FRE 20XXS Series Bi-directional AC Programmable Power Supply User's Manual

爱科赛博 ACTIONPOWER

Contents

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2 Warranty and Safety

2.1 Limited After-Sales Warranty

Xi'an ACTIONPOWER Electric Co., Ltd. is responsible for free maintenance of the PRE20XXS series products manufactured and sold within 12 months from the date of delivery for any failure or damage under normal use.

During the guarantee period, the Company shall not be liable for free repair for any of the following circumstances, and the Company shall charge according to the repair conditions after repair:

Products not directly sold by our company or agents not officially authorized by our company.

Failure or damage caused by irresistible catastrophes, or failure to use in accordance with the User's Manual or fault of the user, such as improper operation or other disposal.

Disassemble, repair, refit or install accessories without the consent of our company, resulting in failure or damage.

During the warranty period, the user is responsible for transporting the faulty or damaged products to the Company at their own expense, and the Company is responsible for transporting the repaired products to the user (mainland China only) or its designated location (mainland China only).

This "Warranty" excludes all other express or implied warranties.

2.2 Safety

Do not make any unauthorized modifications, or install or replace any parts. Please return the product to the Company's maintenance department if maintenance is necessary, to maintain its safety features.

Please refer to the specific warnings or precautions in the user manual to avoid personal injury or product damage.

2.3 Safety Rules

In order to prevent electric shock, it is strictly prohibited to disassemble this product unless it is authorized by the Company.

This product must not be used on any equipment that has safety requirements, including life support systems.

We disclaim all liability for any direct or indirect financial losses resulting from the use of this product.

2.4 Meaning of Safety Signs

Warning:

Cautionary statement, which indicates conditions and precautions that may endanger the life of the operator.

Caution:

Precautionary statement, which indicates that damage may be caused to the product or to other equipment connected to the product.

2.5 Safety Information

This section contains important information that should be read before attempting to install and start the PRE20XXS family of products and is intended for use by experienced operators. Experienced operators should understand and be familiar with the importance of life 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 manual and include important information and related issues affecting the safety of the end user or operator.

Note: Please read the user manual of this product in detail before installation and operation.

Symbols	Interpretation

⏚	Protective earth identification (equivalent to "PE" symbol)
○	Disconnect the power supply
3~	Three-phase AC
~	AC
|	On (power on)
⎓	DC
≂	AC and DC

 **Warning: High voltage hazard/electric shock hazard.**

 **CAUTION: When you see this warning symbol, be sure to refer to this manual to familiarize yourself with the nature of potential hazards and measures to avoid them.**

2.6 Safety Precautions

The following general safety precautions must be observed during all phases of operation, maintenance and repair of this product. Violation with safety standards for design, manufacture, and intended use of the product caused by failure to observe these precautions or specific warnings elsewhere in this manual. Xi'an ACTIONPOWER Electric Co., Ltd. shall not be liable for any failure of the customer to comply with these requirements.

 **Warning: Class I equipment.**

With a protective grounding terminal, this product is Class I safety equipment. The protective function of this product could be harmed if it is used contrary to the instructions.

Warning: Ambient conditions.

This product is only suitable for installation in an indoor environment with pollution level 2, altitude not exceeding 2000m, overvoltage level OVCII and without direct sunlight, dust, flammable and explosive gases and strong magnetic fields. The operating temperature range is 0~50°C and the relative humidity is less than 80%.

Note: Before power-on.

Confirm that the AC input specifications of the product indicated on the nameplate match the parameters such as voltage and frequency of the available common circuit.

Safety precautions: grounding.

With a protective grounding terminal, this product is Class I safety equipment. In order to reduce the risk of electric shock, the enclosure grounding terminal of this product must be connected to the electrical safety ground. This product must be connected to the AC power supply through a suitably rated three-phase cable (L1-L2-L3-PE) with protective earthing.

Disconnecting the protective (grounding) conductor or protective earthing terminal could result in an electric shock hazard that could be harmful to people.

This product is equipped with line filters to reduce electromagnetic interference and must be properly grounded to minimize the risk of electric shock. Leakage currents greater than 5.0 mApeak may occur during operation at line

voltages or frequencies that are higher than those listed on the model plate.

Warning: Avoid operating in an explosive environment.

Do not operate this product in flammable or explosive atmospheres.

WARNING: Disconnect the device.

A disconnecting device (external switch or circuit breaker) must be a part of the installation for the AC input connection. The disconnecting device must be located in an easily accessible position and must be marked as the disconnecting device for this product. All conductors must be simultaneously disconnected by the disconnecting device.

It is necessary to provide external overcurrent protection devices (fuses, circuit breakers, and so on).

The overcurrent protection device's breaking capacity must be appropriate for the rated current of the device.

On the supply side of the overcurrent protective device, there must be at least minimal insulation between supply connection components with opposing polarities.

Protective conductors cannot have overcurrent protective devices installed in them. The neutral conductor of multi-phase equipment must be installed in accordance with GB19517-2009, without fuses or single-pole circuit breakers.

Before touching the equipment or any terminal block or pin, after cutting off the mains power, make sure to check any residual DC voltage from each line terminal to the grounding stud as shown in Figure 1 using the DC position of the digital multimeter (DMM) to detect the safety voltages (< 5Vdc).

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

WARNING: Do not replace parts or modify.

Due to the risk of introducing additional hazards, do not install replacement parts or make any unauthorized modifications to this product. This product should be mailed back to the Sales Service Department of Xi'an ACTIONPOWER Electric Co., Ltd. for service and repair to ensure that this product is properly maintained.

Damaged or defective products shall be taken out of service and affixed with a similar "Faulty/To be repaired" sign to prevent accidental operation until they are repaired by professional service personnel.

NOTE: Instrument position.

Do not place the instrument in any position that prevents easy access to the power disconnecting means or in any manner that makes it difficult to operate the power disconnecting means.

Note: Please keep the product surface clean and dry.

 **Note: Do not place heavy objects on the product shell.**

 **Caution: Avoid damage to the machine due to severe impact or improper handling.**

 **Note: Rear, front and side plates' vents should not be blocked.**

 **WARNING: To prevent fire, only fuses of the specification specified for this product are permitted.**

 **Caution: Maintain cleanliness.**

Electric shock could occur if this product were to be maintained and cleaned while it live. Do not directly spray the detergent on the soft cloth; rather, dampen it with water and mild detergent. Avoid using chemicals or detergents that contain abrasive substances such as benzene, toluene, xylene and acetone.

Non-professionals should not repair and maintain this product, otherwise it will cause personal injury or product damage.

Warning: Wait until 10 minutes after the power-off before opening the enclosure for operations or maintenance.

The product has an electrolytic capacitor built into it that discharges for a very long time after a power outage. To avoid electric shock accidents brought on by residual voltage, professionals must discharge the electrolytic capacitor following a power outage or wait until the voltage reaches a safe level after 10 minutes before performing an operation or maintenance.

Note: It is strictly prohibited for non-professionals to operate.

3 Product Overview

This chapter mainly describes the general operating characteristics of the PRE20XXS series bidirectional AC programmable power supplies.

3.1 General Description

PRE20XXS series bidirectional AC programmable power supply leads the development direction of a new generation of AC power supply. It has extremely high power density and can achieve rated output power of 20kVA in 3U volume. The whole system is equipped with matrix parallel function, and the parallel expansion can be up to 200kVA to provide greater output power to meet the test requirements. The independent high-precision measurement system has good industry load adaptability and raises the output index to a new height, making the application test more accurate and convenient.

The PRE20XXS series products have four-quadrant working capability, which can meet the general grid simulation regulation test. The unique RLC mode can meet the grid adaptability, island and off-grid operation test of all green energy-related industries, such as PV grid-connected inverter, energy storage system ESS/PCS, microgrid, on-board charger OBC/BOBC, uninterruptible power supply UPS and other products.

Small signal bandwidth up to 10kHz, analog output capability, very low latency and optimization specifically for hardware-in-the-loop simulation (PHIL) capabilities.

The PRE20XXS series products provide accurate, stable, clean AC or DC power, either by operating the front panel display or by remote operation using LAN, USB, analog interfaces for standard testing, automatic testing and more functions.

PRE20XXS series products have built-in five programming functions of List, Wave, Step, Pulse and Advanced, and two harmonic parameter setting functions of harmonic and interharmonic, and support steady-state output functions such as sine wave, pulse wave, triangular wave, leading edge half wave, trailing edge half wave, 30 built-in harmonics and custom wave. It also has waveform point editing function and supports import/export of external USB storage

devices.

3.2 Product Features

The following features apply to all PRE20XXS series products.

Source/load integration, full power feedback, full power four-quadrant load;

Small signal bandwidth up to$10kHz$, large signal bandwidth$2000Hz$, optimized for hardware-in-the-loop simulation (PHIL) functions;

High power density 3U up to $20kVA$, standard 19-inch cabinet capacity configurable$200kVA$;

3 phases can be linked, independent and parallel, with $0-450V_{@L-N}$ output capacity;

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

Frequency range of output fundamental wave$0.01-200Hz$;

Harmonic expansion to 100 times@$40Hz-70Hz$;

Constant power curve output, no need to set high and low voltage gears;

Up to 12 RLC network topology simulation functions;

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

Based on the advanced power conversion technology of PRE20XXS series products, when the product output is connected to energy feedback loads, such as motors, inverters, etc., it can work in four-quadrant state without adding a discharge circuit.

3.3 Function Block Diagram

The PRE20XXS series products use full high frequency devices to raise performance indicators to a whole new height. Figure 2 shows the internal function diagram of the PRE20XXS series products.

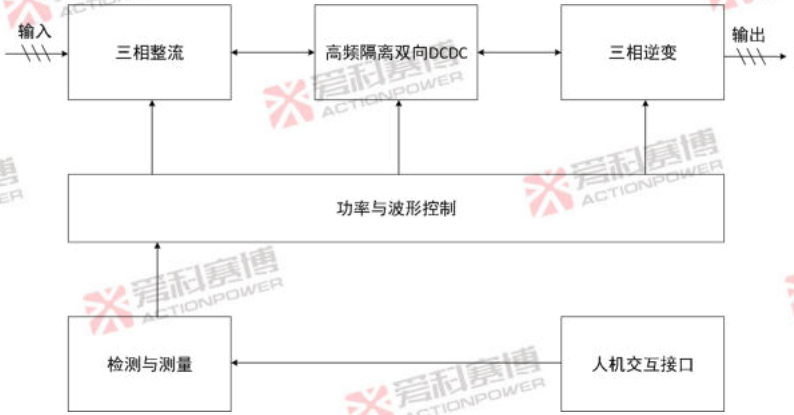


Figure 2 Functional Block Diagram of PRE20XXS Series Bidirectional AC programmable Power Supply

输入	Input
三相整流	Three-phase rectifier
高频隔离双向 DODC	High frequency isolated bidirectional DODC
三相逆变	Three-phase inverter
输出	Output
功率与波形控制	Power and waveform control
检测与测量	Detection and measurement
人机交互接口	Human-computer interaction interface

3.4 Measurements and Data

The operation and setting parameters such as voltage, current and frequency of PRE20XXS series products can be

read and set through the display screen or communication port.

PRE20XXS series products are internally designed with a high precision synchronous measuring system, which has been calibrated at the factory and complies with the specifications. They can be used in general applications without the need for additional instruments. Detailed data content and precision can be found in 4.2.

3.5 Accessories

Each qualified PRE20XXS series product includes the accessories listed in Table 1. If one or more accessories are found to be incorrect or missing, please contact the manufacturer for after-sales service.

Table 1 Name and Quantity of Accessories

Model	Name of accessories	Quantity/Unit
PRE2006S PRE2007S PRE2009S PRE2012S PRE2015S PRE2020S	3-bit input connector	1/pcs.
	6-bit output connector	1/pcs.
	Analog programming conversion box	1/pcs.
	Input cable	1/set
	Mounting Kit	1/set
	Parallel kit	1/set

4 TECHNICAL SPECIFICATIONS

The relevant performance indicators in the technical specifications of this chapter are applicable to the ambient temperature of 0~50°C and the altitude shall not exceed 2000m.

4.1 Product model

There are 6 models available for PRE20XXS series products, with a power range of $6kVA$~$20kVA$. See or detailed product models.

Table 2 Model List of PRE20XS Series Products

Product model	Number of output phases	Rated power (kVA)	Maximum voltage (V_rms)	Maximum three-phase current (A_rms)	Maximum single-phase current (A_rms)	Maximum voltage (V_DC)	Maximum current (A_DC)	Appearance
PRE2006S	Three-phase	6	450	30	90	636	90	3U
PRE2007S	Three-phase	7.5	450	30	90	636	90	3U
PRE2009S	Three-phase	9	450	35	105	636	105	3U
PRE2012S	Three-phase	12	450	35	105	636	105	3U
PRE2015S	Three-phase	15	450	35	105	636	105	3U
PRE2020S	Three-phase	20	450	35	105	636	105	3U

4.2 TECHNICAL SPECIFICATIONS

Table 3 briefly lists the data under rated input and resistive load conditions with ambient temperature of 25°C±5°C, which can meet the general selection reference. For other influencing conditions, refer to 4.4-4.13.

TABLE 3 Summary of Technical Specifications

Product model	PRE2006S	PRE2007S	PRE2009S	PRE2012S	PRE2015S	PRE2020S
Output mode	AC, DC, AC+DC, DC+AC					
Operating mode	Bidirectional feedback source					
Number of output phases	Three-phase, single-phase, split-phase					
Maximum power (kVA)	6	7.5	9	12	15	20
AC output						
Voltage						
Range (V_rms)	L-N/0-450，L-L/0-779@0.001Hz-200Hz					
Setting resolution (V)	0.01					
Precision ①	0.01%±0.05% F.S					
Type of waveform	Sine wave, triangular wave, pulse wave, clipping, multipulse wave, built-in harmonic, custom wave					
DC component (mV) ②	<20					
Voltage distortion ③	<0.3%@50Hz/60Hz					
	<1%@0.001Hz-200Hz					
Load adjustment rate	±0.05% F.S					
Source Adjustment Rate	±0.01% F.S@10% Variation					
Remote compensation	Adaptive					
Voltage slew rate	AC>3.0V/μs					
Frequency						
Range (Hz)	DC,0.001-200.0					
Resolution (Hz)④	0.001					
Precision	±0.01%					
Phase						
Scope	A = 0°, B = 240°, C = 120° (default); programmable range 0°~359.9°					
Precision ⑤	±0.1°@0.001-200Hz					
Set resolution	±0.1°					
Harmonics						
Number of times	100 times@40-70Hz; 25 times@70-200Hz;					
Content ⑥	40%					
Amplitude error	±5% @ 0.1% of set value or fundamental value					
Phase angle range	0°-359.9°					

Current						
Single-phase effective value (A_rms)	90	90	105	105	105	105
Single-phase peak value (A_peak)	270	270	315	315	315	315
Three-phase effective value (A_rms)	30	30	35	35	35	35
Three-phase peak value (A_peak)	90	90	105	105	105	105
Setting resolution (A)	0.01					
Peak Factor ⑦	1-6					
Precision ⑧	0.1%+0.1%F.S@15-200Hz					
Transient						
Programming						
Mode	List, Wave, Step, Pulse, Advanced, Harmonic, Interharmonic, 30 groups of DST					
Minimum programming time step	100μs					
Number of programmed waveforms	50					
Synchronization source/trigger source	Internal, external					
Data Source	Edit, Import, Export					
Analog Programming	Effective value, amplitude, instantaneous value (power amplifier mode)					
Standard						
AC IEC 61000	4-11, 4-13, 4-14, 4-27, 4-28, 3-2, 3-3, 3-11, 3-12					
DC IEC 61000	4-17, 4-29					
Internal resistance mode						
R range (Ω)⑨	0-10					
L range (mH)	0-2					
Set resolution	0.001					
Precision	0.1%+0.2% F.S.					
RLC Load						
Resistance						
Range (Ω)	0.001-1000					
Setting resolution (Ω)	0.001					
Precision	±0.1% F.S.					
Inductance						
Range (mH)	1-5000					
Setting resolution (mH)	0.001					

Precision	±0.1% F.S.					
Capacitance						
Range (μF)	1-5000					
Setting resolution (μF)	0.001					
Precision	±0.1% F.S.					
DC output						
Voltage						
Scope (V)	±636					
Setting resolution (V)	0.01					
Output precision ⑩	0.01%+0.05%F.S.					
Output ripple (V_rms)⑪	<0.35@(DC-300kHz)					
Load adjustment rate	±0.05%F.S.					
Source Adjustment Rate	±0.01 F.S.%@10% Variation					
Output swing rate	DC>3.0V/μs					
Current						
Scope (A)	90	90	95	95	95	95
Setting resolution (A)	0.01					
Precision	0.1%+0.1% F.S.					
Measurement parameters						
AC voltage						
Range (V_rms)	L-N/0-600					
Resolution (V_rms)	0.01					
Precision	0.01%+0.05% F.S.					
Frequency						
Range (Hz)	0.001–500					
Resolution (Hz)	0.001					
Precision	±0.01%					
AC current						
Scope (A)	140					
Resolution (A)	0.01					
Precision	0.1%+0.2% F.S.					
Peak current						

Scope (A)	4x rated					
Resolution (A)	0.01					
Precision	±2% F.S.					
Peak factor						
Scope	1.00–6.00					
Resolution	0.01					
Precision	±2.0% F.S.					
Active power						
Range (kW)	20					
Resolution (W)	1					
Precision ⑫	±0.2% F.S.					
Apparent power						
Range (kVA)	20					
Resolution (VA)	1					
Precision ⑫	±0.2% F.S.					
Power factor						
Scope	-1.00-1.00					
Resolution	0.01					
DC voltage						
Scope (V)	±1000					
Resolution (V)	0.01					
Precision	±0.1% F.S.					
DC current						
Scope (A)	±200					
Resolution (A)	0.01					
Precision	0.1%+0.2% F.S					
Input						
Wiring mode	Three-phase four-wire ABC+PE					
Frequency (Hz)	47 - 63					
Voltage range (V) ⑬	304 - 480					
Current per phase (A_max)	12	15	18	22	30	35
Input peak current (A)	< 1.5x rated					
Power factor ⑭	> 0.99					

Efficiency ⑭	> 0.91
Interface	
Generic Interface	Type-B, USB, LAN
Multifunctional interface	"Anyport", as defined in the user manual
Environment	
Operating range (°C)	0-50
Storage range (°C)	-20-70
Humidity	≤80%
Dimensions Weight	
Dimensions (W×H×D)	435×132×680mm(780mm With Breaker)
Weight	35kg
Protection	
Protection	Effective value overcurrent-disconnected
	Peak overcurrent disconnected
	Overpower disconnected
	Overcapacity disconnected
	Overvoltage (set 1%-105%) disconnected
	Over-temperature disconnected
	Overvoltage or undervoltage when being connected to the power grid-Disconnected

Notes:

1) F.S. in the parameter table related to AC output voltage refers to the maximum AC voltage of 450V;
2) The DC component is set as output voltage 220VAC and frequency 50Hz, tested under no load;
3) When the output frequency is ≤200Hz, the maximum distortion is tested under 250VAC and the pure resistive load to the rated output power;
4) When the resolution is 0.001 or 0.01% of the current setting value, whichever is greater;
5) The phase precision is set to 220V for the three-phase output voltage, and the three-phase phase is set to the default phase. The test is conducted under no load;
6) 40% of the amplitude of 300V_rms refers to the total content of superimposed harmonics;
7) Peak factor refers to the ratio of peak current to effective value. The typical value of standard sine wave is 1.414, and the maximum allowable value is 6, but the peak value does not exceed the maximum current value of a single machine, and does not refer to the peak factor under rated values;
8) F.S. in the parameter table related to AC current refers to the maximum current of the corresponding model;

9) Output impedance refers to the steady-state output impedance, and does not exceed the maximum output;
10) In the parameters table, the FS related to DC output voltage refers to the maximum DC voltage of 636V;
11) The output ripple voltage is 500V for the output DC voltage, and the output is under no load. The oscilloscope is AC coupled with 20MHz bandwidth limit;
12) The FS of active power and apparent power precision refers to the maximum measured power value of the machine of the corresponding model;
13) The input voltage 304-323V needs to be derated by 60%, and the input voltage 323-342V needs to be derated by 80%. See Figure 5 for detailed derating requirements;
14) Power factor and efficiency index are tested under the three-phase input voltage of 380V, the set output of 220V, pure resistive load to the rated output power.

4.3 Overall dimensions

The PRE20XXS series products are standard 19-inch chassis construction. See Figure 3 for overall dimensions. It can be applied to standard cabinet systems or desktops.

Figure 3 Overall Dimensions of PRE20XXS Series Bidirectional AC programmable Power Supply

4.4 Output voltage vs. current curve

Conventional AC supply voltage output ranges have two gears to provide either high voltage or high current. The PRE20XXS series is designed with a unique single voltage range operating along a constant power curve. The constant output power curve is shown in Figure 4. Taking PRE2020S as an example, the rated power can be output at L-N/190 Vac@35 A, and this operating state range can be extended to L-N/450 Vac@15 A output without interruption. When other power supplies switch in the high and low voltage range, it will cause output disconnection and EUT power failure, which is difficult to test AC products with wide voltage input.

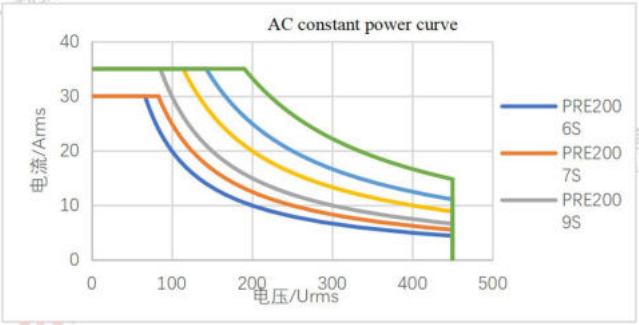


Figure 4 Output Voltage and Output Current Curve of PRE20XXS Series Products in AC Constant Power Mode

交流恒功率曲线	AC constant power curve
电流/Arms	Current/Arms
电压/Urms	Voltage/Urms

Notes:

The output voltage range is determined by a number of constraints, for example, the output voltage and output power are affected to varying degrees at different output frequencies, as detailed in Section 4.4-4.8.

This feature also applies to the DC output mode. General AC programmable power supply, its output current will be 1/2 of the AC effective value when outputting DC mode. The PRE20XXS series products benefit from advanced power conversion technology. When DC mode output is selected, the average value of the maximum output current is equal to the AC effective value, and it can operate in a four-quadrant state. Figure 5 shows the four-quadrant voltage-current relationship in DC mode.

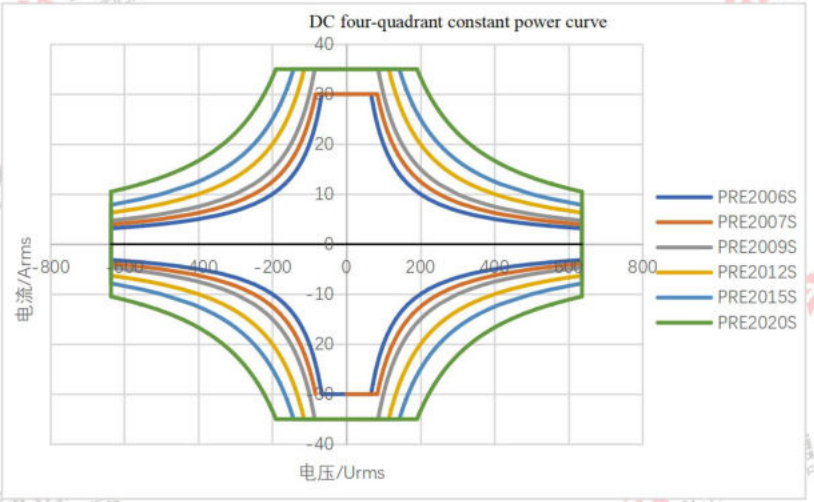


Figure 5 Output Voltage and Output Current Curve of PRE20XXS Series Products in DC Constant Power Mode

直流四象限恒功率曲线	DC four-quadrant constant power curve
电流/Arms	Current/Arms
电压/Urms	Voltage/Urms

The PRE20XXS series products can provide up to 3 independent outputs in DC output mode. Positive, ground and negative three-wire DC output can be achieved by simple connection, e.g. producing ±270V output for aviation test systems. Fully adaptable to 100% unbalanced loads. One output can also be realized in parallel to provide 3 times the current.

4.5 Output voltage vs. frequency curve

The maximum output range of PRE20XXS series products can reach L-N/450 Vac and L-L/0-779 Vac at 40Hz-70Hz, which can meet the test requirements of 660 and 690 systems.

The maximum output frequency of the PRE20XXS series products is 200Hz, and full power output is available in the full frequency range. The voltage, frequency and output power curves of the PRE20XXS series products are shown in Figure 6 to Figure 11.

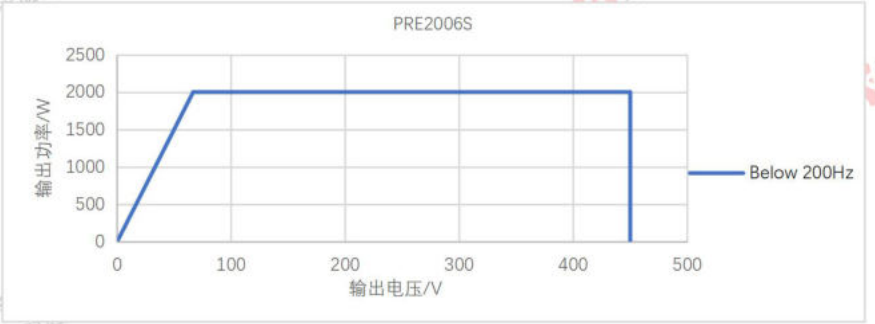


Figure 6 Single-phase Output Voltage and Output Power Curve of PRE2006S in Three-phase Mode

200Hz 以下	Below 200Hz
输出功率/W	Output power/W
输出电压/V	Output voltage/V

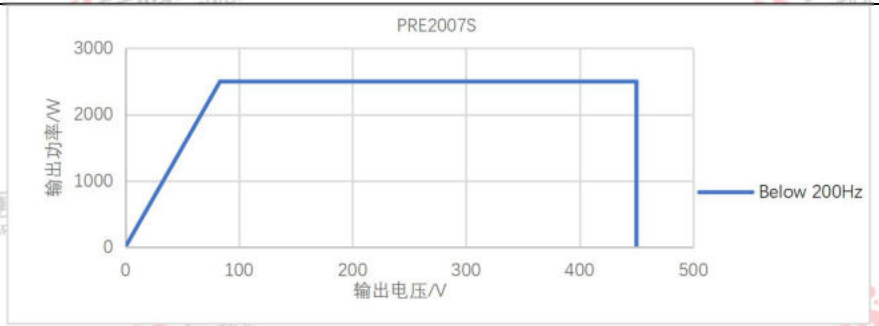


Figure 7 Single-phase Output Voltage and Output Power Curve of PRE2007S in Three-phase Mode

200Hz 以下	Below 200Hz
输出功率/W	Output power/W
输出电压/V	Output voltage/V

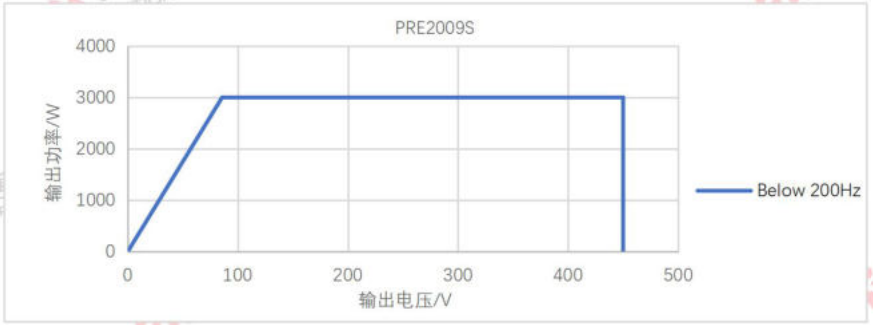
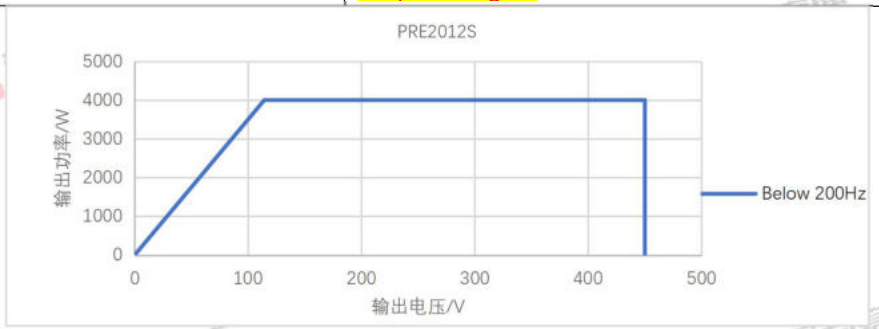


Figure 8 Single-phase Output Voltage and Output Power Curve of PRE2009S in Three-phase Mode

200Hz 以下	Below 200Hz
输出功率/W	Output power/W
输出电压/V	Output voltage/V



200Hz 以下	Below 200Hz
输出功率/W	Output power/W
输出电压/V	Output voltage/V

Figure 9 Curve of Single-phase Output Voltage and Output Power in PRE2012S Three-phase Mode

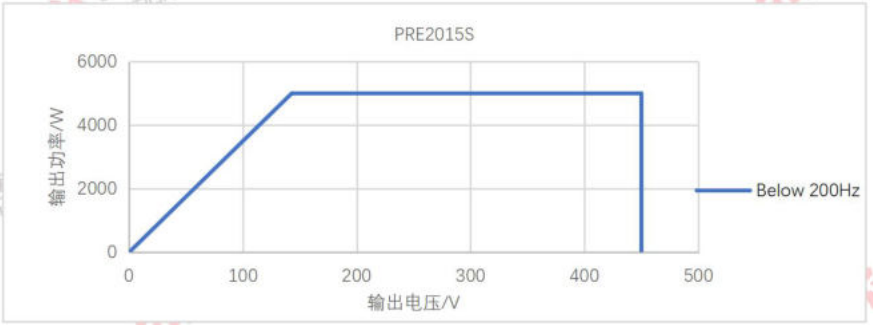
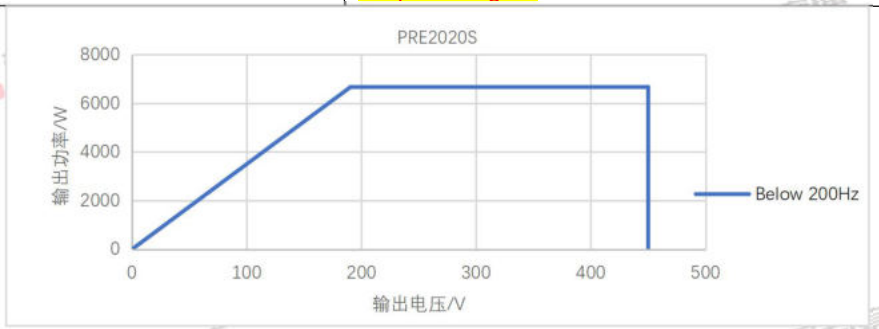


Figure 10 Curve of Single-phase Output Voltage and Output Power in PRE2015S Three-phase Mode

200Hz 以下	Below 200Hz
输出功率/W	Output power/W
输出电压/V	Output voltage/V



200Hz 以下	Below 200Hz
输出功率/W	Output power/W
输出电压/V	Output voltage/V

Figure 11 Curve of Single-phase Output Voltage and Output Power in PRE2020S Three-phase Mode

4.6 Output voltage THD and power

At steady-state output, the change of resistive load power will affect the THD index of output voltage. It is shown that PRE20XXS series products have good THD at light load. With the increase of load power, the THD value will increase, but it will not exceed the nominal value in the specification table.

