359.99
Input Stop	/	When an emergency stop signal is sent via the Anyport Digital Input interface, the island experiment will end and the product output will automatically disconnect. For more details about the Anyport Digital Input, see page8.15.1.1.	ALL	/	/
Voltage Stop Threshold	V	When the port voltage is less than or equal to the set voltage threshold, the island experiment will end and the product output will automatically disconnect.	ALL	0.01	0 ~ 450
Current Stop Threshold	A	When the port current is ≤ the set current threshold, the island mode test will end and the Product output will be automatically disconnected.	CA06-450	0.01	Single Phase: 0~30 Three-Phase: 0~90
			CA7.5-450		Single Phase: 0~30 Three-Phase: 0~90
			CA09-450		Single Phase: 0~35 Three-Phase: 0~105
			CA12-450		Single Phase: 0~35 Three-Phase: 0~105
			CA15-450		Single Phase: 0~35 Three-Phase: 0~105
			CA20-450		Single Phase: 0~35 Three-Phase: 0~105
			CA22-450		Single Phase: 0~35 Three-Phase: 0~105
Power Stop Threshold	kW	When the port power is ≤ the set power threshold, the island mode test will end and the Product output will be automatically disconnected.	CA06-450	0.001	Single Phase: 0~2 Three-Phase: 0~6
			CA7.5-450		Single Phase: 0~2.5 Three-Phase: 0~7.5
			CA09-450		Single Phase: 0~3 Three-Phase: 0~9
			CA12-450		Single Phase: 0~4 Three-Phase: 0~12
			CA15-450		Single Phase: 0~5 Three-Phase: 0~15
			CA20-450		Single Phase: 0-6.667 Three-Phase: 0-20
			CA22-450		Single Phase: 0-7.333 Three-Phase: 0-22

Note: The setting ranges listed in the table refer to single unit parameters. When units are operated in parallel, the current stop threshold and power stop threshold settings should be multiplied by the number of parallel units.

8.8 Limit Value

Click 'Limit Value' in the menu bar to enter the limit value setting interface. The limit value setting interface is shown in Figure 123, where the specified ranges for voltage, frequency, current, and power can be set. For definitions of limit value parameters, see Table 33.

Figure 123 Limit Value Interface Diagram

Table 33 Limit Value Function Table

Parameter Item	Unit	Definition and Application	Model	Resolution	Initial Value	Setting Range
AC Voltage Lower Limit	V	The minimum AC voltage value that can be set in the Output Setting Area. To prevent damage to the device under test caused by excessively low AC voltage due to improper operation, users can set the AC voltage lower limit within a safe range here.	ALL	0.01	0	0.00~450
AC Voltage Upper Limit	V	This is the maximum adjustable value for the AC voltage in the Output Setting Area. To prevent damage to the device under test from excessive output AC voltage due to operational errors, users can set the AC voltage upper limit within a safe range here.	ALL	0.01	450	0.00~450
Direct Current Voltage Lower Limit	V	This is the minimum adjustable value for the direct current voltage in the Output Setting Area. To prevent damage to the device under test from excessively low output direct current voltage due to operational errors, users can set the DC voltage lower limit within a safe range here.	ALL	0.01	-636	-636~0
Direct Current Voltage Upper Limit	V	This is the maximum adjustable value for the direct current voltage in the Output Setting Area. To prevent damage to the device under test from excessively high output direct current voltage due to operational errors, users can set the DC voltage upper limit within a safe range here.	ALL	0.01	636	0~636
Lower Limit of AC Current Limit Value	A	Indicates the minimum value of AC current output for each phase. This is valid when the coupling mode is AC. When the number of output phases is three-phase or phase-separated, the actual value equals the set value. When the number of output phases is single phase, the actual value is three times the set value. To avoid damage to the device under test caused by excessively low output AC current due to incorrect operation, users may set the lower limit of the AC current within a safe range here.	CA06-450	0.01	0	0.00~30
			CA7.5-450			
			CA09-450		0	0.00~35
			CA12-450			
			CA15-450			
			CA20-450			
			CA22-450			
Upper Limit of AC Current Limit Value	A	Indicates the maximum value of AC current output for each phase. This is valid when the coupling mode is AC. When the number of output phases is three-phase or phase-separated, the actual value equals the set value. When the number of output phases is single phase, the actual value is three times the set value. To prevent damage to the device under test caused by excessive output AC current resulting from incorrect operation, the user may set the upper limit of the AC current within a safe range here.	CA06-450	0.01	30	0.00~30
			CA7.5-450			
			CA09-450		35	0.00~35
			CA12-450			
			CA15-450			
			CA20-450			
			CA22-450			
Lower Limit Value of Direct Current	A	Indicates the minimum value of direct current output per phase, valid when the coupling mode is DC. When the number of output phases is three-phase or split-phase, the actual value equals the set value. When the number of output phases is single phase, the actual value is three times the set value. To prevent damage to the device under test caused by excessively low output direct current resulting from incorrect operation, the user may set the lower limit of the direct current within a safe range here.	CA06-450	0.01	-30	-30~0
			CA7.5-450			
			CA09-450		-35	-35~0
			CA12-450			
			CA15-450			
			CA20-450			
			CA22-450			
Upper Limit Value of Direct Current	A	Indicates the maximum value of direct current output per phase, valid when the coupling mode is DC. When the number of output phases is three-phase or split-phase, the actual value equals the set value. When the number of output phases is single phase, the actual value is three times the set value. To prevent damage to the device under test caused by excessive direct current output due to improper operation, the user can set the upper limit of direct current within a safe range here.	CA06-450	0.01	30	0~30
			CA7.5-450			
			CA09-450		35	0~35
			CA12-450			
			CA15-450			
			CA20-450			
			CA22-450			
Lower Limit of Active Power Limit Value	kW	Indicates the minimum active power value for each phase, effective when the coupling mode is DC. When the number of output phases is three-phase or split-phase, the actual value equals the set value. When the output is single phase, the actual value is three times the set value. To prevent damage to the device under test caused by insufficient source power due to improper operation, the user can set the lower limit of active power within a safe range here.	CA06-450	0.001	-2	-2~0
			CA7.5-450		-2.5	-2.5~0
			CA09-450		-3	-3~0
			CA12-450		-4	-4~0
			CA15-450		-5	-5~0
			CA20-450		-6.667	-6.667~0
			CA22-450		-7.333	-7.333~0
Upper Limit of Active Power Limit Value	kW	Indicates the maximum active power value for each phase, effective when the coupling mode is DC. When the output is three-phase or split-phase, the actual value equals the set value. When the output is single phase, the actual value is three times the set value. To prevent accidental damage to the device under test caused by excessive source power due to user error, the upper limit of active power can be set within the safe range here.	CA06-450	0.001	2	0~2
			CA7.5-450		2.5	0~2.5
			CA09-450		3	0~3
			CA12-450		4	0~4
			CA15-450		5	0~5
			CA20-450		6.667	0~6.667
			CA22-450		7.333	0~7.333
Lower Limit Value of Apparent Power	kVA	Indicates the minimum apparent power per phase, applicable when the coupling mode is AC or AC+DC. When the number of output phases is three-phase or split-phase, the actual value equals the set value. When the number of output phases is single phase, the actual value is three times the set value. To prevent accidental damage to the device under test caused by insufficient source power due to user error, the lower limit of apparent power can be set within the safe range here.	CA06-450	0.001	0	0~2
			CA7.5-450		0	0~2.5
			CA09-450		0	0~3
			CA12-450		0	0~4
			CA15-450		0	0~5
			CA20-450		0	0~6.667
			CA22-450		0	0~7.333
Upper Limit Value of Apparent Power	kVA	Indicates the maximum apparent power per phase, applicable when the coupling mode is AC or AC+DC. When the number of output phases is three-phase or split-phase, the actual value equals the set value. When the number of output phases is single phase, the actual value is three times the set value. To prevent damage to the device under test caused by excessive apparent power resulting from improper operation, users can set the upper limit of apparent power within a safe range here.	CA06-450	0.001	2	0~2
			CA7.5-450		2.5	0~2.5
			CA09-450		3	0~3
			CA12-450		4	0~4
			CA15-450		5	0~5
			CA20-450		6.667	0~6.667
			CA22-450		7.333	0~7.333

Note: The setting ranges listed in the table are parameters for a single unit. When operating in parallel, the current and power settings should be multiplied by the number of parallel units.

8.9 Protection

Click 'Protection' in the menu bar to enter the Protection Setting interface. The Protection Setting interface is shown in Figure 124, where you can set

protection thresholds for voltage, current, power, and frequency. For explanations of the protection parameters, see Table 34.

Figure 124 Protection Setting Interface Diagram

Table 34 Protection Setting Parameter Table

Parameter Item	Unit	Definition and Application	Model	Resolution	Initial Value	Setting Range
Fast Peak Overvoltage Threshold	V	Fast peak overvoltage protection threshold, valid only in Load Mode. When it is necessary to protect the instantaneous value of the Maximum Voltage at the Output Terminal, this parameter can be configured.	ALL	0.01	650	0~700
RMS Overvoltage Threshold	V	RMS overvoltage protection limit. This parameter can be configured to protect the RMS value of the Maximum Voltage at the Output Terminal, if required.	ALL	0.01	636	0~636
AC Overvoltage Threshold	V	AC overvoltage protection limit. This parameter can be configured to protect the Maximum AC Voltage at the Output Terminal, if required.	ALL	0.01	450	0~450
Direct Current Forward Overvoltage Threshold	V	Direct Current forward overvoltage protection limit. This parameter can be configured to protect the maximum forward Direct Current voltage at the Output Terminal, if required.	ALL	0.01	636	0~636
Direct Current Reverse Overvoltage Threshold	V	Direct Current reverse overvoltage protection limit. This parameter can be configured to protect the maximum reverse Direct Current voltage at the Output Terminal, if required.	ALL	0.01	-636	-636~0
Load AC Undervoltage Threshold	V	Load AC undervoltage protection threshold, effective only in Load Mode. This parameter can be set when the user needs to protect the minimum AC voltage at the Output Terminal.	ALL	0.01	10	10~450
RMS Overcurrent Threshold	A	Indicates the RMS overcurrent protection threshold for each phase. When the output phase number is Three-Phase or split phase, this indicates the RMS overcurrent protection threshold for each phase. When the output phase number 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.	CA06-450 CA7.5-450	0.01	31.5	0~31.5
			CA09-450 CA12-450 CA15-450 CA20-450 CA22-450		36.75	0~36.75
Active Power Threshold	kW	Total Active Power protection threshold. This parameter can be set when the user needs to protect the maximum Active Power at the Output Terminal.	CA06-450	0.001	6.3	0~6.3
			CA7.5-450		7.875	0~7.875
			CA09-450		9.45	0~9.45
			CA12-450		12.6	0~12.6
			CA15-450		15.75	0~15.75
			CA20-450		21	0~21
			CA22-450		23.1	0~23.1
Apparent Power Threshold	kVA	Total apparent power protection threshold. To protect the maximum apparent power at the Output Terminal, set this parameter.	CA06-450	0.001	6.3	0~6.3
			CA7.5-450		7.875	0~7.875
			CA09-450		9.45	0~9.45
			CA12-450		12.6	0~12.6
			CA15-450		15.75	0~15.75
			CA20-450		21	0~21
			CA22-450		23.1	0~23.1
Over-frequency threshold	Hz	Over-frequency protection threshold. To protect the maximum Frequency of AC voltage at the Output Terminal, set this parameter.	ALL	0.001	2000	0.001~2000
Under-frequency threshold	Hz	Under-frequency protection threshold. To protect the minimum Frequency of AC voltage at the Output Terminal, set this parameter.	ALL	0.001	0.001	0.001~2000
Protection time	s	If the output value of any parameter continuously exceeds the protection threshold during the specified protection time, protection will be triggered.	ALL	0.001	0.1	0.001~3

Note: The setting ranges listed in the table are parameters for a single unit. When operating in parallel, the current and power settings should be multiplied by the number of parallel units.

8.10 Event

The Cortex AC Series Products are equipped with an event recording function, which monitors specific occurrences during operation to assist users in observing and understanding product operation. Click on 'Event' in the menu bar to enter the event settings interface. The event settings interface is shown in Figure 125.

Figure 125 Event Interface Diagram

When the event is enabled, parameter setting is available; see Figure 126. For event functionality, refer to Table 35.

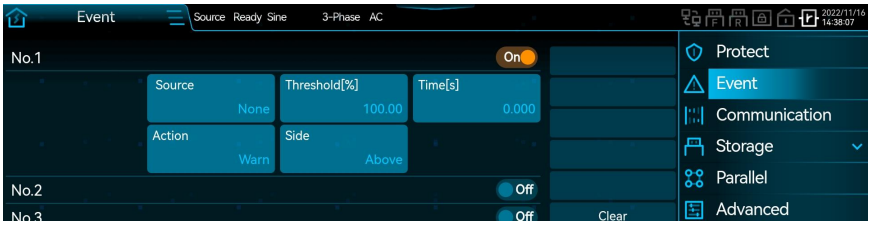


Figure 126 Event Parameter Setting Interface Diagram

Table 35 Event Function Table

Parameter Item	Unit	Definition and Application	Model	Resolution	Initial Value	Setting Range
Event Number	\	\	ALL	\	\	\
Trigger Source	\	Displays the voltage, current, frequency, power, and temperature of each phase. When it is necessary to monitor the status of voltage, current, power, and temperature, the user can select the corresponding trigger source to initiate an event.	ALL	\	Φ1 Urms	\
Trigger Threshold	%	A percentage of the rated value of the trigger source. For rated values of each model, seeTable 36, with the rated value for temperature being 65°C. Users may set the trigger threshold to specify the triggering condition for the event.	ALL	0.01	100	0~100
Trigger Time	s	The duration from surpassing the trigger threshold to event activation. Users can configure this parameter to control the event response time.	ALL	0.001	0	0~9999
Action Mode	\	Log: When an event occurs, users are required to record the event in the log by selecting 'Log' as the action mode. The product may continue to operate normally during logging. It is necessary to8.12.2click 'Start Recording' on the log interface described in Section	ALL	\	Log	\
		Alarm: When an event occurs that requires an alarm and disconnection of the output terminal, the action mode can be set to 'Alarm.'Upon an alarm, the product will disconnect the output terminal, and 'Event X' will flash in the Status Display Area.	ALL			
		Warning: When an event occurs and a warning notification is required, the action mode can be set to 'Warning.'After a warning, the product may continue to operate normally, and 'Event X' will flash in the Status Display Area.	ALL			
Threshold Direction	\	When voltage, current, power, or temperature exceeds the trigger threshold in the upward direction, an event will be triggered. If the user requires an event to be triggered when the trigger threshold is exceeded in the upward direction, the threshold direction must be set to Upward. An event is triggered when voltage, current, power, or temperature falls below the trigger threshold. If the user requires an event to be triggered when the trigger threshold is exceeded in the downward direction, the threshold direction must be set to Downward.	ALL		Upward	
Clear Event	\	Clear all triggered event statuses. The Power/Reset key also has the event clearing function. If the user needs to clear the event and remove the event status from the Status Display Area, this button can be clicked.	ALL	\	\	\

