SPD3000X Series Programmable Linear DC Power Supply

Service Manual

SM0503X-E01A

SIGLENT TECHNOLOGIES CO.,LTD

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General Safety Summary

Please review the following safety precautions carefully to avoid personal injury or damage to this product or any product connected to it. To prevent potential danger, please use the instrument as specified.

Only qualified personnel should perform service procedures.

To Avoid Fire or Personal Injuries

Use Proper Power Cord. Use only the power cord specified for this product and approved by local state.

Avoid Electric Shock. To avoid injuries or losses of life, do not connect or disconnect probes or test leads while they are connected to a voltage source.

Ground the Product. This product is grounded through the protective terra conductor of the power line. To avoid electric shock, the grounding conductor must be connected to the earth. Make sure the instrument is grounded correctly before connecting its input or output terminals.

Connect the Probe Properly. Do not connect the probe ground lead to a high voltage since it has the isobaric electric potential as ground.

Observe All Terminal Ratings. To avoid fire or shock hazard, observe all ratings and markers on the instrument and check your manual for more information about ratings before connecting.

Use Proper Fuse. Use only the specified fuse.

Do Not Operate Without Covers. Do not operate this instrument with covers or panels removed.

Avoid Circuit or Wire Exposed. Do not touch exposed junctions and components when the unit is powered.

Do Not Operate With Suspected Failures. If you suspect damage occurs to this instrument, have it inspected by qualified service personnel before

further operation. Any maintenance, adjustment or replacement especially to the circuits or accessories should be performed by SIGLENT authorized personnel.

Keep Product Surfaces Clean and Dry.

Do Not Operate in Wet/Damp Conditions. To avoid electric shock, do not operate the instrument in wet or damp condition.

Do Not Operate in an Explosive Atmosphere. To avoid injuries or fire hazards, do not operate in an explosive atmosphere.

ESD Protection. ESD can cause damage to the instrument and should be tested in a static electricity area whenever possible. Before connecting the cable to the instrument, ground the inner and outer conductors briefly to discharge static electricity.

Safety Terms and Symbols

Terms on the Product.

Terms may appear on the product:

DANGER: Indicates direct injury or hazard that may occur.

WARNING: Indicates potential injury or hazard that may occur.

CAUTION: Indicates potential damage to the instrument or other property that may occur.

Symbols may appear on the product:

Hazardous power

Protective Earth Terminal

Warning

Earth Ground

Power switch

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Chapter 1 General Features and Specifications

General Features

The SPD3000 Series Programmable Linear DC Power Supply is equipped with a 4.3-inch TFT-LCD or LED display with programmable and real-time waveform display for a new experience. It has three independent outputs: two sets of adjustable voltage values and a fixed set of voltage values of 2.5V, 3.3V and 5V, with output short-circuit and overload protection for use in different types of production and research.

Features and benefits

- Three-way high-precision programmable output: 32V/3.2A×2，Switchable 2.5V/3.3V/5V/3.2A×1, total power 220W
- Compact, easy to use, powerful, ideal for bench power supply
- Stable, Reliable and Low Noise: ≤ 1mVrms
- Fast Transient Response Time: < 50us
- Minimum resolution of 1mV, 1mA with 5-bit voltage and 4-bit current display.
- Timer function sequences output values
- 4.3-inch LED or TFT-LCD display with 480 * 272 high resolution
- Three output modes: independent, series and parallel connection
- Four kinds of input/line voltage values includes 100V, 110V, 220V and 230V to satisfy different requirements
- Intelligent temperature controlled fan, effectively reduces noise

- Clear graphical interface, with waveform display
- 5 internal system parameters save / recall, support for data storage space expansion
- Provide EasyPower PC software, real-time control via USB, LAN, support SCPI command set and LabView driver package to meet the remote control and communication requirement

Specifications

To verify that the power supply meets the specifications, the power supply must have been operating continuously for 30 minutes within the specified operating temperature range. The specific technical specifications are subject to the actual model.

Model		SPD3303X-E	SPD3303X
Chanel output		CH1output voltage：0~32V，output current：0~3.2A	
		CH2 output voltage：0~32V，current：0~3.2A	
		CH3 output voltage:2.5V/3.3V/5.0V, current：3.2A	
Display		4.3-inch true color TFT-LCD 4-bit voltage, 3-bit current display	4.3-inch true color TFT-LCD 5-bit voltage, 4-bit current display
Resolution		10mV/10mA	1mV/1mA
Setting accuracy		voltage±（0.5%of reading+2digits）	voltage±（0.03%of reading+10mV）
		current±（0.5%of reading+2digits）	current±（0.3%of reading+10mA）
Readback accuracy		voltage±（0.5%of reading+2digits）	voltage±（0.03%of reading+10mV）
		current±（0.5%of reading+2digits）	current±（0.3%of reading+10mA）
Constant voltage mode	Power regulation rate	≤0.01%+3mV	
	Load regulation rate	≤0.01%+3mV	
	Ripple and noise	≤1mVrms（5Hz~1MHz）	
	Recovery Time	<50us(Load change 50%, minimum load 0.5A)	
Constant current mode	Power regulation rate	≤0.2%+3mA	
	Line regulation rate	≤0.2%+3mA	
	Ripple and noise	≤3mArms	
Parallel	Power regulation	≤0.01%+3mV	

mode	rate	
	Load regulation rate	≤0.01%+3mV
Series mode	Power regulation rate	≤0.01%+5mV
	Load regulation rate	≤300mV
CH3	Output voltage	（2.5/3.3/5V）±8%
	Linear regulation rate	≤0.01%+3mV
	Load regulation rate	≤0.01%+3mV
	Ripple and noise	≤1mVrms（5Hz~1MHz）
Lock key		YES
Save/call		5 sets
Maximum output power		220W
Input power		AC100V/120V/220V/230V±10% 50/60Hz
Standard interface		USB Device、LAN
Insulation		Base to terminal≥20MΩ （DC500V） Base to AC line≥30MΩ （DC500V）
Operating environment		Outdoor use: Elevation≤2000m Environment temperature 0~40°C Relative humidity≤80% Installation level：II Pollution level：2
Storage environment		Environment temperature：-10~70°C Relative humidity≤80%
Dimension		225（W）×143（H）×278（D）mm
Weight		About 8.0kg

Prepare Information

Before doing performance verifying, you should master the following operations to make the power work in a good state or deal with some simple functional problems. The following contents are included in this chapter:

- How to perform functional checks
- How to test the interface working properly

For more detailed information about Power operation, please refer to the Quick Guide for Power.