4.7 Output voltage THD versus frequency curve

PRE20XXS series products have good THD characteristics in the full frequency range, which can meet most test requirements. Affected by limiting parameters, the output THD value will increase with the increase of output frequency. The output curve is shown in Figure 12.

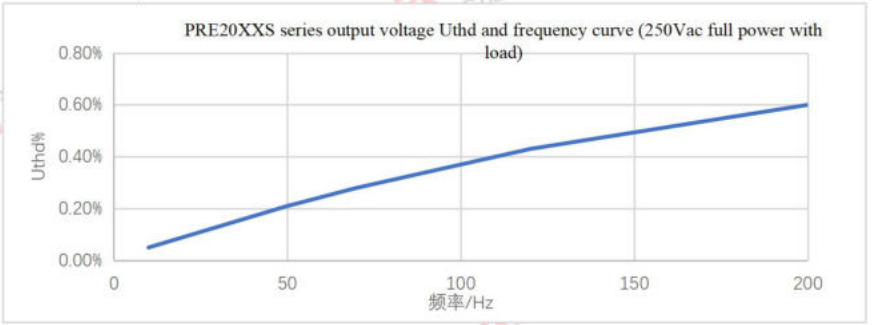


Figure 12 Curve of Output Frequency and Output Voltage THD

PRE20XXS 系列输出电压 Uthd 和频率曲线 (250Vac 满功率带载)	PRE20XXS series output voltage Uthd and frequency curve (250Vac full power with load)
频率/Hz	Frequency/Hz

4.8 Output voltage precision and frequency

PRE20XXS series products adopt high-speed and high-precision asynchronous sampling technology, which can maintain high voltage precision in a large output range. When the output voltage is greater than 10V, the output voltage precision is less than the values indicated in the specification table.

4.9 Relationship curve between single harmonic content and superposition number

The PRE20XXS series products have a wide harmonic generation capability. The harmonic frequency can reach 100 times at the fundamental frequency of 40Hz~70Hz, and the harmonic frequency can reach 25 times at 200Hz. See Figure 13 for the relationship between the single harmonic content and the number of superpositions under the conditions of 40Hz-70Hz.

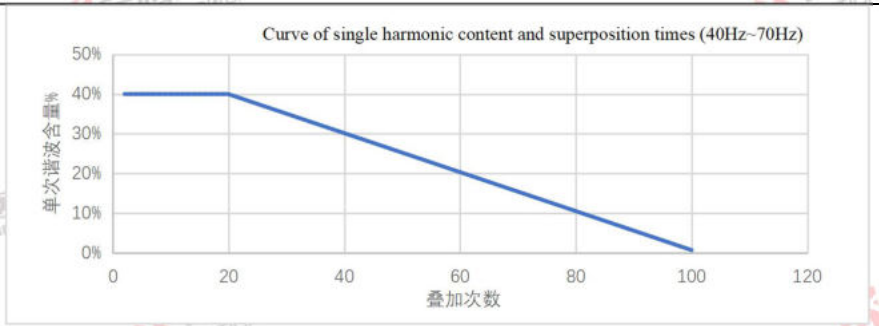


Figure 13 Curve of Single Harmonic Content and Superposition Times (40Hz~70Hz)

单次谐波含量与叠加次数曲线(40Hz~70Hz)	Curve of single harmonic content and superposition times (40Hz~70Hz)
单次谐波含量%	Single harmonic content %
叠加次数	Number of superpositions

See Figure 14 for the relationship between the single harmonic content and the number of superpositions under the condition of 70Hz~200Hz.

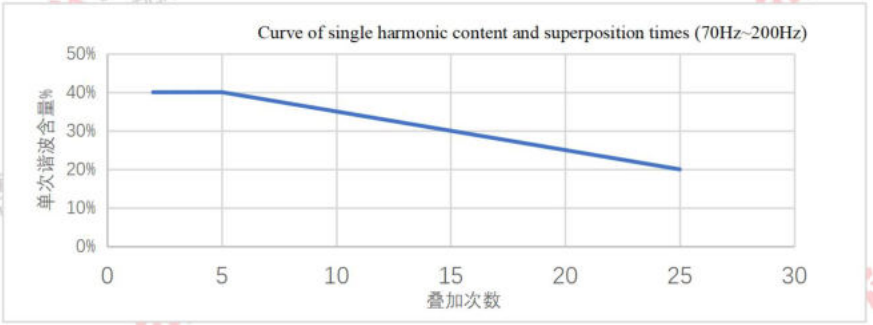


Fig.14 Curve of Single Harmonic Content and Superposition Times (70Hz~200Hz)

单次谐波含量与叠加次数曲线(70Hz~200Hz)	Curve of single harmonic content and superposition times (70Hz~200Hz)
单次谐波含量%	Single harmonic content %
叠加次数	Number of superpositions

4.10 Input voltage versus output power derating curve

The PRE20XXS series adopts an advanced power conversion topology, which broadens the input voltage range to L-L/(304-480) to meet more demanding environmental requirements. $Vac\,Vac$However, when the input voltage is low, the output power is derated, and the derating curve is shown in Figure 15.

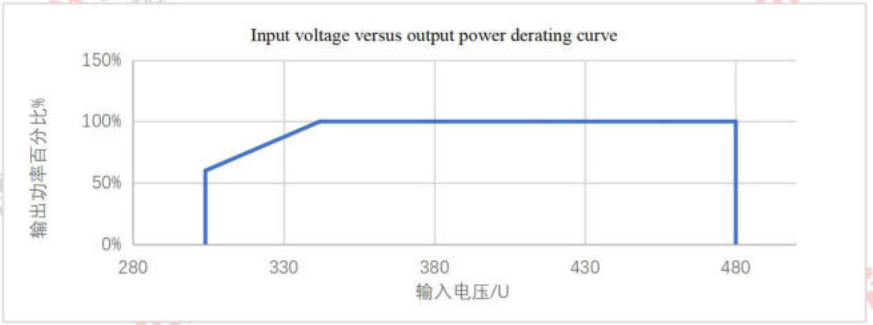


Figure 15 Derating Curve of Input Voltage and Output Power

输入电压与输出功率降额曲线	Input voltage versus output power derating curve
输出功率百分比%	% of output power
输入电压/U	Input voltage/U

4.11 Output overcurrent protection delay curve

PRE20XXS series products are equipped with a relatively complete protection system, especially for various protections of loads, which can be adjusted by users as required, but the maximum limit is reserved for each item. In order to effectively prevent the misoperation of the protection device when the PRE20XXS series products are connected with impact load, the overcurrent protection delay time can be adjusted in a wide range, and the maximum setting area is shown in Figure 16. See Section 8.8 for setting operations.

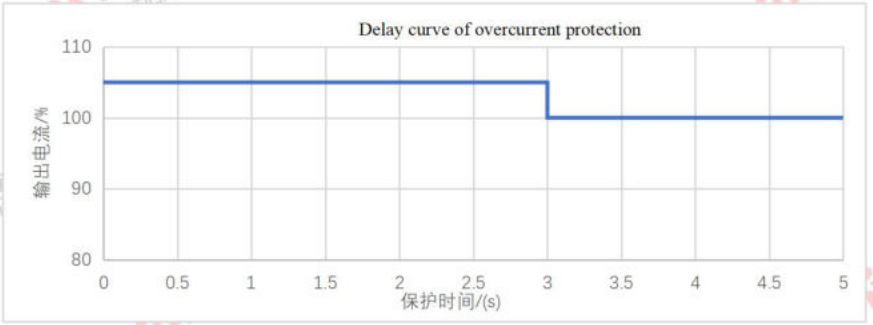


Figure 16 Overcurrent Protection Delay Curve

过流保护延迟曲线 110	Overcurrent protection delay curve 110
输出电流/%	Output current/%
保护时间/(s)	Protection time/(s)

4.12 Environmental conditions

In order to ensure the good performance of PRE20XXS series products and guarantee its working life, the use environment shall not exceed the following limiting conditions. The environmental conditions are shown in Table 4.

Table 4 Environmental Conditions of PRE20XS Series Products

Working environment	
Cooling mode	Intelligent speed regulating fan cooling
Audio noise	Standard: 55dB
	Full power: 70dB
Operating temperature	0℃-50℃
Storage temperature	-20℃-70℃
Humidity	≤80%, no condensation

Working environment	
Altitude	Up to 2000m

4.13 Output derating and ambient temperature curve

General electronic product development laboratories or production lines can ensure a good temperature environment, and PRE20XXS series products can ensure good performance under these environmental conditions. When the ambient temperature rises, the output power of the PRE20XXS series products will decrease until the overtemperature protection. The output power derating and temperature curves are shown in Figure 17.

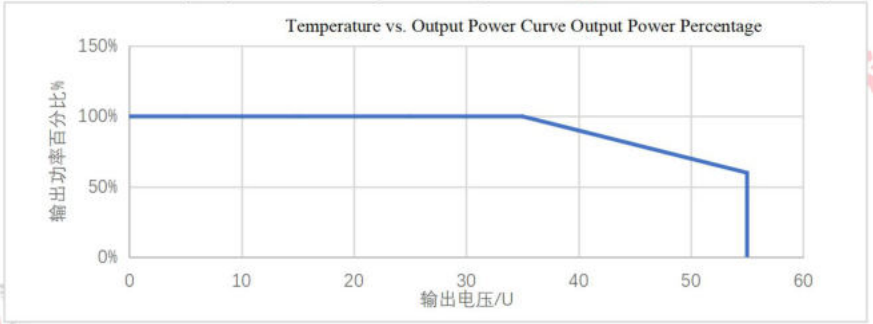


Figure 17 Output power derating versus temperature curve

温度与输出功率曲线输出功率百分比	Temperature vs. Output Power Curve Output Power Percentage
输出功率百分比%	% of output power
输出电压/U	Output voltage/U

4.14 Audio noise and ambient temperature

The PRE20XXS series products will generate audio noise of fan noise and fundamental noise when they work. Only

fan noise is calculated during audio noise test. The PRE20XXS series products are equipped with intelligent speed regulating fans, which can effectively reduce the audio noise at low ambient temperatures.

4.15 Audio noise versus output power curve

The PRE20XXS series products will generate audio noise of fan noise and fundamental noise when they work. Only fan noise is calculated during audio noise test. The PRE20XXS series products are equipped with intelligent speed regulating fan, which can effectively reduce the audio noise at low output power. As the output power increases, the fan noise also increases, and the relationship curve between the two is shown in Figure 18.

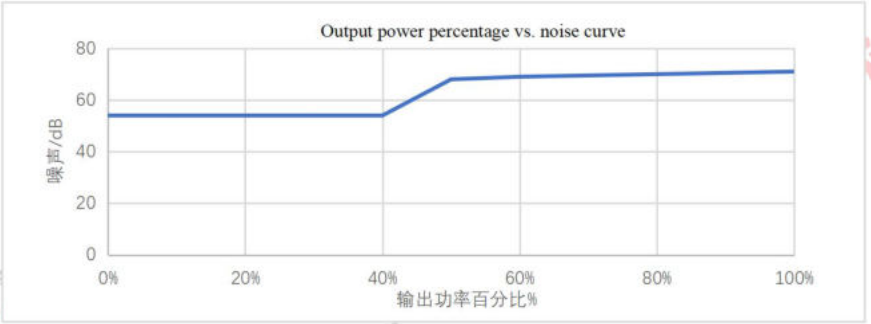


Figure 18 Output Power vs. Noise Curve

输出功率百分比与噪声曲线	Output power percentage vs. noise curve
噪声/dB	Noise/dB
输出功率百分比%	% of output power

4.16 Audio noise and output frequency

PRE20XXS series products can output fundamental waves of 200Hz and harmonics of 100 times @40Hz-70Hz

and 25 times @200Hz. When working under these conditions, the power supply will produce audio noise that can be felt by human ears. Due to individual differences, different sensations will be felt under the same conditions. It is recommended that sensitive people take protective measures to protect their hearing.

4.17 Safety regulations and standards

Standards to be followed	
Safety regulations and standards	IEC 61010-1;2010 (Edition 3)
EMC Limits	EN 55011:2009+A1:2010
EMC withstand	IEC 61000-4-2, -3, -4, -5, -6, -8, -11
Product Category	IEC61326-1:2010

5 Unpacking and Installation

5.1 Inspection

Please carefully check the completeness of the packaging before unpacking. If there is any abnormality or you think it may cause damage to the product, please contact Xi'an ACTIONPOWER Electric Co., Ltd. for the after-sales service immediately.

After unpacking, please carefully check the appearance of the product and the quantity of accessories according to the packing list. If there is any abnormality, please contact Xi'an ACTIONPOWER Electric Co., Ltd. for the after-sales service immediately.

All PRE20XXS Series models require a three-phase AC input and are equipped with a pluggable terminal block.

5.2 Packing and Handling Instructions

注意	Caution

The packaging of PRE20XXS series products is shown in Figure 19. According to the safety regulations, the weight of this series of products is more than 18kg (about 35kg). Before unpacking, the package needs to be placed on a suitable flat surface. After unpacking, two people are required to take the product out of the package. One person is required to lift the long side of the package and place it in a suitable position. The position should support the weight of the product.

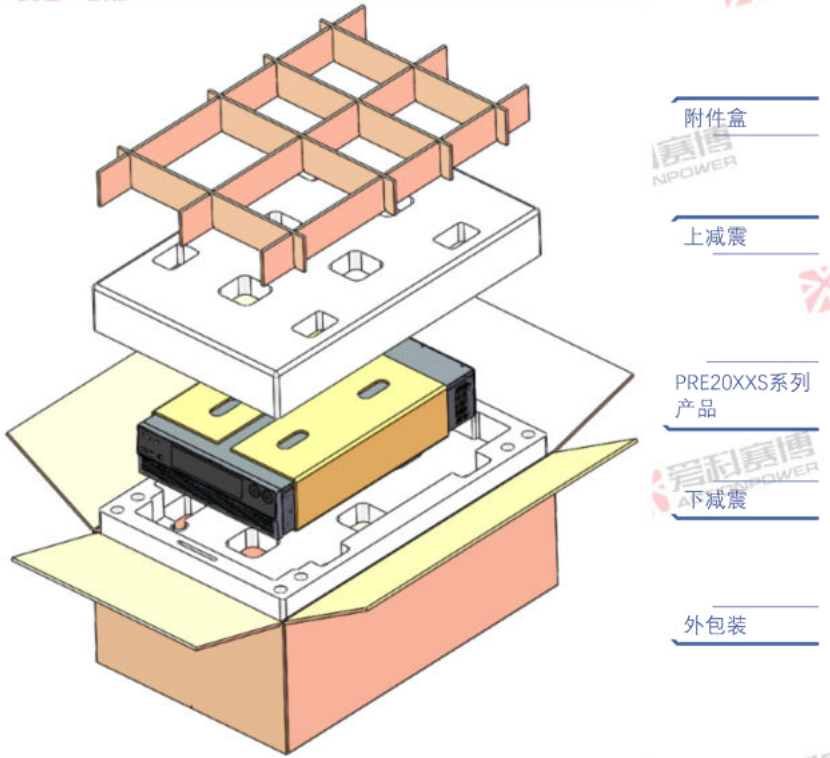


Figure 19 Schematic Diagram of Package Disassembly of PRE20XXS Series Products

附件盒	Accessory box
上减震	Upper shock absorber
PRE20XXS 系列产品	PRE20XXS series products
下减震	Lower shock absorber
外包装	Outer packaging

During laboratory use, two people are required to lift or handle the product if it is necessary to move it. Do not attempt to lift alone or use the two handles on the front panel to lift the product alone. See Figure 20 for the schematic diagram of standardized handling.

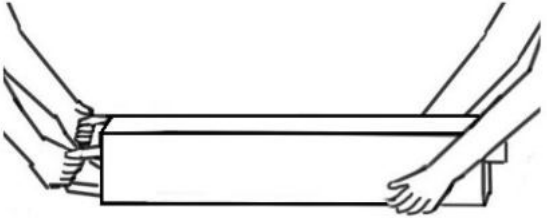


FIGURE 20 Schematic Diagram of Handling

5.3 Placement instructions

The only correct way to place the PRE20XXS series products is shown in Figure 21, position 1, and no other way is allowed.

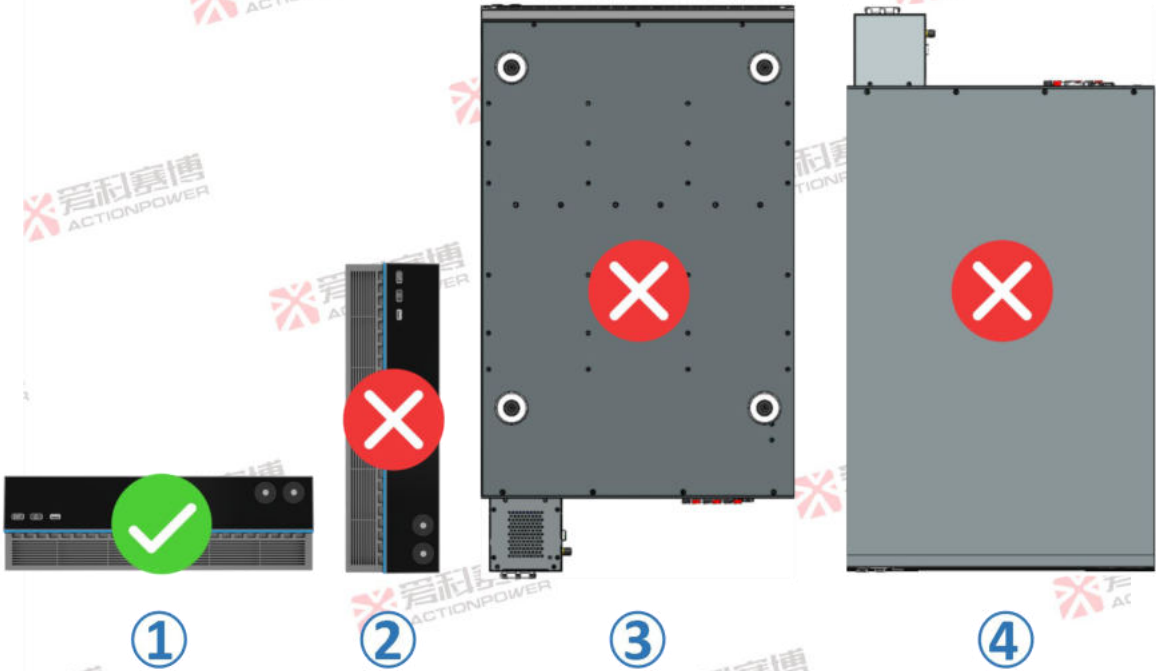


Figure 21 Schematic Diagram of Product Placement

5.4 Installation of lug

When the PRE20XXS series products need to be placed in a standard cabinet, the lugs in the "Mounting Kit" can be

installed according to Figure 22.

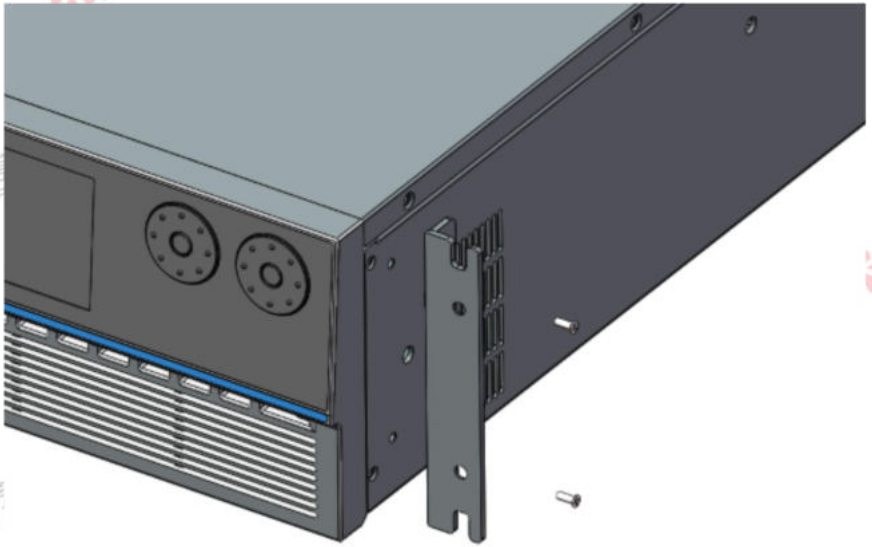


Figure 22 Schematic Diagram of Installation of Hanging Lugs

5.5 Installation of handle

If the PRE20XXS series products need to be pushed and pulled in the cabinet, the handle in the "Installation Kit" can be installed according to Figure 23.

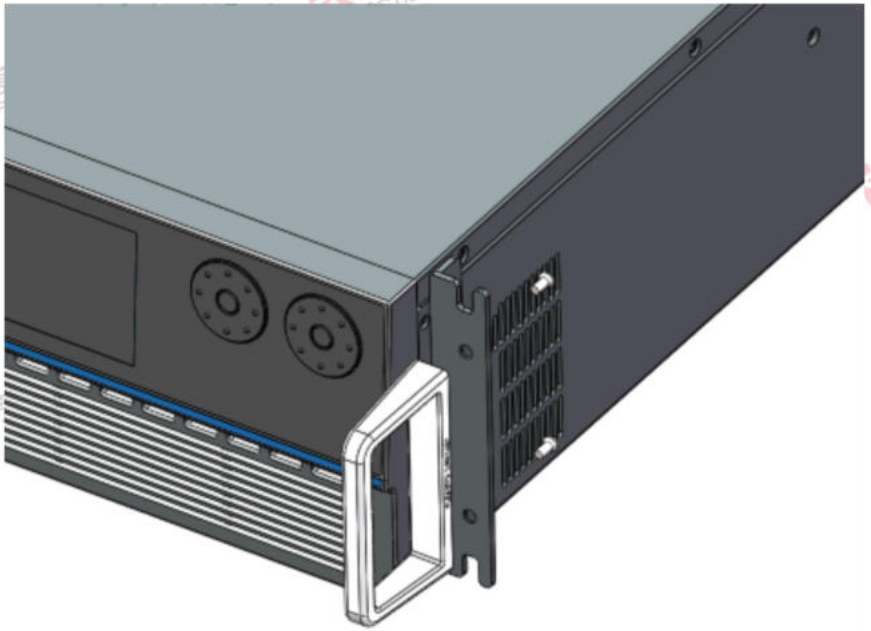


Figure 23 Schematic Diagram of Handle Installation

5.6 Mat Installation

The PRE20XXS series products have been installed with foot mats by default. If you need to raise the product for use, you can replace the high foot mat in the "Mounting Kit" as shown in Figure 24.

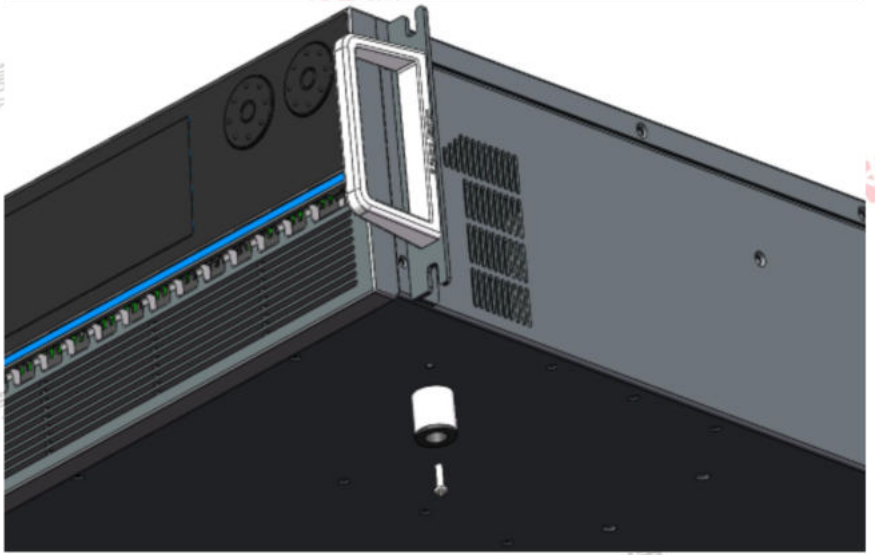


Figure 24 Schematic Diagram of Foot Pad Installation

5.7 Check AC input

The PRE20XXS series products support a wide voltage and frequency range. Before connecting an AC power supply to the PRE20XXS 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 a power supply to this product.

5.8 AC input connection

注意	Caution

The product AC input connection must include a disconnecting device (external switch or circuit breaker). As part of the installation, the disconnecting means must be in the proper position to be reached and must be marked as the disconnecting means of the product. All conductors must be simultaneously disconnected by the disconnecting device.

It is necessary to provide external overcurrent protection devices (fuses, circuit breakers, and so on).

The overcurrent protection device's breaking capacity must be appropriate for the rated current of the device.

On the supply side of the overcurrent protective device, there must be at least minimal insulation between supply connection components with opposing polarities.

Protective conductors cannot have overcurrent protective devices installed in them. The neutral line of multiphase products shall not be equipped with fuses or single-pole circuit breakers, and shall be installed in accordance with the requirements of GB19517-2009. For each model of PRE20XXS series product, please select the corresponding cable according to Table 5.

Table 5 AC Input Wire Diameter/Wire Gauge

Product model	Rated power (kVA)	Rated input voltage (V_rms)	Rated input current (A_rms)	Recommended distribution current (A_rms)	Recommended wire diameter (mm^2)
PRE2006S	6	380	12	30	4
PRE2007S	7.5	380	15	30	4
PRE2009S	9	380	18	30	4
PRE2012S	12	380	22	30	4
PRE2015S	15	380	30	50	6
PRE2020S	20	380	35	50	6

The AC input connection must be on the AC input connector. The phase of the AC input is marked on the rear panel and requires a four-wire power connection (L1, L2, L3 and ground). The PRE20XXS series products adapt to the phase of AC input voltage. Unless there is a special need, it is not necessary to distinguish the three-phase phase correspondence. See Figure 25 for the wiring diagram.

Note: When installing the input connector, tighten the screws.

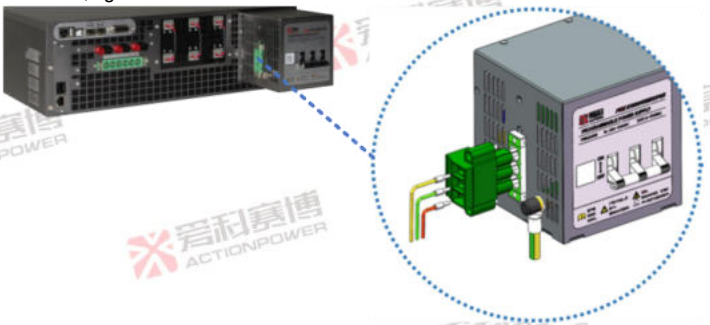


FIGURE 25 Schematic Diagram of AC Input Connection

注意	Caution

Electric shock hazard: At no time should the PRE20XXS series be operated without proper grounding.
This product must be earthed through the AC input.
A well-grounded cable must always be used.
Grounding of electrical systems in accordance with applicable national standards must be observed.
The grounding terminal is the screw-fastened port in the lower right corner of the AC input connector, see Figure 25.

5.9 Load connection

注意	Caution

Hazardous output: The product output is at a hazardous voltage level. The output is electrically isolated from the AC input power supply, so the output must always be considered hazardous. In all cases, when the AC input is connected to the product, the operator must disconnect the input of the PRE20XXS series before connecting or disconnecting the output connector.

All products can be configured for single-phase or three-phase output. The external voltage detection connector maintains the three-phase connection regardless of single-phase or three-phase operation. With the system

configuration, the PRE20XXS series products automatically detect the channel and set it to the appropriate configuration.

5.9.1 Output wiring and recommended wire diameter

The connection of the output terminals of the PRE20XXS series products to the load shall be made using the mating output connector provided. The connector is safe, the contact capacity is matched with the power output and must be used when connecting the load line.

Note: When installing the output connector, tighten the screws.