Table 36 Parameter Value Reference Table for 100% Trigger Threshold

Parameter Item	Unit	Definitions	Model	Parameter Value Corresponding to 100% Trigger Threshold
Φ1 Urms	V	Φ1 Voltage RMS	ALL	636
Φ1 Irms	A	Φ1 Current RMS	CA06-450	30
			CA7.5-450	
			CA09-450	35
			CA12-450	
			CA15-450	
			CA20-450	
			CA22-450	
Φ1 P	kW	Φ1 Active Power	CA06-450	2
			CA7.5-450	2.5
			CA09-450	3
			CA12-450	4
			CA15-450	5
			CA20-450	6.667
			CA22-450	7.333
Φ1 S	kW	Φ1 Apparent Power	CA06-450	2
			CA7.5-450	2.5
			CA09-450	3
			CA12-450	4
			CA15-450	5
			CA20-450	6.667

Parameter Item	Unit	Definitions	Model	Parameter Value Corresponding to 100% Trigger Threshold
			CA22-450	7.333
Φ1 Q	kW	Φ1 Reactive Power	CA06-450	2
			CA7.5-450	2.5
			CA09-450	3
			CA12-450	4
			CA15-450	5
			CA20-450	6.667
			CA22-450	7.333
Σ P	kW	Total Active Power	CA06-450	6
			CA7.5-450	7.5
			CA09-450	9
			CA12-450	12
			CA15-450	15
			CA20-450	20
			CA22-450	22
Σ S	kW	Total Apparent Power	CA06-450	6
			CA7.5-450	7.5
			CA09-450	9
			CA12-450	12
			CA15-450	15
			CA20-450	20
			CA22-450	22
Σ Q	kW	Total Reactive Power	CA06-450	6
			CA7.5-450	7.5
			CA09-450	9
			CA12-450	12
			CA15-450	15
			CA20-450	20
			CA22-450	22
Φ1 Uac	V	Φ1 AC Voltage	ALL	450
Φ1 Udc	V	Φ1 Direct Current Voltage	ALL	636
Φ1 Iac	A	Φ1 AC Current	CA06-450	30
			CA7.5-450	
			CA09-450	35
			CA12-450	
			CA15-450	
			CA20-450	
			CA22-450	
Φ1 Idc	A	Φ1 Direct Current	CA06-450	30
			CA7.5-450	
			CA09-450	35
			CA12-450	
			CA15-450	
			CA20-450	
			CA22-450	
Φ1 Upk	V	Φ1 Voltage Peak Value	ALL	636
Φ1 Ipk	A	Φ1 Current Peak Value	ALL	90
Φ1 U12	V	Line Voltage UAB	ALL	779
Φ1 Irush	A	Φ1 Inrush Current	ALL	90
Temp	℃	Exhaust Outlet Temperature	ALL	65
Freq	Hz	Frequency	ALL	Source Mode: 200 Load Mode: 450

Note: 1. For Φ1 in Single Phase, the corresponding current and power parameters must be multiplied by 3.

2. Φ2 and Φ3 are invalid in Single Phase; for other corresponding parameters, refer to Φ1.

3. The ranges listed in the table are parameters for a single unit; when operating in parallel, the current and power settings must be multiplied by the number of parallel units.

Example: For the parameter setting of Event 1, see Table 37.

Table 37 Event 1 Parameter Setting Table

Trigger Source	Trigger Threshold [%]	Trigger Time [s]	Action Mode	Threshold Direction
Φ1 Urms	50	1	Warning	Upward

For the schematic diagram of Event 1 triggering, see Figure 127 The duration T1 is less than the trigger time; therefore, Event 1 is not triggered. The duration T2 equals the trigger time; therefore, Event 1 is triggered at the 4th second.

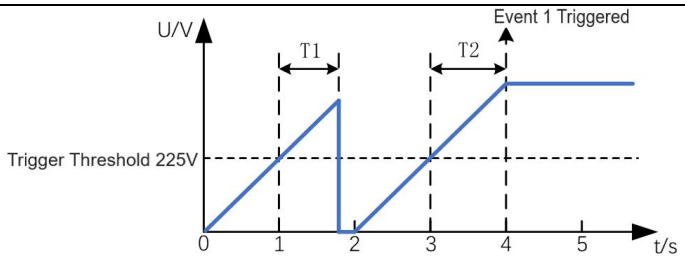


Figure 127 Event 1 Trigger Schematic Diagram

8.11 Communication

Cortex AC Series Products can switch between local and remote communication modes. Remote mode supports communication with user devices via LAN and USB. Click Communication in the menu bar to access the communication settings interface. In the communication settings interface, you can assign control of this Product to different ports, enabling local or remote control. For the communication interface, see Figure 128 See the definitions of each parameter in Table 38.

Figure 128 Communication Interface Diagram

Table 38 Communication Interface Parameter Definition Table

Parameter Item	Unit	Definitions	Model	Resolution	Initial Value	Setting Range
Local Lock	/	Locks local control authority; other ports cannot obtain control authority. The local lock can only be enabled in local control mode. Once enabled, remote communication cannot be configured.	ALL	/	/	/
Device Number	/	Used to set the product address.	ALL	/	1	1~127
Communication Port	/	Select the control mode for this Product. When the local lock is disabled, the remote communication port can obtain control authority over the Product via commands. SCREEN: Local control via Display Screen. LAN: Remote control via Ethernet. USB: Remote control via USB.	ALL	/	/	/
Communication Protocol	/	The LAN port of this Product supports two communication protocols: SCPI and Modbus-TCP.	ALL	/	/	/
IP Allocation	/	Automatic and Manual.	ALL	/	/	/
IP Address	/	The IP address type is IPv4.	ALL	/	/	/
Port Number	/	The port number is 502.	ALL	/	/	/
USB	/	The USB port supports both SCPI and Modbus-RTU communication protocols. When selecting the USB port for control, the corresponding communication protocol must also be configured.	ALL	/	/	/

8.11.1 LAN Interface IP Allocation

8.11.1.1 Automatic Mode

In Automatic Mode, if a DHCP server is present on the local area network, Cortex AC Series Products will request network parameters from the server via the DHCP protocol, with a request timeout of 30 seconds. For the network topology, see Figure 129.

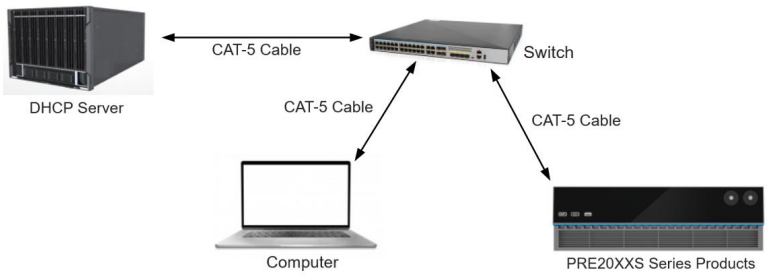


Figure 129 Network Topology with DHCP Server

In a local area network without a DHCP server, or if the DHCP request times out, Cortex AC Series Products will automatically assign network parameters via the AutoIP protocol. For AutoIP-assigned network parameters, see Table 39. For the network topology, see Figure 130.

Table 39 AutoIP Automatically Assigned Network Parameter Table

Parameter Item	Parameter Range
IP Address	169.254.1.0~169.254.254.255
Subnet Mask	255.255.0.0
Gateway Address	0.0.0.0

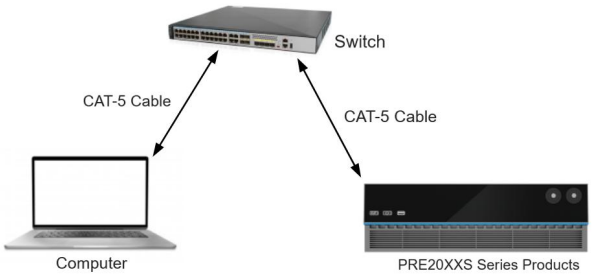


Figure 130 AutoIP Automatically Assigned Network Topology Diagram

Network parameters obtained in automatic Mode are not saved. Each time the network cable is inserted or switched to automatic Mode, the network parameters will be reacquired.

8.11.1.2 Manual Mode

In Manual Mode, network parameters are configured by the user on the LAN configuration page. When used in a local area network, if the IP address set is identical to that of another network device, the configuration will not take effect. If an IP conflict occurs, the Cortex AC Series Products will automatically assign a new IP address using the AutoIP protocol. Manual Mode is suitable for various network topologies.

8.11.1.3 LAN Status Description

For the explanation of LAN status display, see Table 40.

Table 40 LAN Status Display Explanation Table

Status	Status Definition
Fault	Network cable not inserted or IP address conflict
Device Identity	Network configuring
Normal Operation	Configuration successful

8.11.1.4 Communication Monitoring

If no communication data is received in remote output mode, either via any command or a specific command, a fault will be reported. See Figure 131.

Figure 131 Communication Monitoring Settings Interface

8.11.2 USB Interface Configuration

8.11.2.1 Interface Description

For details on the USB interface, see Table 41.

Table 41 USB Interface Description Table

Category	Support Status
Connector Type	USB Type B
Hardware Support	USB 2.0、USB 1.1
Protocol Type	USBTMC Class, USB488 Subclass
Driver	NI-VISA Driver

8.11.2.2 Instructions for Use

After the NI-VISA driver has been successfully installed on the computer, connect the computer and the Cortex AC Series Products using a USB cable. Once the device information is detected in the computer's Device Manager,Figure 132this indicates that both hardware and software are functioning properly.

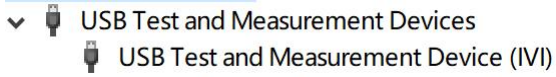


Figure 132 USB Information Diagram in Device Manager

After the device has been successfully recognized, SCPI commands may be sent to the Cortex AC Series Products using the NI-MAX software. When sending query commands, an interval of at least 10 ms must be maintained between the DEV_DEP_MSG_OUT message (Write) and the REQUEST_DEV_DEP_MSG_IN message (Read).

8.12 Storage

Storage comprises five sections: information, logs, parameters, waveforms, and files. For details on storage functionality, refer to Figure 133.

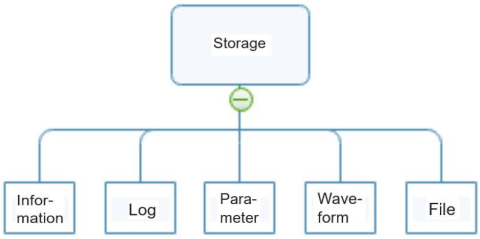


Figure 133 Storage Function Tree Diagram

8.12.1 Information

Click Storage > Information in the menu bar to access the information interface. The Information Interface records the operating status of Cortex AC Series Products, including operations, protections, alarms, and events, with a total of 300 entries. Refer to Figure 134.

Figure 134 Information Interface Diagram

8.12.2 Log

In the menu bar, click Storage - Log to access the Log Settings Interface. The Log Settings Interface is shown in Figure 135, where the sampling rate, number of records, and recording mode can be configured. Parameter definitions are provided in Table 42.

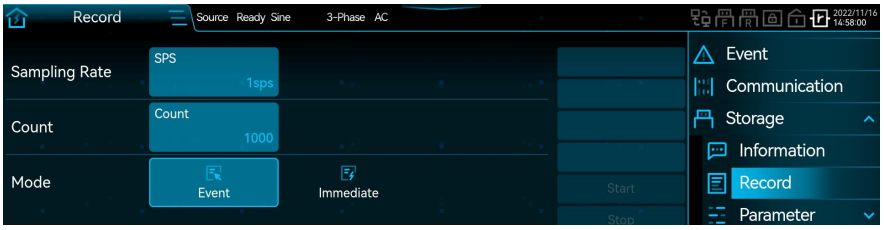


Figure 135 Log Settings Interface Diagram

Table 42 Log Settings Interface Parameter Definition Table

Parameter Item	Unit	Definitions	Model	Resolution	Initial Value	Setting Range
Sampling Rate	sps	Sampling and recording rate; sps indicates the number of log entries recorded per second.	ALL	/	1	1,2,5,10
Number of Records	/	The maximum number of records that can be logged.	ALL	/	0	0~999999
Recording Mode	/	Log recording mode, including event-triggered and immediate trigger. Event Triggered: After pressing Start, this Product will begin log recording when an event occurs. Event trigger conditions must be configured in the Event Interface; for details, refer to Section 8.10. Immediate Trigger: The Product initiates log recording immediately after the Start button is pressed.	ALL	/	Event Trigger	/
Start Button	/	After pressing the Start button, the Product will automatically record the event to a USB storage device connected to the Rear Panel.	ALL	/	/	/
Stop Button	/	After pressing the Stop button, the Product will stop the recording function.	ALL	/	/	/

Note: 1. The external USB storage device connected to the Rear Panel supports FAT32 and exFAT formats.

2. Log files are supported only in CSV format, with data separated by commas ','.

3. File naming convention: filename prefix + file sequence number + group sequence number, e.g., 'LOG' + '001' + '001'.

4. File segmentation rule: each file will be split after recording 5,000 log entries.

5. For definitions of parameters in the log file, see Table 43.

Table 43 Log Recording Parameter Explanation Table

Parameter Item	Definitions	Parameter Item	Definitions
CA20-450	Cortex AC Series Product Model	Ipk(A)	Peak Current
E1022G0017	Cortex AC Series Product Serial Number	CF	Current Crest Factor
Urms(V)	RMS Voltage	S(kVA)	Apparent Power
Uthd(V)	Total Voltage Harmonic Distortion	P(kW)	Active Power
Uac(V)	AC Voltage Value	Q(kvar)	Reactive Power
Udc(V)	Direct Current Voltage Value	sigmaS(kVA)	Total Apparent Power
Upk(V)	Peak Voltage	sigmaP(kW)	Total Active Power
theta(deg)	Voltage Phase Angle	sigmaQ(kvar)	Total Reactive Power
Freq(Hz)	Frequency Value	PF	Power Factor
U12(V)	Line Voltage Value	Irush(A)	Inrush Current Value
Irms(A)	RMS Current	PowerOnHours(h)	Operating Time
Ithd	Total Current Harmonic Distortion	TransferTime(ms)	Switching Time
Iac(A)	AC Current Value	Time	Record Time
Idc(A)	Direct Current Value		

Note: phi1, phi2, and phi3 represent Φ1, Φ2, and Φ3, respectively.