Power-on Inspection

Verify that the power supply is working by performing a power-on check.
The SPD3000X series has a supply voltage of 100VACRMS to 240VACRMS.Before connect the instrument to a power source, please select the AC voltage selector on the rear panel of your power according to the power supply. Then connect the power line to the socket on the rear panel of the multimeter.

Note: to avoid electric shock, make sure that the instrument is correctly grounded to the earth before connecting AC power.

Figure 1-1 connect the power cord

Interface test

The SPD3000X series power supply supports two standard interfaces: USB Device and LAN interface. Through these interfaces, the power supply communicates with the outside world and implements some higher-level functions. To ensure that the power supply is working properly, perform the following interface tests.

USB Device test

Use EasyPower of the host computer software to test whether the USB Device interface is working properly.

Tools:

- One SPD3000X series power supply;
- One PC with USB interface;
- Standard USB cable (AB type);
- PC software EasyPower;

step：

1. Install the EasyPower on the PC and follow the prompts to install the driver.

2. Connect the power supply to the PC with a USB cable.

Figure 1-2 USB Device interface

3. Run the EasyPower software. Double-click to open the software interface, click “Function” in the upper left corner of the interface, then the “control” drop-down option will pop up, click “control”, then the “Connect Type” window will pop up, continue to click the “USBTMC” option on the window, and pop up the information of the connected power device, click “Open” to complete the connection.

LAN test

Use EasyPower of the host computer software to test whether the LAN interface is working properly.

Tools:

- One SPD3000X series power supply
- One PC with a network cable interface
- One standard network cable
- EasyPower of the PC software

Step：

1. Install the EasyPower on the PC and follow the prompts to install the driver.

2. Connect the power supply to the PC with a network cable.

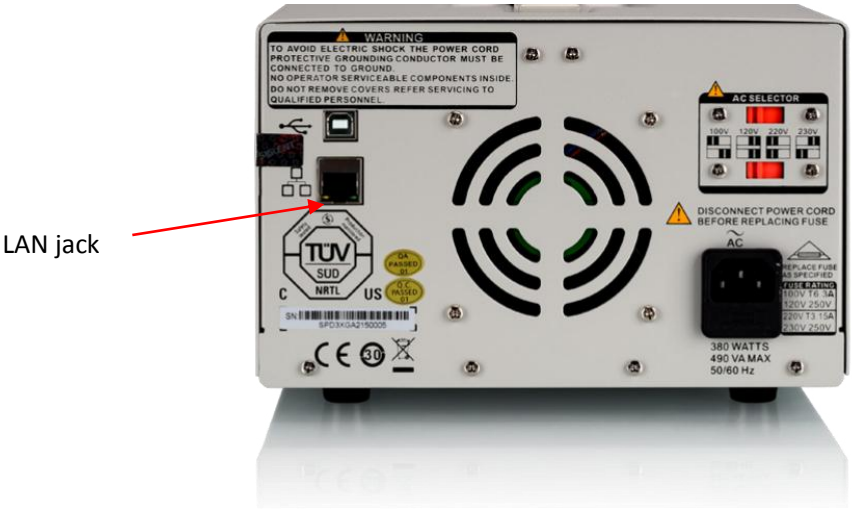

Figure 1-3 LAN interface

3. Run the EasyPower software. Double-click to open the software interface,

click the “Function” in the upper left corner of the interface, the “control” drop-down option will pop up, click “control”, the“ ConnectType” window will pop up, continue to click the “VXI11” option on the window, and then input the setted power supply IP address in the pop-up window, click “OK” to complete the connection. (See the user manual or quick guide for IP address settings)

Chapter 2 Performance Verification

This chapter mainly describes how to test and verify whether the relevant indicators of the verification power supply meet the specifications. To ensure the accuracy of the measurements, preheat all instruments for 30 minutes.
Here are the equipment needed to perform the test:
Table 2-1 equipment required for test:

description	specification	example
Digital multimeter	6-digit half precision	SDM3065X
Electronic load	Voltage and current power is greater than the power supply parameters	SDL1020X
Connection cable	Power supply cable	
Adjustable transformer	80V-240V voltage adjustable	
Oscilloscope	200MHz brandwidth	SDS1202X-E
Switching power supply	Output DC voltage exceed 40V	

The following is a schematic diagram of the connection between the electronic load and the power supply under test:

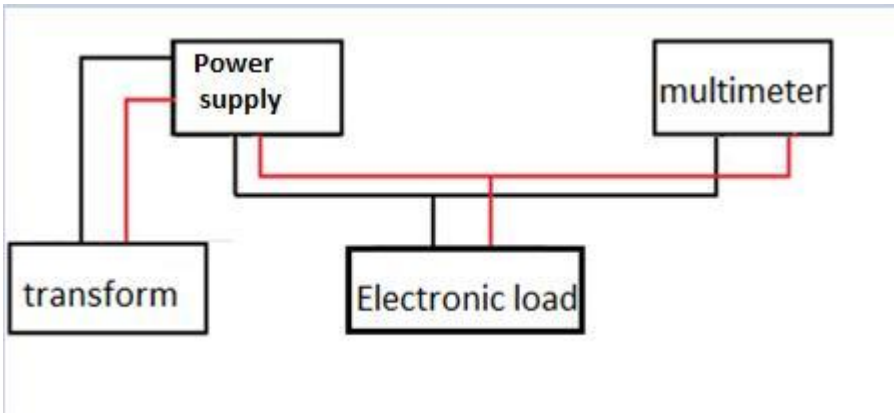

Figure 2-1 Connect the test equipment

Testing report

In order to verify that the test results meet the specifications, please record the test data in the test report in time.

Verify power regulation rate

(1) Constant voltage mode

Test Overview: The input voltage regulation rate is also called the line regulation rate, that is, the change of the input voltage will cause the output voltage to fluctuate. Under the input voltage changes across the full input range, test the percentage of the output voltage that deviates from the setting output voltage. This test verifies the power regulation of the power supply in constant voltage mode.

Formula: power regulation rate = $\frac{\Delta Vo}{V_{set}} * 100\%$ （1）

Specifications: 0.01% + 3mV

Preset conditions: room temperature

Test instrument: adjustable transformer, multimeter, electronic load

Test methods and steps:

(a) The input of the SPD3000X is powered by a variable transformer, the output terminal connect to the electronic load, and the multimeter meter pen connect to the positive and negative terminals of the power output terminal.