The load output cable has a certain derating relationship with the current size. For 40Hz-70Hz, it is recommended to select the corresponding wire diameter/wire gauge by referring to Table 6. The insulation withstand voltage rating of the load cable shall also be considered. Due to the skin effect, the same wire loss will increase with the increase of the output frequency. If the frequency exceeds 120Hz, it is recommended to use the output wire with reference to the standard derating.

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

Product model	Rated power (kVA)	Rated output voltage (V_rms)	Rated output current (A_rms)	Recommended distribution current (A_rms)	Recommended wire diameter (mm^2)
PRE2006S	6	300	12	30	4
PRE2007S	7.5	300	15	30	4
PRE2009S	9	300	18	30	4
PRE2012S	12	300	22	50	4
PRE2015S	15	300	30	50	6
PRE2020S	30	300	35	50	6

5.9.2 Three-phase Y-load connection

The three-phase and six-wire output of PRE20XXS series products are independent of each other. When butting Y-shaped load, the connection method is shown in Figure 26. NA, NB, NC are shorted to a neutral point which is the reference point for all phases. The PRE20XXS series products have been designed with an independent detection system, which does not need to be adjusted.

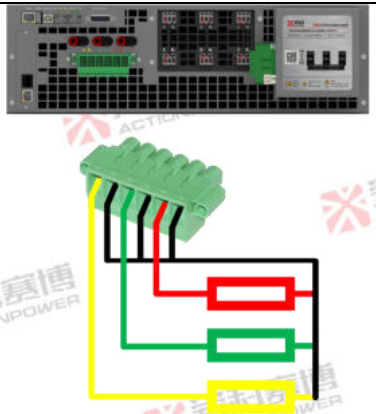


FIG.26 Schematic Diagram of Y-Load Connection

With the increase of AC output frequency, the load terminal voltage will decrease greatly. To obtain a more accurate voltage at the load port, adjust the remote compensation cable as described in 7.10.

5.9.3 Three-phase Δ-load connection

The three-phase and six-wire output of PRE20XXS series products are independent of each other. When butting Δ-shaped load, the connection method is shown in Figure 27. The PRE20XXS series products have been designed with an independent detection system, which does not need to be adjusted.

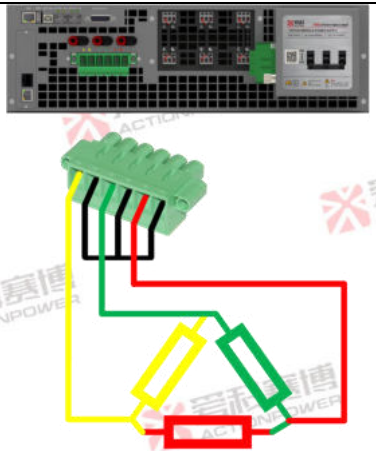


FIG.27 Schematic Diagram of Δ-Shaped Load Connection

5.9.4 Output neutral grounding

Ungrounded power output neutral terminal is equivalent to output midpoint suspension. The power supply allows its output to float relative to earth. The midpoint of the power supply can be earthed through the load. The output midpoint can also be connected to the grounding terminal on the rear panel of the power supply through a wire to obtain a stable grounding potential. The wiring method is shown in Figure 28.

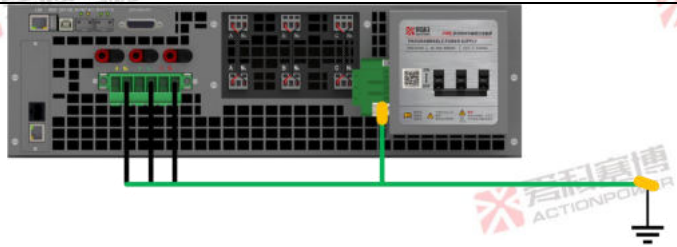


Figure 28 Schematic Diagram of Output Midpoint Grounding

5.9.5 Single phase / DC load connection

Although the internal space of PRE20 is very compact, two sets of devices, parallel switch and load switch, are still designed. The parallel switch is associated with single-phase mode, which can automatically parallel three-phase to A-phase outputs, reducing the operation complexity and solving the problem of protection when forgetting to remove external short-circuit wires. The load switch is associated with the OUT function, realizing the output and load isolation, making the R&D test and production line ATE conversion of the test object safer.

注意！

注意	Caution

The three-phase and six-wire output of the PRE20XXS series products are independent of each other. Either one of the phases can be used, or the three phases can be connected in parallel to form a single phase/DC to extend the output capacity to the rated value. The PRE20XXS series products have been designed with an independent detection system, which does not need to adjust the detection system or set the current detection multiplier.

The output terminal of PRE20XXS series products supports a maximum of 50Arms/Port effective value current. When the current is less than 50Arms, the wiring method is shown in Figure 29. When the current is ≥50Arms, it is necessary to short the external connection, and the wiring method is shown in Figure 30.

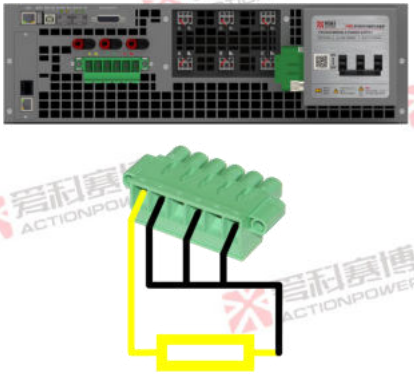


Figure 29 Wiring Diagram of Single-phase/DC Load with Current <50A_rms

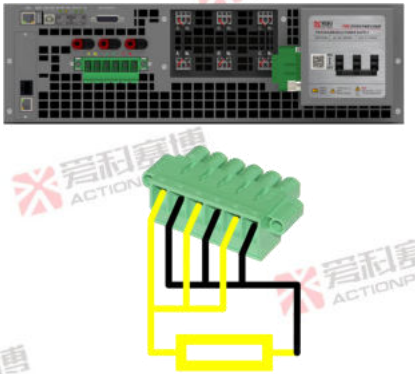


Figure 30 Wiring Diagram of Single-phase/DC Load with Current ≥50A_rms

Note: 1. The N line of all wiring modes must be short-circuited.

2. It is necessary to switch from three-phase mode to single-phase/DC mode after correct wiring as shown in the diagram. See Section 8.2 for details.

5.10 Installation of Energy Matrix Interface

When the PRE20XXS series products are parallel, the outputs shall be short-circuited and the optical fiber cable shall be used for communication. This product only opens the Energy Matrix interface on the left side. Take 3 PRE20XXS series products in parallel as an example. The optical fiber connection method is shown in Figure 31. Insert the optical fiber cable into the optical module, fasten the optical fiber module, and then insert the optical fiber module into the Energy Matrix interface of the product.

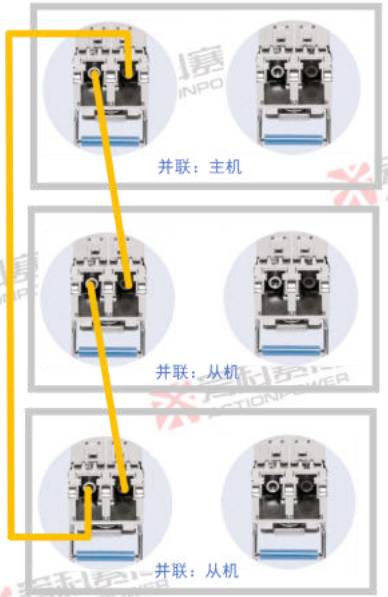


Figure 31 Connection Mode of Parallel Optical Fiber

并联:主机	Parallel: Host
并联:从机	Parallel: Slave
并联:从机	Parallel: Slave

5.11 Installation of Anyport Interface

Anyport is a flexible user interface. An analog programming converter can be connected to this interface to use it. It is necessary to disconnect the power input before connecting or unplugging the Anyport interface. The installation method of Anyport is shown in Figure 32.

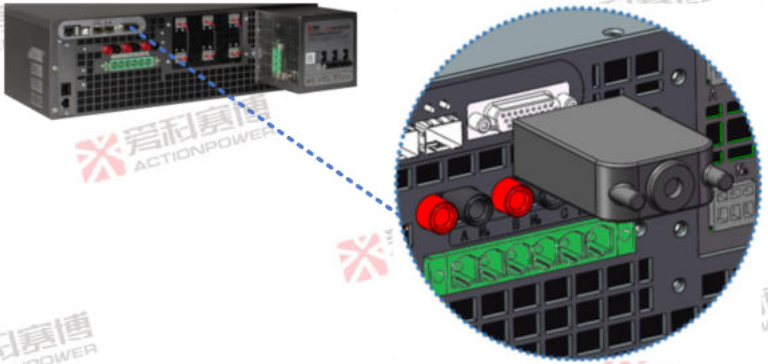


Figure 32 Schematic Diagram of Anyport Installation

5.12 Desktop Use

注意	Caution

When placing the product on the bench or table, ensure that the maximum rated capacity of the bench/table is greater than the actual weight of the product.

The PRE20XXS series products are equipped with instrument pads at the bottom to prevent sliding damage to the desktop when used on the desktop. However, do not push the product forcibly when moving, to prevent the rubber parts of the instrument pad from falling off and damaging the desktop.

5.13 Rack mounting

The PRE20XXS series products can be installed in standard 19-inch racks. Customers/system integrators who want to install one or more PRE20XS series products in their systems can order the PRE20XXS dedicated rack directly. The rack is equipped with input and output terminals and has reserved L-shaped support mounting space for zero stacking with other devices or test equipment. Xi'an ACTIONPOWER Electric Co., Ltd. can provide corresponding technical support.

5.14 Ventilation

The PRE20XXS series products adopt the design of front panel air inlet and rear panel air outlet. In order to ensure the normal operation of the product, there shall be no obstacle 30cm away from the rear panel to block the outlet air flow during installation of the PRE20XXS series products to prevent overheating.

5.15 Noise level

注意	Caution

When the product is running at or near rated full power in high temperature environment, the fan speed will reach its maximum. The noise level of the power supply may exceed 70 dB at a distance of 1 m from the front panel of the power supply. The installer shall provide measures to reduce the noise level at the point of use by the operator to a safe level. These measures may include the installation of noise reduction baffles or the provision of protective earplugs. Operators should wear ear protection when exposed to these levels of noise.

5.16 Liquid Prevention

PRE20XXS series products have no liquid spillage protection. Do not install it in areas where chemicals or liquids may spill.

5.17 Cleaning

PRE20XXS series products have no user cleaning design or cleaning accessories, and can be used for a long time in the recommended environment. If necessary, please contact the manufacturer for after-sales service.

5.18 Handling of abnormal conditions

In the unlikely event of product failure, or if the power supply cannot be turned on even if the correct AC power supply is connected, please attach 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 services.

6 Front Panel

6.1 Front panel layout

The PRE20XXS series products are designed with an integrated panel. At the same time, the operation functions are distributed according to the principle of frequency of use and operation habits. The key function is placed at the lower left and the rotation function is placed at the upper right, which greatly speeds up the operation efficiency and improves the precision. The division of the operation functions takes into account the left-handed and right-handed users at the same time, so that each operator can be comfortable.

The functional partition of the front panel is shown in Figure 33, 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 33 Functional Zoning of Front Panel

显示屏	Display Screens
厂家 LOGO	Manufacturer LOGO

外部存储接口	External storage interface
电源/复位按键-	Power/reset button -
输出按键	Output button
左飞梭旋钮	Left shuttle knob
左飞梭按键	Left shuttle button
右飞梭旋钮	Right shuttle knob
右飞梭按键	Right shuttle button

6.1.1 Display Screens

PRE20XXS series products use 8.8 inches, 1920*480 resolution, 16-bit RGB ultra-large aspect ratio LCD touch screen, which can display more information. The user can operate the controls by touching the display and physical keys.

6.1.2 Manufacturer LOGO

The manufacturer's LOGO has the function of indicating the product status. When the PRE20XXS series products are powered on, the LOGO will be lit up in red. The upper left corner is the company logo, the right side is the product series name PRE, and the bottom is the full name of the product PROGRAMMABLE POWER SUPPLY, that is, bidirectional AC programmable power supply.

6.1.3 External storage interface

This interface is used for external USB storage device, which can access and exchange the information of internal and external USB storage devices of PRE20XS series products.

6.1.4 Power/reset button

The power/reset button is the ON, OFF and reset button for PRE20XXS series products, with tri-color indicator lamp function. Yellow for standby, green for normal operation and red for protection.

6.1.5 Output button

The output button is a button to turn on or off the output terminal. When the button indicator is not on, it indicates

that the output terminal is inoperable; when the button indicator is green, it indicates that the output terminal is disconnected; when the indicator is red, it indicates that the output terminal is connected.

6.1.6 Left/right shuttle button and knob

The backlight of the left/right shuttle button is off by default. The backlight is on when the shuttle button is pressed, and the shuttle knob at the corresponding position is enabled. After no operation for 5s, the shuttle button backlight will be automatically extinguished, and the shuttle knob function at the corresponding position will be invalid.

The left/right shuttle knobs are used to set the values on the right side of the main screen of the display. The left shuttle knob sets the output voltage and the right shuttle knob sets the frequency. The user can set the desired value by using the shuttle knob instead of the on-screen numeric keypad. Rotating the left/right shuttle knob clockwise increases the value and rotating it counterclockwise decreases the value in steps of 1.

6.2 Operation related to power/reset button

The power/reset button can realize three functions: power on, off and reset.

6.2.1 Power On/Off

The power-on operation of the PRE20XXS series products is as follows:

Step1: Turn the rear panel AC circuit breaker upwards to ON, as shown in Figure 34, State 1;

Step2: Wait for the front panel manufacturer's LOGO to light up, and the power/reset button indicator light turns yellow. At this time, it is the standby state, as shown in Figure 34, state 2;

Step3: Press and hold the power/reset button until the indicator light turns green, see Figure 34, status 3, that is, the product is turned on.

Figure 34 Startup Process

状态 1	State 1
状态 2	State 2
状态 3	State 3

The shutdown operation of the PRE20XXS series products is as follows:

Step1: Disconnect the output terminal, see Figure 35, State 1;

Step2: Press and hold the power/reset button until the indicator light changes from green to yellow, see Figure 35, State 2;

Step3: Turn the rear panel AC circuit breaker down to OFF, see Figure 35, status 3, that is, the product shutdown is completed.

Although the PRE20XXS series is a feedback device, it has anti-islanding function. In an emergency, when energy is fed back to the grid through the product, it can still be shut down by directly disconnecting the AC terminal circuit breaker. However, it is usually recommended to follow the above shutdown steps.

Figure 35 Shutdown Process Diagram

状态 1	State 1
状态 2	State 2
状态 3	State 3

6.2.2 Automatic start-up

PRE20XXS series products have automatic startup function, which simplifies the startup steps and is convenient for users.

The automatic start-up shall set the starting mode of the product to be automatic, as detailed in Section 8.13.

6.2.3 Reset

The reset operation of the PRE20XXS series products is as follows:

Step1: The power/reset button indicator turns red and the status display area shows the protection status, see Figure 36, State 1;

Step2: Press the power/reset button briefly and the output button indicator starts to flash. The reset action is completed until the power/reset button indicator and output key indicator turn green, and the status display area changes from the protection state to the standby state, as shown in Figure 36, State 2.

Figure 36 Diagram of Reset Process

状态 1	State 1
状态 2	State 2

6.3 Output button-related operation

The output button is a button to turn on or off the output terminal. When the button indicator is not on, it indicates that the output terminal is inoperable; when the button indicator is green, it indicates that the output terminal is disconnected; when the indicator is red, it indicates that the output terminal is connected.

6.3.1 Manual output

The output operation of the PRE20XXS series products is as follows:

Step 1: The power supply is in standby state, see Figure 37, state 1;

Step2: Press the output button, the output relay is engaged, and the indicator lamp of the output button changes from green to red, as shown in Figure 37, State 2. At this time, the output terminal of the product is connected;

Step3: Press the output button again, the output relay is disconnected, and the output button indicator lamp changes from red to green, as shown in Figure 37, State 3, and the output terminal of the product is disconnected at this time.

Figure 37 Output On State

状态 1	State 1
状态 2	State 2
状态 3	State 3

6.3.2 Automatic output

The PRE20XXS series products have the function of automatic output. When the product operation mode is set to automatic, as shown in Section 8.13, the product will automatically output according to the parameter settings saved last time after startup.

6.3.3 Output on/off delay

PRE20XXS series products have the functions of output on-time delay and off-time delay.

When setting the on-delay time of the product, see Section 8.13 for details. In the standby state, after pressing the output button, the indicator light of the output button turns from green to yellow, as shown in State 2 of Figure 38. After the set on-delay time, the output relay is closed, and the indicator light of the output button turns from yellow to red, as shown in State 3 of Figure 38. At this time, the output end of the product is connected.

Figure 38 Output Connection Delay State Diagram

状态 1	State 1
状态 2	State 2
状态 3	State 3

When the product disconnection delay time is set, see Section 8.13 for details. In the output state, after the output button is pressed, the output button indicator turns from red to yellow, as shown in State 2 of Figure 39. After the set disconnection delay time, the output relay is disconnected, and the output button indicator turns from yellow to green, as shown in State 3 of Figure 39. At this time, the output end of the product is disconnected.

Figure 39 Output Disconnect Delay State Diagram

状态 1	State 1
状态 2	State 2
状态 3	State 3

6.3.4 Working sequence

6.3.4.1 Output connection sequence

In order to prolong the service life of the internal relay, the output connection sequence is shown in Figure 40.

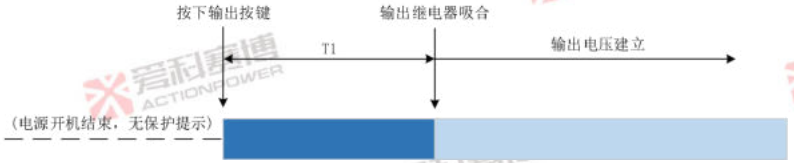


Figure 40 Output Connection Sequence Diagram

按下输出按键	Press the output button.
输出继电器吸合	Output relay closing
输出电压建立	Output voltage setup
(电源开机结束，无保护提示)	(Power on is over, no protection prompt)

In Figure 40, T1 is the time from pressing the output button to the closing of the output relay, which will be affected by many factors such as on-time delay parameters and response delay, and the minimum time is 100ms.

6.3.4.2 Output disconnection sequence

See Figure 41 for the output disconnection sequence.

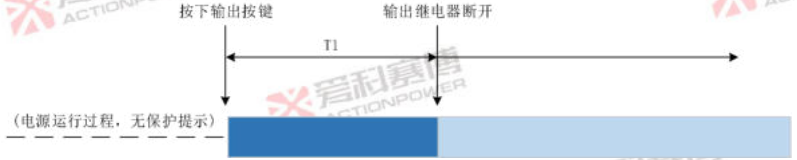


Figure 41 Output Disconnection Sequence Diagram

按下输出按键	Press the output button.
输出继电器断开	Output relay is disconnected.
(电源运行过程，无保护提示)	(Power supply operation process, no protection prompt)

In Figure 41, T1 is the time from pressing the output button to disconnecting the output relay, which is affected by various factors such as shutdown slew rate, shutdown angle and disconnection delay parameter. The output voltage has dropped to zero before the output relay is disconnected.

7 Rear Panel

The rear panel of PRE20XXS series products provides a simple and standard interface. This chapter introduces the layout of the rear panel and matters needing attention in use.

7.1 Rear panel layout

The rear panel includes 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, as shown in Figure 42.

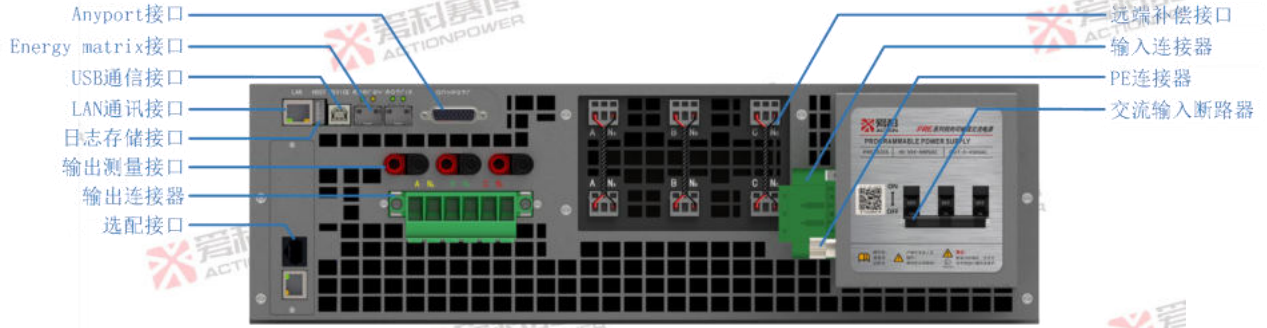


Figure 42 Function Partition Diagram of Rear Panel

Anyport 接口	Anyport interface
Energy matrix 接口	Energy matrix interface
USB 通信接口	USB communication interface
LAN 通讯接口	LAN communication interface
日志存储接口	Log storage interface

输出测量接口	Output measurement interface
输出连接器	Output connector
选配接口	Optional interface
远端补偿接口	Remote compensation interface
输入连接器	Input connector
PE 连接器	PE connector
交流输入断路器	AC input circuit breaker

7.2 Anyport interface

Anyport is a multi-functional interface, which has four types: digital input, digital output, analog input and analog output. By configuring the corresponding functions of this interface, users can operate and monitor the product's status.

6-channel digital input interfaces and 6-channel digital output interfaces can be independently configured to realize different demand control. See Figure 43 for the functions of digital input and digital output interfaces.

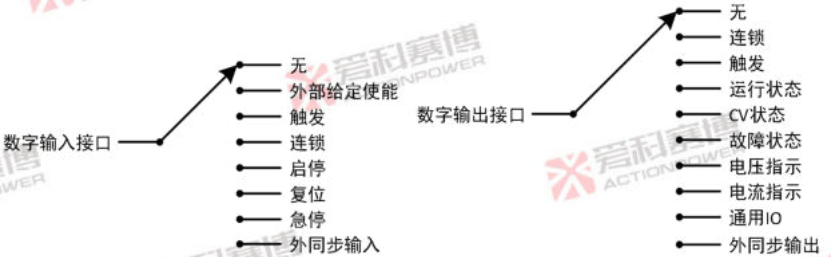


Figure 43 Functional schematic diagram of digital input and digital output interface of AnyPort

数字输入接口	Digital input interfaces
无	None
外部给定使能	External given enabling
触发	Triggering
连锁	Interlocking
启停	Startup
复位	Reset
急停	Emergency stop
外同步输入	External synchronous input
数字输出接口	Digital output interfaces
无	None
连锁	Interlocking
触发	Triggering
运行状态	Operation status
CV 状态	CV status

敏障状态	Sensitive barrier state
电压指示	Voltage indication
电流指示	Current indication
通用 IO	Universal IO
外同步输出	External synchronous output

Analog interface function has been fixed, which can be configured to realize voltage, current, power, internal resistance and analog control. See Table 7for detailed functional information.

Table 7 Functions of Anyport Interface

Interface type	Pin position	Signal level	Functional description
Digital input	Pin10 Pin11 Pin19 Pin20 Pin21 Pin22	3V~27V	Six pins correspond to six input interfaces, each of which can be configured with external given enabling, triggering, interlocking, start-stop, reset, emergency stop and external synchronous input functions. The schematic diagram of digital input interface is shown in Figure 44.
Digital output	Pin1 Pin2 Pin3 Pin4 Pin14 Pin15	3V~27V	Six pins correspond to six output interfaces, each of which can be configured with interlocking, trigger, general I/O, voltage indication, current indication and external synchronous output functions, and each of which can be configured to monitor the running state, CV state and protection state of the product. The default interface is OC (open collector), and the current limit shall be 3~10mA when using. See Figure 45 for the schematic diagram of digital output interface.
Analog input	Pin9	-5V~5V/ -10V~10V	This pin can be configured with the tracking amplitude, tracking valid value or real-time tracking function of Φ 1, and the measuring range can be configured in the "Anyport-Analog" interface. See Section 8.14.2 for details.
	Pin8		This pin can be configured with the tracking amplitude, tracking valid value or real-time tracking function of Φ 2, and the measuring range can be configured in the "Anyport-Analog" interface. See Section 8.14.2 for details.
	Pin7		This pin can be configured with the tracking amplitude, tracking valid value or real-time tracking function of Φ 3, and the measuring range can be configured in the

Interface type	Pin position	Signal level	Functional description
			"Anyport-Analog" interface. See Section 8.14.2 for details.
	Pin6		This pin can be configured to track the output frequency. See Section 8.14.2 for details.
Analog output	Pin24	5V	This pin is a 5V voltage reference output. Users can divide the voltage of this pin appropriately, and connect it by themselves according to the requirements, and set the setting value of this product.
	Pin25	-5V~5V	Both pins can indicate the voltage valid value, current valid value, active power, apparent power and reactive power of each phase, as well as total active power, total apparent power and total reactive power. Configure the measuring range in the "Anyport- Analog" interface. See Section 8.14.2 for details. The parameter value of analog output is proportional to the parameter value of actual output.
	Pin26		
Ground terminal	Pin5		The seven pins are the negative terminals of the digital input, digital output, analog input and analog output interface pins, and are grounded together.
	Pin12		
	Pin13		
	Pin16		
	Pin17		
	Pin18		
	Pin23		

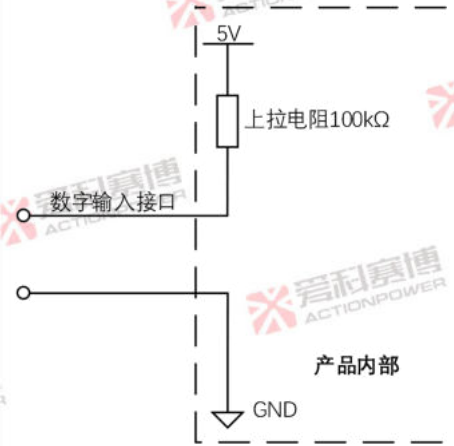


Figure 44 High-level Schematic Diagram of Anyport Digital Input Interface

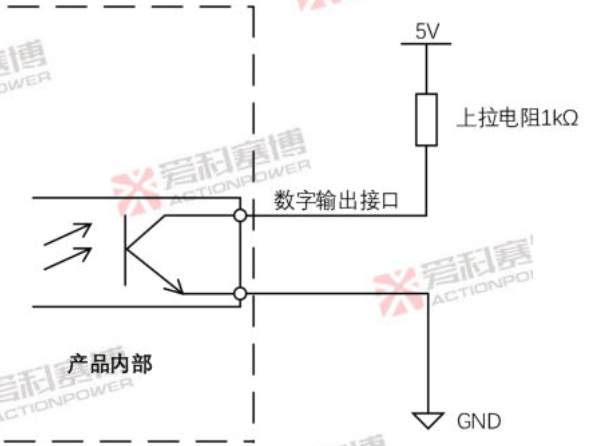


Figure 45 Schematic Diagram of External High Level of Anyport Digital Output Interface

上拉电阻 100kΩ	Pull-up resistance 100kΩ
数字输入接口	Digital input interfaces
产品内部	Product interior

产品内部	Product interior
数字输出接口	Digital output interfaces
上拉电阻 1kΩ	Pull-up resistance 1 kΩ

7.3 Energy Matrix Interface

Energy Matrix is an energy matrix interface, which is a unique parallel function of this product, and can realize the parallel expansion of 10 products to 200kVA capacity. The general parallel system will have uneven flow after parallel expansion, and the maximum output capacity of the system will be less than the product of the single machine capacity and the number of parallel connections. With the increase of the number of parallel systems, this situation will become

more and more obvious. The Energy Matrix interface of this product can provide an uneven fluidity of less than 0.02%, with almost no loss of capacity.

7.4 USB interface

The USB interface is used for remote control. It is a Type-B interface, which supports two types of USB2.0 and USB1.1, and includes two protocols, namely USBTMC and USB488. The transmission rate can reach 480Mbps. In order to ensure the communication reliability, the length of the connecting line is not allowed to exceed 2m, and both SCPI and Modbus-RTU protocol instruction sets are supported. See PRE20 series bidirectional AC programmable power supply programming guide for details.

Note: USB and LAN interfaces can receive inquiry instructions at the same time, but only one control instruction can be selected.

7.5 LAN interface

Remote control is accomplished through the LAN interface. Standard RJ45 interface, port number is 502. Support SCPI or Modbus-TCP two protocol instruction sets. See PRE20 series bidirectional AC programmable power supply programming guide for details.

Note: USB and LAN interfaces can receive inquiry instructions at the same time, but only one control instruction can be selected.

7.6 Log storage interface

The log storage interface can be connected with an external USB storage device to import/export the contents of the log interface. See Section 8.11.2 for specific operations.

7.7 Output measurement interface

PRE20XXS series products are designed with a standard 4mm banana socket, which can be adapted to various types of measuring instruments to quickly measure the output end voltage.

7.8 Output connector

The output connector is the output end of PRE20XXS series products. In all cases, when the AC input is connected

to the product, the operator must disconnect the input of the product before connecting or disconnecting the wiring of the output connector.

7.9 Optional interface

Optional interface can expand the functions of PRE20XXS series products, which can be used in different industries. Users can refer to the Magic-Box/Magic-Bus manual to select the required expansion components. The optional interface has two card slots, both of which can automatically identify Magic-Box/Magic-Bus functional components, but only one Magic-Box and one Magic-Bus can be installed, and two Magic-Boxes or Magic-Buses with different functions cannot be identified.

7.10 Remote compensation interface

The remote compensation interface of PRE20XXS series products has the function of remote compensation voltage, which can directly compensate the voltage drop on the line from the output end to the external load. The value displayed on the display screen is calculated by sampling from the compensation interface, so the remote compensation cable must always be connected to the output end or the user load end.

With the increase of AC output frequency or output power, the terminal voltage of load may decrease. If you want to obtain more accurate voltage at the load port, please use the remote compensation cable, and the user can connect it by himself as required. See Figure 46 for the connection mode.

One end of the compensation cable is connected to the "sampling end" and the other end is connected to the "user load end" according to the corresponding phase sequence, and the remote compensation function is automatically enabling.