8.12.3 Parameter

Parameters include both user and communication sections, see Figure 136. All files can be imported or exported.

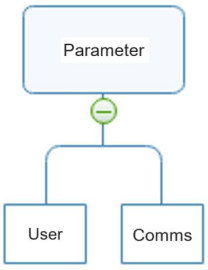


Figure 136 Parameter Function Tree Diagram

8.12.3.1 User

In the menu bar, click Storage > Parameter > User to enter the user interface. For the user interface, see Figure 137, which includes data for Mode, Parameter, Limit Value, Protection, Event, Parallel, Advanced, Anyport, Source Load, and System, all saved as files.

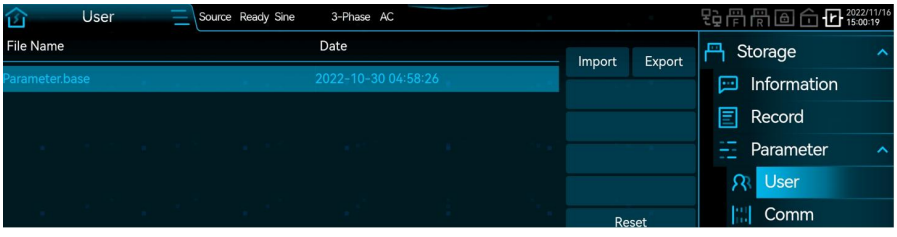


Figure 137 User Interface Diagram

8.12.3.2 Communication

In the menu bar, click Storage > Parameter > Communication to enter the communication interface. For the communication interface, see Figure 138, which includes parameters from the communication settings interface in the menu bar, all saved as files.

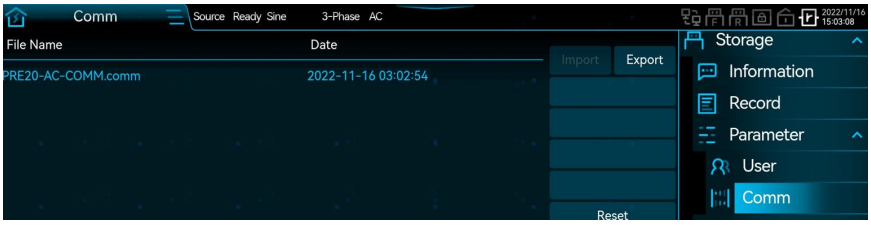


Figure 138 Communication Interface Diagram

8.12.4 Waveform

Click Storage - Waveform in the menu bar to enter the waveform interface. For the waveform interface, see Figure 139, users can export or import waveforms using a USB storage device on the Front Panel or from the host PC.

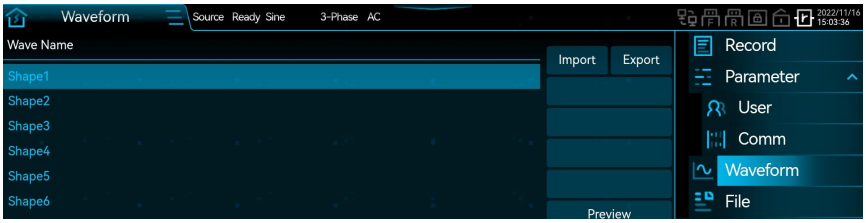


Figure 139 Waveform Interface Diagram

Select the waveform file and click 'Preview' in the lower right corner to view the waveform of the current file. After importing the waveform into Shape1, click Shape1, then click 'Preview.' For the preview interface, see Figure 140.

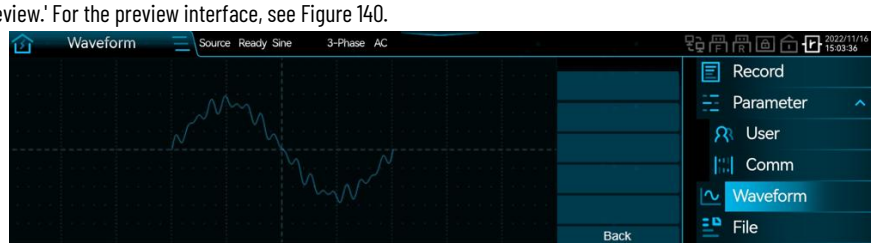


Figure 140 Waveform Preview Interface Diagram

8.12.5 File

Click Storage - File in the menu bar to enter the file interface. The file interface includes all files in the internal storage and on external USB storage devices. All internal storage files are automatically assigned their respective save paths. Only files relevant to the function being accessed will be displayed.

Refer to the Product internal storage file interface in Figure 141.

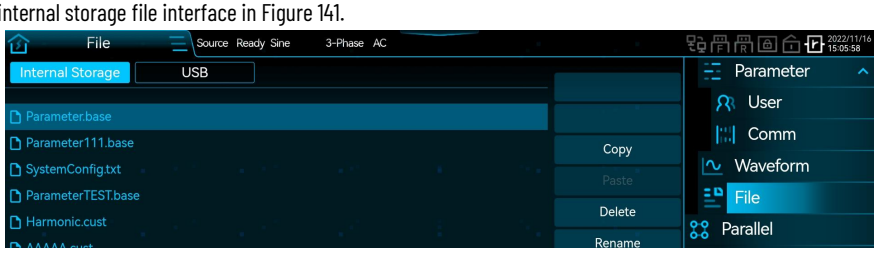


Figure 141 Product Internal Storage File Interface Diagram

Refer to the external USB storage file interface in Figure 142.

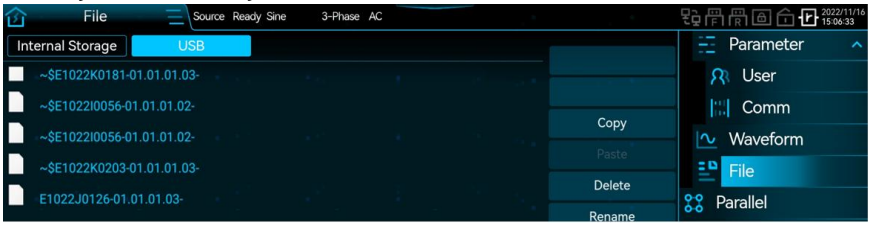


Figure 142 External USB Storage File Interface Diagram

File interaction between internal storage and external USB storage devices can be performed via the copy/paste function in the file interface.

8.13 Parallel Operation

When connecting Cortex AC Series Products in parallel, ensure the parallel fiber optic cable is correctly connected first, see section 5.10, then select 'Parallel Operation' in the menu bar to enter the parallel operation interface, and configure the master/slave settings in the Figure 143 parallel operation interface.

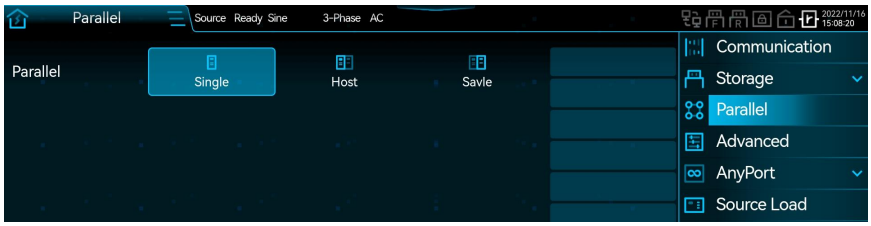


Figure 143 Parallel Operation Settings Interface Diagram

8.13.1 Master Device Configuration

When configuring the master device, set the Product as the master within the parallel operation interface; see Figure 144. All functions of the parallel system can be managed from the master device.

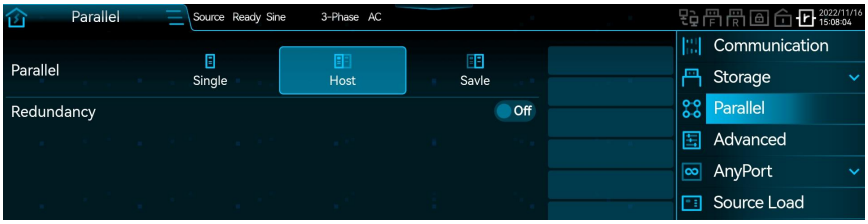


Figure 144 Master Device Configuration Interface Diagram

8.13.2 Slave Device Settings

When configuring the slave device, set the product as a slave in the parallel Main Interface; see Figure 145. For the slave Main Interface, see Figure 146, the identification number will be automatically generated according to the number of slave devices.

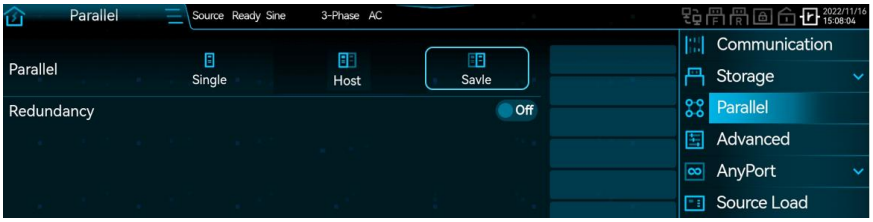


Figure 145 Slave Device Settings Interface Diagram

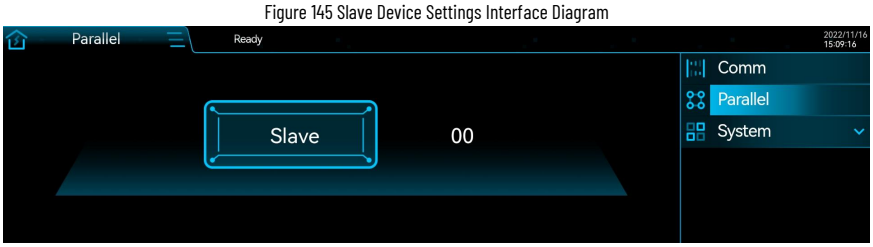
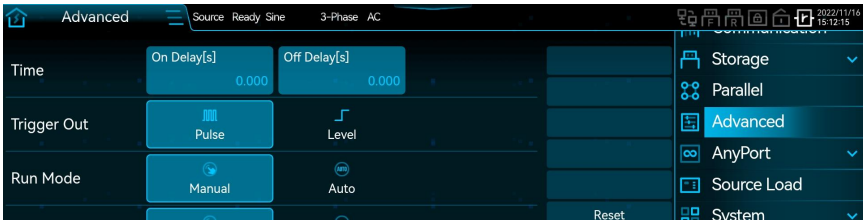


Figure 146 Slave Main Interface Diagram

8.14 Advanced

Click Advanced in the menu bar to enter the Advanced Settings interface. For the Advanced Settings interface, see Figure 147, which allows users to configure power-on/off delay time, trigger output, operation and startup modes, rotary knob function options, and Product calibration parameters. For the definition of each parameter, see Table 44. This Product supports calibration. Users may calibrate independently or contact after-sales service for factory calibration.



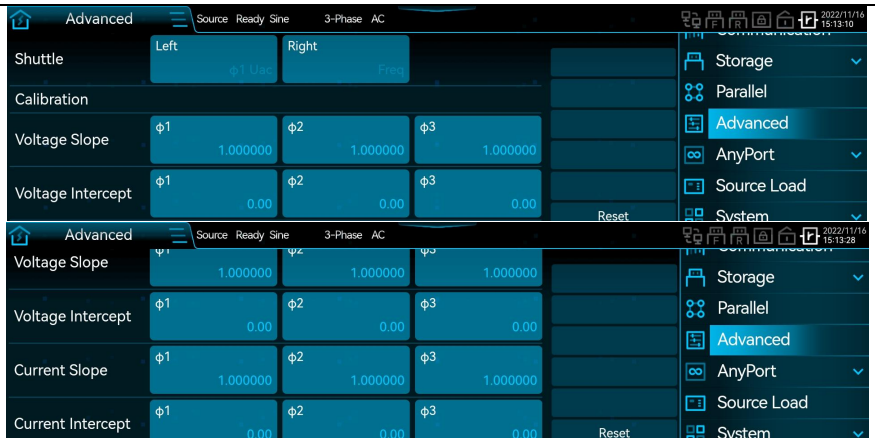


Figure 147 Advanced Settings Interface Diagram

Table 44 Advanced Settings Parameter Table

Parameter Item	Unit	Definition and Application	Model	Initial Value	Resolution	Setting Range
Power-On Delay	s	When the Product is not outputting, press the output key. The output will start after the specified delay time has elapsed.	ALL	0	0.001	0~999.999
Shutdown Delay	s	When the product is outputting, pressing the output key will stop the output after the configured delay time.	ALL	0	0.001	0~999.999
Operating Mode	\	When Automatic is selected, the output will turn on automatically after the product is powered on.	ALL	Manual	\	\
Startup Mode	\	When Automatic is selected, the product will power on automatically after being energized.	ALL	Manual	\	\
Trigger Output	\	Pulse or level trigger can be selected.	ALL	Pulse		
Left Shuttle	\	Adjusts voltage in Source Mode; adjusts current in Load Mode.	ALL	\	\	\
Right Shuttle	\	Adjusts frequency in Source Mode; not applicable in Load Mode.	ALL	\	\	\
Calibration	\	Includes four parameters: voltage slope, voltage intercept, current slope, and current intercept.	ALL	\	\	\
Voltage Slope	\	Users can set the voltage slope within the specified range.	ALL	0	0.000001	0.95~1.05
Voltage Intercept	\	Users may set the voltage intercept within the specified range.	ALL	0	0.01	-5~5
Current Slope	\	Users may set the current slope within the specified range.	ALL	0	0.000001	0.95~1.05
Current Intercept	\	Users may set the current intercept within the specified range.	ALL	0	0.01	-3~3

Calibration includes voltage calibration and current calibration. Prior to calibration, short the N line of the Output Terminal, then perform calibration according to the following procedures.

1. Voltage Calibration

No external load is required for the Product. Set all protection parameters to their maximum values; see Section 8.9. Connect a voltmeter with an accuracy better than 0.01% (set to DC mode) to the Output Measurement Interface on the Rear Panel, and set the Product coupling mode to Three-Phase DC. Set the voltage values to +600V, -600V, and 0V respectively, and apply the output. Record the voltmeter readings and Product display values for each phase (as one set). Using the three sets of data for each phase, calculate the voltage slope and voltage intercept for each phase, and enter themFigure 147in the corresponding fields to complete the voltage calibration.