(b) Turn on the power of each device, set the output to 100VAC of the transformer. The SPD3000X works in constant voltage mode after power-on, the electronic load set to constant current mode, and the multimeter set to DCV gear.

(c) The output of SPD3000X set to 2V/3.2A. At this time, the electronic load is set to 3.198A, and record the reading value of the multimeter.

(d) SPD3000X set to 5V/3.2A, 8V/3.2A, 11V/3.2A, 14V/3.2A, 17V/3.2A, 20V/3.2A, 23V/3.2A, 26V/3.2A, 29V/3.2. A, 32V/3.2A, the electronic load set to 3.198A, and record the reading value of the multimeter in each case.

(e) Then set the outputs of the adjustable transformers to 110VAC, 120VAC, 200V, 220V, 230V, 240V, repeat steps (c) and (d).

(Note: the SPD3000X's rear case input power should be switched to the corresponding position, otherwise the fuse will burn out)

(f) Calculate the corresponding power regulation rate by the formula (1). Take the maximum value in the calculation result to determine whether the SPD3000X has reached the predetermined specification.

Table 2-2

Vo / Vin	2 V	5 V	8 V	11 V	14 V	17 V	20 V	23 V	26 V	29 V	32 V	regulation rate
100V												
110V												
120V												

200V												
220V												
230V												
240V												

2) Constant current mode

Test Overview: When the power supply is working in constant current mode, the change of input voltage will cause fluctuations to the output current. Under the input voltage changes across the full input range, test the percentage of the output current that deviates from the setting output current.

Formula: power regulation rate=$\frac{\Delta Io}{I_{set}} * 100\%$ （**2**）

Specifications: 0.2% + 3mA

Preset conditions: room temperature

Test instrument: adjustable transformer, multimeter, electronic load

Test methods and steps:

(a)The input of the SPD3000X is powered by a variable transformer, turn on the power of each device, the electronic load set to constant current mode, the multimeter set to the 10A range of the DCI gear, and the multimeter pen connect to the electronic load in series.

(b)Set the output to 100VAC of the transformer, the output of SPD3000X set to 1A/32V, the electronic load set to 31V, the SPD3000X works in constant current mode after power-on, and record the reading value of the multimeter.

(c) SPD3000X set to 2A/32V、3.2A/32V, and record the reading value of the multimeter in each case.

(d) Then set the outputs of the adjustable transformers to 110VAC, 120VAC, 200V, 220V, 230V, 240V, repeat steps (b) and (c).

(Note: the SPD3000X's rear case input power should be switched to the corresponding position, otherwise the fuse will burn out)

(e) Calculate the corresponding power regulation rate by the formula (2). Take the maximum value in the calculation result to determine whether the SPD3000X has reached the predetermined specification.

Table 2-3

Vo / Vin	1A	2A	3.2A	regulation rate
100V				
110V				
120V				

200V				
220V				
230V				
240V				

Verify load regulation rate

（1）Constant voltage mode

Test Overview: In the case of rated input voltage, change the output load within the full load range and test the percentage of the output voltage relative to the set value at this time. It reflect the ability of the circuit to maintain a predetermined output voltage when change the load.

Formula: load regulation rate = $\frac{\Delta Vo}{V_{set}} * 100\%$ （3）

Specifications: 0.01% + 3mV

Preset conditions: room temperature

Test instrument: adjustable transformer, multimeter, electronic load

Test methods and steps:

(a) The input of the SPD3000X is set to 220V by the variable transformer, the output terminal connect to the electronic load, and the multimeter meter pen connect to the positive and negative terminals of the power output terminal in parallel.

(b) Turn on the power of each device, the electronic load set to constant current mode, and the multimeter set to DCV gear.

(c) The output of SPD3000X set to 1V/3.2A. Turn on the output and note the reading of the multimeter when the SPD3000X is without loading.

(d)Set the current of the electronic load to 1A、2A、3A, and record the reading value of the multimeter in each case. (Note: the connection point between the multimeter and the power supply should be fixed, otherwise it will affect the results of the test)

(e) Then set the SPD3000X to 5V/3.2A, 9V/3.2A, 13V/3.2A, 17V/3.2A, 21V/3.2A, 25V/3.2A, 29V/3.2A, 32V/3.2A, in each setting, repeat step (d) separately.

(f) Calculate the corresponding load regulation rate by the formula (3). Take the maximum value in the calculation result to determine whether the SPD3000X has reached the predetermined specification.

Table 2-4

Io / Vo	0A	1A	2A	3.2A	regulation rate
1V					
5V					
9V					
13V					
17V					
21V					
25V					
29V					
32V					

（2）Constant current mode

Test Overview: In the case of rated input voltage, change the output load within the full load range and test the percentage of the output current relative to the set value at this time. It reflect the ability of the circuit to maintain a predetermined output current when change the load.

Formula: load regulation rate = $\frac{\Delta Io}{I_{set}} * 100\%$ **（4）**

Specifications: 0.2% + 3mA

Preset conditions: room temperature

Test instrument: adjustable transformer, multimeter, electronic load

Test methods and steps:

(a) The input of the SPD3000X is set to 220V by the variable transformer, after turn on the power of each device, the electronic load set to constant voltage mode, the multimeter set to the 10A range of the DCI gear, and the multimeter pen connect to the electronic load in series.

(b) The output of SPD3000X set to 1A/32V, turn on the output, and the electronic load set to 31V， record the current reading value of the multimeter at this time.

(c) Set the voltage of the electronic load to 1V, 5V, 9V, 13V, 17V, 21V, 25V and 29V in turn, and record the reading value of the multimeter in each setting. (Considering that when the connected wire between the electronic load and the SPD3000X have current flows, the voltage have wire loss, so the voltage of the electronic load should be adjusted according to the actual wire loss to make the SPD3000X works in the constant current mode)

(d) Set the SPD3000X to 2A/32V、3.2A/32V, in each setting, repeat step (b)、（c）separately.

(f) Calculate the corresponding load regulation rate by the formula (4). Take the maximum value in the calculation result to determine whether the SPD3000X has reached the predetermined specification.

Table 2-5

Vo / Io	1 V	5 V	9 V	13 V	17 V	21 V	25 V	29 V	32 V	regulation rate
1A										
2A										
3.2A										

Verify output voltage accuracy

Test overview: In the two-wire or four-wire mode, under the rated input voltage, test the actual output voltage and readback voltage value relative to the set voltage; reflect the voltage accuracy of the power supply.