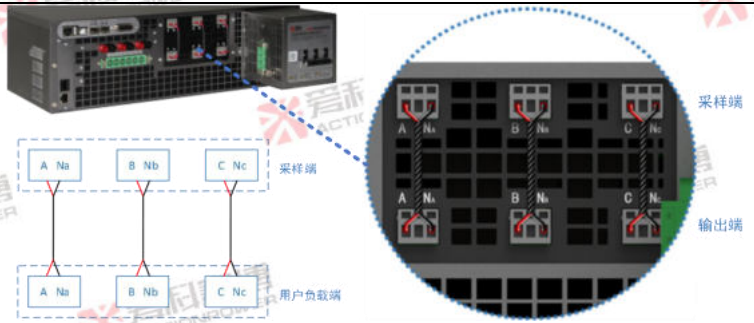


Figure 46 Schematic Diagram of Remote Compensation Connection

采样端	Sampling end
用户负载端	User load end
采样端	Sampling end
输出端	Output end

The requirements for remote compensation cables connected by users themselves are as follows:

For the line compensation cable with a length of less than 5m, the cross-sectional area is suggested to be 0.5mm²;

The compensation line shall be twisted;

In parallel mode, the compensation line only needs to be connected to the host product;

The dielectric strength of the compensation line must at least meet the rated DC voltage of 636 V;

7.11 Input connector

The input connector is the AC input end of PRE20XXS series products, which can be directly connected to the power grid. Before connection, be sure to turn the input circuit breaker to the OFF position.

7.12 PE connector

PE connector is the ground terminal of PRE20XXS series products. In order to ensure personal and product safety, PE connector must always be connected to the ground.

7.13 AC end circuit breaker

The AC-side circuit breaker is an important switch connecting the PRE20XXS series products with the network side, which has the functions of overload and short circuit protection. When the circuit breaker at the AC end is turned ON, it will be powered on, and when it is turned OFF, it will be powered off. When not using this product, be sure to turn the circuit breaker to the OFF position.

8 Display screen function and operation

All parameter settings and functional applications of PRE20XXS series products can be realized by operating the front panel display screen, and the functional interface of the display screen is divided into 16 parts, as shown in Figure 47. You can swipe left and right or up and down in each function interface to view related content.

Figure 47 Function Tree Diagram

8.1 Main Interface

The main interface, as shown in Figure 48, is divided into the following five areas: menu operation area, status display area, output display area, drop-down shortcut area and output setting area. Different areas can achieve different functions, and users can quickly obtain the required information in these interfaces.

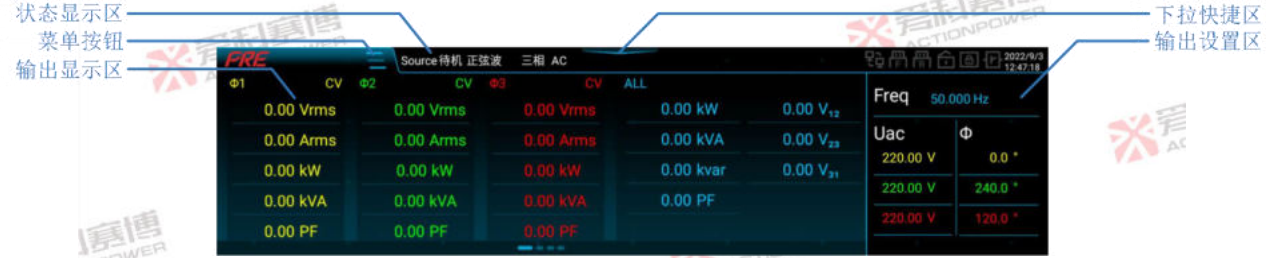


Figure 48 Main Interface Diagram

状态显示区	State display area

菜单按钮	Menu button
输出显示区	Output display area
下拉快捷区	Drop-down shortcut area
输出设置区	Output setting area

8.1.1 State display area

The status display area at the top of the display screen is shown in Figure 49, which indicates the working status and working mode of PRE20XXS series products. See Table 8 for details.

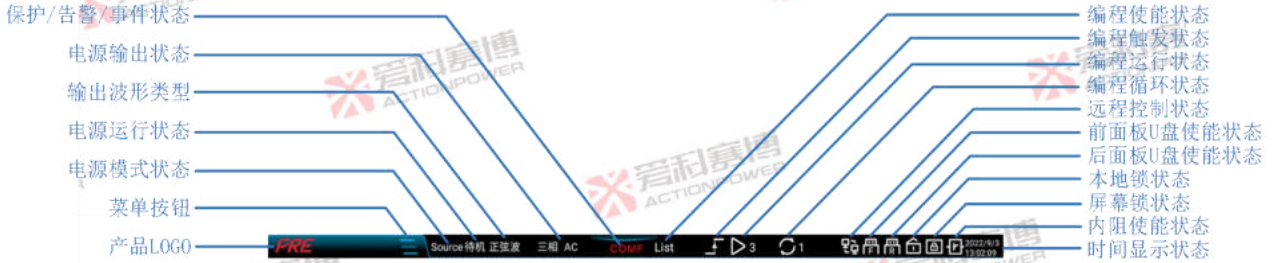


Figure 49 Status Display Area Diagram

保护/告警/事件状态	Protection/alarm/event state
电源输出状态	Power output state
输出波形类型	Output waveform type
电源运行状态	Power supply operation state
电源模式状态	Power supply mode state
菜单按钮	Menu button
产品 LOGO	Product LOGO
编程使能状态	Programming enabling state

编程触发状态	Programming triggering state
编程运行状态	Programming running state
编程循环状态	Programming cycle state
远程控制状态	Remote control state
前面板 U 盘使能状态	U disk enabling status of front panel
后面板 U 盘使能状态	Enabling status of rear panel USB flash drive
本地锁状态	Local lock state
屏幕锁状态	Screen lock state
内阻使能状态	Internal resistance enabling state
时间显示状态	Time display status

Table 8 Menu of Status Display Area

State area	Display content	Interpretation and application
Product LOGO	PRE	PRE20XXS series product LOGO.
Menu button	☰	Click the menu button and a menu bar will appear on the right side of the interface.
Power supply mode state	Source	Users can set this product to work in Source mode when they need bidirectional power flow. See Section 8.15 for the operation mode.
	Load	When users need to absorb external power, they can set this product to work in Load mode. See Section 8.15 for the operation mode.
Power supply operation state	Standby	The output end of this product is disconnected. When the output end is not used, the product can work in standby state. See Section 6.3 for the operation mode.
	Operation	The output end of this product is connected. When the output end is needed, the product can be operated. See Section 6.3 for the operation mode.
	Protection	This product enters the protection state, at this time, the output end is disconnected and reset operation is required to restore the standby state. See Section 6.2.2 for the operation mode. When users need to protect products and user equipment from working in a safe range, they can do so by setting protection parameters, as shown in Section 8.8.
	Reset	Product reset can be restored to standby state. In case of protection/alarm/event, if the user needs to return to the standby state, he can click the power/reset button or use the external input reset signal of

State area	Display content	Interpretation and application
		Anyport for reset operation. See Section 8.14.1 for the operation mode.
	Emergency stop	The emergency stop of this product disconnects the output. When the user needs to disconnect the output urgently, he can click the output button or use the emergency stop signal input from Anyport for emergency stop operation. See Section 8.14.1 for the operation mode.
Output waveform type	Sine wave	In "Waveform Selection", you can select the waveform type. See Figure 59 for details.
Power output state	Three-phase AC	Displays the current output phase number and coupling mode.
Protection status	LVP	Load undervoltage protection. The output port voltage in load mode is lower than the set value in Section 9.6 "Protection" interface.
	OVP	Overvoltage protection. It indicates that the output voltage is higher than the set value in Section 8.8 "Protection" interface.
	OCP	Overcurrent protection. It indicates that the output current is higher than the set value in Section 8.8 "Protection" interface.
	OPP	Overpower protection. It indicates that the output power is higher than the set value in Section 8.8 "Protection" interface.
	LFP	Low frequency protection. It indicates that the output frequency is lower than the set value in Section 8.8 "Protection" interface.
	OFP	Overfrequency protection. It indicates that the output frequency is higher than the set value in Section 8.8 "Protection" interface.
	CHAF	Chain protection. Receive external interlocking signal through "Anyport", see Section 8.14 for details.
	SLAF	Slave protection. When the machine is connected in parallel, any slave machine will be protected, which will be displayed in the interface of the host machine.
	INSF	Internal protection. It indicates internal module protection.
	POWF	Power supply protection. It indicates that external power supply is abnormal.
	PARF	Parallel communication protection. It indicates that the optical fiber line connection is abnormal.
	COMF	Communication timeout protection. It indicates abnormal communication within the product.
	OPT	Over-temperature protection of air outlet.
	SENF	Telemetry protection. It indicates that the feedback cable is abnormal.
Alarm status	EMST	Emergency stop alarm. Receive external emergency stop signal through "Anyport". See Section 8.14 for details.

State area	Display content	Interpretation and application
	IPAF	IP conflict alarm. It indicates that the IP address of the product conflicts.
	SPDL	Alarm of data range overrun of AC source programming. It indicates that during programming operation, when the set data is higher than the set value in Section 8.7 "Limits", it will run according to the limits and give an alarm at the same time.
	LVL	Cut-off voltage alarm Load mode gives an alarm when the external input voltage is lower than the AC cut-off voltage during operation.
	WAIT	Parallel WAIT alarm. It indicates that the parallel machine conditions are not available.
	PARA	Parallel redundant alarm. It indicates that the parallel system is running in parallel redundancy state.
	TMCE	USBTMC queue empty alarm. USBTMC query queue is empty.
Event state	Event X	It displays triggered user events, for example, Event 1.
Programming enabling state	List	This status is displayed after the List mode in the programming interface is loaded.
	Wave	This status is displayed after the Wave mode in the programming interface is loaded.
	Step	This status is displayed after the Step mode in the programming interface is loaded.
	Pulse	This status is displayed after the Pulse mode in the programming interface is loaded.
	Advanced	This status is displayed after the Advanced mode in the programming interface is loaded.
Programming triggering state		When the programming mode is triggered, this icon will light up.
Programming running state		It displays the serial number that the current programming is executing.
Programming cycle state		It displays the number of cycles that the current programming is executing.
Remote control state		This icon will light up when the remote control is turned on.
U disk trigger status of front panel		This icon will light up when the product recognizes the USB storage device on the front panel.
U disk trigger status of rear panel		This icon will light up when the product recognizes the USB storage device on the rear panel.
Local lock state		This icon will light up when the local lock is opened.
Screen lock state		This icon will light up when the screen lock is opened.

State area	Display content	Interpretation and application
Internal resistance enabling state		When the internal resistance is enabling, this icon will light up.
Time state	2022/9/3 13:02:09	It displays the current time (year-month-day-hour-minute-second).

8.1.2 Menu operation area

Press the menu button in the main interface, and a menu interface will appear on the right side of the main interface, as shown in Figure 50. You can view all menu items by sliding up and down in the menu interface. Click in any interface to enter the main interface.

Figure 50 Menu Interface Diagram

8.1.3 Output display area

The output display area is the display area of product output parameters, which is divided into four pages, namely, output basic parameters display page, output detail parameter display page, voltage/current distortion rate digital display page of voltage/current distortion rate column display page. Swipe left and right in this area to see the corresponding content.

8.1.3.1 Output basic parameters display page

The display page of output basic parameters is shown in Figure 51. See Table 9 for the definition of each parameter.

Figure 51 Output Basic Parameters Display Page Diagram

Table 9 Output Basic Parameter Interpretation Table

Parameter term	Interpretation
Vrms	Valid value of output voltage
Arms	Valid value of output current
kW	Active power
kVA	Apparent power
PF	Power factor
kvar	Reactive power
V_{12}、V_{23}、V_{31}	Line voltage

8.1.3.2 Output detail parameter display page

See Figure 52 for the output detail parameter display page. See Table 10 for the definition of each parameter.

Figure 52 Output Page Diagram of Detail Parameter Display.

Table 10 Output Detail Parameter Interpretation Table

Parameter term	Interpretation
%Uthd	Total voltage distortion rate
Vac	AC voltage
Vdc	DC voltage
Vpk	Crest voltage
%Ithd	Total current distortion rate
Aac	AC current
Adc	DC current
Apk	Peak current
Arush	Impact current
CF	Current peak factor
Hz	Output frequency

8.1.3.3 Digital display page of voltage/current distortion rate

The digital display page of voltage/current distortion rate is shown in Figure 53. This page shows the odd and even harmonic content in the output voltage/current.

Figure 53 Digital Display Page Diagram of Voltage/Current Distortion Rate

8.1.3.4 Voltage/current distortion rate column display page

The column display page of voltage/current distortion rate is shown in Figure 54. This page displays the histogram of 2-50 harmonic content of output voltage/current.

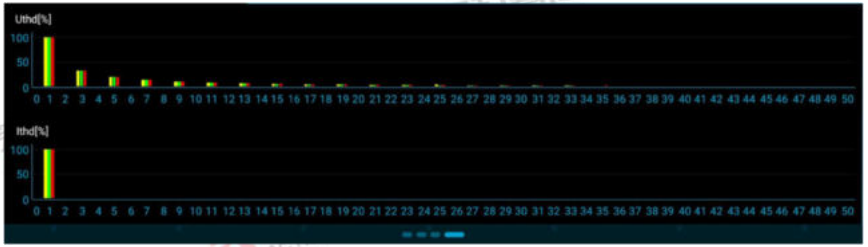


Figure 54 Page Diagram of Voltage/Current Distortion Rate Column Display

8.1.4 Drop-down shortcut area

The drop-down shortcut area provides some basic operations, which can improve the user's operation efficiency, and the same function can still be operated in the corresponding menu items. The function options in the drop-down shortcut area are temporarily not supported for adjustment or modification.

Users can click the middle button  at the top of the screen to open the drop-down shortcut area, and click the button  at the top right to close the drop-down shortcut area. See Figure 55 and Table 11 for the established functions.

Figure 55 Drop-down Shortcut Area Map

Table 11 Functions of Shortcut Area

Button	Interpretation and operation
Alarm tone	Click this button when the protection/alarm/event signal sound prompt is needed, and the alarm sound prompt will sound when the product screen displays the status.
Local control/LAN/USB	Click this button to quickly switch communication ports.
Screen lock	Click this button when you need to prevent misoperation or lock the screen. Click this button again and the screen lock function will be released.
Local lock	When it is necessary to prevent the remote command from modifying the control right, click this button, and the product can only allocate the control right through the display screen.
Clear event	Clear the events and status that have occurred.
List	Quickly jump to the programming interface or the corresponding functional interface.

8.1.5 Output setting area

The output setting area can set the output voltage and frequency. Click the numerical value and enter the desired parameters in the right numeric keypad, as shown in Figure 56 and Figure 57. You can also use the left/right shuttle to set the parameters. See Section 6.1.6 for details.

Figure 56 Output Setting Area Figure 1

Figure 57 Output Setting Area Figure 2

8.2 Mode

Click Mode in the menu bar to enter the mode setting interface. In the mode setting interface, you can select the output phase number, coupling mode, output waveform and the percentage of waveform of PRE20XXS series products. See Figure 58 for the setting interface.

Figure 58 Mode Setting Interface Diagram

Click the arrow to the right of "Select Waveform" to enter the waveform selection interface, as shown in Figure 59, which provides not only common sine wave, pulse wave, triangle wave, clipping wave and pulse wave, but also 30 kinds of harmonics, and opens 100 kinds of user-defined waveforms. Users can get the required waveforms by setting the percentages of pulse wave, triangle wave, clipping wave, leading half wave and trailing edge half-wave. See Table 12 for the percentage interpretation.

Figure 59 Waveform Selection Interface Diagram

Table 12 Percent Interpretation Table of Different Waveforms

Waveform name	Unit	Percent interpretation	Model	Resolution	Initial value	Setting range
Pulse wave	/	Duty cycle D	ALL	0.01	50	0~100
Triangular wave	/	Symmetry S	ALL	0.01	50	0~100
Clipping wave	/	Percentage C	ALL	0.01	0	0~50
Leading half wave	/	Percentage of conduction angle L	ALL	0.01	0	0~100
Trailing edge half-wave	/	Turn-off angle percentage T	ALL	0.01	50	0~100

8.3 Parameters

Click Parameters in the menu bar to enter the parameter setting interface. The parameter setting interface includes the parameter setting and function configuration related to product output.

The relevant parameter settings of product output include AC/DC output voltage, phase and frequency; Functional configuration includes AC limit, DC limit and internal resistance; You can also set the slope, response speed, slew rate, angle, impact current and external synchronization delay.

Figure 60 Parameter Setting Interface Diagram

See Figure 61 for the interface of AC limit enabling.

Figure 61 Interface Diagram of AC Limit Enabling

The interface for enabling DC limit is shown in Figure 62.

Figure 62 Interface Diagram of DC Limit Enabling

The internal resistance enabling interface is shown in Figure 63.

Figure 63 Internal Resistance Enabling Interface Diagram

See Figure 64 for transient angle enabling interface.

Figure 64 Transient Angle Enabling Interface Diagram

See Table 13 for detailed functions of each parameter.

Table 13 Parameter Detailed Menu

Parameter term	Unit	Interpretation and application	Model	Resolution	Initial value	Setting range
AC voltage	V	AC voltage setting of product output.	ALL	0.01	220	0~450
DC voltage	V	DC voltage setting of product output.	ALL	0.01	0	-636~636
Phase	°	Phase angle setting of product output three-phase AC voltage.	ALL	0.1	0	0~359.9
Frequency	Hz	Frequency setting of product output AC voltage.	ALL	0.001	50	0.001~200
AC limit enabling	\	The enabling button is only effective when	ALL	\	\	\

Parameter term	Unit	Interpretation and application	Model	Resolution	Initial value	Setting range
switch		the coupling mode is AC. When enabled, the maximum AC current and apparent power output by the product are limited to the settings.				
Current	A	When the number of output phases is three-phase or split-phase, it indicates the maximum output AC current of each phase. When the number of output phases is single-phase, it indicates the maximum total output AC current.	PRE2006S	0.01	Three-phase/split-phase: 30 Single-phase: 90	Three-phase/split-phase: 0~30 Single-phase: 0~90
			PRE2007S			
			PRE2009S		Three-phase/split-phase: 35 Single-phase: 105	Three-phase/split-phase: 0~35 Single-phase: 0~105
			PRE2012S			
			PRE2015S			
			PRE2020S			
Apparent power	kVA	When the number of output phases is three-phase or split-phase, it indicates the maximum apparent power of each phase. When the number of output phases is single phase, it indicates the maximum total apparent power.	PRE2006S	0.001	Three-phase/split-phase: 2 Single-phase: 6	Three-phase/split-phase: 0~2 Single-phase: 0~6
			PRE2007S		Three-phase/split-phase: 2.5 Single-phase: 7.5	Three-phase/split-phase: 0~2.5 Single-phase: 0~7.5
			PRE2009S		Three-phase/split-phase: 3 Single-phase: 9	Three-phase/split-phase: 0~3 Single-phase: 0~9
			PRE2012S		Three-phase/split-phase: 4 Single-phase: 12	Three-phase/split-phase: 0~4 Single-phase: 0~12
			PRE2015S		Three-phase/split-phase: 5 Single-phase: 15	Three-phase/split-phase: 0~5 Single-phase: 0~15
			PRE2020S		Three-phase/split-phase: 6.667	Three-phase/split-phase: 0~6.667

Parameter term	Unit	Interpretation and application	Model	Resolution	Initial value	Setting range
					Single-phase: 20	Single-phase: 0~20
DC limit enabling switch	\	The enabling button is only effective when the coupling mode is DC. After it is enabled, the maximum positive/negative DC current and the maximum positive and negative active power output by the product are limited to the settings.	ALL	\	\	\
Positive current	A	When the number of output phases is three-phase or split-phase, it indicates the maximum direct current output of each phase. When the number of output phases is single-phase, it indicates the maximum total positive output DC current.	PRE2006S	0.01	Three-phase/split-phase: 30 Single-phase: 90	Three-phase/split-phase: 0~30 Single-phase: 0~90
			PRE2007S			
			PRE2009S		Three-phase/split-phase: 35 Single-phase: 105	Three-phase/split-phase: 0~35 Single-phase: 0~105
			PRE2012S			
			PRE2015S			
			PRE2020S			
Negative current	A	When the number of output phases is three-phase or split-phase, it indicates the minimum value of negative output DC current of each phase. When the number of output phases is single phase, it indicates the minimum value of total negative output DC current.	PRE2006S	0.01	Three-phase separation: -30 Single phase: -90	Three-phase/split-phase: -30~0 Single phase: -90~0
			PRE2007S			
			PRE2009S		Three-phase separation: -35 Single phase: -105	Three/phase separation: -35~0 Single phase: -105~0
			PRE2012S			
			PRE2015S			
			PRE2020S			
Positive active power	kW	When the number of output phases is three-phase or split-phase, it indicates the maximum positive active power of each phase. When the number of output phases is single-phase, it indicates the maximum total positive active power.	PRE2006S	0.01	Three-phase/split-phase: 2 Single-phase: 6	Three-phase/split-phase: 0~2 Single-phase: 0~6
			PRE2007S		Three-phase/split-phase: 2.5 Single-phase: 7.5	Three-phase/split-phase: 0~2.5 Single-phase: 0~7.5
			PRE2009S		Three-phase/sp	Three-phase/split-p

Parameter term	Unit	Interpretation and application	Model	Resolution	Initial value	Setting range
					lit-phase: 3 Single-phase: 9	hase: 0~3 Single-phase: 0~9
			PRE2012S		Three-phase/split-phase: 4 Single-phase: 12	Three-phase/split-phase: 0~4 Single-phase: 0~12
			PRE2015S		Three-phase/split-phase: 5 Single-phase: 15	Three-phase/split-phase: 0~5 Single-phase: 0~15
			PRE2020S		Three-phase/split-phase: 6.667 Single-phase: 20	Three-phase/split-phase: 0~6.667 Single-phase: 0~20
Negative active power	kW	When the number of output phases is three-phase or split-phase, it indicates the minimum value of negative active power of each phase. When the number of output phases is single phase, it indicates the minimum value of total negative active power.	PRE2006S	0.01	Three-phase/split-phase: -2 Single-phase: -6	Three-phase/split-phase: -2~0 Single-phase: -6~0
			PRE2007S		Three-phase/split-phase: -2.5 Single-phase: -7.5	Three-phase/split-phase: -2.5~0 Single-phase: -7.5~0
			PRE2009S		Three-phase/split-phase: -3 Single-phase: -9	Three-phase/split-phase: -3~0 Single-phase: -9~0
			PRE2012S		Three-phase/split-phase: -4 Single-phase: -12	Three-phase/split-phase: -4~0 Single-phase: -12~0
			PRE2015S		Three-phase/split-phase: -5	Three-phase/split-phase: -5~0

Parameter term	Unit	Interpretation and application	Model	Resolution	Initial value	Setting range
					Single-phase: -15	Single-phase: -15~0
			PRE2020S		Three-phase/split-phase: -6.667 Single-phase: -20	Three-phase/split-phase: -6.667~0 Single-phase: -20~0
Internal resistance enabling switch	\	When enabled, a set impedance will be added to the output end of the product, which will reduce the output voltage.	ALL	\	\	\
R	Ω	Built-in resistor.	ALL	0.001	0	0~10
L	mH	Built-in inductance. Calculate the inductive reactance by X=2πfL.	ALL	0.001	0	0~2
Voltage slope	V/ms	A parameter that describes the output voltage in steady state, that is, the ratio of the increment of the valid value of the output voltage to time.	ALL	0.01	500	0.01~3000
Frequency slope	Hz/ms	A parameter that describes the output frequency in steady state, that is, the ratio of output frequency increment to time.	ALL	0.0001	2000	0.0001~2000
Response rate	\	The response bandwidth of the system, users can choose different loudness speeds to adapt to the tested equipment.	ALL	\	Medium	\
Voltage slew rate	V/μs	The larger the parameter describing the output voltage transient, the shorter the response time to the set voltage.	ALL	1	1	0.02~10
Shutdown slew rate	V/μs	After disconnecting the output, the voltage at the output end drops by an instantaneous value every μs, and the voltage drop time can be controlled by setting the shutdown slew rate.	ALL	0.001	2	0.002~10
Starting angle	°	The output starts at the set angle.	ALL	0.1	0	0~359.9

Parameter term	Unit	Interpretation and application	Model	Resolution	Initial value	Setting range
Shutdown angle	°	The output ends at the set angle.	ALL	0.1	0	0~359.9
Transient angle enabling switch	/	When enabled, when the voltage or frequency is changed, the output will change synchronously according to the set transient angle.	ALL	\	\	\
angle	°	Transient angle.	ALL	0.1	0	0~359.9
Impact current starting time	s	Time from product output to measurement of impact current.	ALL	0.001	0	0~999.999
Impact current measuring time	s	Measuring time of impact current.	ALL	0.001	0	0~999.999
External synchronization delay time	s	Delay time of external synchronous phase input. It can realize multi-phase synchronous output of multiple products.	ALL	0.001	0	0~999.999

Note: When paralleling, the relevant parameter settings of current and power need to be multiplied by the number of paralleling.

8.4 Programming

PRE20XXS series products are designed with five programming modes. Through flexible configuration parameters, the required waveform can be edited. See Figure 65 for programming functions. All programming modes must be used when the product has been exported.

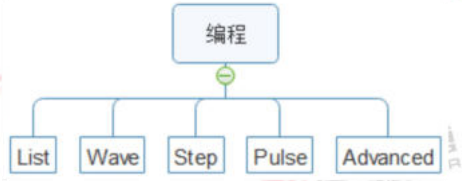


Figure 65 Programming Function Tree Diagram

Programming	Programming

8.4.1 List

List includes editing and configuration, as shown in Figure 66.

Figure 66 List Function Tree Diagram

编辑	Edit
配置	Configuration

Click Programming -List- Edit in the menu bar to enter the List programming interface, and you can set the list programming parameters yourself, as shown in Figure 67. See Table 14 for the definition of each parameter.

Figure 67 List Programming Interface Diagram

Table 14 List Programming Interface Parameter Interpretation Table

Parameter term	Unit	Interpretation	Model	Resolution	Setting range
No.	/	Serial number.	ALL	/	1~300
Uac[V]	V	Valid value of AC voltage of each phase.	ALL	0.01	0~450

Parameter term	Unit	Interpretation	Model	Resolution	Setting range
Freq[Hz]	Hz	Frequency of the output voltage.	ALL	0.001	0.001~200
Dwell[s]	s	The holding time of the current sequence.	ALL	0.0001	0~999.9999
	/	Clear all the current programming data and return to the initial programming state in Figure 67.	ALL	/	/
"+"	/	The current sequence inserts a set of new sequences backward, and the parameter values are the same as the current sequence.	ALL	/	/
"-"	/	Delete the current sequence.	ALL	/	/
Export	/	Store the programmed waveform data into the interior product.	ALL	/	/
Import	/	Import the stored waveform data into the current programming interface.	ALL	/	/
Loading	/	Lock the programming data and enter the state to be triggered.	ALL	/	/
Exit	/	At any time when the programming mode is running, you can click "Exit" to end the current programming mode.	ALL	/	/
Triggering	/	From the stable output state to the programming waveform output state.	ALL	/	/

Note: The expected output waveform is still limited by the value parameters, and improper limit setting may distort the expected output waveform.

List programming example:

1) Press the output button on the front panel to let the product output a steady-state voltage.
2) List programming data are shown in table 15.

Table 15 List Programming Data Sample Table

Serial number / Parameter term	No.1	No.2	No.3
Uac[V]	100	250	50
Freq[Hz]	50	50	50
Dwell[s]	0.1	0.1	0.1

See Figure 68 for an example of List programming.

Figure 68 List Programming Example Figure I

3) Click "Load" in the lower right corner, and both "Exit" and "Trigger" are highlighted, as shown in Figure 69.

Figure 69 List Programming Example Figure II

Note: The programming data cannot be modified after loading. If you need to modify it, you must click "Exit".

4) Click "Trigger" to display the programmed waveform on the oscilloscope (only Φ 1 waveform is shown here), as shown in Figure 70.

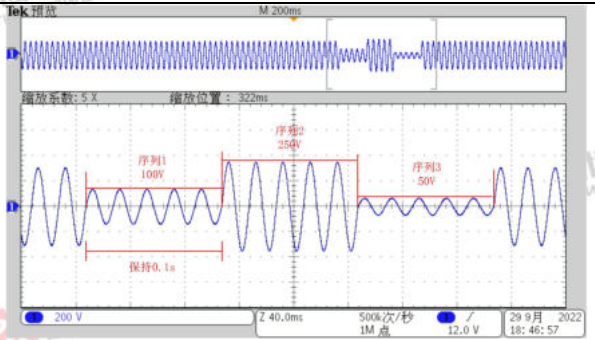


Figure 70 List Programming Waveform Example Figure I

Tek 预览	Tek preview
缩放系数：5X	Scaling factor: 5X
缩放位置：322ms	Zoom position: 322ms
序列 1 100V	Sequence 1 100V
序列 2 250V	Sequence 2 250V
序列 3 50V	Sequence 3 50V
保持 0.1s	Keep 0.1s
500k 次/秒	500k times/second
1M 点	1M point
9 月	September

Note:At any time when the programming mode is running, you can click "Exit" to end the current programming mode.

Click Programming -List- Configuration in the menu bar to enter the list mode configuration interface, as shown in Figure 71.

Figure 71 List Configuration Interface Diagram

The configuration interface can change the number of cycles of the programming waveform. If the number of cycles of the List programming waveform is set to 2, the programming waveform is shown in Figure 72.