2. Current Calibration

After properly connecting an appropriate Load to the Product, set all protection parameters to their maximum values as described in Section 8.9. Connect a current meter with an Accuracy of 0.1% or better to the Output Terminal, set the meter to DC mode, and configure the Product's coupling mode to Three-Phase DC. Set the voltage value to +100V, output +30A, -30A, and 0A respectively, and record the current meter readings and Product display values for each phase (as one set). Using the three sets of data for each phase, calculate the current slope and current intercept for each phase, and enter themFigure 147At the corresponding position, current calibration is thus completed.

After completing both voltage and current calibrations, press and hold the Power/Reset Button to shut down. Upon restarting, the calibration parameters will have been saved.

Note: If Reset Calibration is pressed, the above calibration parameters will be cleared. To retain the parameters, press and hold the Power/Reset Button again to shut down.

8.15 Anyport

Anyport includes both digital and analog sections; seeFigure 148。Each enable switch corresponds to a specific pin on the Anyport Interface. Ensure correct one-to-one correspondence during operation.

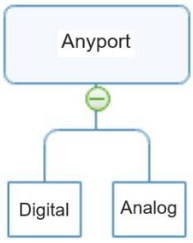


Figure 148 Anyport Function Tree Diagram

8.15.1 Digital

Click Anyport – Digital in the menu bar to access the digital settings interface.

8.15.1.1 Digital Input

The Anyport Digital Input settings interface is shown in Figure 149, enabling external enable, trigger, interlock, start/stop, reset, emergency stop, and external synchronization input functions under both positive and negative polarities. For further details on digital input functions, see Table 45.

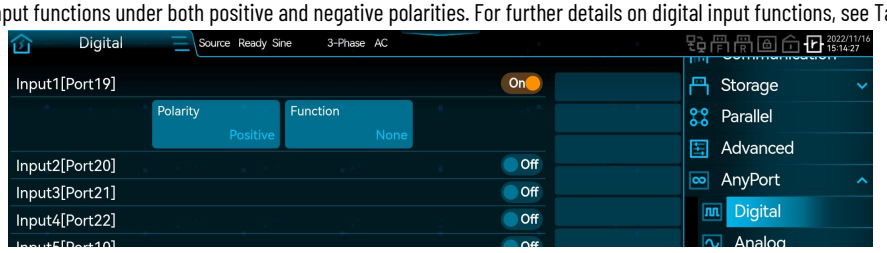


Figure 149 Digital Input Settings Interface Diagram

Table 45 Digital Input Function Description Table

Interface Type	Interface Name	Function Description
Digital Input	Input 1 [Port19]	Polarity: Select the active level. 1) Positive: Active high. 2) Negative: Active low. Function 1) External Enable: Enables the Analog Input function. 2) Trigger: Utilizes an external pulse signal (pulse width greater than 50 μs) to trigger List, Wave, Step, Pulse, Advanced programming, as well as Harmonic and Interharmonic operation. 3) Interlock: Interlock shutdown. 4) Start/Stop: Utilizes an external level signal; starts when active, stops when inactive. 5) Reset: Utilizes an external pulse signal (pulse width greater than 50 μs) to reset. 6) Emergency Stop: Utilizes an external level signal for emergency stop. 7) External Synchronization Input: Utilizes an external pulse signal (pulse width exceeding 50 μs) to enable multiphase output functionality.
	Input 2 [Port20]	
	Input 3 [Port21]	
	Input 4 [Port22]	
	Input 5 [Port10]	
	Input 6 [Port11]	

8.15.1.2 Digital Output

See the Anyport Digital Output interface Figure 150, which enables interlock, trigger, voltage indication, current indication, general-purpose I/O, and external synchronization output functions under positive or negative polarity. It can also monitor the product's operating status, CV status, and protection status. For details on Digital Output functions, refer to Table 46.

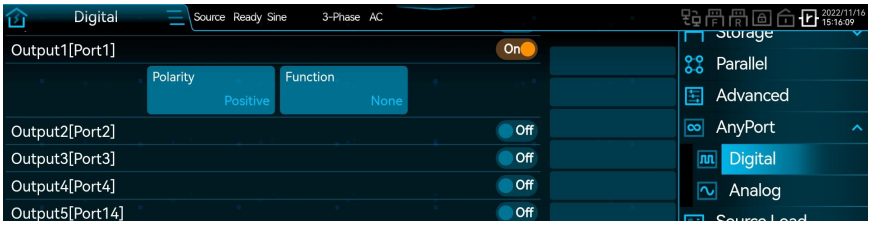


Figure 150 Digital Output Settings Interface Diagram

Table 46 Digital Output Function Definition Table

Interface Type	Interface Name	Function Description
Digital Output	Output 1 [Port1]	Polarity: Select the active level. 1) Positive: Active high. 2) Negative: Active low. Function 1) Interlock: Follows the Digital Input interlock. 2) Trigger: When output switching, steady-state setpoint changes, or programmed trigger output occurs, a 100 μs pulse signal is generated. The pulse amplitude is determined by the external pull-up voltage. 3) Voltage Indicator: In Source Mode, when the external setpoint is enabled and any of Analog Input Φ1, Φ2, or Φ3 is enabled, an active output level is provided. 4) Current Indicator: In Load Mode, when the external setpoint is enabled and any of Analog Input Φ1, Φ2, or Φ3 is enabled, an active output level is provided. 5) General I/O: User-defined output I/O interface, continuously outputs an active level. 6) External Synchronization Output: Used for multiphase output functionality. 7) Operating Status: Continuously outputs an active level when the output is enabled. 8) CV Status: Constant Voltage status indicator. 9) Protection Status: Continuously outputs an active level when the product is in protection mode.
	Output 2 [Port2]	
	Output 3 [Port3]	
	Output 4 [Port4]	
	Output 5 [Port14]	
	Output 6 [Port15]	

8.15.2 Analog

Click Anyport-Analog in the menu bar to access the analog settings interface.

8.15.2.1 Analog Input

Anyport-Analog Input Interface Diagram Figure 151and Figure 152, the analog input becomes active after an external enable is provided to any terminal of the Digital Input. For details on the analog input function, see Table 47.

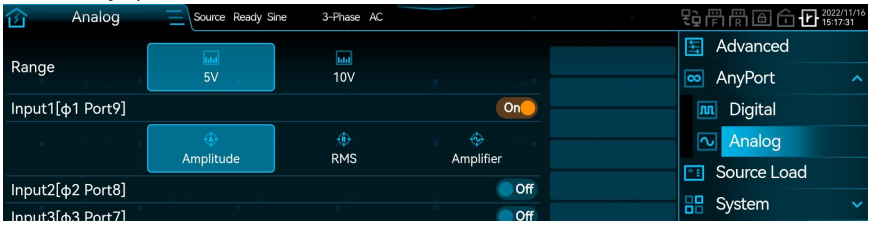


Figure 151 Analog Input Settings Interface Diagram 1

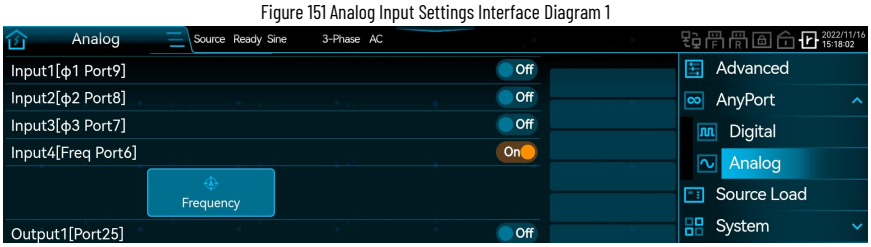


Figure 152 Analog Input Settings Interface Diagram 2

Table 47 Analog Input Function Description Table

Interface Type	Interface Name	Function Description
Analog Input	Input 1 [Φ1 Port9]	Tracking Amplitude Tracking RMS Value Real-Time Tracking
	Input 2 [Φ 2 Port8]	
	Input 3 [Φ 3 Port7]	
	Input 4 [Freq Port6]	Frequency Tracking: Supported only in Source Mode.

(1) Tracking Amplitude:

1) When the coupling mode is AC or AC+DC, the following formula may be used:

5V range: Peak value of output sine wave = Vref(dc) / 5V(dc) × 450V(ac) × 1.414

10V range: Peak value of output sine wave = Vref(dc) / 10V(dc) × 450V(ac) × 1.414

Example: When using the 5V range, if a sine wave peak value of 300V is required, the external reference voltage Vref should be set to 2.357V(dc).

When using the 10V range, if a sine wave peak value of 300V is required, the external reference voltage Vref should be set to 4.715V(dc).

If the external reference is less than 0, the output is 0.

2) When the coupling mode is set to DC, the following formula can be used:

5V range: Vout = Vref(dc) / 5V(dc) × 636V(dc)

10V Range: Vout = Vref(dc)/10V(dc) × 636V(dc).

Example: When using the 5V range, if Vout is required to be 300V, the external reference voltage Vref should be set to 2.358V(dc). If Vout is required to be -300V, the external reference voltage Vref should be set to -2.358V(dc).

When using the 10V range, if Vout is required to be 300V, the external reference voltage Vref should be set to 4.717V(dc). If Vout is required to be -300V, the external reference voltage Vref should be set to -4.717V(dc).

(2) Tracking RMS value:

1) When the coupling mode is AC or AC+DC, the following formula may be used:

5V Range: RMS value of output sine wave = Vref(dc)/5V(dc) × 450V(ac).

10V Range: RMS value of output sine wave = Vref(dc)/10V(dc) × 450V(ac).

Example: When using the 5V range, if an RMS output of 300V sine wave is required, the external reference voltage Vref should be 3.333V (DC).

When using the 10V range, if an RMS output of 300V sine wave is required, the external reference voltage Vref should be 6.667V (DC).

If the external reference is less than 0, the output is 0.

2) When the coupling mode is set to DC, the following formula can be used:

5V range: Vout = Vref(dc) / 5V(dc) × 636V(dc)

10V Range: Vout = Vref(dc)/10V(dc) × 636V(dc).

Example: When using the 5V range, if Vout is required to be 300V, the external reference voltage Vref should be set to 2.358V(dc). If Vout is required to be -300V, the external reference voltage Vref should be set to -2.358V(dc).

When using the 10V range, if Vout is required to be 300V, the external reference voltage Vref should be set to 4.717V(dc). If Vout is required to be -300V, the external reference voltage Vref should be set to -4.717V(dc).

(3) Real-Time Tracking

The following formulas can be used for calculation:

5V range: Vout = Vref(dc) / 5V(dc) × 636V(dc)

10V Range: Vout = Vref(dc)/10V(dc) × 636V(dc).

Example: When using the 5V range, if Vout is required to be 300V, the external reference voltage Vref should be set to 2.358V(dc). If Vout is required to be -300V, the external reference voltage Vref should be set to -2.358V(dc).

When using the 10V range, if Vout is required to be 300V, the external reference voltage Vref should be set to 4.717V(dc). If Vout is required to be -300V, the external reference voltage Vref should be set to -4.717V(dc).

(4) Tracking Frequency

When the coupling mode is AC or AC+DC, the following formula may be used:

5V range: Freq = Vref (DC) / 5V (DC) × 200Hz

10V range: Freq = Vref (DC) / 10V (DC) × 200Hz

Example: When using the 5V range, if the required Output Frequency (Freq) is 50Hz, the external reference voltage Vref should be 1.25V.

When using the 10V range, if the required Output Frequency (Freq) is 50Hz, the external reference voltage Vref should be 2.5V.

Note: In load Mode, the Anyport-Analog Input does not support frequency tracking; real-time tracking is equivalent to tracking the effective value. For tracking amplitude and tracking the effective value, refer to the above formulas.

8.15.2.2 Analog Output

See the Anyport-Analog Output Interface Diagram Figure 153 For detailed information on analog input/output functions, see Table 48.

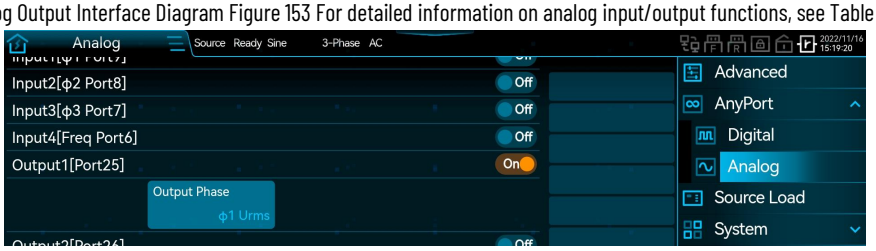


Figure 153 Analog Output Setting Interface Diagram

Table 48 Analog Output Function Definition Table

Interface Type	Interface Name	Function Description		
Analog Output	Output 1 [Port25]	Indicates the RMS voltage, RMS current, Active Power, apparent power, and reactive power for each phase, as well as the total active power, total apparent power, and total reactive power. Analog Output supports only the 5V Range. For the corresponding parameter Range table, see Table 49。		
		Φ1 Urms: Φ1 RMS Voltage	Φ2 Urms: Φ2 Voltage RMS	Φ3 Urms: Φ3 Voltage RMS
		Φ1 Irms: Φ1 Current RMS	Φ2 Irms: Φ2 Current RMS	Φ3 Irms: Φ3 Current RMS
	Output 2 [Port 26]	Φ1 P: Φ1 Active Power	Φ2 P: Φ2 Active Power	Φ3 P: Φ3 Active Power
		Φ1 S: Φ1 Apparent Power	Φ2 S: Φ2 Apparent Power	Φ3 S: Φ3 Apparent Power
		Φ1 Q: Φ1 Reactive Power	Φ2 Q: Φ2 Reactive Power	Φ3 Q: Φ3 Reactive Power
		Σ P: Total Active Power	Σ S: Total Apparent Power	Σ Q: Total Reactive Power