Formula: Setting voltage accuracy = $\frac{\Delta Vo}{V_{set}} * 100\%$ （5）

Formula: Readback voltage accuracy = $\frac{\Delta V_{back}}{V_{set}} * 100\%$ （6）

Specifications: 0.03% + 10mV

Preset conditions: room temperature

Test instrument: adjustable transformer, multimeter

Test methods and steps:

(a) The input of the SPD3000X is set to 220V by the variable transformer, the output terminal connect to the electronic load, and the multimeter meter pen connect to the positive and negative terminals of the power output terminal in parallel.

(b) Turn on the power of each device and set the multimeter to the auto range of the DCV gear.

(c) The output of SPD3000X set to 32V/0.1A. Turn on the output and note the reading of the multimeter and the voltage readback value of the power when the SPD3000X is without loading.

(d) Set the SPD3000X to 28V/0.1A, 22V/0.1A, 15V/0.1A, 10V/0.1A, 1V/0.1A, 0.1V/0.1A, 0.01V/0.1A, 0V/0.1A, In each setting, repeat step (c)separately.

(e) Calculate the corresponding setting voltage accuracy by the formula (5) and the readback voltage accuracy by the formula（6）. Take the maximum

value in the calculation result to determine whether the SPD3000X has reached the predetermined specification.

Table 2-6

Mode	Set Volt (V)	Measured Volt (V)	Readback Volt (V)	Pass / Fail
2 wire	32V			
	28V			
	22V			
	15V			
	10V			
	1V			
	0.1V			
	0.01V			
	0V			
4 wire	32V			
	28V			
	22V			
	15V			
	10V			
	1V			
	0.1V			
	0.01V			
	0V			

Verify output current accuracy

Test overview: under the rated input voltage, test the actual output current and readback current value relative to the set voltage; reflect the current accuracy of the power supply.

Formula: Setting current accuracy = $\frac{\Delta Io}{I_{set}} * 100\%$ （7）

Formula: Readback current accuracy = $\frac{\Delta I_{back}}{I_{set}} * 100\%$ （8）

Specifications: 0.3% + 10mA

Preset conditions: room temperature

Test instrument: adjustable transformer, multimeter, electronic load

Test methods and steps:

(a) The input of the SPD3000X is set to 220V by the variable transformer,

turn on the power of each device, set the electronic load to constant voltage mode, the multimeter set to the 10A range of the DCI gear, and the multimeter pen connect to the electronic load in series.

(b) Set the SPD3000X to 0A/32V, turn on the output, and set the electronic load to 31V.record the reading of the multimeter and the current readback value of the power.

(c) Set the SPD3000X to 0.01A/32V，0.1A/32V，1A/32V，2A/32V，3.2A/32V, in each setting, repeat step (b)separately.

(d) Calculate the corresponding setting current accuracy by the formula (7) and the readback current accuracy by the formula（8）. Take the maximum value in the calculation result to determine whether the SPD3000X has reached the predetermined specification.

Table 2-7

channel	Set Curr (A)	Measured Curr (A)	Readback Curr (A)	Pass / Fail
1	0A			
	0.01A			
	0.1A			
	1A			
	2A			
	3.2A			
2	0A			
	0.01A			
	0.1A			
	1A			
	2A			
	3.2A			

Verify CH3 channel output voltage

Test overview: In the case of rated input voltage, select the required 2.5V, 3.3V, 5V output voltage by dialing the CH3 dial switch, and then test the actual output voltage value of CH3 channel.

Preset conditions: room temperature

Test instrument: adjustable transformer, multimeter

Test methods and steps:

(a)The input of the SPD3000X is set to 220V by the variable transformer,

the multimeter pen connect to the positive and negative terminals of the CH3 output terminal in parallel.

(b) Turn on the power of each device and set the multimeter to the auto range of the DCV gear.

(c) Toggle the CH3 dial switch of the SPD3000X to the 2.5V position, turn on the output, and record the reading of the multimeter when the SPD3000X is without loading.

(d) Then push the CH3 DIP switch of the SPD3000X to the 3.3V position and the 5V position. Repeat step (c) for each setting.

(e) The CH3 output voltage error range is within 8% to determine whether the SPD3000X has reached the predetermined specification.

Verify output ripple and noise

Test overview:

Ripple: The ripple is the AC component superimposed on the output of DC voltage; The ripple voltage is the peak-to-peak value between the peaks and valleys of the fingerprint wave; during each on and off process, the electric energy is extracted from the input terminal to the output terminal to form a process of charging and discharging, thereby causing fluctuations in the output voltage.

noise:

(1) Noise voltage refers to its peak-to-peak value, in switching power supplies, there are two main reasons for formation:

(a) A high-frequency pulse train generated by the switching power supply itself, which is caused by a sharp pulse generated when the switch is turned on and off.

(b) Interference from external electromagnetic fields, entering the switching power supply through radiation or entering the switching

power supply through the power line;

(2) In the linear power supply, the noise is mainly related to the loop stability of the system. In addition, the switching power supply module on the main board and the signal line layout of the display screen may also cause radiation interference.

Specifications: 1mVrms

Preset conditions: room temperature

Test instrument: oscilloscope, common probe (with 1:10 probe), electronic load

Test environment: 220V power supply, SPD3000X set output to 32V/3.2A, full load output, electronic load set to 3.198A in constant current mode.

Test methods and steps:

(a). The probe is grounded in the shortest grounding manner. It is recommended to use a grounding spring. In addition, in the SPD3000X output terminal, that is, a 10uF electrolytic capacitor should be connected in parallel with the test point of the probe to reduce the electronic load which can conduct the noise through the connecting line and radiated noise

(b). The oscilloscope turn on the bandwidth limit of 20MHz, set the appropriate time base and storage depth to ensure the sampling rate is 100M/s, set the probe amplification factor to 1:1, the coupling mode is AC coupling, turn on the statistical function, and record the valid value, peak-to-peak value, maximum value, and minimum value, then save them as screenshots.

Other instructions: In order to get more accurate results, grounding should be tested with reference to the following methods.