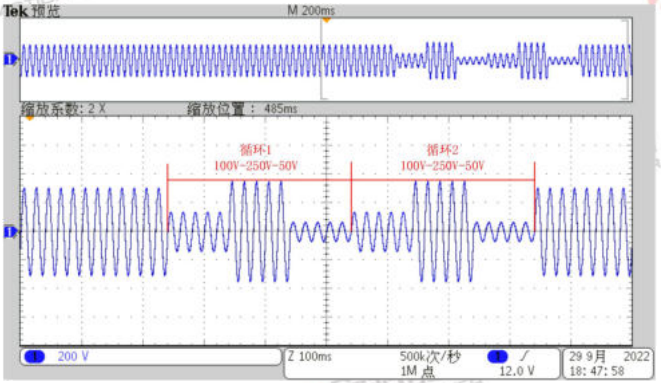


Figure 72 List Programming Waveform Example Figure II

Tek 预览	Tek preview
缩放系数：2X	Scaling factor: 2X
缩放位置：485ms	Zoom position: 485ms
循环 1 100V-250V-50V	Cycle 1 100V-250V-50V
循环 2 100V-250V-50V	Cycle 2 100V-250V-50V
500k 次/秒	500k times/second
1M 点	1M point
9 月	September

See Table 16 for parameter definitions in the configuration interface.

Table 16 List Configuration Interface Parameter Interpretation Table

Parameter term	Unit	Interpretation and application	Model	Resolution	Setting range

Parameter term	Unit	Interpretation and application	Model	Resolution	Setting range
Number of cycles	/	Setting the number of cycle outputs of the List programming waveform. The number of cycles of 0 indicates an infinite cycle.	ALL	/	0~9999999
Ending state	/	Steady state: After programming, the output waveform returns to steady state. Hold: After programming, the output waveform is held in the last programming sequence. Standby: After programming, the output is disconnected and the output button turns green.	ALL	/	/
Continuous triggering	/	After it is enabled, when the same programming data is triggered again, you don't need to click "Load", just click "Trigger".	ALL	/	/
Trigger mode	/	Automatic: it is executed in sequence according to the programming order. Single shot: Only one sequence is executed at a time.	ALL	/	/
Trigger input	/	Internal: Click "Trigger" manually on the display screen or send a trigger instruction through the communication interface to realize internal trigger. External: send a trigger signal to it through Anyport digital input interface to realize external trigger. See Section 8.14.1 for details.	ALL	/	/
Trigger delay	s	Press "Trigger" and wait for the set trigger delay before executing the programming sequence.	ALL	/	0~999.999
Trigger output	/	After the trigger function is set in the Anyport digital output interface, the product will send out a pulse indication signal at the Anyport digital output port when outputting the programming waveform. This operation needs to enable the trigger function in the Anyport digital output configuration interface. See Section 8.14.1 for details. See Figure 73 for the schematic diagram of pulse output waveform. One-time: Only when the programming starts to be executed, the pulse indication signal is output. Single step: when each sequence is executed, a pulse indication signal is issued. Single cycle: send out pulse indication signal at the beginning of each cycle.	ALL	/	/
Valid value	/	Automatic: When the programming waveforms of all sequences in the	ALL	/	/

Parameter term	Unit	Interpretation and application	Model	Resolution	Setting range
Mode		programming data are sine waves, clipping wave and built-in harmonics, the valid value mode is automatically enabled, and the output voltage value is closed-loop, and the output voltage value is automatically adjusted to be consistent with the set value. Otherwise, the valid value mode is automatically disabled, and the output voltage value is open-loop. Enabled: Forced closed loop. Forbidden: Forced open loop.			

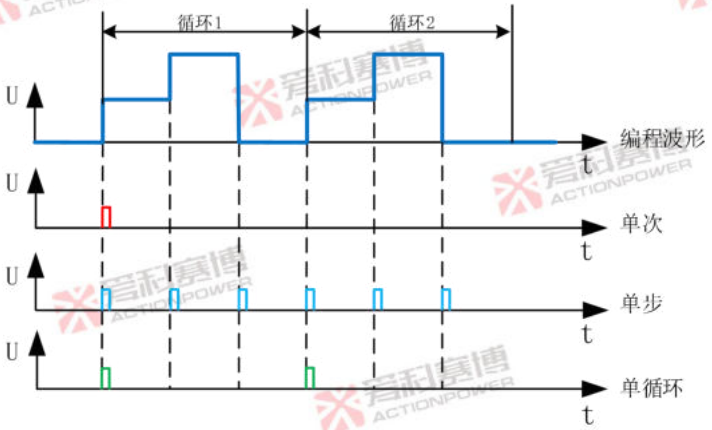


Figure 73 Schematic Diagram of Trigger Output

循环 1	Cycle 1
循环 2	Cycle 2
编程波形	Programmed waveform
单次	Single
单步	Single step
单循环	Single cycle

The configured List programming waveform data can be stored in the product interior or in an external USB storage device, which is convenient for direct calling next time, so as to reduce the repeated configuration operation of users. See Section 8.11.5 for details.

List programming waveform data is stored in internal storage as follows:

1) Click "Export" in the upper right corner of Figure 68 to enter the interface in Figure 74.

Figure 74 Waveform Export Interface Diagram

2) Enter the name of the saved file in the keyboard area, and click "Enter" to finish saving.

3) Return to the List programming interface, click "Import", select the saved file (suffix:. List) in Figure 75, and click "OK" to import the saved waveform data into the list programming interface.

Figure 75 Waveform File Selection Interface

8.4.2 Wave

Wave includes editing and configuration, as shown in Figure 76.

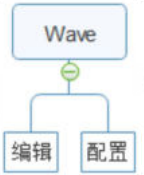


Figure 76 Wave Function Tree Diagram

编辑	Edit
配置	Configuration

Click Programming -Wave- Edit in the menu bar to enter the Wave programming interface, where you can set the wave programming parameters yourself, as shown in Figure 77. See Table 17 for the definition of each parameter.

Figure 77 Wave Programming Interface Diagram

Table 17 Interpretation Table of Wave Programming Interface Parameters

Parameter term	Unit	Interpretation	Model	Resolution	Setting range
No.	/	Serial number.	ALL	/	1~300
Uac[V]	V	Valid value of AC voltage of each phase.	ALL	0.01	0~450
Freq[Hz]	Hz	Frequency of the output voltage.	ALL	0.001	0.001~200
Ramp[s]	s	Variation time of voltage values between adjacent sequences.	ALL	0.0001	0~999.9999
	/	Clear all the current programming data and return to the initial programming	ALL	/	/

Parameter term	Unit	Interpretation	Model	Resolution	Setting range
		state in Figure 77.			
"+"	/	The current sequence inserts a set of new sequences backward, and the parameter values are the same as the current sequence.	ALL	/	/
"-"	/	Delete the current sequence.	ALL	/	/
Export	/	Store the programmed waveform data into the interior product.	ALL	/	/
Import	/	Import the stored waveform data into the current programming interface.	ALL	/	/
Loading	/	Lock the programming data and enter the state to be triggered.	ALL	/	/
Exit	/	At any time when the programming mode is running, you can click "Exit" to end the current programming mode.	ALL	/	/
Triggering	/	From the stable output state to the programming waveform output state.	ALL	/	/

Note: The expected output waveform is still limited by the value parameters, and improper limit setting may distort the expected output waveform.

Wave programming example:

1) Press the output button on the front panel to let the product output a steady-state voltage.
2) See Table 18 for Wave programming data.

Table 18 Sample Table of Wave Programming Data

Serial number / Parameter term	No.1	No.2	No.3
Uac[V]	100	250	50
Freq[Hz]	50	50	50
Ramp[s]	0.1	0.1	0.1

See Figure 78 for an example of Wave programming.

Figure 78 Wave Programming Example Figure I

3) Click "Load" in the lower right corner, and both "Exit" and "Trigger" are highlighted, as shown in Figure 79.

Figure 79 Wave Programming Example Figure II

Note: The programming data cannot be modified after loading. If you need to modify it, you must click "Exit".

4) Click "Trigger" to display the programmed waveform on the oscilloscope (only Φ 1 waveform is shown here), as shown in Figure 80.

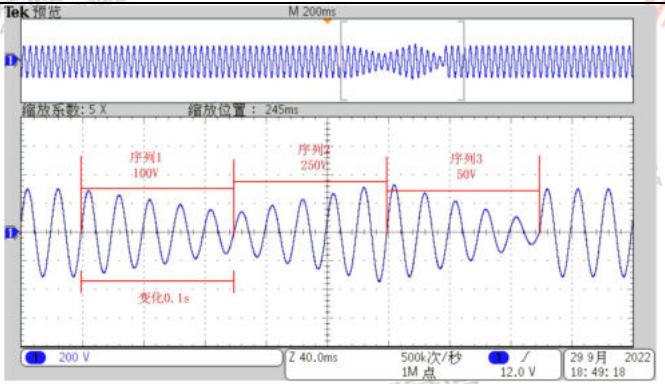


Figure 80 Wave Programming Waveform Example Figure I

Tek 预览	Tek preview
缩放系数：5X	Scaling factor: 5X
缩放位置：245ms	Zoom position: 245ms
序列 1 100V	Sequence 1 100V
序列 2 250V	Sequence 2 250V
序列 3 50V	Sequence 3 50V
保持 0.1s	Keep 0.1s
500k 次/秒	500k times/second
1M 点	1M point
9 月	September

Note:At any time when the programming mode is running, you can click "Exit" to end the current programming mode.

Click Programming -Wave- Configuration in the menu bar to enter the Wave mode configuration interface. The

parameters and functions of the Wave configuration interface are the same as those of the List mode configuration interface, as shown in Figure 71. Set the cycle number of Wave programming waveform to 2 in the configuration interface, and the programming waveform is shown in Figure 81.

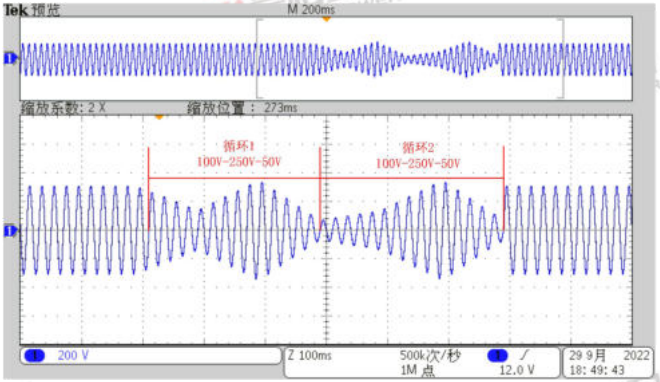


Figure 81 Wave Programming Waveform Example Figure II

Tek 预览	Tek preview
缩放系数：2X	Scaling factor: 2X
缩放位置：273ms	Zoom position: 273ms
循环 1 100V-250V-50V	Cycle 1 100V-250V-50V
循环 2 100V-250V-50V	Cycle 2 100V-250V-50V
500k 次/秒	500k times/second
1M 点	1M point
9 月	September

The configured Wave programming waveform data can be stored in the product interior or in an external USB

storage device, which is convenient for direct calling next time, so as to reduce the repeated configuration operation of users. See Section 8.11.5 for details.

The specific method of storing Wave programming waveform data into the product interior can refer to the storage method of List programming.

8.4.3 Step

Step includes editing and configuration, as shown in Figure 82.

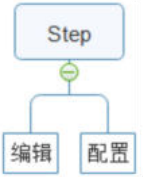


Figure 82 Step Function Tree Diagram

编辑	Edit
配置	Configuration

Click Programming -Step- Edit in the menu bar to enter the Step programming interface, and you can set the Step programming parameters yourself, as shown in Figure 83. See Table 19 for the definition of each parameter.

Figure 83 Step Programming Interface Diagram

Table 19 Interpretation Table of Step Programming Interface Parameters

Parameter term	Unit	Interpretation	Model	Resolution	Setting range
Waveform	/	Waveform.	ALL	/	/
Phase[°]	°	Phase.	ALL	0.1	0~359.9
Percent[%]	/	Percentage of waveform.	ALL	0.01	0~100
Uac[V]Start	V	Valid value of initial voltage.	ALL	0.01	0~450
Uac[V]End	V	Valid value of ending voltage.	ALL	0.01	0~450
Uac[V]Δ	V	Voltage variation.	ALL	0.01	0~450
Freq[Hz]Start	Hz	Starting voltage frequency.	ALL	0.001	0.001~200
Freq[Hz]End	Hz	Ending voltage frequency.	ALL	0.001	0.001~200
Freq[Hz]Δ	Hz	Frequency variation.	ALL	0.001	0.001~200
Degree[°]	°	Trigger angle.	ALL	0.1	0~359.9
Time[s]	s	The holding time of each step.	ALL	0.0001	0~999.9999
Export	/	Store the programmed waveform data into the interior product.	ALL	/	/
Import	/	Import the stored waveform data into the current programming interface.	ALL	/	/
Loading	/	Lock the programming data and enter the state to be triggered.	ALL	/	/
Exit	/	At any time when the programming mode is running, you can click "Exit" to end the current programming mode.	ALL	/	/
Triggering	/	From the stable output state to the programmed waveform output state.	ALL	/	/

Note: The expected output waveform is still limited by the value parameters, and improper limit setting may distort the expected output waveform.

Step programming example:

1) Press the output button on the front panel to let the product output a steady-state voltage.
2) See Table 20 for Step programming data.

Table 20 Example Table of Step Programming Data

Parameter term	Settings	Parameter term	Settings
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

See Figure 84 for an example of Step programming.

Figure 84 Step Programming Example Figure I

3) Click "Load" in the lower right corner, and both "Exit" and "Trigger" are highlighted, as shown in Figure 85.

Figure 85 Step Programming Example Figure II

Note: The programming data cannot be modified after loading. If you need to modify it, you must click "Exit".

4) Click "Trigger" to display the programmed waveform on the oscilloscope (only Φ 1 waveform is shown here), as shown in Figure 86.

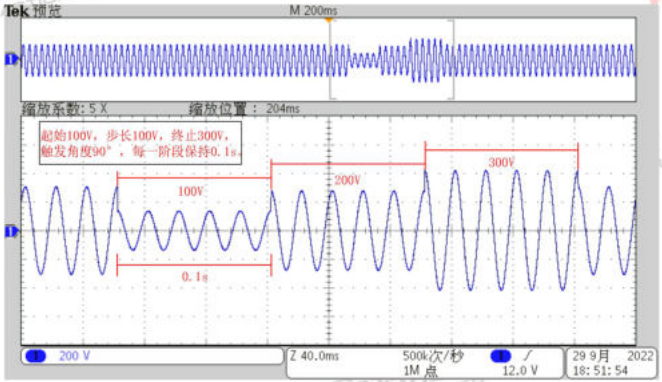


Figure 86 Step Programming Waveform Example Figure I

Tek 预览	Tek preview
缩放系数：5X	Scaling factor: 5X
缩放位置：204ms	Zoom position: 204ms
起始 100V，步长 100V，终止 300V，触发角度 90°，每一阶段保持 0.1s。	Start at 100V, step at 100V, end at 300V, trigger angle at 90°, and keep 0.1s at each stage.
500k 次/秒	500k times/second
1M 点	1M point
9 月	September

Keep other parameters unchanged, set the trigger angle Degree to 90°, click "Load" and "Trigger", and display the waveform with trigger angle of 90° on the oscilloscope (only Φ 1 waveform is shown here), as shown in Figure 87.

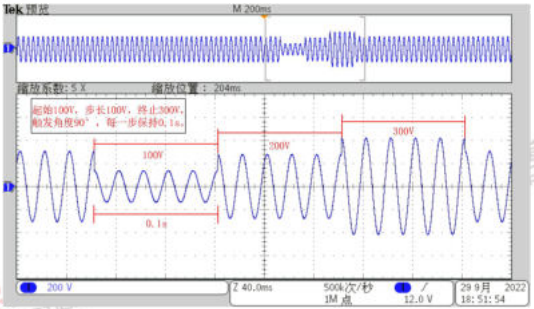


Figure 87 Step Programming Waveform Example Figure II

Tek 预览	Tek preview
缩放系数：5X	Scaling factor: 5X
缩放位置：204ms	Zoom position: 204ms
起始 100V，步长 100V，终止 300V，触发角度 90°，每一阶段保持 0.1s。	Start at 100V, step at 100V, end at 300V, trigger angle at 90°, and keep 0.1s at each stage.
500k 次/秒	500k times/second
1M 点	1M point
9 月	September

Note:At any time when the programming mode is running, you can click "Exit" to end the current programming mode.

Click Programming -Step- Configuration in the menu bar to enter the Step mode configuration interface. The parameters and functions of the Step configuration interface are the same as those of the List mode configuration interface, as shown in Figure 71. Set the cycle number of Step programming waveform to 2 in the configuration interface, and the programming waveform is shown in Figure 88.

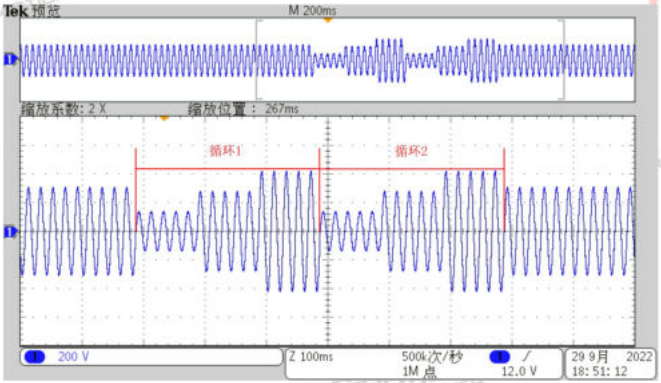


Figure 88 Step Programming Waveform Example Figure III

Tek 预览	Tek preview
缩放系数：2X	Scaling factor: 2X
缩放位置：267ms	Zoom position: 267ms
循环 1	Cycle 1
循环 2	Cycle 2
500k 次/秒	500k times/second
1M 点	1M point
9 月	September

The configured Step programming waveform data can be stored in the product interior or in an external USB storage device, which is convenient for direct calling next time, so as to reduce the repeated configuration operation of users. See Section 8.11.5 for details.

For the specific method of storing the waveform data of Step programming in the product interior, please refer to the

storage method of List programming.

8.4.4 Pulse

Pulse includes editing and configuration, as shown in Figure 89.

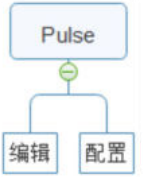


Figure 89 Pulse Function Tree Diagram

编辑	Edit
配置	Configuration

Click Programming -Pulse- Edit in the menu bar to enter the Pulse programming interface, where you can set the Pulse programming parameters yourself, as shown in Figure 90. See Table 21 for the definition of each parameter.

Figure 90 Pulse Programming Interface Diagram

Table 21 Interpretation Table of Pulse Programming Interface Parameters

Parameter term	Unit	Interpretation	Model	Resolution	Setting range
Fundamental	/	Steady-state waveform programmed by the user.	ALL	/	/

Parameter term	Unit	Interpretation	Model	Resolution	Setting range
wave					
Pulse	/	Replace a section of waveform in the fundamental wave.	ALL	/	/
Waveform	/	Waveform.	ALL	/	/
Phase[°]	°	Phase.	ALL	0.1	0~359.9
Percent[%]	/	Percentage of waveform.	ALL	0.01	0~100
Uac[V]	V	Valid value of AC voltage of each phase.	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	Fundamental period.	ALL	0.0001	0~999.9999
Degree[°]	°	Trigger angle.	ALL	0.1	0~359.9
Export	/	Store the programmed waveform data into the interior product.	ALL	/	/
Import	/	Import the stored waveform data into the current programming interface.	ALL	/	/
Loading	/	Lock the programming data and enter the state to be triggered.	ALL	/	/
Exit	/	At any time when the programming mode is running, you can click "Exit" to end the current programming mode.	ALL	/	/
Triggering	/	From the stable output state to the programming waveform output state.	ALL	/	/

Note: The expected output waveform is still limited by the value parameters, and improper limit setting may distort the expected output waveform.

Pulse programming example:

1) Press the output button on the front panel to let the product output a steady-state voltage.
2) See Table 22 for Pulse programming data.

Table 22 Sample Table of Pulse Programming Data

Category / Parameter term	Fundamental wave	Pulse	Others
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. See Figure 91 for an example of Pulse programming.

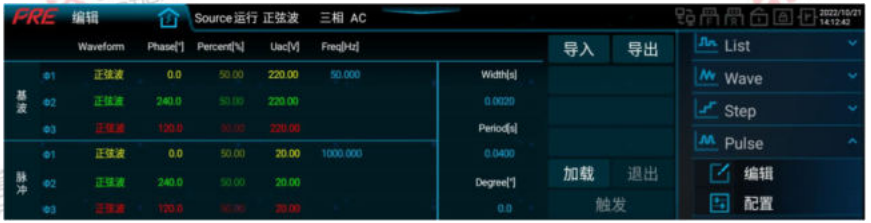


Figure 91 Pulse Programming Example Figure I

3) Click "Load" in the lower right corner, and both "Exit" and "Trigger" are highlighted, as shown in Figure 92.

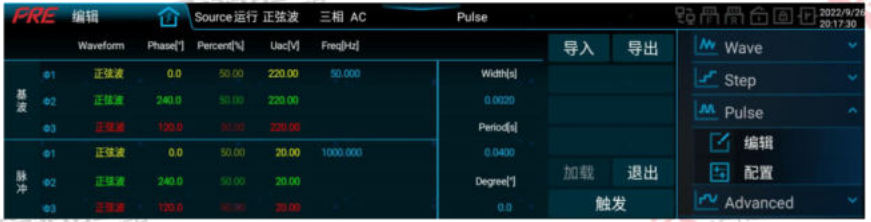


Figure 92 Pulse Programming Example Figure II

Note: The programming data cannot be modified after loading. If you need to modify it, you must click "Exit".

4) Click "Trigger" to display the programmed waveform on the oscilloscope (only Φ 1 waveform is shown here), as shown in Figure 93.

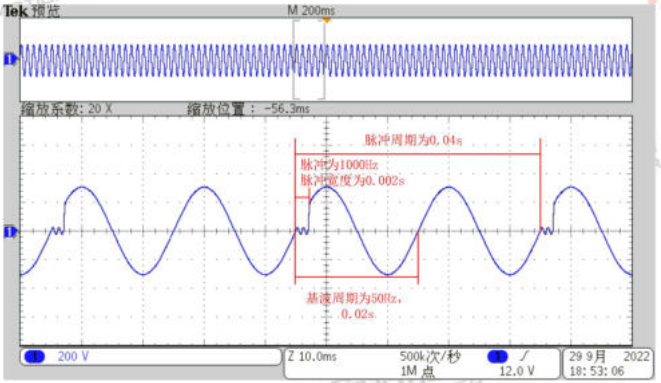


Figure 93 Sample Diagram of Pulse Programming Waveform

Tek 预览	Tek preview
缩放系数：20X	Scaling factor: 20X
缩放位置：-56.3ms	Zoom position: -56.3ms
脉冲周期为 0.04s	The pulse period is 0.04s s.
脉冲为 1000Hz	The pulse is 1000Hz.
脉冲宽度为 0.002s	The pulse width is 0.002s
基波周期为 50Hz，0.02s.	The fundamental period is 50Hz, 0.02s.
500k 次/秒	500k times/second
1M 点	1M point
9 月	September

Note:At any time when the programming mode is running, you can 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 the same as those of the List mode configuration interface, as shown in Figure 71.

The configured Pulse programming waveform data can be stored in the product interior or in an external USB storage device, which is convenient for direct calling next time, so as to reduce the repeated configuration operation of users. See Section 8.11.5 for details.

The specific method of storing Pulse programming waveform data into the product interior can refer to the storage method of List programming.

8.4.5 Advanced

Advanced includes editing and configuration, as shown in Figure 94.

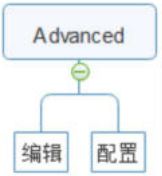


Figure 94 Advanced Function Tree Diagram

编辑	Edit
配置	Configuration

Click Programming -Advanced- Editing in the menu bar to enter the Advanced programming interface, where you can set advanced programming parameters by yourself. Slide left and right in the interface to see the complete programming parameters, as shown in Figure 95 and Figure 96. See Table 23 for the definition of each parameter.

Figure 95 Advanced Programming Interface Figure 1

Figure 96 Advanced Programming Interface Figure 2

Table 23 Interpretation Table of Advanced Programming Interface Parameters

Parameter term	Unit	Interpretation	Model	Resolution	Setting range
No.	/	Serial number.	ALL	/	1~300
Waveform	/	Waveform.	ALL	/	/
Phase[°]	°	Phase.	ALL	0.1	0~359.9
Percent[%]	/	Percentage of waveform.	ALL	0.01	0~100
Uac[V]	V	Valid value of AC voltage of each phase.	ALL	0.01	0~450
Freq[Hz]	Hz	Frequency of the output voltage.	ALL	0.001	0.001~200
Ramp[s]	s	Change time between adjacent sequences.	ALL	0.0001	0~999.9999
Dwell[s]	s	The holding time of the current sequence.	ALL	0.0001	0~999.9999
Link	/	After the current sequence is executed, jump to the specified sequence,	ALL	/	0~300

Parameter term	Unit	Interpretation	Model	Resolution	Setting range
		and the rule is "current serial number -Link value = jump to serial number". If the Link of sequence 3 is set to 2 (at this time, the Count must be set to a value ≥1, otherwise the function of Link will be invalid), then after executing sequence 3, jump to sequence 1.			
Count	/	Used in conjunction with Link, it indicates the number of cycles to jump from the current sequence to the specified sequence. If the Link of sequence 3 is set to 1 and the Count is set to 2, after executing sequence 3, jump to sequence 2, execute sequence 3 in sequence, and then jump to sequence 2 to complete two cycles.	ALL	/0	0~9999999
Degree[°]	°	Starting angle, and enabling is effective.	ALL	0.1	0~359.9
Trig In	/	When prohibited, it shall be executed in sequence according to the serial number. When enabled, the trigger mode in the "Configuration" interface must be set to automatic, and the enabling sequence shall be executed by using internal trigger or external trigger.	ALL	/	/
Trig Out	/	When enabled, the trigger output in the "Configuration" interface must be set to single step, and a single-step pulse indication signal can be sent out in the Anyport digital output interface. This operation needs to enable the Anyport digital output interface and select the trigger function. See Section 8.14.1 for details.	ALL	/	/
	/	Clear all the current programming data, and return to the initial programming state of Figure 95 and Figure 96.	ALL	/	/
"+"	/	The current sequence inserts a set of new sequences backward, and the parameter values are the same as the current sequence.	ALL	/	/
"-"	/	Delete the current sequence.	ALL	/	/
Export	/	Store the programmed waveform data into the interior product.	ALL	/	/
Import	/	Import the stored waveform data into the current programming interface.	ALL	/	/
Loading	/	Lock the programming data and enter the state to be triggered.	ALL	/	/
Exit	/	At any time when the programming mode is running, you can click "Exit" to end the current programming mode.	ALL	/	/
Triggering	/	From the stable output state to the programming waveform output state.	ALL	/	/

Note: The expected output waveform is still limited by the value parameters, and improper limit setting may distort the expected output

waveform.

Advanved programming example:

1) Press the output button on the front panel to let the product output a steady-state voltage.
2) See Table 24 for Pulse programming data.

Table 24 Example Table of Advanced Programming Data

Serial number / Parameter term	No.1	No.2	No.3
Uac[V]	50	150	300
Freq[Hz]	50	50	50
Ramp[s]	0	0	0.06
Dwell[s]	0.06	0.06	0.06
Link	0	0	1
Count	0	0	1
Degree[°]	Enabled, 60	Enabled, 90	Prohibited
Trig In	Prohibited	Prohibited	Prohibited
Trig Out	Enabling	Enabling	Enabling

See Figure 97 to Figure 100 for an example of Advanced programming.

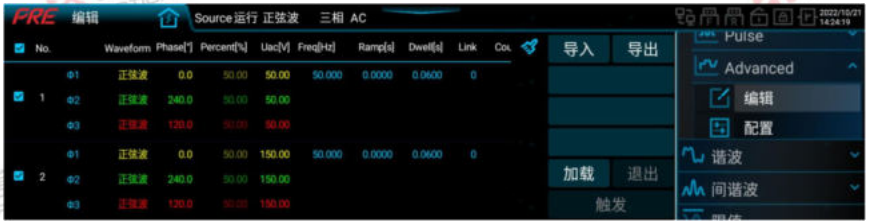


Figure 97 Advanced Programming Example Figure I

Figure 98 Advanced Programming Example Figure II

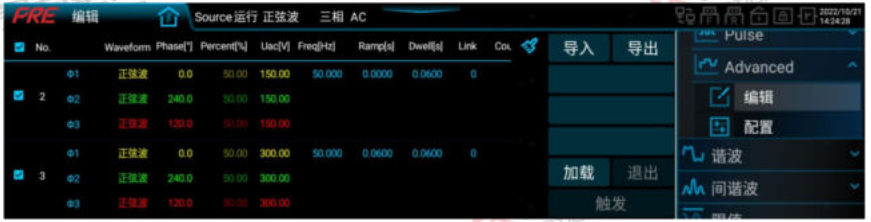


Figure 99 Advanced Programming Example Figure III

Figure 100 Advanced Programming Example Figure IV

3) Click "Load" in the lower right corner, and both "Exit" and "Trigger" are highlighted, as shown in Figure 101.

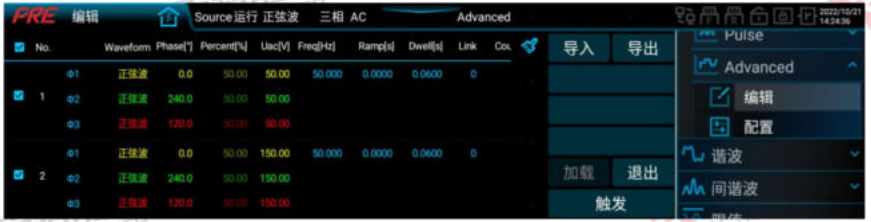


Figure 101 Advanced Programming Example Figure V

Note: The programming data cannot be modified after loading. If you need to modify it, you must click "Exit".

4) Click "Trigger" to display the programmed waveform on the oscilloscope (only Φ 1 waveform is shown here), as shown in Figure 102.