Table 49 Analog Output Range Parameter Table

Parameter Item	Unit	Coupling Method	Range (V)	Parameter Range	Model
Φ1 Urms	V	AC or AC+DC	0~5	0~636	ALL
		DC	-5~5	-636~636	
Φ1 Irms	A	AC or AC+DC	0~5	0~30	CA06-450
		DC	-5~5	-30~30	CA7.5-450
		AC or AC+DC	0~5	0~35	CA09-450
					CA12-450
		DC	-5~5	-35~35	CA15-450
					CA20-450
					CA22-450
Φ1 P	kW	AC or AC+DC	0~5	0~2	CA06-450
		DC	-5~5	-2~2	
		AC or AC+DC	0~5	0~2.5	CA7.5-450
		DC	-5~5	-2.5~2.5	
		AC or AC+DC	0~5	0~3	CA09-450
		DC	-5~5	-3~3	
		AC or AC+DC	0~5	0~4	CA12-450
		DC	-5~5	-4~4	
		AC or AC+DC	0~5	0~5	CA15-450
		DC	-5~5	-5~5	
		AC or AC+DC	0~5	0~6.667	CA20-450
		DC	-5~5	-6.667~6.667	
		AC or AC+DC	0~5	0~7.333	CA22-450
		DC	-5~5	-7.333~7.333	
Φ1 S	kW	AC or DC or AC+DC	0~5	0~2	CA06-450
				0~2.5	CA7.5-450
				0~3	CA09-450
				0~4	CA12-450
				0~5	CA15-450
				0~6.667	CA20-450
				0~7.333	CA22-450
Φ1 Q	kW	AC or DC or AC+DC	0~5	0~2	CA06-450
				0~2.5	CA7.5-450
				0~3	CA09-450
				0~4	CA12-450
				0~5	CA15-450
				0~6.667	CA20-450
				0~7.333	CA22-450
Σ P	kW	AC or AC+DC	0~5	0~6	CA06-450
		DC	-5~5	-6~6	
		AC or AC+DC	0~5	0~7.5	CA7.5-450
		DC	-5~5	-7.5~7.5	
		AC or AC+DC	0~5	0~9	CA09-450
		DC	-5~5	-9~9	
		AC or AC+DC	0~5	0~12	CA12-450
		DC	-5~5	-12~12	
		AC or AC+DC	0~5	0~15	CA15-450
		DC	-5~5	-15~15	
		AC or AC+DC	0~5	0~20	CA20-450
		DC	-5~5	-20~20	
		AC or AC+DC	0~5	0~22	CA22-450
		DC	-5~5	-22~22	
Σ S	kW	AC or DC or AC+DC	0~5	0~6	CA06-450
				0~7.5	CA7.5-450
				0~9	CA09-450
				0~12	CA12-450
				0~15	CA15-450
				0~20	CA20-450
				0~22	CA22-450
Σ Q	kW	AC or DC or AC+DC	0~5	0~6	CA06-450
				0~7.5	CA7.5-450
				0~9	CA09-450
				0~12	CA12-450
				0~15	CA15-450
				0~20	CA20-450
				0~22	CA22-450

Note: 1. For Φ1 in Single Phase, the corresponding current and power parameters must be multiplied by 3.

2, Φ2, and Φ3 are invalid in Single Phase. For other corresponding parameter ranges, refer to Φ1.

3. The ranges listed in the table are parameters for a single unit; when operating in parallel, the current and power settings must be multiplied by the number of parallel units.

8.16 Source Load

Click Source Load in the menu bar to enter the Source Load settings interface. See Figure 154. The Source Load settings interface allows switching the operating mode of Cortex AC Series Products. Upon switching, the power supply mode status display will also change accordingly.

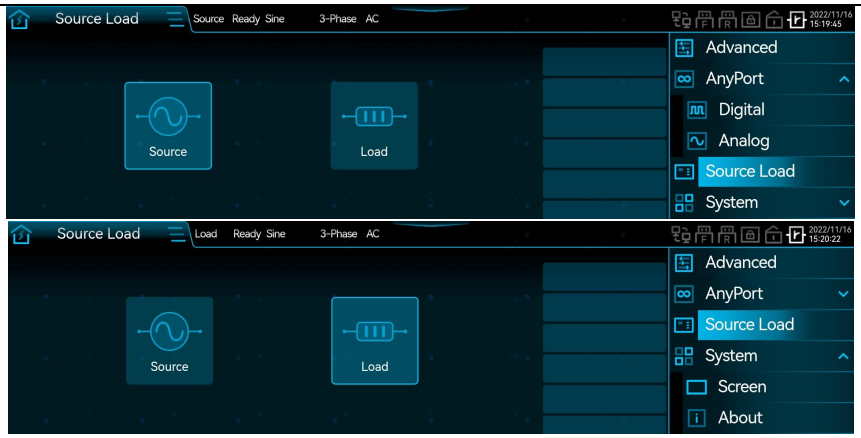


Figure 154 Source Load Settings Interface Diagram

For functions and operations in Load Mode, see section 9 chapter.

8.17 System

The system consists of two parts: Screen and About. See Figure 155.

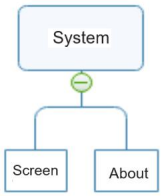


Figure 155 System Function Tree Diagram

8.17.1 Screen

Click System - Screen in the menu bar to enter the Screen interface. See Figure 156. Within the Display Screen interface, you can configure the screen brightness, screensaver duration, alarm sound, and date and time.

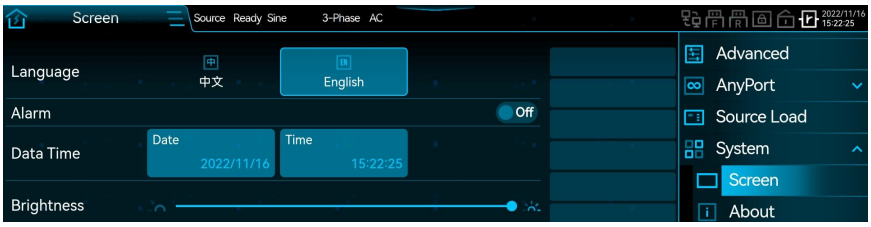


Figure 156 Display Screen Interface Diagram

8.17.2 About

Click System - About in the menu bar to access the About interface. In the About interface, you can view the device information and software version of the Cortex AC Series Products, see Figure 157. Device information includes product model, hardware version, device serial number, power-on count, and operating time (as applicable).

Figure 157 About Interface Diagram

9 Load Mode

The Cortex AC Series Products can also operate in Load Mode. All functions and operations in Load Mode can be performed on the Display Screen, and you can swipe horizontally or vertically within each function interface to view related content. This chapter primarily introduces certain aspects of the Main Interface, Mode, Parameters, Limit Values, and Protection in Load Mode. The remaining sections are consistent with those in Source Mode; for details, refer to Section 8 chapter.

9.1 Source/Load Switching

For Source/Load Switching, refer to Section 8.16. A prompt box will appear during the switching process, as shown in Figure 158.

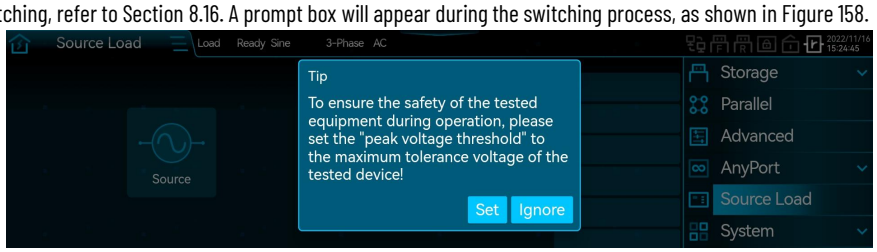


Figure 158 Source/Load Switch Prompt Interface Diagram

Users can set the rapid peak overvoltage threshold of the Cortex AC Series Products according to the maximum withstand voltage of the device under test. If 'Set' is selected, the system enters the 'Protection' interface to configure the rapid peak overvoltage threshold. If 'Ignore' is selected, the prompt box will close.

9.2 Main Interface

The Cortex AC Series Products provide five modes in Load Mode: CC, CP, CR, RLC, and PQ. Refer to Section 9.3 for the selection. When CC Mode is selected, refer to the Main Interface Figure 159.

Figure 159 CC Mode Main Interface Diagram

Time indicates the operating duration. When enabled in Section9.4After enabling load timing in the 'Parameters' interface of this section, the timing duration can be set, at which point Time indicates the countdown. In the Output Setting Area, you can set the Output Current (Iac), Crest Factor (CF), and Power Factor (PF); CF and PF can be selected in 'Mode' - 'CF/PF Setting'. For the Status Display Area, Menu Key, Home Key, Output Display Area, and Dropdown Quick Access Area, please refer to the Main Interface of source mode.

9.3 Mode

In the menu bar, click Mode to enter the Mode Settings interface. In the Mode Setting Interface, you can select the number of output phases, Load Mode, coupling method, CF/PF setting, and waveform selection for Cortex AC Series Products.

9.3.1 Number of Output Phases

The number of output phases available for Cortex ACLoad Modes includes: Single Phase, Three-Phase, and Split Phase. In Split-phase Mode, there are three options for the number of output phases: Φ1 indicates only Phase A is enabled; Φ1Φ2 indicates only Phases A and B are enabled; Φ1Φ2Φ3 indicates Phases A, B, and C (Three-Phase) are enabled. SeeFigure 160 Split-phase Mode Enable Interface.

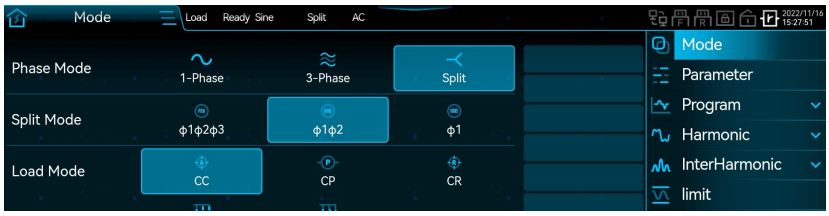


Figure 160 Split-phase Mode Enable Interface

When using Load Split-phase Mode, pay attention to the wiring method:

a) When Φ1 is selected, the device under test needs only to be connected to Phase A of the PRE20 Product; Phases B and C are not connected.

b) When Φ1Φ2 is selected, the device under test needs only to be connected to Phases A and B of the PRE20 Product; Phase C is not connected.

Note: After pressing the Output Button, the Output Terminal must not be touched. Observe electrical safety precautions.

9.3.2 Load Mode

The Load Mode of the Cortex AC Series Products includes five Modes: CC, CP, CR, RLC, and PQ.

9.3.2.1 CC Mode

CC mode, or Constant Current mode, allows for constant current output according to the set current when the input voltage mee he minimum startup voltage requirement. Press the menu key to enter the CC mode settings, as shown in Figure 161.

a) For detailed settings on the number of output phases, refer to Section 9.3.1.

b) For detailed settings on coupling mode, refer to Section 9.3.3.

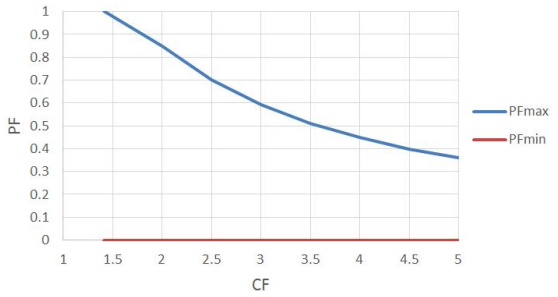
c) CF/PF settings: In CC mode, there are four CF/PF configuration options: CF, PF, CF Priority, and PF Priority.

d) Press the Home key to enter the Main Interface, configure parameters, and set the current amplitude, CF, and PF values. Using Three-Phase AC as an example, the configuration interface is shown in Figure 159.

Figure 161 CC Mode Settings Interface Diagram

When CF/PF setting is selected as PF, the CF value is 1.414; when selected as CF, the PF value corresponds to PFmax.

When the CF/PF setting is configured to either PF Priority or CF Priority, specifying one value will automatically match the corresponding range of the other value. The relationship between PF and CF is provided in Figure 162.



CF	PFmax	PFmin
1.414	1.000	0.000
2.000	0.849	0.000
2.500	0.703	0.000
3.000	0.593	0.000
3.500	0.511	0.000
4.000	0.449	0.000
4.500	0.399	0.000
5.000	0.360	0.000

Figure 162 PF and CF Relationship Curve Diagram

When PF Priority is selected:

If PF=0.7 and CF=3 are set, according to their relationship, when PF=0.7, the valid CF range is 1.414-2.516. The Product will operate at the CF value closest to 3. In this scenario, the CF value corresponding to PF=0.7 is 2.516.

If PF=0.7 and CF=2 are set, according to their relationship, when PF=0.7, the valid CF range is 1.414-2.516. Since CF=2 is within this range, in this case, the CF value corresponding to PF=0.7 is 2.

When CF Priority is selected:

If CF=1.6 and PF=0.98 are set, according to the relationship between the two, when CF=1.6, the valid PF range is 0 to 0.973. The product will operate at the PF value closest to 0.98, which is 0.973 when matched with CF=1.6.

If CF=1.6 and PF=0.8 are set, according to the relationship between the two, when CF=1.6, the valid PF range is 0 to 0.973. Since PF=0.8 is within this range, the PF value matched with CF=1.6 is 0.8.

9.3.2.2 CP Mode

CP Mode refers to Constant Power Mode, in which the output maintains a constant power level according to the set power parameters. When CP mode is set and the coupling method is AC or AC+DC, the Output Setting Area on the Main Interface allows configuration of apparent power S, crest factor CF, and power factor PF. If the coupling method is DC, the Output Setting Area on the Main Interface allows configuration of active power P. Press the Menu key to enter CP mode settings, see Figure 163- Figure 164.

a) For detailed settings on the number of output phases, refer to Section 9.3.1.

b) For detailed coupling method settings, refer to Section 9.3.3.

c) CF/PF Settings: In CC mode, there are four options for CF/PF setting: CF, PF, CF Priority, and PF Priority. For details, refer to Section 9.3.2.1.

d) Press the Home key to enter the Main Interface for parameter configuration. Apparent power S, crest factor CF, power factor PF, or active power P can be set. For an example with three-phase AC, refer to Figure 165.

Figure 163 CP Mode Setting Interface Diagram 1

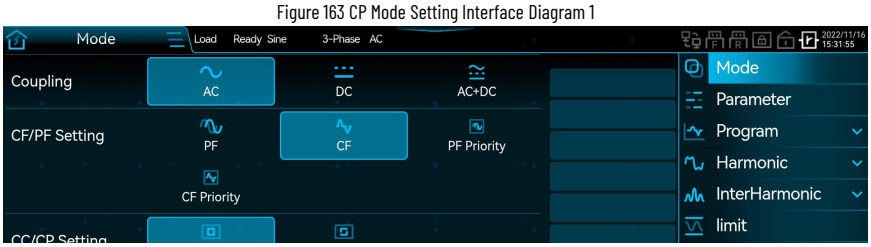


Figure 164 CP Mode Setting Interface Diagram 2

Figure 165 CP Mode Parameter Setting Main Interface

9.3.2.3 CR Mode

CR Mode refers to Constant Resistance Mode. In this mode, the load is equivalent to a constant resistor, and the load output current is linearly proportional to the input voltage at the port. Press the menu key. Enter the CP Mode settings, see Figure 166.

a) For detailed settings on the number of output phases, refer to Section 9.3.1.

b) For detailed coupling method settings, refer to Section 9.3.3.

c) CF/PF settings are not valid in this mode.

d) Press the Home key Enter the Main Interface to configure parameters, set the load R, and display the transfer time (Transfer). Using three-phase AC as an example, for details on the main interface settings, refer to Figure 167.