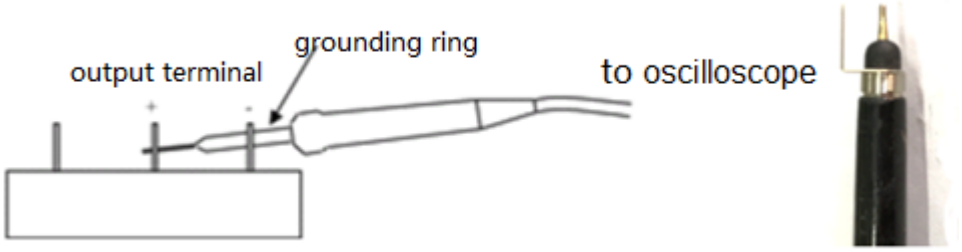

Figure2- 2 Grounding method

Verify the output voltage overshoot of on/off

Test overview:

Output overshoot: The output voltage of the power supply will generate voltage overshoot at the moment of switching. This is mainly related to loop feedback stability. The linear power supply is used as a laboratory power supply equipment, so it should not have overshoot strictly.

Test instrument: oscilloscope, ordinary probe

Specifications: no overshoot

Preset conditions: room temperature

Test environment: 220V power supply, the probe is grounded in the shortest way.

Test methods and steps:

(a). Set the oscilloscope in single trigger, select the appropriate trigger level, and use the oscilloscope's measurement function.

(b) When the power input is turned on or off, test the voltage waveform of the output of the power supply under no-loading and full-loading conditions.

Verify transient response recovery time

Test overview:

The transient response of the regulated power supply can be divided into source transient response and load transient response, and the recovery time is generally used to predict the quality of the transient response. The transient voltage characteristic is an inherent characteristic of the power supply itself. There are many energy storage components inside the power supply. The voltage adjustment needs to read back from the output, compare the standard voltage, and adjust the switching duty cycle. Increasing the speed of the control loop provides shorter transient response times. However, it is

possible that the output is very unstable and even oscillates. If the voltage transient response capability is poor, the voltage drop/overshoot time is too long and the amplitude is too large, which directly causes many problems. This will make the measurement not work properly. Therefore, if you have such an application, you must consider a power supply that is more responsive.

Specifications: When the output current is from full load to half load, or from half load to full load, the output voltage is restored to within 15mV for less than 50μs.

Test instrument: SDS1202X-E, common probe, electronic load

Preset conditions: room temperature

Test environment: 220V power supply, the probe is grounded in the shortest way.

Test methods and steps:

(a). Turn on the power of the instrument, set the oscilloscope to AC coupling, DC trigger mode, select the appropriate trigger level, and the probe test point is the positive and negative terminals of the output of the power supply;

(b). The SPD3000X power supply connect to the electronic load, and the electronic load set to the dynamic test mode. The relevant settings are as follows: set to continuous mode, set the rising and falling slopes to10A/us, level A=1.598A, level B=3.198A, set the frequency to 50Hz, and the screenshot retains the test result;

Verify short circuit protection

Test overview:

When the output is shorted, the power supply works normally and the readback current value is equal to the set current value. When the short circuit is removed, the power supply can resume normal output.

Test instrument: SPD3000X

Preset conditions: room temperature

Test methods and steps:

(a) Connect the device, pay attention to that after short the output of the main circuit artificially, then turn on the output, because after the

output is turned on, if the set current value is relatively large, the sudden short-circuit will cause a very large spark, and there is a safety hazard; (Please set the current value to do the experiment in comparison)

(b). Observe whether the readback value of the power supply is equal to the set value, and whether the state before the short circuit is restored after the short circuit is removed.

Other instructions: If the power supply does not return to normal after removing the short circuit, it meets the design requirements.

Verify overvoltage protection

Test overview: SPD3000X power supply with overvoltage protection circuit, when the output exceeds 38V (±1V), trigger the thyristor to turn on to short the output circuit, and then control the mos tube through the overvoltage protection loop to make the short circuit current to 0.5A. After the short circuit, the output needs to be turned off, and then it will work normally after being turned back on.

Test instrument: switching power supply

Preset conditions: none

Test environment: room temperature

Test methods and steps:

(a) Connect the SPD3000X power output to the switching power supply;

(b) Turn on the power of the instrument, set the output voltage of the switching power supply near 38V, and then increase the output voltage of the switching power supply gradually. When the overvoltage point is reached, the SPD3000X power supply output is short-circuited.

Chapter 3 Calibration channel parameters

Calibration instructions:

The parameters to be calibrated are the voltage setting value, voltage displaying value, current setting value and current displaying value of two channels; all parameters are determined by linear calibration, and the fitting function is Y=aX+b, “a” is the linear coefficient and “b” is the offset. In order to find the parameters “a” and “b”, it is necessary to know two corresponding points, namely (x1, y1), (x2, y2) and then find their parameters “a” and “b”. The system can implement calibration commands through a combination of SCPI commands. Send SCPI commands through the NI interface.

Users can control the instrument remotely by using National Instruments Corporation's NI-VISA. NI MAX is a user interface that controls the device.

Open the NI Control Command interface

Step:

1. Open the NI MAX user port interface;

2. Click on the “device and interface” in the upper left corner, find the connected power supply information, click on the power supply device and click “Open VISA Test Panel” ,then pop up the bullet box. As shown in Figure 3-1 below.

3. Click the “Input/Output” option of the box, enter the command in the command box, and click Write to make the command take effect. As shown in Figure 3-2 below.