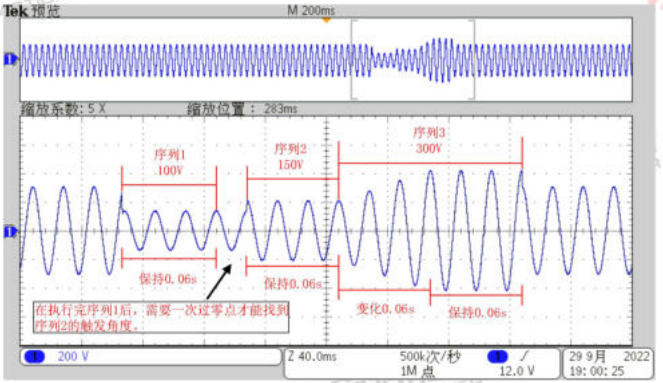


Figure 102 Example of Advanced Programming Waveform Figure I

Tek 预览	Tek preview
缩放系数：5X	Scaling factor: 5X
缩放位置：283ms	Zoom position: 283ms
序列 1 100V	Sequence 1 100V
序列 2 150V	Sequence 2 150V
序列 3 300V	Sequence 3 300V
保持 0.06s	Hold for 0.06s
保持 0.06s	Hold for 0.06s
变化 0.06s	Change by 0.06s
保持 0.06s	Hold for 0.06s
在执行完序列 1 后，需要一次过零点才能找到序列	After executing sequence 1, it needs a zero crossing to find the trigger angle of sequence 2.

2 的触发角度。	
500k 次/秒	500k times/second
1M 点	1M point
9 月	September

Note:At any time when the programming mode is running, you can click "Exit" to end the current programming mode.

Keep other parameters unchanged, set all Link and Count of Sequence 3 to 1, click "Load" and click "Trigger", and the waveform displayed on the oscilloscope (only Φ 1 waveform is shown here) is shown in Figure 103.

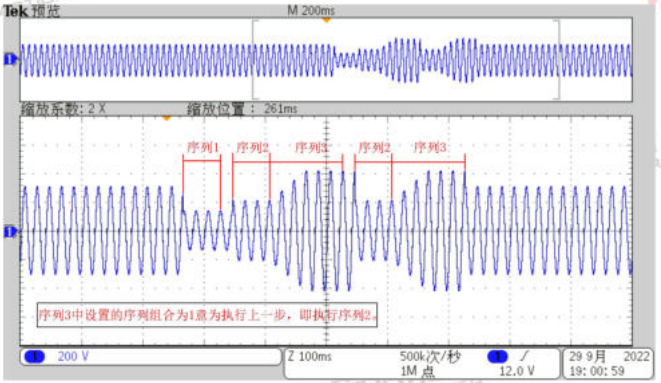


Figure 103 Example of Advanced Programming Waveform Figure II

Tek 预览	Tek preview
缩放系数：2X	Scaling factor: 2X
缩放位置：261ms	Zoom position: 261ms
序列 1	Sequence 1
序列 2	Sequence 2
序列 3	Sequence 3
序列 2	Sequence 2
序列 3	Sequence 3
序列 3 中设置的序列组合为 1 意为执行上一步，即执行序列 2.	The sequence combination set in sequence 3 as 1 means to execute the previous step, i.e. execute sequence 2.
500k 次/秒	500k times/second

1M 点	1M point
9 月	September

Click Programming-Advanced-Configuration in the menu bar to enter the Advanced mode configuration interface. The parameters and functions of the Advanced configuration interface are the same as those of the List mode configuration interface, as shown in Figure 71.

The configured Advanced programming waveform data can be stored inside the product or to an external USB storage device to facilitate direct call next time to reduce the repeated configuration operation of the user. See Section 8.11.5 for details.

For the specific method of storing waveform data of Advanced Programming into the product, please refer to the storage method of List Programming.

8.5 Harmonics

Harmonic includes editing and configuration, as shown in Figure 104.

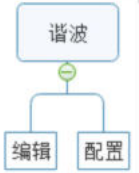


Figure 104 Harmonic Function Tree

谐波	Harmonics
编辑	Edit
配置	Configuration

Click Harmonic-Edit in the menu bar to enter the harmonic parameter setting interface. You can set harmonic parameters and output them yourself, or output 30 kinds of harmonics built in the product. See "Appendix-Built-in

Harmonic Examples" for waveforms. The harmonic parameter setting interface is shown in Figure 105. See Table 25 for the explanation of each parameter.

Figure 105 Interface of Harmonic Parameter Setting

Table 25 Interpretation of Harmonic Interface Parameters

Parameter term	Unit	Interpretation	Model	Resolution	Setting range
No.	/	Number of harmonics. Up to 100 harmonics can be edited, see Section 4.9.	ALL	/	/
Value[%]	/	Harmonic content.	ALL	0.01	See Section 4.9 for details
Phase[°]	°	Harmonic phase.	ALL	0.1	0~359.9
	/	Clear all current data and return to the initial programming state of Figure 105.	ALL	/	/
Export	/	Store harmonic parameters into the product.	ALL	/	/
Import	/	Import the stored harmonic parameters to the Harmonic Settings screen.	ALL	/	/
DST	/	It contains 30 kinds of built-in harmonics, which can be imported to a certain phase or three phases in the DST interface, as shown in Figure 106.	ALL	/	/
Preview	/	Preview the output waveform under the currently set harmonic parameter.	ALL	/	/
Export waveform	/	Store the set harmonic waveform inside the product and import it to a custom waveform in 8.11.4, which can be output as a steady-state	ALL	/	/

Parameter term	Unit	Interpretation	Model	Resolution	Setting range
		waveform.			
Loading	/	Lock the harmonic data and enter the to-be-triggered state.	ALL	/	/
Exit	/	At any time during harmonic operation, you can click "Exit" to end the current mode.	ALL	/	/
Triggering	/	Transition from steady output state to harmonic output state.	ALL	/	/
Update	/	After the user modifies the harmonic parameters, simply click "Update" and the product will output the waveform according to the harmonic parameters currently set.	ALL	/	/

Note: The expected output waveform is still limited by the value parameters, and improper limit setting may distort the expected output waveform.

Figure 106 DST Interface Diagram

Example of harmonic setting:

1) Press the output button on the front panel to let the product output a steady-state voltage.
2) Set the 3rd harmonic content to 20% and the 5th harmonic content to 40%, see Fig.107.

Figure 107 Example I of Harmonic Parameter Setting

3) Click "Load" in the lower right corner. At this time, "Exit" and "Trigger" are highlighted, as shown in Figure 108.

Figure 108 Example II of Harmonic Parameter Setting

4) Click "Trigger" to display the programmed waveform on the oscilloscope (only ϕ1 waveform is displayed here), see Figure 109.

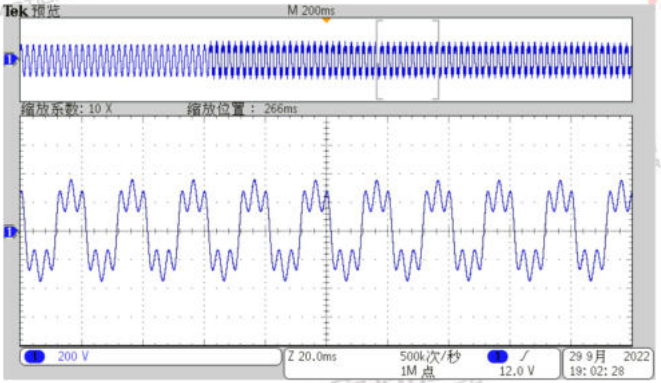


Figure 109 Example of Harmonics

Tek 预览	Tek preview
缩放系数：10X	Scaling factor: 10X
缩放位置：266ms	Scaling position: 266ms
500k 次/秒	500k times/second
1M 点	1M point
9 月	September

Note: 1. At any time during harmonic operation, you can click "Exit" to end the current mode.

2. After modifying the harmonic parameters, "Update" is highlighted and click "Update". The product will output the waveform according to the harmonic parameters currently set.

3. How to use "Export Waveform": click "Export Waveform" → enter the name of the saved waveform → click "Enter" → click φ1/φ2/φ3 to export, that is, to store the currently edited waveform to the product.

Click Harmonic - Configuration in the menu bar to enter the harmonic configuration interface, as shown in Figure

110. The parameters are explained in Table 26.

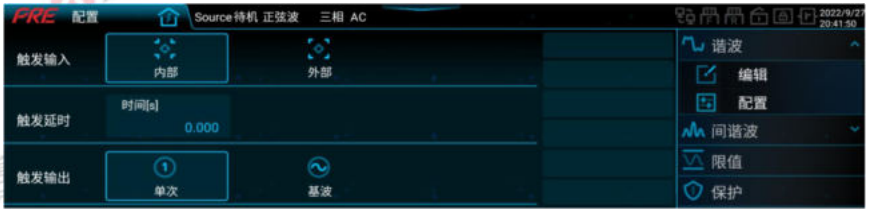


Figure 110 Interface of Harmonic Configuration

Table 26 Interpretation of Harmonic Configuration Parameters

Parameter term	Unit	Interpretation and application	Model	Resolution	Setting range
Trigger input	/	Internal: manually click "Trigger" on the display to realize internal triggering. External: send a trigger signal to it through Anyport digital input interface to realize external trigger. See Section 8.14.1 for details.	ALL	/	/
Trigger delay	s	When "Trigger" is pressed, the harmonics are output after a set trigger delay.	ALL	0.001	0~999.999
Trigger output	/	Single: A pulse indication signal is sent through the digital output of Anyport at the moment of harmonic output. See Section 8.14.1 for details. Fundamental wave: After harmonic output, a pulse indication signal is sent through the digital output of Anyport at each zero-crossing point of the fundamental wave.	ALL	/	/

The configured harmonic parameters can be stored inside the product or to an external USB storage device for direct call next time to reduce repeated configuration by users. See Section 8.11.5 for details.

For the specific practice of storing harmonic parameters inside the product, refer to the storage method of List programming.

8.6 Interharmonic

Interharmonics include editing and configuration, as shown in Figure 111.

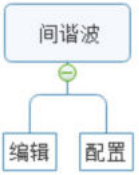


Figure 111 Interharmonic Function Tree Diagram

间谐波	Interharmonic
编辑	Edit
配置	Configuration

Click Interharmonic-Edit in the menu bar to enter the interharmonic parameter setting interface, where you can set the interharmonic parameters by yourself. See Figure 112 for the interharmonic parameter setting interface. The parameters are explained in Table 27.

Figure 112 Interharmonic Parameter Setting Interface

Table 27 Interharmonic Interface Parameter Interpretation

Parameter term	Unit	Interpretation	Model	Resolution	Setting range
No.	/	Serial number, supporting up to 300 steps.	ALL	/	/
Value[%]	/	Interharmonic content.	ALL	0.01	0~40
Start[Hz]	Hz	Initial frequency.	ALL	0.001	0.001~2000
End[Hz]	Hz	End frequency.	ALL	0.001	0.001~2000
Δ[Hz]	Hz	Frequency step.	ALL	0.001	0.001~2000
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 the initial programming state of FIGURE 112.	ALL	/	/
"+"	/	The current sequence inserts a set of new sequences backward, and the parameter values are the same as the current sequence.	ALL	/	/
"-"	/	Delete the current sequence.	ALL	/	/
Export	/	Interharmonic parameters are stored in the product.	ALL	/	/
Import	/	Import the stored interharmonic parameters to the harmonic setting interface.	ALL	/	/
Loading	/	Lock the interharmonic data and enter the state to be triggered.	ALL	/	/
Exit	/	At any time during interharmonic operation, you can click "Exit" to end the current mode.	ALL	/	/
Triggering	/	From the stable output state to the programming waveform output state.	ALL	/	/

Note: The expected output waveform is still limited by the value parameters, and improper limit setting may distort the expected output waveform.

Example of setting interharmonic parameters:

1) Press the output button on the front panel to let the product output a steady-state voltage.
2) The interharmonic parameters are shown in Table 28.

Table 28 Examples of Interharmonic Parameters

Parameter term	Settings	Parameter term	Settings
Value[%]	20	Δ[Hz]	200
Start[Hz]	400	Dwell[s]	0.02
End[Hz]	600	Pause[s]	0.02

An example diagram of interharmonics is shown in Figure 113.

Figure 113 Example I of Interharmonic Parameter Setting

3) Click "Load" in the lower right corner, and both "Exit" and "Trigger" are highlighted, as shown in Figure 114.

Figure 114 Example II of Interharmonic Parameter Setting

Note: The interharmonic parameters cannot be modified after loading. Click "Exit" if necessary.

4) Click "Trigger" to display the programmed waveform on the oscilloscope (only ϕ1 waveform is displayed here), see Figure 115.

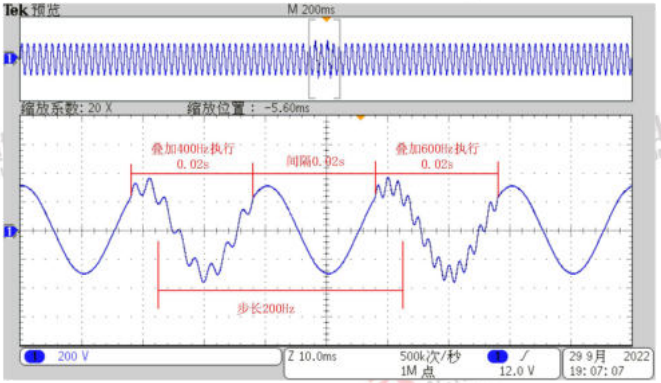


Figure 115 Example of Interharmonics

Tek 预览	Tek preview

缩放系数：20X	Scaling factor: 20X
缩放位置：-5.60ms	Scaling position: -5.60ms
叠加 400H 执行 0.02s	Superimpose 400H for 0.02s
间隔 0.02s	Interval 0.02s
叠加 600H 执行 0.02s	Superimpose 600H for 0.02s
步长 200Hz	Step size: 200Hz
500k 次/秒	500k times/second
1M 点	1M point
9 月	September

Note: At any time during interharmonic operation, you can click "Exit" to end the current mode.

Click Interharmonic - Configuration in the menu bar to enter the harmonic configuration interface, as shown in Figure 116.

Figure 116 Interface of Interharmonic Configuration

Refer to List and Harmonic Configuration Interface for parameter functions and interpretation in the interharmonic configuration interface.

The configured interharmonic parameters can be stored inside the product or to an external USB storage device to facilitate direct call next time to reduce repeated configuration by the user. See Section 8.11.5 for details.

For the specific practice of storing interharmonic parameters inside the product, refer to the storage method of List programming.

8.7 Limit

Click the limit in the menu bar to enter the limit setting interface. The limit setting interface is shown in Figure 117, where the given range of voltage, frequency, current and power can be set. See Table 29 for the definition of limit parameters.

Figure 117 Interface of Limit Setting

Table 29 Functions of Limits

Parameter term	Unit	Interpretation and application	Model	Resolution	Initial value	Setting range
AC voltage lower limit	V	The minimum value that can be set for AC voltage in the output setting area. When the user needs to avoid damage to the tested equipment due to too low output AC voltage caused by misoperation, the lower limit of AC voltage can be set in the safe range here.	ALL	0.01	0	0.00~450
AC voltage upper limit	V	The maximum value that can be set for AC voltage in the output setting area. When the user needs to avoid damage to the tested equipment due to excessive output AC voltage caused by misoperation, the upper limit of AC voltage can be set in the safe range here.	ALL	0.01	450	0.00~450
DC voltage lower limit	V	The minimum value that can be set for DC voltage in the output setting area. When the user needs to avoid damage to the tested equipment due to too low output DC voltage caused by misoperation, the lower limit of DC voltage can be set in the safe range here.	ALL	0.01	-636	-636~0
Upper limit of DC voltage	V	The maximum value that can be set for DC voltage in the output setting area. When the user needs to avoid damage to the tested equipment due to excessive output DC voltage caused by misoperation, the upper limit of DC voltage can be set in the safe range here.	ALL	0.01	636	0~636
Lower limit of AC current limit	A	The minimum value of the output AC current of each phase, which is valid when the coupling mode is AC. When the output phase is three-phase or split-phase, the actual value is equal to the set value. When the output phase is single phase, the actual value is 3 times the set value. When the user needs to avoid damage to the equipment under test due to low output AC current due to misoperation, the lower limit of AC current can be set in a safe range here.	PRE2006S PRE2007S	0.01	0	0.00~30
			PRE2009S PRE2012S PRE2015S PRE2020S		0	0.00~35
Upper limit of AC current	A	The maximum value of the output AC current of each phase, which is valid when the coupling mode is AC.	PRE2006S PRE2007S	0.01	30	0.00~30

Parameter term	Unit	Interpretation and application	Model	Resolution	Initial value	Setting range
		When the output phase is three-phase or split-phase, the actual value is equal to the set value. When the output phase is single phase, the actual value is 3 times the set value. When the user needs to avoid damage to the equipment under test due to excessive output AC current caused by misoperation, the upper limit of AC current can be set in the safe range here.	PRE2009S PRE2012S PRE2015S		35	0.00~35
			PRE2020S			
Lower limit of DC current limit	A	The minimum value of the output DC current of each phase, which is valid when the coupling mode is DC. When the output phase is three-phase or split-phase, the actual value is equal to the set value. When the output phase is single phase, the actual value is 3 times the set value. When the user needs to avoid damage to the equipment under test due to too low output DC current due to misoperation, the lower DC current limit can be set in the safe range here.	PRE2006S	0.01	-30	-30~0
			PRE2007S			
			PRE2009S PRE2012S PRE2015S		-35	-35~0
			PRE2020S			
Upper limit of DC current	A	The maximum value of the output DC current of each phase, which is valid when the coupling mode is DC. When the output phase is three-phase or split-phase, the actual value is equal to the set value. When the output phase is single phase, the actual value is 3 times the set value. When the user needs to avoid damage to the equipment under test due to excessive output DC current caused by misoperation, the upper limit of DC current can be set in the safe range here.	PRE2006S	0.01	30	0~30
			PRE2007S			
			PRE2009S PRE2012S PRE2015S		35	0~35
			PRE2020S			
Lower limit of active power limit	kW	The minimum active power of each phase. When the output phase is three-phase or split-phase, the actual value is equal to the set value. When the output phase is single phase, the actual value is 3 times the set value. When the user needs to avoid damage to the equipment under test due to low source power due to misoperation, the lower limit of active power can be set in the safe range	PRE2006S	0.001	-2	-2~0
			PRE2007S		-2.5	-2.5~0
			PRE2009S		-3	-3~0
			PRE2012S		-4	-4~0
			PRE2015S		-5	-5~0
			PRE2020S		-6.667	-6.667~0

Parameter term	Unit	Interpretation and application	Model	Resolution	Initial value	Setting range
		here.				
Upper limit of active power limit	kW	The maximum active power of each phase. When the output phase is three-phase or split-phase, the actual value is equal to the set value. When the output phase is single phase, the actual value is 3 times the set value. When the user needs to avoid damage to the equipment under test due to excessive source power due to misoperation, the upper limit of active power limit can be set in a safe range.	PRE2006S	0.001	2	0~2
			PRE2007S		2.5	0~2.5
			PRE2009S		3	0~3
			PRE2012S		4	0~4
			PRE2015S		5	0~5
			PRE2020S		6.667	0~6.667
Apparent power limit lower limit	kVA	The minimum apparent power of each phase. When the output phase is three-phase or split-phase, the actual value is equal to the set value. When the output phase is single phase, the actual value is 3 times the set value. When the user needs to avoid damage to the equipment under test due to low source power due to misoperation, the lower limit of apparent power can be set in the safe range here.	PRE2006S	0.001	0	0~2
			PRE2007S		0	0~2.5
			PRE2009S		0	0~3
			PRE2012S		0	0~4
			PRE2015S		0	0~5
			PRE2020S		0	0~6.667
Upper limit of apparent power	kVA	The maximum apparent power of each phase. When the output phase is three-phase or split-phase, the actual value is equal to the set value. When the output phase is single phase, the actual value is 3 times the set value. When the user needs to avoid damage to the equipment under test due to excessive apparent power caused by misoperation, the upper limit of apparent power can be set in a safe range.	PRE2006S	0.001	2	0~2
			PRE2007S		2.5	0~2.5
			PRE2009S		3	0~3
			PRE2012S		4	0~4
			PRE2015S		5	0~5
			PRE2020S		6.667	0~6.667

Note: When paralleling, the relevant parameter settings of current and power need to be multiplied by the number of paralleling.

8.8 Protection

Click "Protection" in the menu bar to enter the protection setting interface. The protection setting interface is shown in Figure 118, where protection thresholds for voltage, current, power and frequency can be set. The protection parameters are defined in Table 30.

Figure 118 Interface Diagram of Protection Setting

Table 30 Protection Setting Parameters

Parameter term	Unit	Interpretation and application	Model	Resolution	Initial value	Setting range
Fast peak overvoltage threshold	V	Fast peak overvoltage protection critical value, which is valid only in load mode. This parameter can be set when the user needs to protect the maximum instantaneous voltage at the output end.	ALL	0.01	650	0~700
Effective value overvoltage threshold	V	Critical value of effective value overvoltage protection. This parameter can be set when the user needs to protect the maximum effective value of voltage at the output terminal.	ALL	0.01	636	0~636
AC overvoltage threshold	V	Critical value of AC overvoltage protection. This parameter can be set when the user needs to protect the maximum AC voltage at the output terminal.	ALL	0.01	450	0~450
DC forward overvoltage threshold	V	DC forward overvoltage protection critical value. This parameter can be set when the user needs to protect the maximum forward DC voltage at the output terminal.	ALL	0.01	636	0~636
DC negative overvoltage threshold	V	Critical value of DC negative overvoltage protection. This parameter can be set when the user needs to protect the maximum negative DC voltage at the output terminal.	ALL	0.01	-636	-636~0
Load AC undervoltage threshold	V	Critical value of load AC undervoltage protection, which is valid 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
Effective value overcurrent threshold	A	The critical value of overcurrent protection of the effective value of each phase. When the output phase is three-phase or split-phase, it indicates the critical value of the effective value of each phase overcurrent protection; when the output phase is single-phase, the actual value is 3 times of the set value. This parameter can be set when the user needs to protect the maximum current at the output terminal.	PRE2006S	0.01	31.5	0~31.5
			PRE2007S			
			PRE2009S		36.75	0~36.75
			PRE2012S			
			PRE2015S			
			PRE2020S			
Active power threshold	kW	Total active power protection critical value. This parameter can be set when the user needs to protect the maximum active power of the output terminal.	PRE2006S	0.001	6.3	0~6.3
			PRE2007S		7.875	0~7.875
			PRE2009S		9.45	0~9.45
			PRE2012S		12.6	0~12.6

Parameter term	Unit	Interpretation and application	Model	Resolution	Initial value	Setting range
			PRE2015S		15.75	0~15.75
			PRE2020S		21	0~21
Apparent power threshold	kVA	Total apparent power protection threshold. This parameter can be set when the user needs to protect the maximum apparent power of the output terminal.	PRE2006S	0.001	6.3	0~6.3
			PRE2007S		7.875	0~7.875
			PRE2009S		9.45	0~9.45
			PRE2012S		12.6	0~12.6
			PRE2015S		15.75	0~15.75
			PRE2020S		21	0~21
Overfrequency threshold	Hz	Critical value of overfrequency protection. This parameter can be set when the user needs to protect the maximum frequency of the output terminal AC voltage.	ALL	0.001	2000	0.001~2000
Underfrequency threshold	Hz	Critical value of underfrequency protection. This parameter can be set when the user needs to protect the minimum frequency of the AC voltage at the output terminal.	ALL	0.001	0.001	0.001~2000
Protection time	s	During the set protection time, if the output value of each parameter item continues to exceed the protection threshold, the protection will be triggered.	ALL	0.001	0.1	0.001~3

Note: When paralleling, the relevant parameter settings of current and power need to be multiplied by the number of paralleling.

8.9 Event

The PRE20XXS series products are designed with event logging function, which can monitor specific situations that occur during operation and facilitate users to observe and understand the working condition of the product. Click event in the menu bar to enter the event setting interface. The event setting interface is shown in Figure 119.

Figure 119 Event Interface Diagram

When the event is enabled, each parameter can be set, see Figure 120. The event functions are shown in Table 31.

Figure 120 Interface of Event Parameter Setting

Table 31 Event Setting Functions

Parameter term	Unit	Interpretation and application	Model	Resolution	Initial value	Setting range
Event number	\	\	ALL	\	\	\
Trigger source	\	The voltage, current, frequency, power and temperature are displayed for each phase. When the user needs to monitor the status of voltage, current, power and temperature, the corresponding trigger source can be selected to trigger the event.	ALL	\	ϕ1 Urms	\
Trigger threshold	%	The percentage of the rating of the trigger source, the ratings for each model are given in Table 32, and the temperature rating is 65°C The user can set the trigger condition of the event by setting the trigger threshold.	ALL	0.01	100	0~100
Trigger time	s	Time from when the trigger threshold is exceeded to when the event is triggered. The user can set this parameter to control the speed of event triggering.	ALL	0.001	0	0~9999
Action mode	\	Recording: When an event occurs, the user needs to record the event in the log, and the action mode can be selected as recording. The product can operate normally during recording, and it is necessary to click on the log interface in Section 8.11.2 to start recording.	ALL	\	Record	\
		Alarm: when an event occurs and the user needs to alarm and disconnect the output terminal, the action mode can be selected	ALL			

Parameter term	Unit	Interpretation and application	Model	Resolution	Initial value	Setting range
		as alarm. After the alarm, the product will disconnect the output end, and the word "Event X" will flash in the status display area.				
		Warning: When an event occurs and the user needs a warning prompt, the action mode can be selected as warning. After the warning, the product can operate normally, and the word "Event X" will flash in the status display area.	ALL			
Threshold direction	\	An event is triggered when the voltage/current/power/temperature exceeds the trigger threshold upward. When the user needs to exceed the trigger threshold upward to trigger the event, the threshold direction needs to be set to upward. An event is triggered when the voltage/current/power/temperature exceeds the trigger threshold downward. When the user needs to exceed the trigger threshold downward to trigger the event, the threshold direction needs to be set to downward.	ALL		Upward	
Clear event	\	Clear the status of all triggered events, and the power/reset key also has the function of clearing events. If the user needs to clear the event and clear the event status in the status display area, click this button.	ALL	\	\	\

Table 32 Correspondence of Parameter Values with 100% Trigger Threshold

Parameter term	Unit	Interpretation	Model	Corresponding parameter value at 100% of trigger threshold
ϕ1 Urms	V	Effective value of ϕ1 voltage	ALL	450
ϕ1 Irms	A	Effective value of Φ1 current	PRE2006S	30
			PRE2007S	
			PRE2009S	35
			PRE2012S	
			PRE2015S	
			PRE2020S	
ϕ1 P	kW	Φ1 active power	PRE2006S	2

Parameter term	Unit	Interpretation	Model	Corresponding parameter value at 100% of trigger threshold
			PRE2007S	2.5
			PRE2009S	3
			PRE2012S	4
			PRE2015S	5
			PRE2020S	6.667
ϕ1 S	kW	Φ1 apparent power	PRE2006S	2
			PRE2007S	2.5
			PRE2009S	3
			PRE2012S	4
			PRE2015S	5
			PRE2020S	6.667
ϕ1 Q	kW	Φ1 reactive power	PRE2006S	2
			PRE2007S	2.5
			PRE2009S	3
			PRE2012S	4
			PRE2015S	5
			PRE2020S	6.667
ΣP	kW	Total active power	PRE2006S	6
			PRE2007S	7.5
			PRE2009S	9
			PRE2012S	12
			PRE2015S	15
			PRE2020S	20
ΣS	kW	Total apparent power	PRE2006S	6
			PRE2007S	7.5
			PRE2009S	9
			PRE2012S	12
			PRE2015S	15
			PRE2020S	20
ΣQ	kW	Total reactive power	PRE2006S	6
			PRE2007S	7.5

Parameter term	Unit	Interpretation	Model	Corresponding parameter value at 100% of trigger threshold
			PRE2009S	9
			PRE2012S	12
			PRE2015S	15
			PRE2020S	20
ϕ1 Uac	V	Φ1 AC voltage	ALL	450
ϕ1 Udc	V	Φ1 DC voltage	ALL	636
ϕ1 Iac	A	Φ1 AC current	PRE2006S	30
			PRE2007S	
			PRE2009S	35
			PRE2012S	
			PRE2015S	
			PRE2020S	
ϕ1 Idc	A	Φ1 DC current	PRE2006S	30
			PRE2007S	
			PRE2009S	35
			PRE2012S	
			PRE2015S	
			PRE2020S	
ϕ1 Upk	V	Φ1 Voltage peak	ALL	636
ϕ1 Ipk	A	Φ1 Peak current	ALL	90
ϕ1 U12	V	Line voltage UAB	ALL	779
ϕ1 Irush	A	Φ1 impulse current	ALL	90
Temp	℃	Outlet temperature	ALL	65
Freq	Hz	Frequency	ALL	200

Note: 1. When ϕ1 is single-phase, the corresponding parameters of current and power shall be multiplied by 3.

2. ϕ2 and ϕ3 are invalid in single phase, and refer to ϕ1 for other corresponding parameters.

3. During parallel operation, the corresponding parameters of current and power shall be multiplied by the number of parallel operations.

Example: The parameter settings of Event 1 are shown in Table 33.

Table 33 Parameter Settings of Event 1

Trigger source	Trigger threshold [%]	Trigger time [s]	Action mode	Threshold direction
ф1 Urms	50	1	Warning	Upward

A schematic diagram of the triggering of Event 1 is shown in Figure 121. The holding time of T1 is less than the triggering time, so event 1 is not triggered; The holding time of T2 is equal to the trigger time, so event 1 is triggered at 4s.