Figure 166 CR Mode Setting Interface Diagram

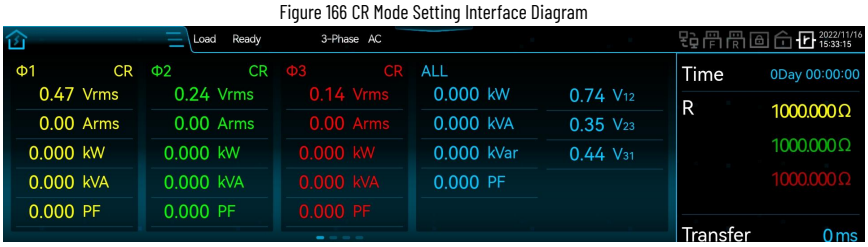


Figure 167 CR Mode Setting Main Interface Diagram

9.3.2.4 RLC Mode

In RLC Mode, you can select the circuit topology. Different topologies require different parameter settings to achieve various simulation states. Press the menu key. Enter RLC Mode settings, see Figure 168.

a) For detailed settings on the number of output phases, refer to Section 9.3.1.

b) Press the Home key Enter the Main Interface to configure parameters and set RLC-related load parameters. For basic parameters, seeTable 50As an example of a three-phase AC, for Main Interface settings, see Figure 169.

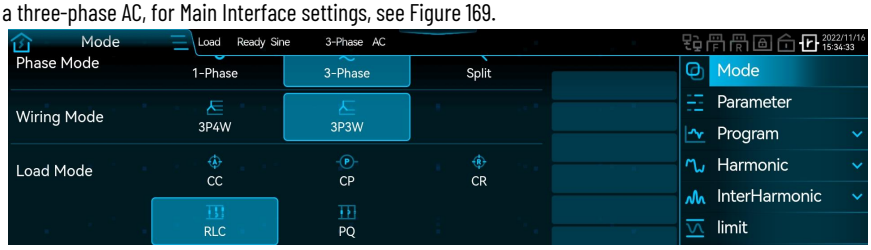


Figure 168 RLC Mode Interface Diagram

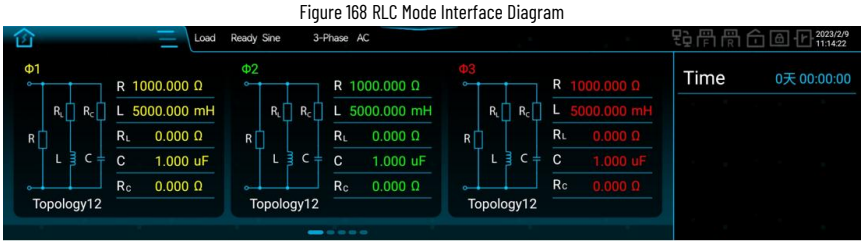


Figure 169 RLC Mode Parameter Setting Page Diagram

Table 50 RLC Mode Basic Parameter Table

Parameter Item	Unit	Definitions	Model	Initial Value	Resolution	Setting Range
R	Ω	Load Resistance	ALL	1000	0.1	0.001~1000
L	mH	Load Inductance	ALL	5000	0.1	1~5000
R_L	Ω	Inductor Internal Resistance	ALL	0	0.001	0~1000
C	μF	Load Capacitance	ALL	1	0.001	1~5000
R_C	Ω	Capacitor Internal Resistance	ALL	0	0.001	0~1000

9.3.2.5 PQ Mode

PQ Mode refers to Power Control Mode. By setting the Active Power P, the Inductive Reactive Power Q_L, and the Capacitive Reactive Power Q_C, different load conditions can be simulated. Select the menu button Enter PQ Mode settings, see Figure 170.

a) For detailed settings on the number of output phases, refer to Section 9.3.1.

b) Press the Home key Enter the Main Interface, configure the parameters, and set PQ-related load parameters. For basic parameters, see Table 51, Taking the Three-Phase AC as an example, refer to Figure 171 for the Main Interface configuration details.

Figure 170 PQ Mode Interface Diagram

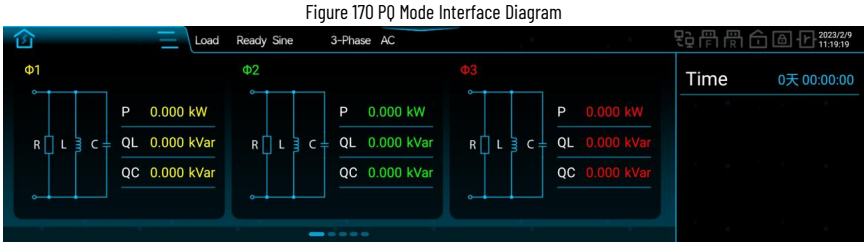


Figure 171 PQ Mode Parameter Setting Interface Diagram

Table 51 PQ Mode Basic Parameter Table

Parameter Item	Unit	Definitions	Model	Initial Value	Resolution	Setting Range
P	kW	Active Power	CA06-450	0	0.001	0~2
			CA7.5-450			0~2.5
			CA09-450			0~3
			CA12-450			0~4
			CA15-450			0~5
			CA20-450			0~6.667
			CA22-450			0~7.333
QL	kVar	Inductive Reactive Power	CA06-450	0	0.001	0~2
			CA7.5-450			0~2.5
			CA09-450			0~3
			CA12-450			0~4
			CA15-450			0~5
			CA20-450			0~6.667
			CA22-450			0~7.333
QC	kVar	Capacitive Reactive Power	CA06-450	0	0.001	0~2
			CA7.5-450			0~2.5
			CA09-450			0~3
			CA12-450			0~4
			CA15-450			0~5
			CA20-450			0~6.667
			CA22-450			0~7.333

Note: The setting ranges listed in the table apply to a single unit. For parallel operation, multiply by the number of units.

9.3.3 Coupling Method

PRE20 offers three coupling methods: AC, DC, and AC+DC.

a) When AC coupling is selected, PRE20 outputs only the configured alternating current. It is recommended that the Output Voltage of the device under test should be an AC voltage without DC bias (such as sine wave, square wave, or clipped wave), and PRE20 outputs the waveform selected in the interface.

b) When DC coupling is selected, PRE20 outputs only the configured direct current.

c) When AC+DC coupling is selected, PRE20 outputs only the configured combination of alternating current and direct current; PRE20 outputs alternating current plus direct current.

d) When the output voltage of the device under test is irregular and does not conform to the aforementioned three coupling methods, select CR Mode for loading. For detailed instructions, refer to Section 9.3.2 Settings.

9.4 Parameter

Click 'Parameter' in the menu bar to access the parameter setting interface, see Figure 172 and Figure 173. For the parameter definition table, see Table 52.

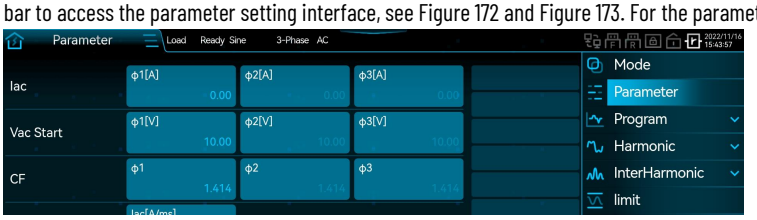


Figure 172 Load Mode Parameter Setting Interface Diagram 1

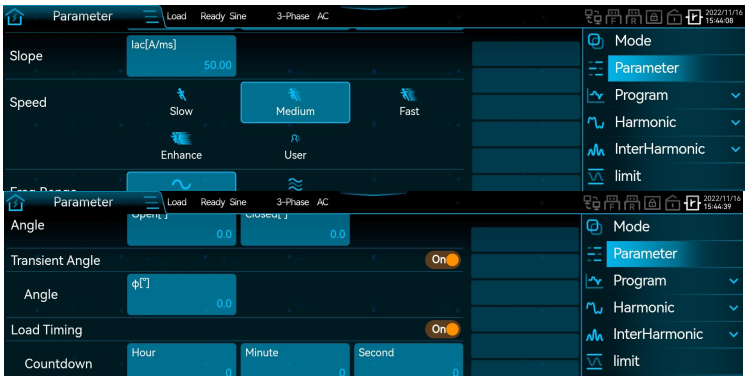


Figure 173 Load Mode Parameter Setting Interface Diagram 2

Table 52 Partial Parameter Definitions Table for Load Mode

Parameter Item	Unit	Definition and Application	Model	Resolution	Initial Value	Setting Range
AC Current	A	In CC Mode, the Output Alternating Current setting of the Product.	CA06-450	0.01	0	Three-Phase/Split Phase: 0-30 Single Phase: 0-90
			CA7.5-450			
			CA09-450			Three-Phase/Split Phase: 0-35 Single Phase: 0-105
			CA12-450			
			CA15-450			
			CA20-450			
			CA22-450			
Direct Current	A	In CC Mode, the Output Direct Current setting of the Product.	CA06-450	0.01	0	Three-Phase/Split Phase: -30 to 30 Single Phase: -90 to 90
			CA7.5-450			
			CA09-450			Three-Phase/Split Phase: -35 to 35 Single Phase: -105 to 105
			CA12-450			
			CA15-450			
			CA20-450			
			CA22-450			
Apparent Power	kVA	In AC or AC+DC coupling mode, apparent power setting in CP Mode.	CA06-450	0.001	0	Three-Phase/Split-Phase: 0-2 Single Phase: 0-6
			CA7.5-450			Three/Phase: 0-2.5 Single Phase: 0-7.5
			CA09-450			Three/Phase: 0-3 Single Phase: 0-9
			CA12-450			Three/Phase: 0-4 Single Phase: 0-12
			CA15-450			Three/Phase: 0-5 Single Phase: 0-15
			CA20-450			Three-/Split-Phase: 0~6.667 Single Phase: 0~20
			CA22-450			Three-/Split-Phase: 0~7.333 Single Phase: 0~22
Active Power	kW	In DC coupling mode, active power setting in CP Mode.	CA06-450	0.001	0	Three/Neutral Phase: -2 to 2 Single Phase: -6 to 6
			CA7.5-450			Three/Neutral Phase: -2.5 to 2.5 Single Phase: -7.5 to 7.5
			CA09-450			Three/Neutral Phase: -3 to 3 Single Phase: -9 to 9
			CA12-450			Three/Neutral Phase: -4 to 4 Single Phase: -12 to 12
			CA15-450			Three/Neutral Phase: -5 to 5 Single Phase: -15 to 15
			CA20-450			Three/Neutral Phase: -6.667 to 6.667 Single Phase: -20 to 20
			CA22-450			Three/Neutral Phase: -7.333 to 7.333 Single Phase: -22 to 22
Resistance	Ω	Resistance setting in CR Mode.	ALL	0.001	1000	0.001 ~ 1000
RLC Topology Selection	/	See details in Table 53。	ALL	/	/	/
AC Start Voltage	V	When the coupling mode is AC or AC+DC, the Product will only output when the port voltage exceeds the set value.	ALL	0.01	10	0~450
DC Start Voltage	V	When the coupling mode is DC, the Product will only output when the port voltage exceeds the set value.	ALL	0.01	10	0~450
Slope	A/ms	Describes the steady-state parameter of current, namely the ratio of the increment of output current's effective value to time.	ALL		0.01	3000
Current Slew Rate	A/us	A parameter describing the output voltage transient; a larger value results in a shorter response time to the set voltage.	ALL		0.001	0.001-5
Shutdown Slew Rate	A/us	After disconnecting the output, the instantaneous voltage	ALL		0.001	0.001-5

Parameter Item	Unit	Definition and Application	Model	Resolution	Initial Value	Setting Range
		drop per μs at the output terminal can be controlled by setting the shutdown slew rate.				
Response Speed	/	System response bandwidth; users can select different response speeds to match the device under test.	ALL	/	Medium Speed	
Frequency Range		/	ALL	/	Low	Low, High
Angle		The output begins at the specified angle.	ALL	/	0°	0°~359.9°
Transient Angle		When enabled, the output will synchronously change according to the configured transient angle when changing current or frequency.	ALL	/	0°	0°~359.9°
CF	/	Crest Factor	ALL	0.001	1.414	1.414 ~ 5
PF	/	Power Factor	ALL	0.001	1	-1 ~ 1
Load Timing	/	After enabling Load Timing, the operating duration of the Load Mode can be set, and a countdown will be displayed on the Main Interface.	ALL	/	Hour: 0 Minute: 0 Second: 0	Hour: 0-9999 Minute: 0-60 Second: 0-60

Note: The setting ranges listed in the table are parameters for a single unit. When operating in parallel, the current and power settings should be multiplied by the number of parallel units.

There are a total of 12 topologies available in RLC topology selection, see Table 53. Click the area below Φ1/ Φ2/ Φ3 to select any topology.

Table 53 RLC Topology Table

Topology1	Topology2	Topology3	Topology4
Topology5	Topology6	Topology7	Topology8
Topology9	Topology10	Topology11	Topology12

The functions and operations of other parameters in the Parameter Setting interface are the same as those in Source Mode. For details, see 8.3.

9.5 Limit Value

Click Limit Value in the menu bar to enter the Limit Value Setting interface, see Figure 174. For definitions of the limit value parameters, see Table 54.