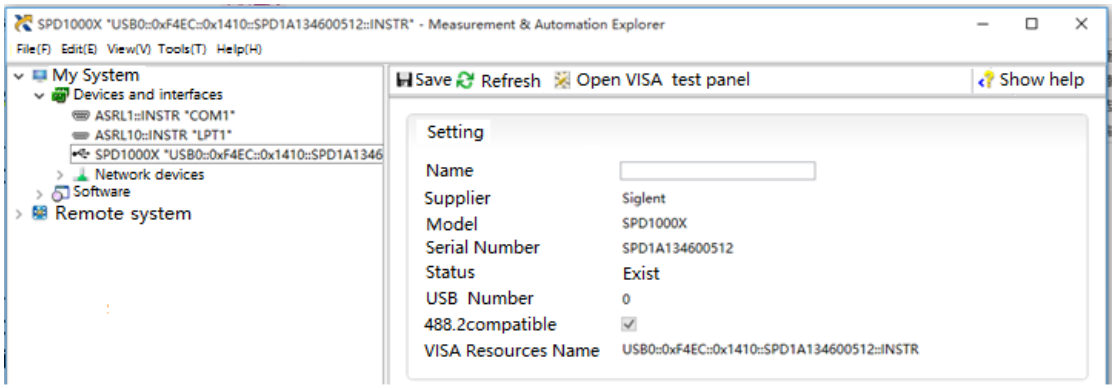

Figure 3-1

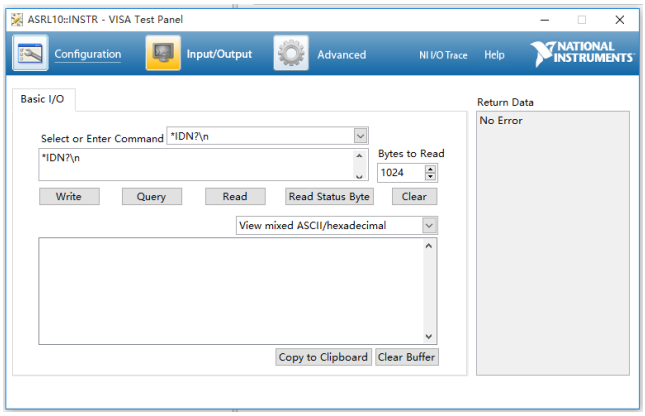

Figure 3-2

Calibration instrument: high precision multimeter, electronic load

Specific method steps:

Clear parameters:

The command *CALCLS is used to clear the “a” and “b” values of the corresponding parameters, let “a”=1; “b”=0. The parameters are restored to the state without calibration parameters.

*CALCLS <NR> (eg *CALCLS 8).

NR is the coefficient of the command and its corresponding meaning is:

0: Clear the voltage setting calibration coefficients “a” and “b” of channel 1 ;

1: Clear the voltage displaying calibration coefficients “a” and “b” of channel 1 ;

2: Clear the current setting calibration coefficients “a” and “b” of channel 1 ;

3: Clear the current displaying calibration coefficients “a” and “b” of channel 1;

4: Clear the voltage setting calibration coefficients “a” and b”” of channel 2;

5: Clear the voltage displaying calibration coefficients “a” and b”” of channel 2;

6: Clear the current setting calibration coefficients “a” and b”” of channel 2;

7: Clear the current displaying calibration coefficients “a” and b”” of channel 2;

8: Clear the “a” and “b” values of all calibration coefficients for channels 1 and 2.

Voltage calibration

Calibrate the setting voltage value and displaying voltage value of channel 1 or 2.
CALibration: VOLTage <NR1>, <NR2>, <NR3>
This command is used to calibrate the related values of the voltage.
NR1:
CH1 select to calibrate the parameters of channel 1.
CH2 select to calibrate the parameters of channel 2
NR3:
The actual measured value of the high-precision multimeter. It is an input parameter.
NR2:
1 At this time, NR3 is the input parameter of the first point.
2 At this time, NR3 is the input parameter of the second point.

Method:

(1) First ,set the channel (1 or 2) voltage value to 1V, then enable the output of its channel, use a multimeter to measure the actual output voltage value of the channel as the value of NR3.

(2) Enter the calibration command CALibration:VOLTage CH<x>,1,<NR3> (eg CALibration:VOLTage ch1,1,1.0234)

(3) Second,set the channel (1 or 2) voltage value to 25V, then enable the output of its channel, use a multimeter to measure the actual output voltage value of the channel as the value of NR3.

(4) Enter the command CALibration:VOLTage CH<x>,2,<NR3> (eg CALibration:VOLTage ch1,2,25.0234)

(5) When step (4) is completed, the setting voltage value and the displaying voltage value coefficients “a” and “b” are all calibrated, so that the correlation coefficient can be saved to the FLASH by the *CALST command.

Note: The setting voltage value and displaying voltage value are calibrated at the same time. After input the second point calibration data, the calibration coefficients “a” and “b” will calculate the corresponding values.

Displaying current calibration

Calibrate the displaying current value of channel 1 or 2. (take channel 1 as an example)

The used instrument is an electronic load and a high-precision multimeter is

connected in series.

CALibration:CURRent <NR1>, <NR2>, <NR3>

This command is used to calibrate related voltage values.

NR1:

CH1 select to calibrate the parameters of channel 1.

CH2 select to calibrate the parameters of channel 2.

NR3:

The actual measured value with a high-precision multimeter. It is an input parameter.

NR2:

1 At this time, NR3 is the input current displaying parameter of the first point.

2 At this time, NR3 is the input current displaying parameter of the second point.

3 At this time, NR3 is the input current setting parameter of the first point.

4 At this time, NR3 is the input current setting parameter of the second point.

(1) Connect the output of the channel to be calibrated to the output of the electronic load, and set the electronic load to constant current mode, set the constant current value to 100mA.

(2) Set the voltage of the channel to be calibrated to a value, such as 10V, etc., set the current to 3A, open the corresponding output of the channel.

(3) Read the displaying current value of the multimeter, enter the calibration parameter of the first point as the value of NR3, and input CALibration:CURRent ch1,1,NR3

(4) Set the electronic load to constant current mode, set the constant current value to 2.5A, and the other settings of the power supply are unchanged.

(5) Read the displaying current value of the multimeter, input the calibration parameter of the second point as the value of NR3, and input CALibration:CURRent ch1,2,NR3. When this command is successfully executed, its corresponding parameters “a” and “b” will change.

(6) Save the correlation coefficient to FLASH with the *CALST command.

Setting current calibration

Calibrate the setting current value of channel 1 or 2. (take channel 1 as an example)

The used instrument is an electronic load and a high-precision multimeter is connected in series.

(1) Connect the output of the channel to be calibrated to the output of the

electronic load, and set the electronic load to constant current mode, set the constant current value to 3A.
(2) Set the voltage of the channel to be calibrated to a value, such as 10V, etc., set the current value to 100mA, open the corresponding output of the channel.
(3) Read the displaying current value of the multimeter, input the calibration parameter of the first point as the value of NR3, and input CALibration:CURRent ch1,3,NR3
(4) The electronic load setting remains unchanged, and the setting current value of the power supply set to 2.5A.
(5) Read the displaying current value of the multimeter as the value of NR3, input the calibration parameter of the second point and input CALibration:CURRent ch1,4,NR3. When this command is successfully executed, its corresponding parameters “a” and “b” will change. .
(6) Save the correlation coefficient to FLASH by the *CALST command.
Note: The setting current value and the displaying current value are calibrated separately. In the command, NR2 indicates that the input is whether the setting current value or the displaying current value, and also includes that the input parameter of the calibration is the first point or the second point.