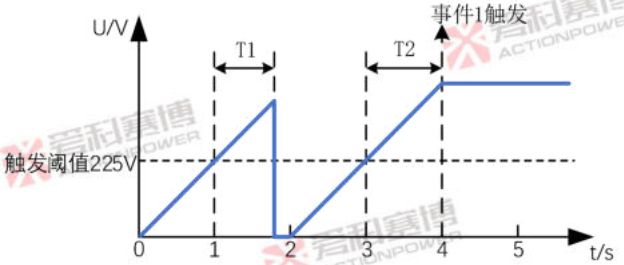


Figure 121 Schematic Diagram of Event 1 Triggering

触发阈值 225V	Trigger threshold 225V
事件 1 触发	Event 1 triggered

8.10 Communication

The PRE20XXS series products can be switched between local and remote communication modes, and the remote supports LAN and USB communication with user equipment. Click Communication in the menu bar to enter the communication setting interface. In the communication setting interface, you can choose to transfer the control of this product to different ports for local/remote control. The communication interface is shown in Figure 122. See Table 34 for the explanation of parameters.

Figure 122 Communication Setting Interface

Table 34 Interpretation of Communication Interface Parameters

Parameter term	Unit	Interpretation	Model	Resolution	Initial value	Setting range
Local lock	/	Locking local control permissions prevents other ports from gaining control. Local lock can only be enabled in local control mode, and remote communication cannot be set after enabling.	ALL	/	/	/
Equipment No.	/	Used to set the product address.	ALL	/	1	1~127
Communication port	/	Select the control method of this product. With the local lock turned off, the remote communication port can obtain product control rights by command. SCREEN: Display local control. LAN: Ethernet remote control. USB: USB remote control.	ALL	/	/	/
Communication protocol	/	The LAN port of this product supports SCPI and Modbus-TCP communication protocols.	ALL	/	/	/
IP Assignment	/	Automatic and manual.	ALL	/	/	/
IP address	/	The IP address type is IPv4.	ALL	/	/	/
Port No.	/	The port number is 502.	ALL	/	/	/
USB	/	The USB port supports SCPI and Modbus-RTU communication protocols. When selecting USB port control, the corresponding communication protocol also needs to be configured.	ALL	/	/	/

8.10.1 LAN Interface IP Assignment

8.10.1.1 Automatic mode

In automatic mode, in a LAN with a DHCP server, the PRE20XXS series products will request network parameters from the server through the DHCP protocol, and the request timeout is 30s. The network topology is shown in Figure 123.

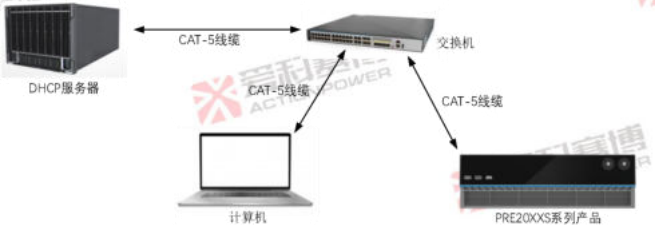


Figure 123 Network Topology with DHCP Server

DHCP 服务器	DHCP Server
CAT-5 线缆	CAT-5 cable
交换机	Switch
CAT-5 线缆	CAT-5 cable
CAT-5 线缆	CAT-5 cable
计算机	Computer
PRE20XXS 系列产品	PRE20XXS series products

In a LAN without a DHCP server or after a DHCP request times out, the PRE20XXS series products will automatically allocate network parameters via the AutoIP protocol. The network parameters automatically allocated by AutoIP are shown in Table 35. The network topology is shown in Figure 124.

Table 35 Network Parameters Automatically Assigned by AutoIP

Parameter term	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 124 Network Topology Diagram of AutoIP Automatic Assignment

交换机	Switch
CAT-5 线缆	CAT-5 cable
CAT-5 线缆	CAT-5 cable
计算机	Computer
PRE20XXS 系列产品	PRE20XXS series products

The network parameters obtained in automatic mode are not saved, and the network parameters will be retrieved every time the network cable is inserted or switched to automatic mode.

8.10.1.2 Manual mode

The network parameters in manual mode are set by the user on the LAN configuration page. When used in the LAN, if the IP address set is the same as that of other network devices, the setting cannot take effect. After the IP conflict, the PRE20XS series products will automatically assign a new IP address through the AutoIP protocol. Manual mode is applicable to various network topologies.

8.10.1.3 LAN Status Description

The description of LAN status display is shown in Table 36.

Table 36 Interpretation of LAN Status Display

Status	Status Interpretation
Fault	No network cable inserted or IP conflict
Device Identity	In network configuration
Normal Operation	Configuration successful

8.10.2 USB interface configuration

8.10.2.1 Interface Description

The description of the USB interface is shown in Table 37.

Table 37 Description of USB Interface

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

8.10.2.2 Use

After the computer has successfully installed the NI-VISA driver, connect the computer and the PRE20XXS series products through a USB cable, and identify the device information in Figure 125 in the computer's device manager, and the software and hardware work normally.

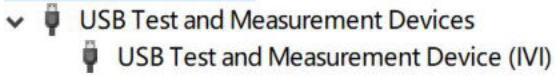


Figure 125 USB Information Diagram in Device Manager

After successful identification, SCPI commands can be sent to the PRE20XXS series products through NI-MAX software. When the query command is sent, the interval between the DEV_DEP_MSG_OUT message (Write) and the REQUEST_DEV_DEP_MSG_IN message (Read) must be more than 10 ms.

8.11 Storage

The storage contents include five items, namely: information, log, parameter, waveform and file. The storage function is shown in Figure 126.

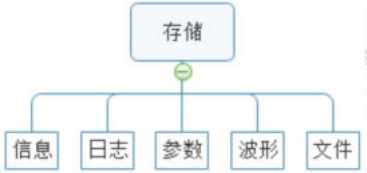


Figure 126 Storage Function Tree Diagram

存储	Storage
信息	Information
日志	Log
参数	Parameters
波形	Waveform
文件	Documents

8.11.1 Information

Click Storage-Information in the menu bar to enter the information interface. The information interface is to record the operation status of the PRE20XXS series products, including operation, protection, alarms and events, as shown in Figure 127.

Figure 127 Information Interface Diagram

8.11.2 Log

Click Storage-Log in the menu bar to enter the log setting interface. The log setting interface is shown in Figure 128, where you can set the sampling rate, number of records and recording method. The parameters are explained in Table 38.

Figure 128 Interface Diagram of Log Setting

Table 38 Parameter Interpretation of Log Setting Interface

Parameter term	Unit	Interpretation	Model	Resolution	Initial value	Setting range
Sampling rate	sps	Sampling and recording rate, sps indicates the number of logs recorded per second.	ALL	/	1	1,2,5,10
Number of records	/	Number of logs that can be logged.	ALL	/	0	0~999999
Recording mode	/	Logging mode, including event trigger and immediate trigger. Event trigger: After pressing the "Start" button, this product will trigger log record when an event is triggered. For event triggering, trigger conditions shall be set in the event interface, as detailed in Section 8.9. Immediate trigger: After pressing the "Start" button, this product will immediately trigger log record.	ALL	/	Event trigger	/
Start button	/	After clicking the Start button, the product automatically logs the event to a USB memory device externally connected to the rear panel.	ALL	/	/	/
End button	/	When you click the End button, the product will stop the recording function.	ALL	/	/	/

Note: 1. The external USB storage device on the rear panel supports the formats FAT32 and exFAT.

2. The log file only supports CSV format, and the contents are separated by ",".
3. File naming rules: file name prefix + file serial number + group serial number, such as "LOG" + "001" + "001".
4. File splitting rules: the number of logs recorded in the file shall be split according to 5000.
5. The parameters in the log file are explained in Table 39.

Table 39 Interpretation of Logging Information Parameters

Parameter term	Interpretation	Parameter term	Interpretation
PRE2020S	PRE20XXS series product model	Ipk(A)	Peak current
E1022G0017	PRE20XXS series product serial number	CF	Current peak factor
Urms(V)	Effective value of voltage	S(kVA)	Apparent power
Uthd(V)	Total voltage distortion rate	P(kW)	Active power
Uac(V)	AC voltage value	Q(kvar)	Reactive power
Udc(V)	DC voltage value	sigmaS(kVA)	Total apparent power
Upk(V)	Voltage peak	sigmaP(kW)	Total active power
theta(deg)	Voltage angle value	sigmaQ(kvar)	Total reactive power
Freq(Hz)	Frequency value	PF	Power factor
U12(V)	Line voltage value	Irush(A)	Impulse current value
Irms(A)	Effective value of current	PowerOnHours(h)	Operating time
Ithd	Total current distortion rate	TransferTime(ms)	Conversion time
Iac(A)	AC current value	Time	Recording time
Idc(A)	DC current value		

Note: phi1, phi2 and phi3 respectively represent ϕ1, ϕ2 and ϕ3.

8.11.3 Parameters

Parameters include user and communication parts, see Figure 129. All files can be imported/exported

Figure 129 Parameter Function Tree

参数	Parameters

用户	User
通信	Communication

8.11.3.1 User

Click Storage-Parameters-User in the menu bar to enter the user interface. The user interface is shown in Figure 130, which contains mode, parameter, limit, protection, event, parallel, advanced, Anyport, source load, data in the system, all of which are saved in the form of files.

Figure 130 User Interface Diagram

8.11.3.2 Communication

Click Storage-Parameter-Communication in the menu bar to enter the communication interface. The communication interface is shown in Figure 131, which contains the parameters in the communication setting interface in the menu bar and is saved in file form.

Figure 131 Communication Interface Diagram

8.11.4 Waveform

Click Storage - Waveform in the menu bar to enter the waveform interface. The waveform interface is shown in Figure 132. The user can export/import the waveform with USB memory device or host computer on the front panel.

Figure 132 Waveform Interface Diagram

Select the waveform file and click "Preview" in the lower right corner to see the waveform of the current file. If the waveform is imported into Shape1, click Shape1 and click "Preview". The preview interface is shown in Figure 133.

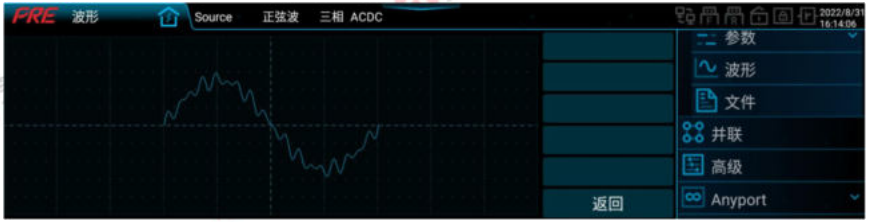


Figure 133 Waveform Preview Interface Diagram

8.11.5 Documents

Click Storage-File in the menu bar to enter the file interface. The file interface contains all internal storage files and files from external USB storage devices. All internally stored files are automatically assigned their own save paths, and

only those files associated with them are displayed when invoked.

The interface of the internal storage file of the product is shown in Figure 134.

Figure 134 Interface Diagram of Internal Storage File of Product

The interface of external USB storage files is shown in Figure 135.

Figure 135 Interface Diagram of External USB Storage File

File interaction between internal storage and external USB storage devices can be realized through copy/paste in the file interface.

8.12 Parallel connection

When the PRE20XXS series products are connected in parallel, it is necessary to connect the parallel optical fiber cable correctly, see Section 5.10 for details, and then click Parallel in the menu bar to enter the parallel interface, and set the master/slave in the parallel interface in Figure 136.

Figure 136 Interface of Parallel Setting

8.12.1 Host settings

During host setting, the product needs to be set as host in the parallel interface, as shown in Figure 137. All functions of the parallel system can be realized on the host machine.

Figure 137 Interface Diagram of Host Setting

8.12.2 Slave setting

During slave setting, the product needs to be set as slave in the parallel interface, as shown in Figure 138. The slave master interface is shown in Figure 139, and the number is automatically generated according to the slave number.

Figure 138 Interface Diagram of Slave Setting

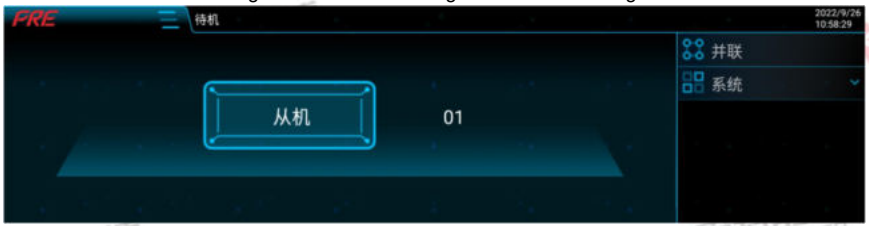


Figure 139 Main Interface of Slave

8.13 Senior

Click Advanced in the menu bar to enter the advanced setting interface. The advanced setting interface is shown in Figure 140, which provides the user with the ability to set the on/off delay time, operation and start mode, the function options of the shuttle and the calibration parameters of the product. The meaning of each parameter is shown in Table 40. This product provides calibration function, users can calibrate by themselves or contact the after-sales factory for calibration.

Figure 140 Interface Diagram of Advanced Settings

Table 40 Advanced Setting Parameters

Parameter term	Unit	Interpretation and application	Model	Initial value	Resolution	Setting range
On-delay	s	When the product is not output, press the output button and start outputting after a set delay time.	ALL	0	0.001	0~999.999
Turn-off delay	s	When the product is outputting, press the output button to stop the output after the set delay time.	ALL	0	0.001	0~999.999
Operation mode	\	When Auto is selected, the output will turn on automatically when the product is turned on.	ALL	Manual	\	\
Startup mode	\	When Auto is selected, the product will turn on automatically when power is on.	ALL	Manual	\	\
Left shuttle	\	Change the voltage in source mode and change the current in load mode.	ALL	\	\	\
Right-hand shuttle	\	The frequency is changed in the source mode, and it is invalid in the load mode.	ALL	\	\	\
Calibration	\	It includes four parameters: voltage slope, voltage intercept, current slope and current intercept.	ALL	\	\	\
Voltage slope	\	The user can set the voltage slope within the setting range.	ALL	0	0.000001	0.95~1.05
Voltage intercept	\	The user can set the voltage intercept within the setting range.	ALL	0	0.01	-5~5
Current slope	\	The user can set the current slope within the setting range.	ALL	0	0.000001	0.95~1.05
Current intercept	\	The user can set the current intercept within the setting range.	ALL	0	0.01	-3~3

The calibration consists of voltage calibration and current calibration. Before calibration, short-circuit the N-wire at the output end of the product, and then perform the calibration as follows.

1. Voltage calibration

The product does not require external loads and all protection parameters are set to their maximum values, see Section 8.8. Connect a voltmeter with precision less than 0.01% to the output measurement interface of the rear panel, adjust it to the DC gear, and set the coupling mode of the product to three-phase DC. Set the voltage values to +600V,

-600V and 0V respectively and output, record the voltmeter display value and product display value of each phase (i.e. one group), calculate the voltage slope and voltage intercept of each phase with three groups of data of each phase, and fill in the corresponding positions in Figure 140, that is, complete the voltage calibration.

2. Current calibration

Set all protection parameters to their maximum values after the product is externally loaded, see Section 8.8 Connect an ammeter with precision of 0.1% below to the output terminal, adjust it to DC gear, and set the coupling mode of the product to three-phase DC. Set the voltage value to +100V, output +30A, -30A and 0A respectively, record the ammeter display value and product display value of each phase (i.e. one group), calculate the current slope and current intercept of each phase with three groups of data of each phase, and fill in the corresponding positions in Figure 140, that is, complete the current calibration.

After completing the voltage calibration and current calibration, press and hold the power/reset button to turn off the machine, and the calibration parameters have been saved after turning it on again.

NOTE: If you press Reset Calibration, the above calibration parameters are cleared to zero. To save, press and hold the power/reset button again to shut down.

8.14 Anyport

Anyport consists of both digital and analog parts, see Figure 141. Each enable switch corresponds to one Anyport interface pin, and pay attention to one-to-one correspondence during use.

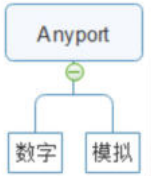


Figure 141 Anyport Function Tree Diagram

数字	Number
模拟	Simulation

8.14.1 Number

Click Anyport - Number in the menu bar to enter the number setting interface.

8.14.1.1 Digital input

The Anyport digital input setting interface is shown in Figure 142, which can realize the external given enable, trigger, interlock, start-stop, reset, emergency stop and external synchronization input functions under positive/negative polarity. The digital input functions are detailed in Table 41.

Figure 142 Interface Diagram of Digital Input Setting

Table 41 Interpretation of Digital Input Functions

Interface type	Interface name	Functional Interpretation
Digital input	Input 1 [Port 19] Input 2 [Port 20] Input 3 [Port 21] Input 4 [Port 22] Input 5 [Port 10] Input 6 [Port 11]	Polarity: Select the effective level. 1) Positive: High level is valid. 2) Negative: Low level is valid. Function 1) External given enable: Enables the analog input function. 2) Trigger: Use external pulse signals (pulse width 50μs or more) to trigger List, Wave, Step, Pulse, Advanced programming, and operation of harmonics and interharmonics. 3) Interlocking: Interlocking shutdown. 4) Start/stop: start when it is valid and stop when it is invalid by using the external level signal. 5) Reset: reset by external pulse signal (pulse width above 50μs). 6) Emergency stop: Emergency stop with external level signal. 7) External synchronous input: multiphase output function is realized by external pulse signal (pulse width above 50μs).

8.14.1.2 Digital output

The Anyport digital output interface is shown in Figure 143, which can realize the functions of interlocking, triggering, voltage indication, current indication, general I/O and external synchronous output under positive/negative polarity, and can also monitor the operating status, CV status and protection status of the product. The digital output functions are detailed in Table 42.

Figure 143 Interface Diagram of Digital Output Setting

Table 42 Interpretation of Digital Output Functions

Interface type	Interface name	Functional Interpretation
Digital output	Output 1 [Port 1] Output 2 [Port 2] Output 3 [Port 3] Output 4 [Port 4] Output 5 [Port 14] Output 6 [Port 15]	Polarity: Select the effective level. 1) Positive: High level is valid. 2) Negative: Low level is valid. Function 1) Interlock: Follow the digital input interlock. 2) Trigger: in case of output turn-on/off, the steady-state given change and the programming trigger output, a 100μs pulse signal is generated, and the pulse amplitude is determined by the external pull-up voltage. 3) Voltage indication: In source mode, an effective level is output when an external enable is given and any one of the analog inputs ϕ1, ϕ2 and ϕ3 is enabled. 4) Current indication: In the on-load mode, if the external enable is given and any one of the analog inputs ϕ1, ϕ2 and ϕ3 is enabled, the effective level is output. 5) Universal I/O: User-defined output I/O interface, always output valid level. 6) External synchronous output: for multiphase output function. 7) Operation status: When the output is ON, a valid level is always output. 8) CV status: Constant voltage status indication. 9) Protection status: When the product is protected, a valid level is always output.

8.14.2 Simulation

Click Anyport - Simulation in the menu bar to enter the simulation setting interface.

8.14.2.1 Analog input

The Anyport analog input interface is shown in Figure 144 and Figure 145. The analog input is valid when enabled is given outside either interface of the digital input. The analog input functions are detailed in Table 43.

Figure 144 Diagram I of Analog Input Setting Interface

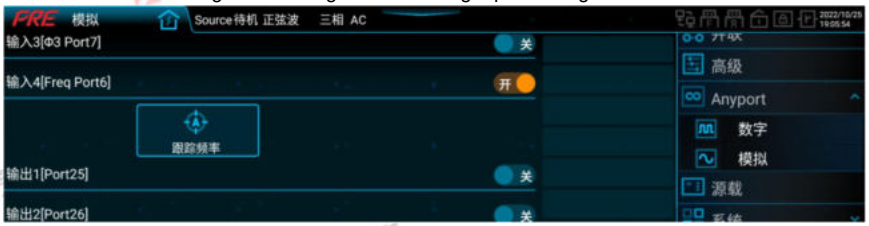


Figure 145 Diagram II of Analog Input Setting Interface

Table 43 Interpretation of Analog Input Functions

Interface type	Interface name	Functional Interpretation
Analog input	Input 1[ϕ1 Port9]	Tracking amplitude Tracking effective value Real-time tracking
	Input 2[ϕ2 Port8]	
	Input 3[ϕ3 Port7]	
	Input 4 [Freq Port6]	Tracking frequency: only the source mode is supported.

(1) Tracking amplitude:

1) When the coupling mode is AC or AC+DC, the following equation can 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: If a sine wave with a peak value of 300V is required to be output with a 5V range, the external given voltage Vref is 2.357V(dc).

If a sine wave with a peak value of 300V is required to be output with a 10V range, the external given voltage Vref is 4.715V(dc).

When the external setting is less than 0, the outputs are all 0.

2) When the coupling mode is 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 5 V range, if a Vout of 300 V is required, the external given voltage Vref is 2.358 V (dc). If Vout is required to be -300 V, the external given voltage Vref is -2.358 V (dc).

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

(2) Tracking effective value

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

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

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

Example: When using the 5V range, if it is desired to output a sine wave with an effective value of 300V, the external given voltage Vref is 3.333V(dc).

If a sine wave with an effective value of 300V is required to be output with a 10V range, the external given voltage Vref is 6.667V(dc).

When the external setting is less than 0, the outputs are all 0.

2) When the coupling mode is 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 5 V range, if a Vout of 300 V is required, the external given voltage Vref is 2.358 V (dc). If Vout is required to be -300 V, the external given voltage Vref is -2.358 V (dc).

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

(3) Real-time tracking

It can be calculated using the following equation:

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

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

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

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

(4) Tracking frequency

When the coupling mode is AC or AC+DC, the following equation can be used:

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

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

Example: When using a 5V range, if the output frequency Freq is 50Hz, the external given voltage Vref is

1.25V.

When using the 10V range, if the output frequency Freq is 50Hz, the external given voltage Vref is 2.5V.

8.14.2.2 Analog output

The Anyport analog output interface is shown in Figure 146, and the analog input/output functions are shown in Table 44.

Figure 146 Interface Diagram of Analog Output Setting

Table 44 Interpretation of Analog Output Functions

Interface type	Interface name	Functional Interpretation		
Analog output	Output 1 [Port 25]	It indicates the voltage effective value, current effective value, active power, apparent power and reactive power of each phase, as well as total active power, total apparent power and total reactive power. The analog output only supports 5V range, and the corresponding table of range parameter range is shown in Table 45.		
		Φ1 Urms: ϕ1 effective voltage value	Φ2 Urms: ϕ2 effective voltage value	Φ3 Urms: ϕ3 effective voltage value
		Φ1 Irms: ϕ1 effective current value	Φ2 Irms: ϕ2 effective current value	Φ3 Irms: ϕ3 effective current value
	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
		ΣP: Total active power	ΣS: Total apparent power	ΣQ: Total reactive power

Table 45 Correspondence of Analog Output Range Parameters

Parameter term	Unit	Coupling mode	Range (V)	Parameter range	Model
ϕ1 Urms	V	AC or AC+DC	0~5	0~450	ALL
		DC	-5~5	-636~636	
ϕ1 Irms	A	AC or AC+DC	0~5	0~30	PRE2006S
		DC	-5~5	-30~30	PRE2007S
		AC or AC+DC	0~5	0~35	PRE2009S
					PRE2012S
		DC	-5~5	-35~35	PRE2015S
					PRE2020S
ϕ1 P	kW	AC or AC+DC	0~5	0~2	PRE2006S
		DC	-5~5	-2~2	
		AC or AC+DC	0~5	0~2.5	PRE2007S
		DC	-5~5	-2.5~2.5	
		AC or AC+DC	0~5	0~3	PRE2009S
		DC	-5~5	-3~3	
		AC or AC+DC	0~5	0~4	PRE2012S
		DC	-5~5	-4~4	
		AC or AC+DC	0~5	0~5	PRE2015S
		DC	-5~5	-5~5	
		AC or AC+DC	0~5	0~6.667	PRE2020S
		DC	-5~5	-6.667~6.667	
ϕ1 S	kW	AC or DC or AC+DC	0~5	0~2	PRE2006S
				0~2.5	PRE2007S
				0~3	PRE2009S
				0~4	PRE2012S
				0~5	PRE2015S
				0~6.667	PRE2020S
ϕ1 Q	kW	AC or DC or AC+DC	0~5	0~2	PRE2006S
				0~2.5	PRE2007S
				0~3	PRE2009S
				0~4	PRE2012S

Parameter term	Unit	Coupling mode	Range (V)	Parameter range	Model
				0~5	PRE2015S
				0~6.667	PRE2020S
ΣP	kW	AC or AC+DC	0~5	0~6	PRE2006S
		DC	-5~5	-6~6	
		AC or AC+DC	0~5	0~7.5	PRE2007S
		DC	-5~5	-7.5~7.5	
		AC or AC+DC	0~5	0~9	PRE2009S
		DC	-5~5	-9~9	
		AC or AC+DC	0~5	0~12	PRE2012S
		DC	-5~5	-12~12	
		AC or AC+DC	0~5	0~15	PRE2015S
		DC	-5~5	-15~15	
		AC or AC+DC	0~5	0~20	PRE2020S
		DC	-5~5	-20~20	
ΣS	kW	AC or DC or AC+DC	0~5	0~6	PRE2006S
				0~7.5	PRE2007S
				0~9	PRE2009S
				0~12	PRE2012S
				0~15	PRE2015S
				0~20	PRE2020S
ΣQ	kW	AC or DC or AC+DC	0~5	0~6	PRE2006S
				0~7.5	PRE2007S
				0~9	PRE2009S
				0~12	PRE2012S
				0~15	PRE2015S
				0~20	PRE2020S

Note: 1. When ϕ1 is single-phase, the corresponding parameters of current and power shall be multiplied by 3.

2. ϕ2 and ϕ3 are invalid in single phase, and for other corresponding parameter ranges, please refer to ϕ1.

3. During parallel operation, the corresponding parameter range of current and power shall be multiplied by the number of parallel operations.

8.15 Source load

Click the source load in the menu bar to enter the source load setting interface, as shown in Figure 147. The operating mode of PRE20XXS series products can be switched in the source load setting interface. After switching, the power mode status display will also change.

Figure 147 Interface Diagram of Source Load Setting

The functions and operation in load mode are described in Chapter 9.

8.16 System

The system consists of the Screen section and the About section, as shown in Figure 148.

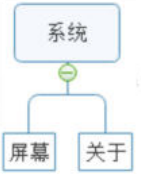


Figure 148 System Function Tree

系统	System
屏幕	Screen
关于	About

8.16.1 Screen

Click System - Screen in the menu bar to enter the screen interface. Screen brightness, language, screen saver time, alarm tone and date time can be set in the screen interface, as shown in Figure 149.

Figure 149 Screen Interface Diagram

8.16.2 About

Click System - About in the menu bar to enter the About interface. Equipment information and software versions of the PRE20XXS series products can be seen in the About interface, see Figure 150. The equipment information includes the product model, hardware version number, serial number of the machine, number of boots and running time (whichever is actual).

Figure 150 About Interface

9 Load mode

The PRE20XXS series can also be operated in load mode. All functions and operations in load mode can be realized on the display, and each function interface can be swiped left or right or up and down to view relevant contents. This chapter mainly introduces part of the main interface, modes, parameters and limits in load mode, and the rest is consistent with the source mode. See Chapter 8.

9.1 Source/load switching

For source/load switching, see Section 8.15. When switching, a prompt box appears, see Figure 151.

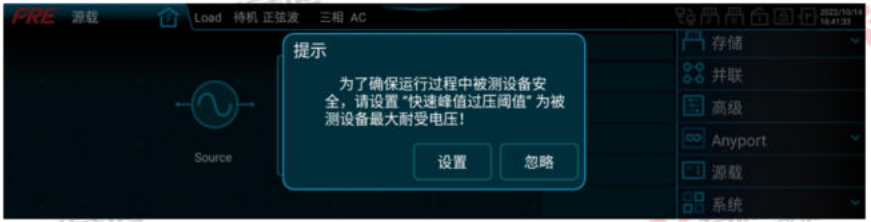


Figure 151 Source/load switching prompt interface diagram

The user can set the fast peak overvoltage threshold of the PRE20XXS series products according to the maximum withstand voltage of the device under test. Click "Settings" to enter the "Protection" interface, where the fast peak overvoltage threshold is set. If you click Ignore, the prompt box disappears.

9.2 Main Interface

The load modes of the PRE20XXS series include CC, CP, RLC, and PQ, which can be selected in Section 9.3. When CC mode is selected, the main interface is shown in Figure 152.

Figure 152 Main Interface Diagram of CC Mode

状态显示区	State display area
菜单按钮	Menu button
输出显示区	Output display area
下拉快捷区	Drop-down shortcut area
运行显示区	Operation display area
输出设置区	Output setting area

Time = run time. When the load timing in the Parameters screen in 9.4 is enabled, the timing time can be set, in which case Time indicates the run countdown. The output setting area can set the output current Iac and the power factor PF. The status display area, menu buttons, output display area and drop-down shortcut area can refer to the main interface of source mode.

When CP mode is selected, the apparent power S and power factor PF can be set in the output setting area in the main interface.

When RLC mode is selected, an RLC parameter setting page will be added to the main interface, as shown in Figure 153. Click the value to set the corresponding parameter. The basic parameters of RLC mode are shown in Table

46.

Figure 153 RLC Mode Parameter Setting Page

Table 46 Basic Parameters of RLC Mode

Parameter term	Unit	Interpretation	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	Inductance internal resistance	ALL	0	0.001	0~1000
C	μF	Load capacitance	ALL	1	0.001	1~5000
R_C	Ω	Capacitance internal resistance	ALL	0	0.001	0~1000

When PQ mode is selected, a page of PQ parameter setting interface will be added to the main interface, as shown in Figure 154. Click the value to set the corresponding parameter. The basic parameters of PQ mode are shown in Table 47.