Figure 174 Load Mode Limit Value Setting Interface Diagram

Table 54 Load Mode Limit Value Setting Parameter Table

Parameter Item	Unit	Definition and Application	Model	Resolution	Initial Value	Setting Range
AC Current Lower Limit	A	Indicates the minimum AC current output for each phase. In CC Mode, this is effective when the coupling mode is set to AC or AC+DC. If the number of output phases is Three-Phase or split phase, the actual value is equal to the set value. If the number of output phases is Single Phase, the actual value is	CA06-450 CA7.5-450	0.01	0	0.00~30
			CA09-450 CA12-450		0	0.00~35

Parameter Item	Unit	Definition and Application	Model	Resolution	Initial Value	Setting Range
		three times the set value. To avoid damage to the device under test caused by excessively low output AC current due to incorrect operation, users may set the lower limit of the AC current within a safe range here.	CA15-450			
			CA20-450			
			CA22-450			
AC Current Upper Limit	A	Indicates the maximum AC output current for each phase. Effective in CC Mode when the coupling method is AC or AC+DC. When the output phase configuration is Three-Phase or Split Phase, the actual value is equal to the set value. When the output phase configuration is Single Phase, the actual value is three times the set value. To prevent damage to the device under test caused by excessive output AC current resulting from incorrect operation, the user may set the upper limit of the AC current within a safe range here.	CA06-450	0.01	30	0.00~30
			CA7.5-450			
			CA09-450		35	0.00~35
			CA12-450			
			CA15-450			
			CA20-450			
			CA22-450			
DC Current Lower Limit	A	Indicates the minimum DC output current for each phase. Effective in CC Mode when the coupling method is DC. When the output phase configuration is Three-Phase or Split Phase, the actual value is equal to the set value. When the output phase configuration is Single Phase, the actual value is three times the set value. To prevent damage to the device under test caused by excessively low output direct current resulting from incorrect operation, the user may set the lower limit of the direct current within a safe range here.	CA06-450	0.01	-30	-30~30
			CA7.5-450			
			CA09-450		-35	-35~35
			CA12-450			
			CA15-450			
			CA20-450			
			CA22-450			
DC Current Upper Limit	A	Indicates the maximum DC output current for each phase. Effective in CC Mode when the coupling method is DC. When the output phase configuration is Three-Phase or Split Phase, the actual value is equal to the set value. When the output phase configuration is Single Phase, the actual value is three times the set value. To prevent damage to the device under test caused by excessive direct current output due to improper operation, the user can set the upper limit of direct current within a safe range here.	CA06-450	0.01	30	-30~30
			CA7.5-450			
			CA09-450		35	-35~35
			CA12-450			
			CA15-450			
			CA20-450			
			CA22-450			
Apparent Power Lower Limit	kVA	Indicates the minimum apparent power value for each phase. This is effective in CP Mode when the coupling mode is AC or AC+DC. When the number of output phases is Three-Phase or split-phase, the actual value equals the set value. When the output phase is Single Phase, the actual value is three times the set value. To avoid potential damage to the device under test caused by excessively low apparent power due to improper operation, users may set the lower limit of apparent power within a safe range here.	CA06-450	0.001	0	0~2
			CA7.5-450		0	0~2.5
			CA09-450		0	0~3
			CA12-450		0	0~4
			CA15-450		0	0~5
			CA20-450			
			CA22-450		0	0~6.667
Apparent Power Upper Limit	kVA	Indicates the maximum apparent power value for each phase. This is effective in CP Mode when the coupling mode is AC or AC+DC. When the number of output phases is Three-Phase or split-phase, the actual value equals the set value. When the output phase is Single Phase, the actual value is three times the set value. To prevent damage to the device under test caused by excessive apparent power resulting from improper operation, users can set the upper limit of apparent power within a safe range here.	CA06-450	0.001	2	0~2
			CA7.5-450		2.5	0~2.5
			CA09-450		3	0~3
			CA12-450		4	0~4
			CA15-450		5	0~5
			CA20-450		6.667	0~6.667
			CA22-450		7.333	0~7.333
Active Power Lower Limit	kW	Indicates the minimum active power value for each phase. This is effective in CP Mode when the coupling method is set to DC. When the number of output phases is three-phase or split-phase, the actual value equals the set value. When the number of output phases is single phase, the actual value is three times the set value. To prevent the tested device from being damaged due to excessively low active power caused by misoperation, the active power lower limit can be set within a safe range here.	CA06-450	0.001	-2	-2~2
			CA7.5-450		-2.5	-2.5~2.5
			CA09-450		-3	-3~3
			CA12-450		-4	-4~4
			CA15-450		-5	-5~5
			CA20-450		-6.667	-6.667~6.667
			CA22-450		-7.333	-7.333~7.333
Active Power Upper Limit	kW	Indicates the maximum active power value for each phase. This is effective in CP Mode when the coupling method is set to DC. When the number of output phases is three-phase or split-phase, the actual value equals the set value. When the number of output phases is single phase, the actual value is three times the set value. To prevent damage to the equipment under test caused by excessive active power due to improper operation, the user may set the upper limit of active power within a safe range here.	CA06-450	0.001	2	-2~2
			CA7.5-450		2.5	-2.5~2.5
			CA09-450		3	-3~3
			CA12-450		4	-4~4
			CA15-450		5	-5~5
			CA20-450		6.667	-6.667~6.667
			CA22-450		7.333	-7.333~7.333
Lower Resistance Limit	Ω	The minimum resistance value set in CR Mode.	ALL	0.001	1	0.001~1000
Upper Resistance Limit	Ω	The maximum resistance value set in CR Mode.	ALL	0.001	1000	0.001~1000

Note: The setting ranges listed in the table are parameters for a single unit. When operating in parallel, the current and power settings should be multiplied by the number of parallel units.

9.6 Protection

Click Protection in the menu bar to enter the Protection Setting interface, see Figure 175. For explanations of the protection parameters, see Table 55.

Figure 175 Load Mode Protection Setting Interface Diagram

Table 55 Load Mode Protection Setting Parameter Table

Parameter Item	Unit	Definition and Application	Model	Resolution	Initial Value	Setting Range
Fast Peak Overvoltage Threshold	V	Fast peak overvoltage protection threshold, valid only in Load Mode. When it is necessary to protect the instantaneous value of the Maximum Voltage at the Output Terminal, this parameter can be configured.	ALL	0.01	650	0~700
RMS Overvoltage Threshold	V	RMS overvoltage protection limit. This parameter can be configured to protect the RMS value of the Maximum Voltage at the Output Terminal, if required.	ALL	0.01	636	0~636
AC Overvoltage Threshold	V	AC overvoltage protection limit. This parameter can be configured to protect the Maximum AC Voltage at the Output Terminal, if required.	ALL	0.01	450	0~450
Direct Current Forward Overvoltage Threshold	V	Direct Current forward overvoltage protection limit. This parameter can be configured to protect the maximum forward Direct Current voltage at the Output Terminal, if required.	ALL	0.01	636	0~636
Direct Current Reverse Overvoltage Threshold	V	Direct Current reverse overvoltage protection limit. This parameter can be configured to protect the maximum reverse Direct Current voltage at the Output Terminal, if required.	ALL	0.01	-636	-636~0
Load AC Undervoltage Threshold	V	Load AC undervoltage protection threshold, effective only in Load Mode. This parameter can be set when the user needs to protect the minimum AC voltage at the Output Terminal.	ALL	0.01	10	10~450
RMS Overcurrent Threshold	A	Indicates the RMS overcurrent protection threshold for each phase. When the number of output phases is three-phase or split-phase, this indicates the RMS overcurrent protection threshold for each phase. When the number of output phases is single phase, the actual value is three times the set value. If the user needs to protect the maximum current at the output terminal, this parameter may be set.	CA06-450 CA7.5-450	0.01	31.5	0~31.5
			CA09-450 CA12-450 CA15-450 CA20-450 CA22-450 CA22-450		36.75	0~36.75
Active Power Threshold	kW	Total Active Power protection threshold. This parameter can be set when the user needs to protect the maximum Active Power at the Output Terminal.	CA06-450	0.001	6.3	0~6.3
			CA7.5-450		7.875	0~7.875
			CA09-450		9.45	0~9.45
			CA12-450		12.6	0~12.6
			CA15-450		15.75	0~15.75
			CA20-450		21	0~21
			CA22-450		23.1	0~23.1
Apparent Power Threshold	kVA	Total apparent power protection threshold. To protect the maximum apparent power at the Output Terminal, set this parameter.	CA06-450	0.001	6.3	0~6.3
			CA7.5-450		7.875	0~7.875
			CA09-450		9.45	0~9.45
			CA12-450		12.6	0~12.6
			CA15-450		15.75	0~15.75
			CA20-450		21	0~21
			CA22-450		23.1	0~23.1
Over-frequency threshold	Hz	Over-frequency protection threshold. To protect the maximum Frequency of AC voltage at the Output Terminal, set this parameter.	ALL	0.001	2000	0.001~2000
Under-frequency threshold	Hz	Under-frequency protection threshold. To protect the minimum Frequency of AC voltage at the Output Terminal, set this parameter.	ALL	0.001	0.001	0.001~2000
Protection time	s	If, within the specified protection time, the Product detects that any output parameter continuously exceeds the protection threshold, protection will be	ALL	0.001	0.1	0.001~3

Parameter Item	Unit	Definition and Application	Model	Resolution	Initial Value	Setting Range
		triggered.				

Note: 1. The setting ranges listed in the table are for single-unit parameters. For parallel operation, the current and power settings should be multiplied by the number of units in parallel.

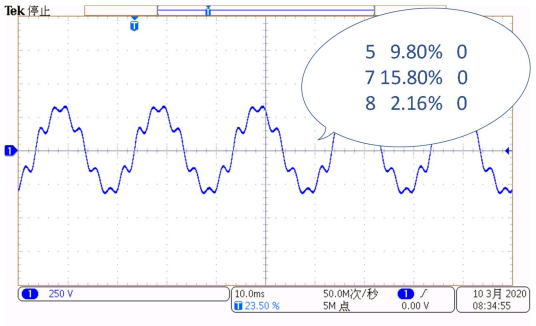
2. In the table, the initial protection time for load AC undervoltage is set to 0.02.

9.7 Anyport

In the menu bar ☰ Click Anyport to enter the digital and analog settings interface. For detailed instructions, refer to 8.15 the relevant section. Note that in Load Mode, Anyport does not support real-time tracking functionality.

10 Appendix – Built-in Harmonic Examples

The Cortex AC Series Products are equipped with 30 commonly used Harmonics. The corresponding internal naming and sample effects are as follows:



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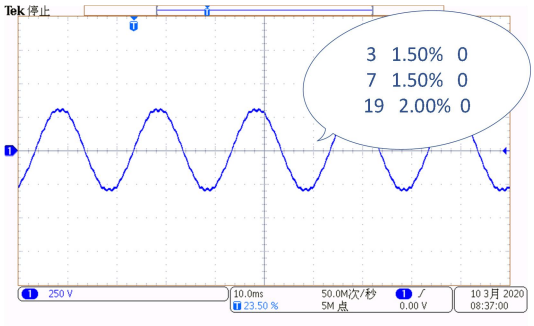

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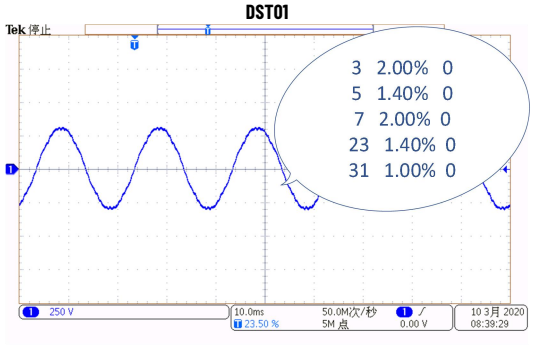

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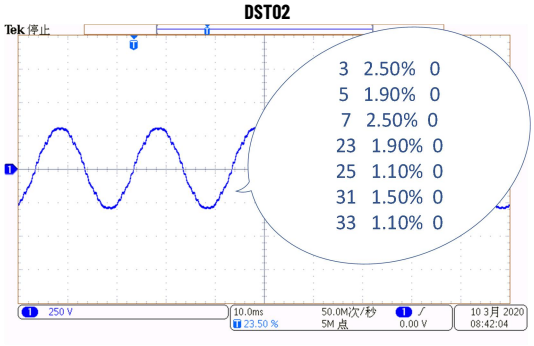

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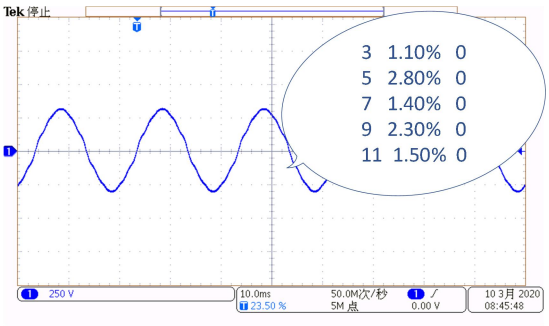

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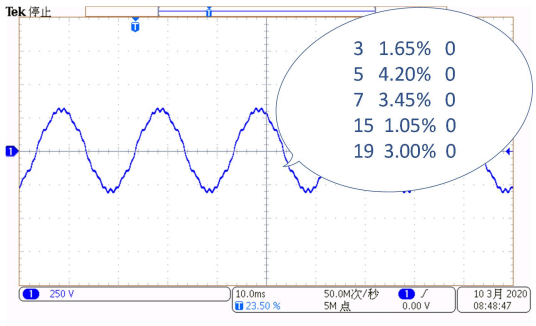

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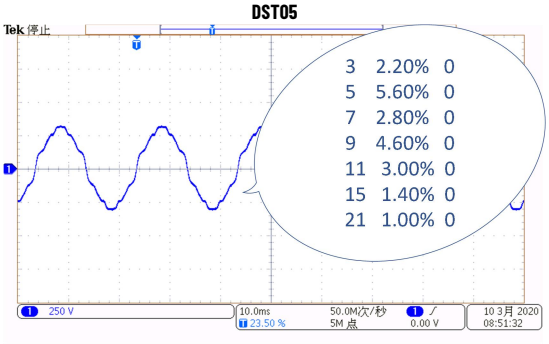

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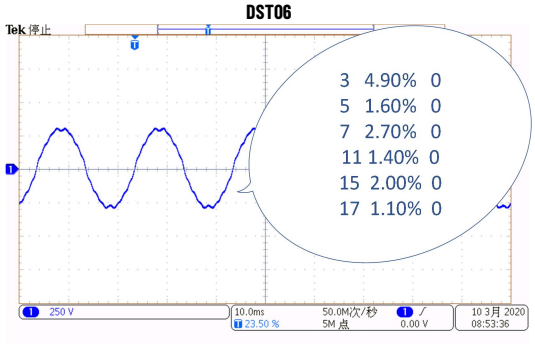
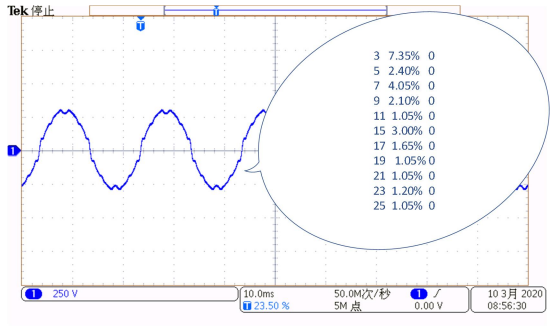
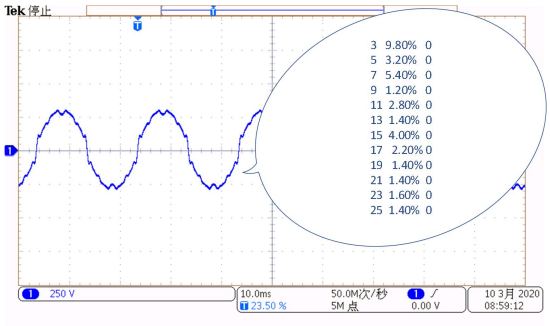