Figure 154 PQ Mode Parameter Setting Page

Table 47 Basic Parameters of PQ Mode

Parameter term	Unit	Interpretation	Model	Initial value	Resolution	Setting range
P	kW	Active power	PRE2006S	0	0.001	0~2
			PRE2007S			0~2.5
			PRE2009S			0~3
			PRE2012S			0~4
			PRE2015S			0~5
			PRE2020S			0~6.667
Q_L	kVar	Inductive reactive power	PRE2006S	0	0.001	0~2

Parameter term	Unit	Interpretation	Model	Initial value	Resolution	Setting range
			PRE2007S			0~2.5
			PRE2009S			0~3
			PRE2012S			0~4
			PRE2015S			0~5
			PRE2020S			0~6.667
Q_C	kvar	Capacitive reactive power	PRE2006S	0	0.001	0~2
			PRE2007S			0~2.5
			PRE2009S			0~3
			PRE2012S			0~4
			PRE2015S			0~5
			PRE2020S			0~6.667

Note: During parallel operation, the above parameter settings shall be multiplied by the number of parallel operations.

9.3 Mode

Click Mode in the menu bar to enter the mode setting interface. The mode setting interface allows you to select the output phase number and load mode of the PRE20XXS series products. See Figure 155 when CC mode is selected. CP mode and CC mode are consistent.

Figure 155 Interface Diagram of CC Mode Setting

See Figure 156 when selecting RLC. The PQ mode is consistent with the RLC mode.

Figure 156 Interface Diagram of RLC Mode Setting

9.4 Parameters

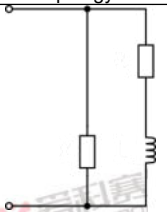
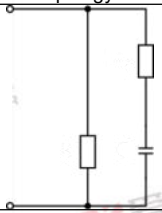
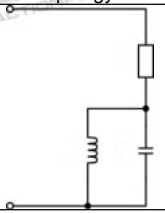
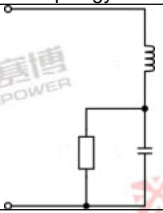
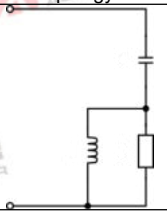
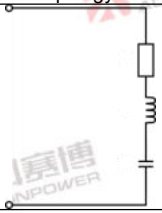
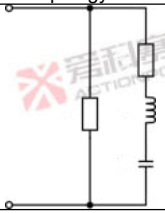
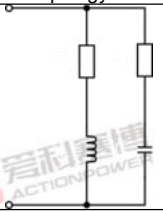
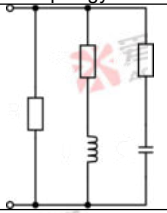
Click the parameter in the menu bar to enter the parameter setting interface, as shown in Figure 157.

Figure 157 Interface Diagram of Load Mode Parameter Setting

There are 12 topologies in RLC topology selection, as shown in Table 48. Click the area below ф1/ф2/ф3 to select

any topology.

Table 48 RLC Topology

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

When the load timing in Figure 157 is enabled, the operation duration of the load mode can be set and the

countdown timer is displayed in the main interface.

Other parameter functions and operations in the parameter setting interface are consistent with the source mode, as detailed in Section 8.3.

9.5 Limit

Click the limit value in the menu bar to enter the limit setting interface, as shown in Figure 158. Definitions of limit parameters are shown in Table 49.

Figure 158 Interface Diagram of Load Mode Limit Setting

Table 49 Load Mode Limit Setting Parameters

Parameter term	Unit	Interpretation and application	Model	Resolution	Initial value	Setting range
AC current lower limit	A	The minimum value of the output AC current of each phase, which is valid when the coupling mode is AC. When the output phase is three-phase or split-phase, the actual value is equal to the set value. When the output phase is single phase, the actual value is 3 times the set value. When the user needs to avoid damage to the equipment under test due to low output AC current due to misoperation, the lower limit of AC current can be set in a safe range here.	PRE2006S PRE2007S	0.01	0	0.00~30
			PRE2009S PRE2012S PRE2015S PRE2020S		0	0.00~35
AC current upper limit	A	The maximum value of the output AC current of each phase, which is valid when the coupling mode is AC.	PRE2006S PRE2007S	0.01	30	0.00~30

Parameter term	Unit	Interpretation and application	Model	Resolution	Initial value	Setting range
		When the output phase is three-phase or split-phase, the actual value is equal to the set value. When the output phase is single phase, the actual value is 3 times the set value. When the user needs to avoid damage to the equipment under test due to excessive output AC current caused by misoperation, the upper limit of AC current can be set in the safe range here.	PRE2009S PRE2012S PRE2015S		35	0.00~35
			PRE2020S			
Apparent power lower limit	kVA	The minimum apparent power of each phase. When the output phase is three-phase or split-phase, the actual value is equal to the set value. When the output phase is single phase, the actual value is 3 times the set value. When the user needs to avoid damage to the equipment under test due to low source power due to misoperation, the lower limit of apparent power can be set in the safe range here.	PRE2006S	0.001	0	0~2
			PRE2007S		0	0~2.5
			PRE2009S		0	0~3
			PRE2012S		0	0~4
			PRE2015S		0	0~5
			PRE2020S		0	0~6.667
Apparent power upper limit	kVA	The maximum apparent power of each phase. When the output phase is three-phase or split-phase, the actual value is equal to the set value. When the output phase is single phase, the actual value is 3 times the set value. When the user needs to avoid damage to the equipment under test due to excessive apparent power caused by misoperation, the upper limit of apparent power can be set in a safe range.	PRE2006S	0.001	2	0~2
			PRE2007S		2.5	0~2.5
			PRE2009S		3	0~3
			PRE2012S		4	0~4
			PRE2015S		5	0~5
			PRE2020S		6.667	0~6.667

9.6 Protection

Click Protection in the menu bar to enter the protection setting interface, as shown in Figure 159. The protection parameters are defined in Table 50.

Figure 159 Interface Diagram of Load Mode Protection Setting

Table 50 Parameters of Load Mode Protection Settings

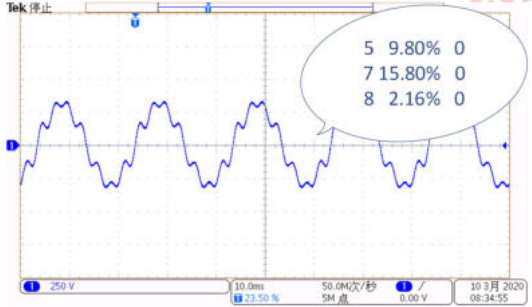
Parameter term	Unit	Interpretation and application	Model	Resolution	Initial value	Setting range
Fast peak overvoltage threshold	V	Fast peak overvoltage protection critical value, which is valid only in load mode. This parameter can be set when the user needs to protect the maximum instantaneous voltage at the output end.	ALL	0.01	650	0~700
Effective value overvoltage threshold	V	Critical value of effective value overvoltage protection. This parameter can be set when the user needs to protect the maximum effective value of voltage at the output terminal.	ALL	0.01	636	0~636
AC overvoltage threshold	V	Critical value of AC overvoltage protection. This parameter can be set when the user needs to protect the maximum AC voltage at the output terminal.	ALL	0.01	450	0~450
DC forward overvoltage threshold	V	DC forward overvoltage protection critical value. This parameter can be set when the user needs to protect the maximum forward DC voltage at the output terminal.	ALL	0.01	636	0~636
DC negative overvoltage threshold	V	Critical value of DC negative overvoltage protection. This parameter can be set when the user needs to protect the maximum negative DC voltage at the output terminal.	ALL	0.01	-636	-636~0
Load AC undervoltage threshold	V	Critical value of load AC undervoltage protection, which is valid 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
Effective value overcurrent threshold	A	The critical value of overcurrent protection of the effective value of each phase. When the output phase is three-phase or split-phase, it indicates the critical value of the effective value of each phase overcurrent protection; when the output phase is single-phase, the actual value is 3 times of the set value. This parameter can be set when the user needs to protect the maximum current at the output terminal.	PRE2006S	0.01	31.5	0~31.5
			PRE2007S			
			PRE2009S		36.75	0~36.75
			PRE2012S			
			PRE2015S			
			PRE2020S			
Active power threshold	kW	Total active power protection critical value. This parameter can be set when the user needs to protect the maximum active power of the output terminal.	PRE2006S	0.001	6.3	0~6.3
			PRE2007S		7.875	0~7.875
			PRE2009S		9.45	0~9.45
			PRE2012S		12.6	0~12.6
			PRE2015S		15.75	0~15.75

Parameter term	Unit	Interpretation and application	Model	Resolution	Initial value	Setting range
			PRE2020S		21	0~21
Apparent power threshold	kVA	Total apparent power protection threshold. This parameter can be set when the user needs to protect the maximum apparent power of the output terminal.	PRE2006S	0.001	6.3	0~6.3
			PRE2007S		7.875	0~7.875
			PRE2009S		9.45	0~9.45
			PRE2012S		12.6	0~12.6
			PRE2015S		15.75	0~15.75
			PRE2020S		21	0~21
Overfrequency threshold	Hz	Critical value of overfrequency protection. This parameter can be set when the user needs to protect the maximum frequency of the output terminal AC voltage.	ALL	0.001	2000	0.001~2000
Underfrequency threshold	Hz	Critical value of underfrequency protection. This parameter can be set when the user needs to protect the minimum frequency of the AC voltage at the output terminal.	ALL	0.001	0.001	0.001~2000
Protection time	s	During the set protection time, if the product detects that the output value of each parameter item continues to exceed the protection threshold, the protection will be triggered.	ALL	0.001	0.1	0.001~3

Note: When paralleling, the relevant parameter settings of current and power need to be multiplied by the number of paralleling.

10 Appendix-Examples of built-in harmonics

The corresponding diagram and effect example of built-in 30 common harmonics and internal naming of PRE20XXS series products are as follows:



Tek 停止	Tek Stop
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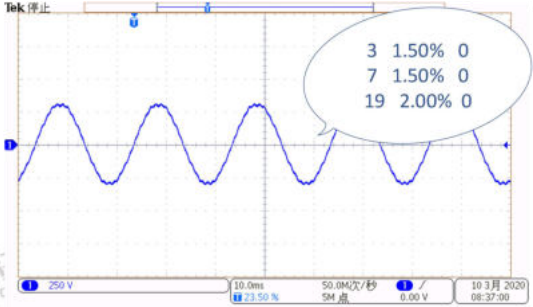
5M 点	5M point
3 月	March

DST01



Tek 停止	Tek Stop
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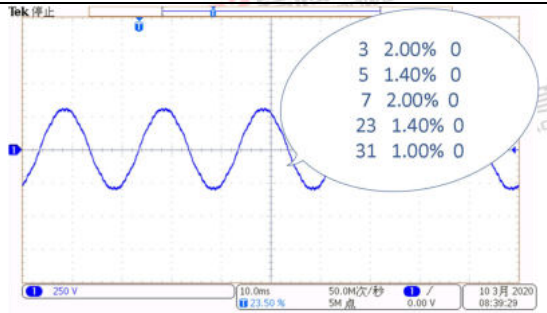
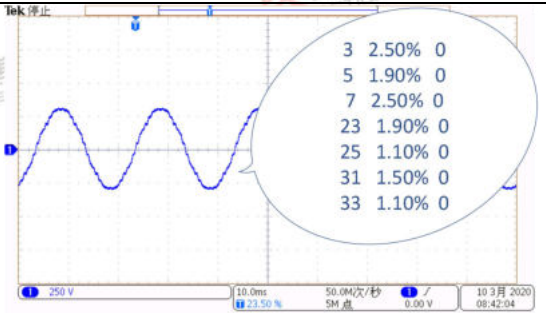
5M 点	5M point
3 月	March

DST02



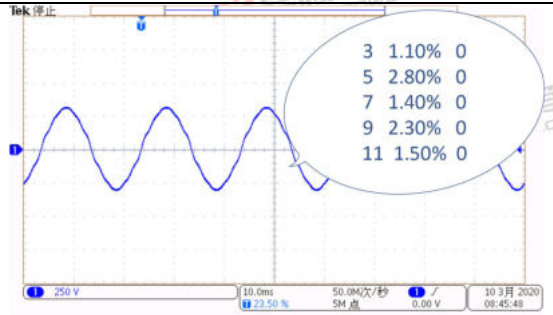
Tek 停止	Tek Stop
50.0M 次/秒	50.0M times/s
5M 点	5M point
3 月	March

DST03



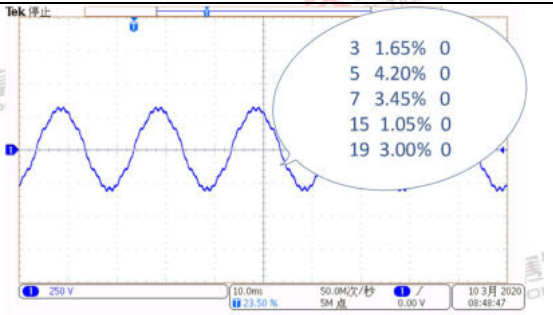
Tek 停止	Tek Stop
50.0M 次/秒	50.0M times/s
5M 点	5M point
3 月	March

DST04



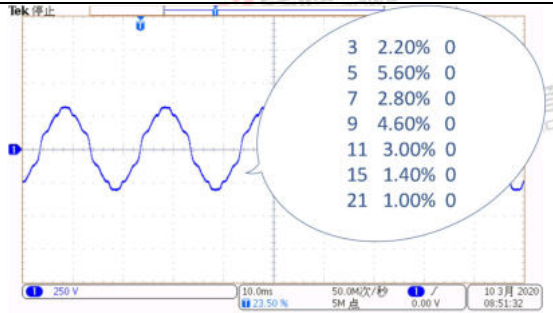
Tek 停止	Tek Stop
50.0M 次/秒	50.0M times/s
5M 点	5M point
3 月	March

DST05



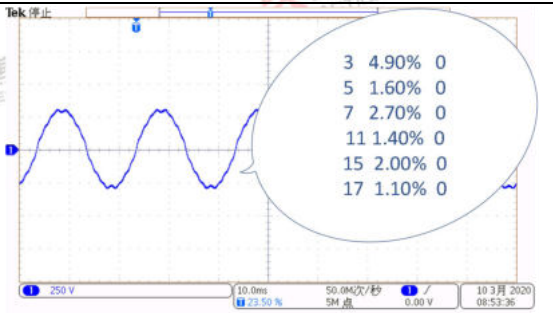
Tek 停止	Tek Stop
50.0M 次/秒	50.0M times/s
5M 点	5M point
3 月	March

DST06



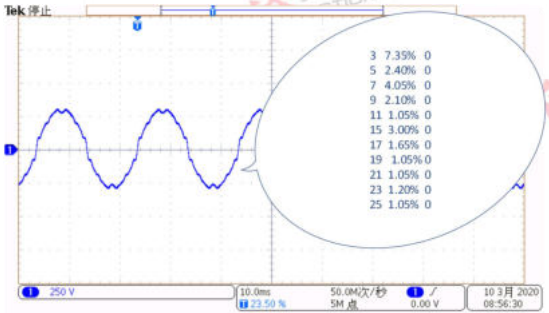
Tek 停止	Tek Stop
50.0M 次/秒	50.0M times/s
5M 点	5M point
3 月	March

DST07



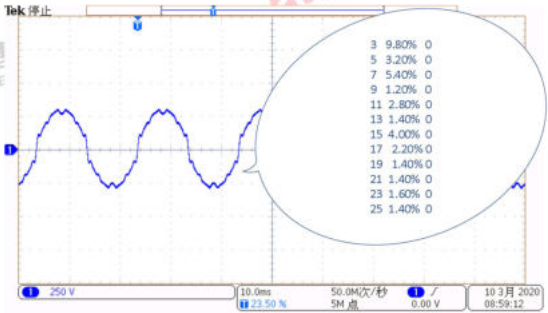
Tek 停止	Tek Stop
50.0M 次/秒	50.0M times/s
5M 点	5M point
3 月	March

DST08



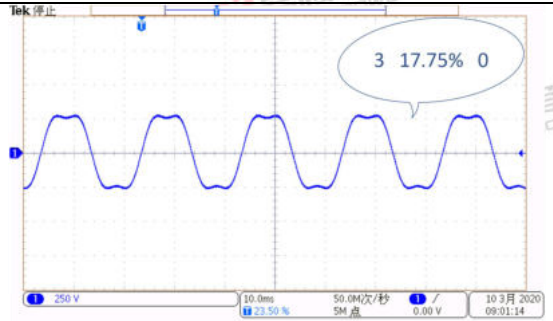
Tek 停止	Tek Stop
50.0M 次/秒	50.0M times/s
5M 点	5M point
3 月	March

DST09



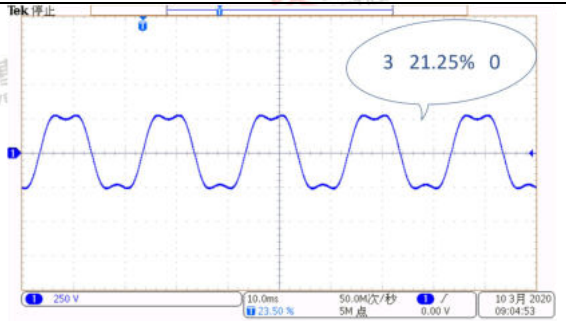
Tek 停止	Tek Stop
50.0M 次/秒	50.0M times/s
5M 点	5M point
3 月	March

DST10



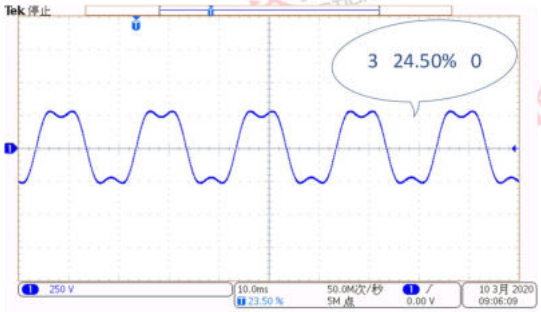
Tek 停止	Tek Stop
50.0M 次/秒	50.0M times/s
5M 点	5M point
3 月	March

DST11



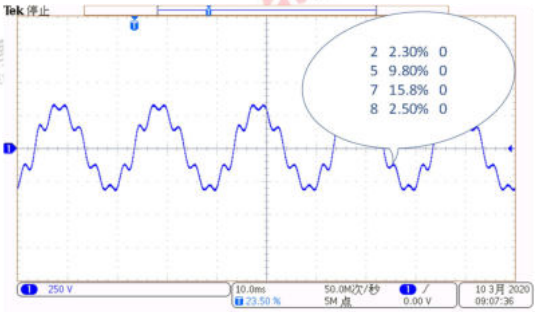
Tek 停止	Tek Stop
50.0M 次/秒	50.0M times/s
5M 点	5M point
3 月	March

DST12



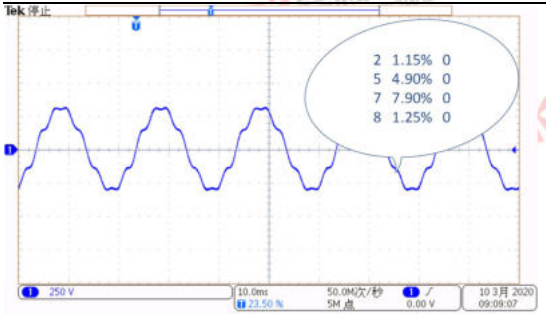
Tek 停止	Tek Stop
50.0M 次/秒	50.0M times/s
5M 点	5M point
3 月	March

DST13



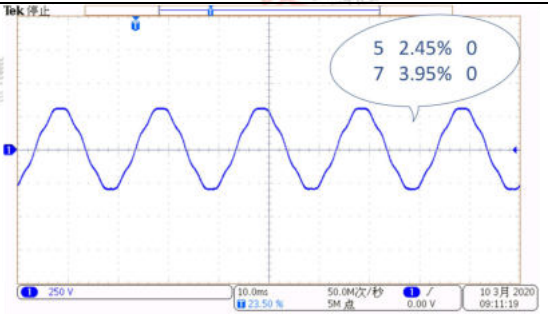
Tek 停止	Tek Stop
50.0M 次/秒	50.0M times/s
5M 点	5M point
3 月	March

DST14



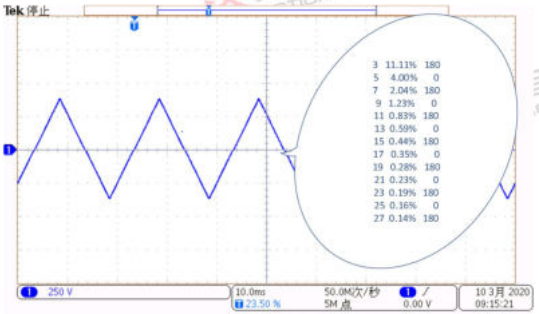
Tek 停止	Tek Stop
50.0M 次/秒	50.0M times/s
5M 点	5M point
3 月	March

DST15



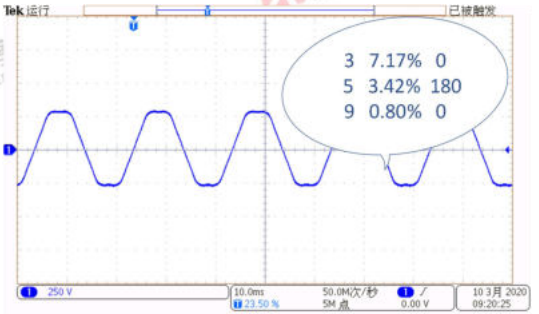
Tek 停止	Tek Stop
50.0M 次/秒	50.0M times/s
5M 点	5M point
3 月	March

DST16



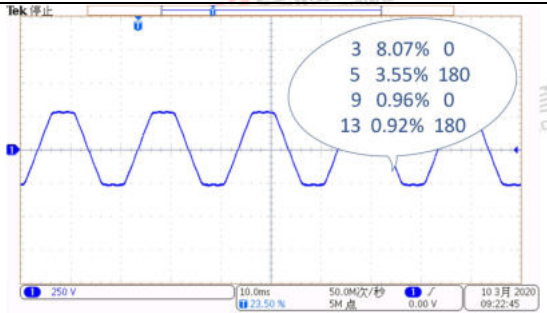
Tek 停止	Tek Stop
50.0M 次/秒	50.0M times/s
5M 点	5M point
3 月	March

DST17



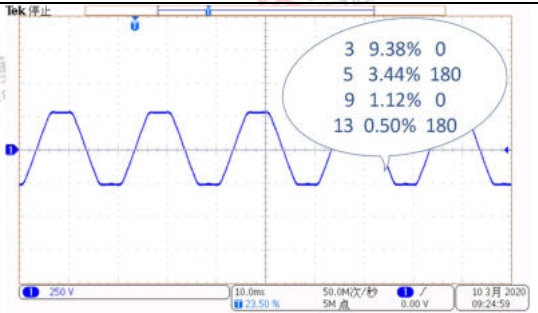
Tek 停止	Tek Stop
50.0M 次/秒	50.0M times/s
5M 点	5M point
3 月	March

DST18



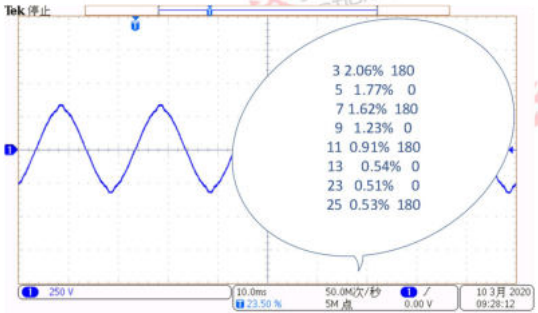
Tek 停止	Tek Stop
50.0M 次/秒	50.0M times/s
5M 点	5M point
3 月	March

DST19



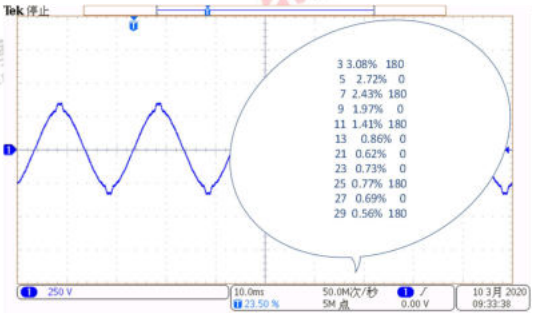
Tek 停止	Tek Stop
50.0M 次/秒	50.0M times/s
5M 点	5M point
3 月	March

DST20



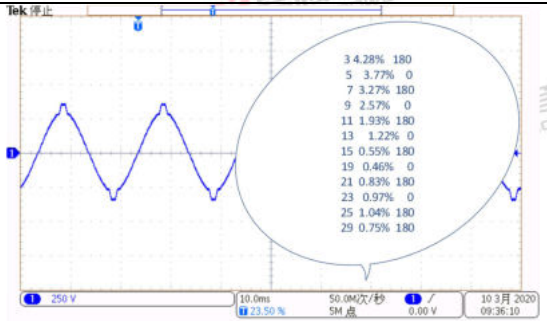
Tek 停止	Tek Stop
50.0M 次/秒	50.0M times/s
5M 点	5M point
3 月	March

DST21



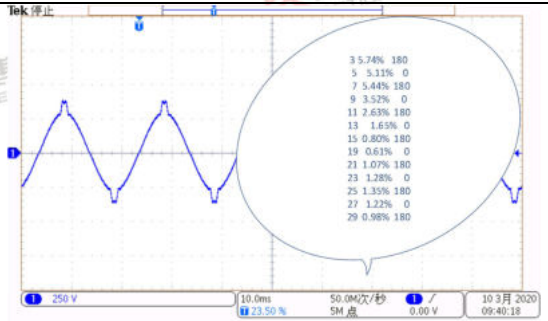
Tek 停止	Tek Stop
50.0M 次/秒	50.0M times/s
5M 点	5M point
3 月	March

DST22



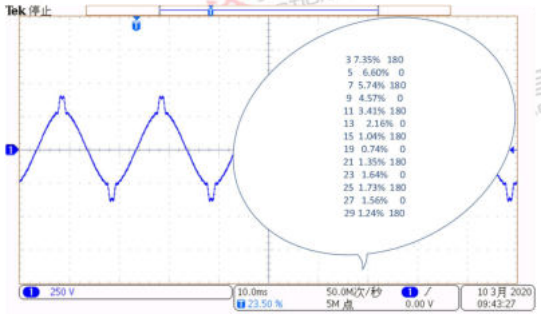
Tek 停止	Tek Stop
50.0M 次/秒	50.0M times/s
5M 点	5M point
3 月	March

DST23



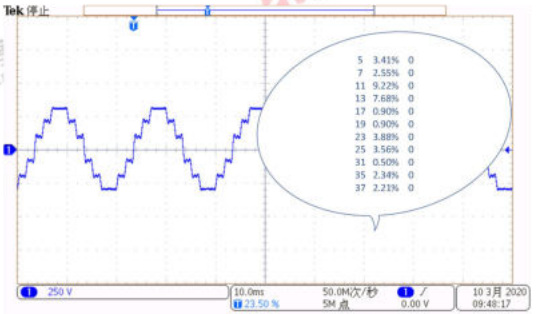
Tek 停止	Tek Stop
50.0M 次/秒	50.0M times/s
5M 点	5M point
3 月	March

DST24



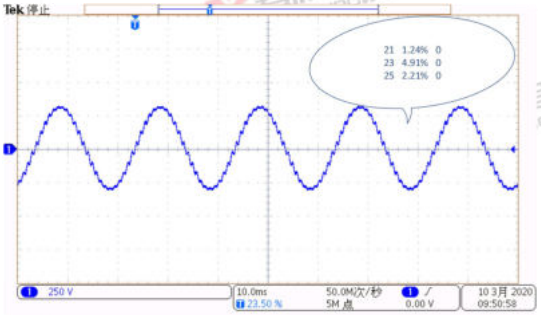
Tek 停止	Tek Stop
50.0M 次/秒	50.0M times/s
5M 点	5M point
3 月	March

DST25



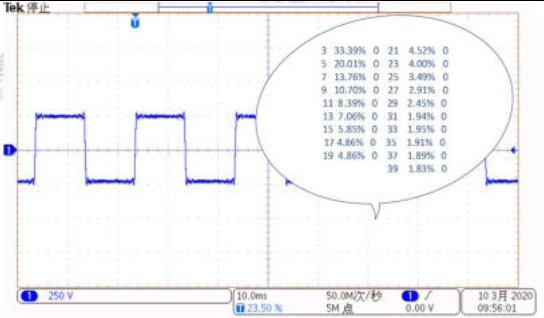
Tek 停止	Tek Stop
50.0M 次/秒	50.0M times/s
5M 点	5M point
3 月	March

DST26



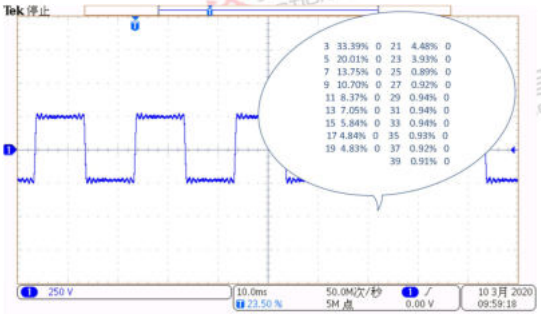
Tek 停止	Tek Stop
50.0M 次/秒	50.0M times/s
5M 点	5M point
3 月	March

DST27



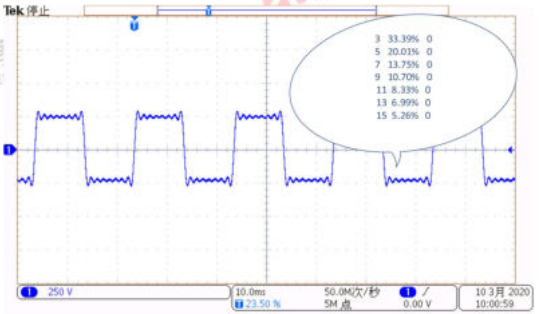
Tek 停止	Tek Stop
50.0M 次/秒	50.0M times/s
5M 点	5M point
3 月	March

DST28



Tek 停止	Tek Stop
50.0M 次/秒	50.0M times/s
5M 点	5M point
3 月	March

DST29



Tek 停止	Tek Stop
50.0M 次/秒	50.0M times/s
5M 点	5M point
3 月	March

DST30

Revision history

Records of version revision
This manual was completed in November 2022 V1.0.