DST08



DST09



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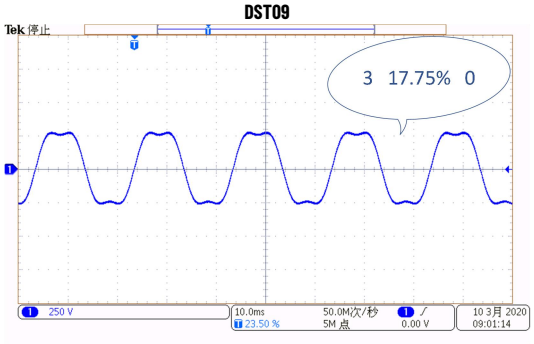

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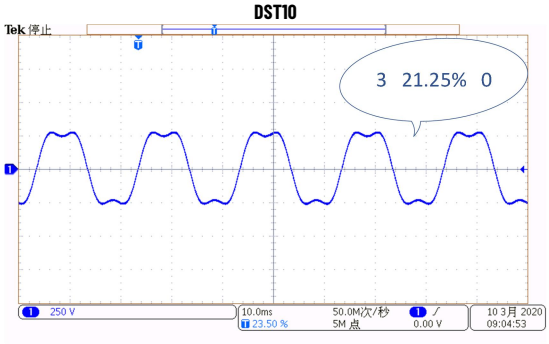

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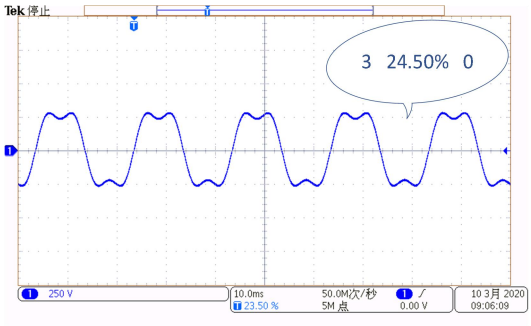

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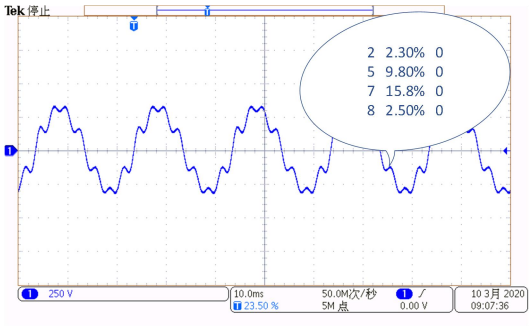

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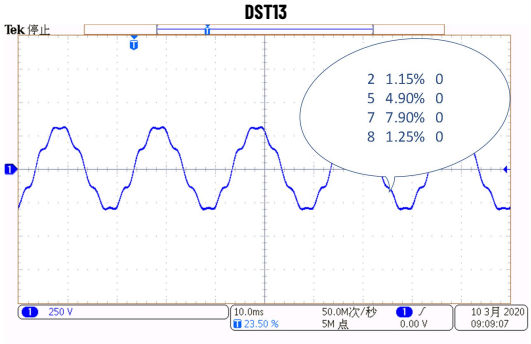
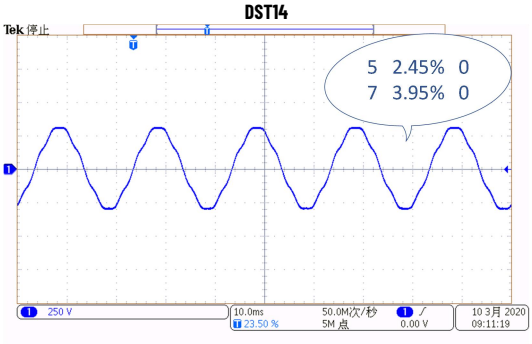


DST15



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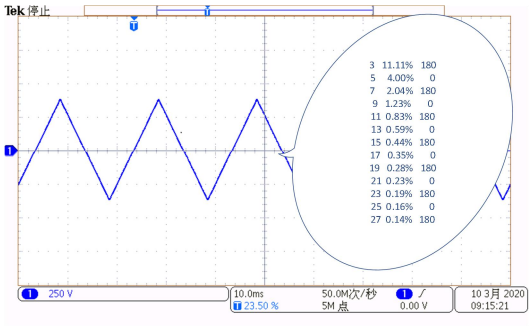

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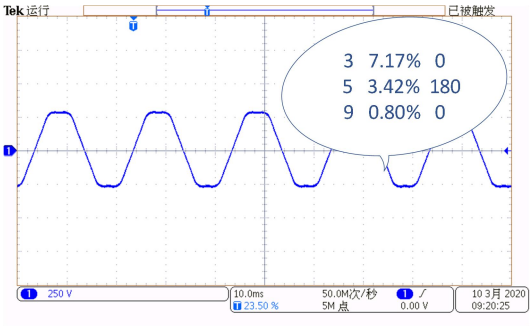

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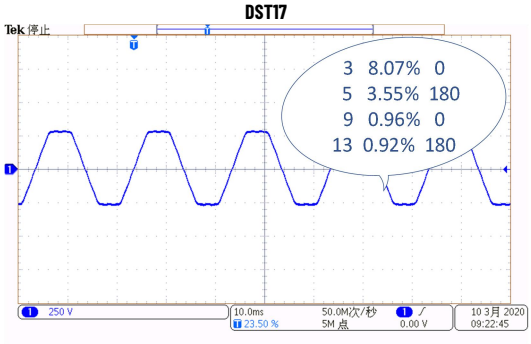

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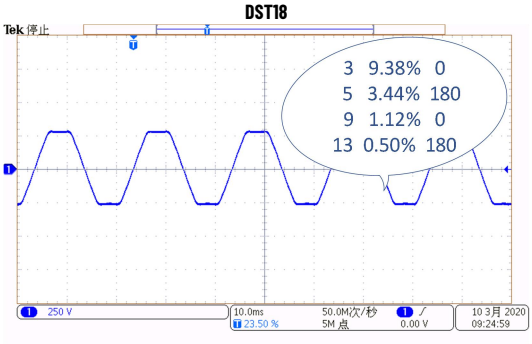

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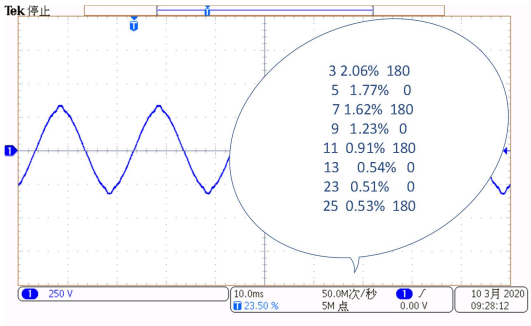

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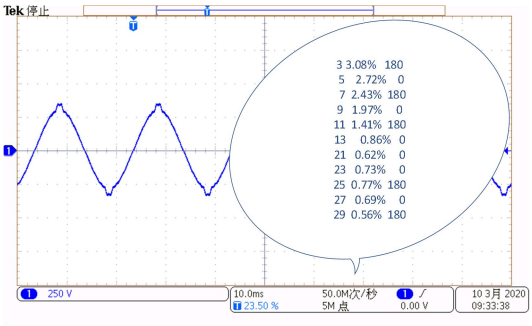

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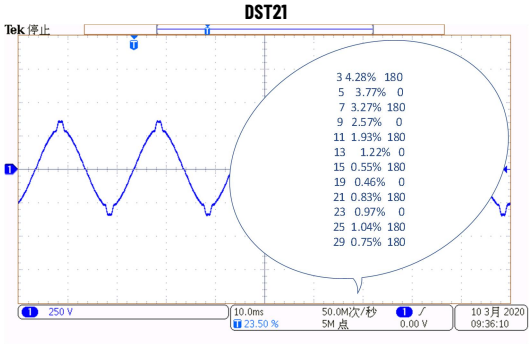

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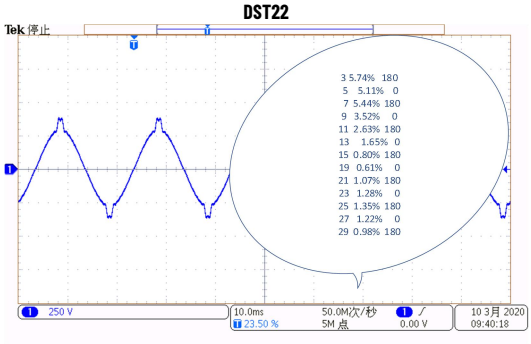

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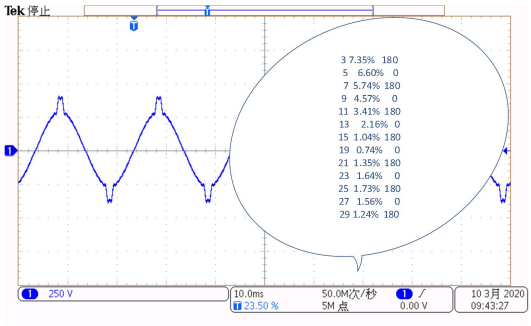

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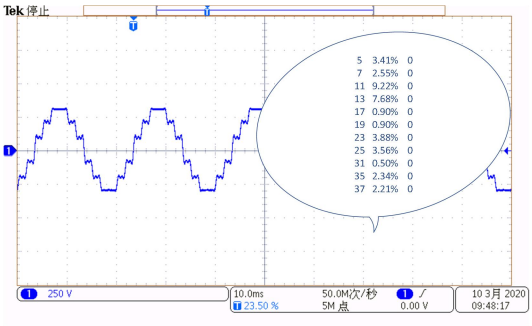

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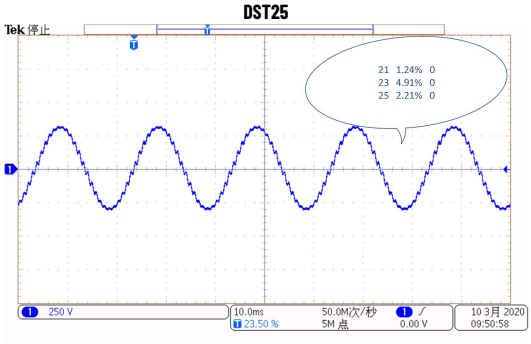

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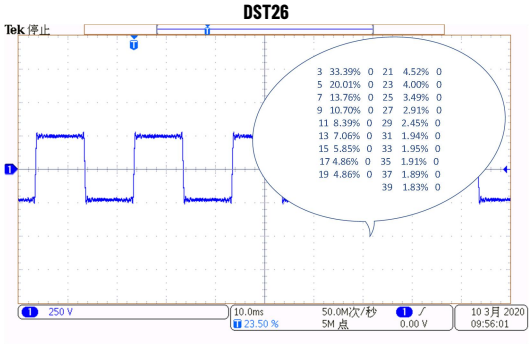

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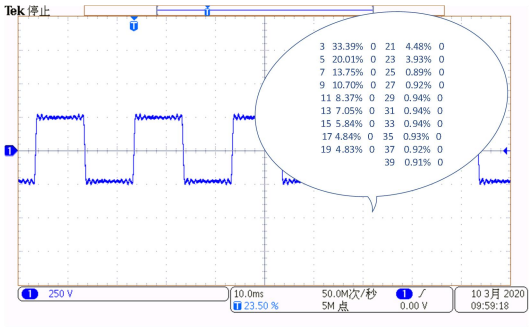
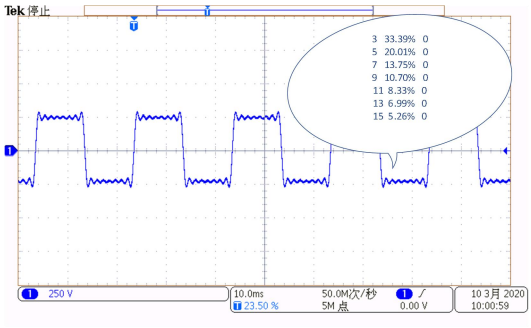

Tek 停止
3 33.39% 0 21 4.48% 0
5 20.01% 0 23 3.93% 0
7 13.75% 0 25 0.89% 0
9 10.70% 0 27 0.92% 0
11 8.37% 0 29 0.94% 0
13 7.05% 0 31 0.94% 0
15 5.84% 0 33 0.94% 0
17 4.84% 0 35 0.93% 0
19 4.83% 0 37 0.92% 0
39 0.91% 0
250 V
10.0ms
T 23.50 %
50.0M次/秒
5M 点
0.00 V
10 3月 2020
09:59:18

DST29


Tek 停止
3 33.39% 0
5 20.01% 0
7 13.75% 0
9 10.70% 0
11 8.33% 0
13 6.99% 0
15 5.26% 0
250 V
10.0ms
T 23.50 %
50.0M次/秒
5M 点
0.00 V
10 3月 2020
10:00:59

DST30

Version Revision History

Date	Version	Revision Details
November 2022	V1.0	Manual completed.
February 2023	V1.1	Updated – Chapter 8 and Chapter 9 Section interface diagram updated. – 8.7 Island function and related introduction added. – 9.2 CR Mode and Main Interface introduction added. – 9.4 Certain content updated and improved.
February 2023	V1.2	Update – 8.6 The upper limit for interharmonic frequency has been changed from '2000' to '5000'.
October 2023	V1.3	Update – 8.11 Communication monitoring function added. – 8.14 Trigger output description added. – 9.3 Portion of the load function content optimized.
August 2024	V1.4	Update – 0 Accessories – 4.1 Technical Specifications; – 5.8 AC Input Connection; – 5.9.1 Output Wiring and Wire Gauge; – 8.3 Parameters; – 8.7 Island; – 0 Limit Value; – 8.9 Protection; – 8.10 Event; – 8.15.2 Simulation; – 9.3.2 Load Mode; – 9.4 Parameters; – 9.5 Limit Value; – 9.6 Protection; The above sections include the addition of the CA22-450 model and its technical specifications.
August 2024	V1.5	Update – Cover watermark removed; watermark lightened throughout the document. – 2.6 Additional safety compliance items included. – 4.2 Power unit changed to kW; input voltage range updated to 380–440 V. – 4.15 Updated safety standards. – 5.3 Added descriptions of specific usage scenarios. – 5.8 Updated overcurrent protection installation standards.