Save calibration parameter

Store the parameter of the coefficients to the internal FLASH.

The *CALST command saves all parameter coefficients to the internal FLASH.

Chapter 4 Disassembly and assembly

This chapter mainly describes how to unassemble and assemble the module units of the SPD3000X series power supply. Please refer to the given procedure to remove or replace the corresponding power unit.
The following are the main contents of this chapter:

- **Safety considerations** include safety factors to be considered when performing disassembly operations
- **Module unit** contains all detachable modular units of the power supply
- **Preparation tool** Contains the tools to be used during the disassembly process
- **Removal procedure** Contains specific removal steps

Safety prevention

Only professional technicians can perform this disassembly step. Be sure to disconnect all the power connections before operation, otherwise damage to the instrument components or personal injury may result.

Avoiding electric shocks

Because there is a dangerous voltage in the power module, be sure to disconnect the power supply before disassembling and wait for about three minutes until the internal capacitor of the power supply is discharged.

ESD Prevention

Electrostatic discharge (ESD) can cause damage to the electronics inside the power supply. Therefore, please use anti-static measures appropriately during the disassembly process. It is best to place the power supply on an antistatic mat and wear antistatic gloves.

Module list

All the module units of the power supply are listed in the order of disassembly as follows:
Table 4-1 list of power modules

Module serial number	Module name
1	handle components
2	the metal plate
3	the handle support bone
4	the front shell component

5	the hardware components
6	back hardware components
7	hardware main component

Equipped with tools:

1. Anti-static gloves;
2. The multifunctional screwdriver or electric group;
3. The screwdriver or long nose pliers.

Teardown steps:

This chapter mainly introduces how to remove and install the power of each module unit, please follow the steps given in below the right operation.

Step 1: open handle components

Remove the 2 PCS KM4 * 16 screw, and remove the handle fixed tablet (2 PCS) and the handle.

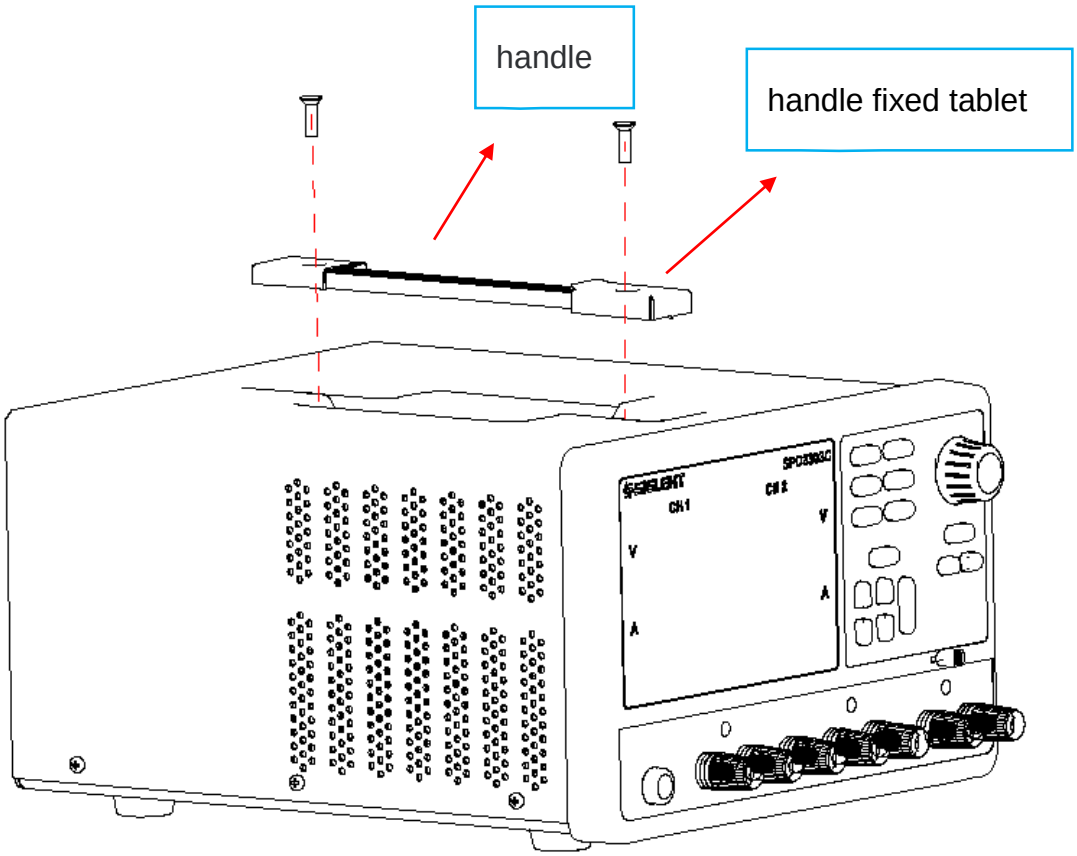

Figure 4-1 open handle components

Step 2: remove the metal plate

Take 6 PCS PM3 * 6 on either side of the screw, and the metal cover plate to remove:

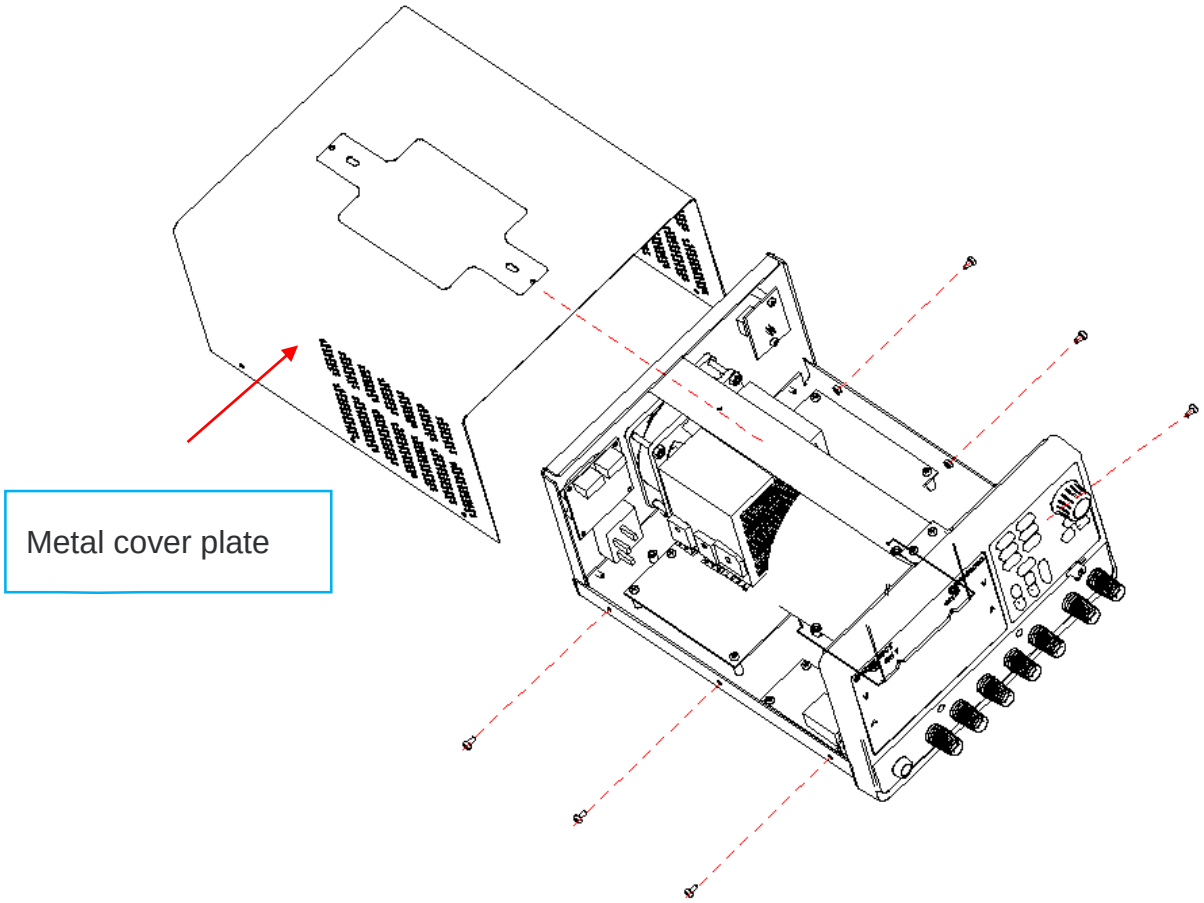

Figure 4-2 remove the metal plate

Step 3: open the handle support bone

Removed as shown in the figure below 4 PCS PM3 * 6 screws, and remove the arrow direction support bone referring to the following figure.

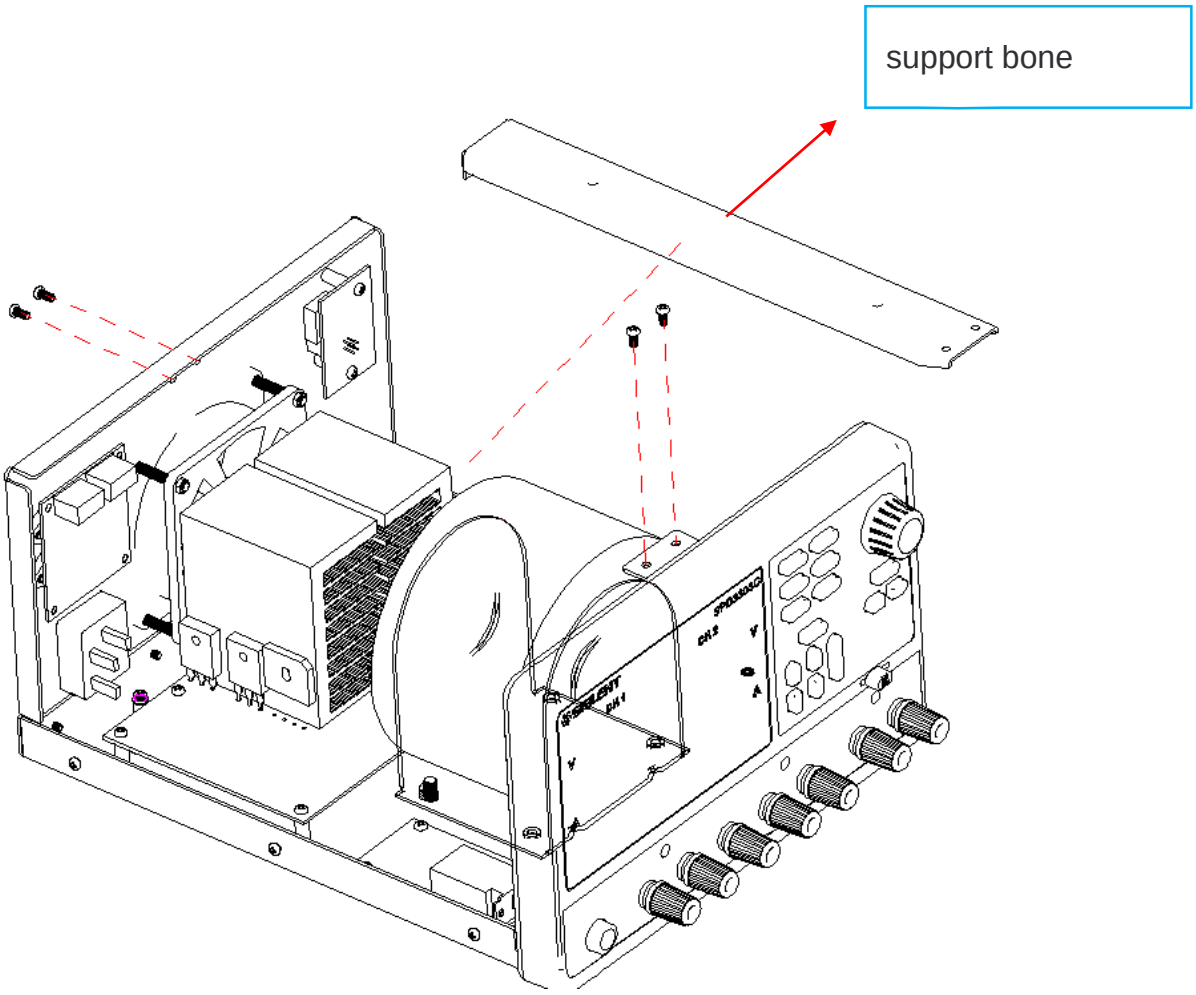

Figure 4-3 open the handle support bone

Step 4: apart the front shell component and the hardware components

Remove between the front shell components and hardware backplane 4 PCS PM3 * 6 screws and the corresponding cable, remove the shell front component and the power button.

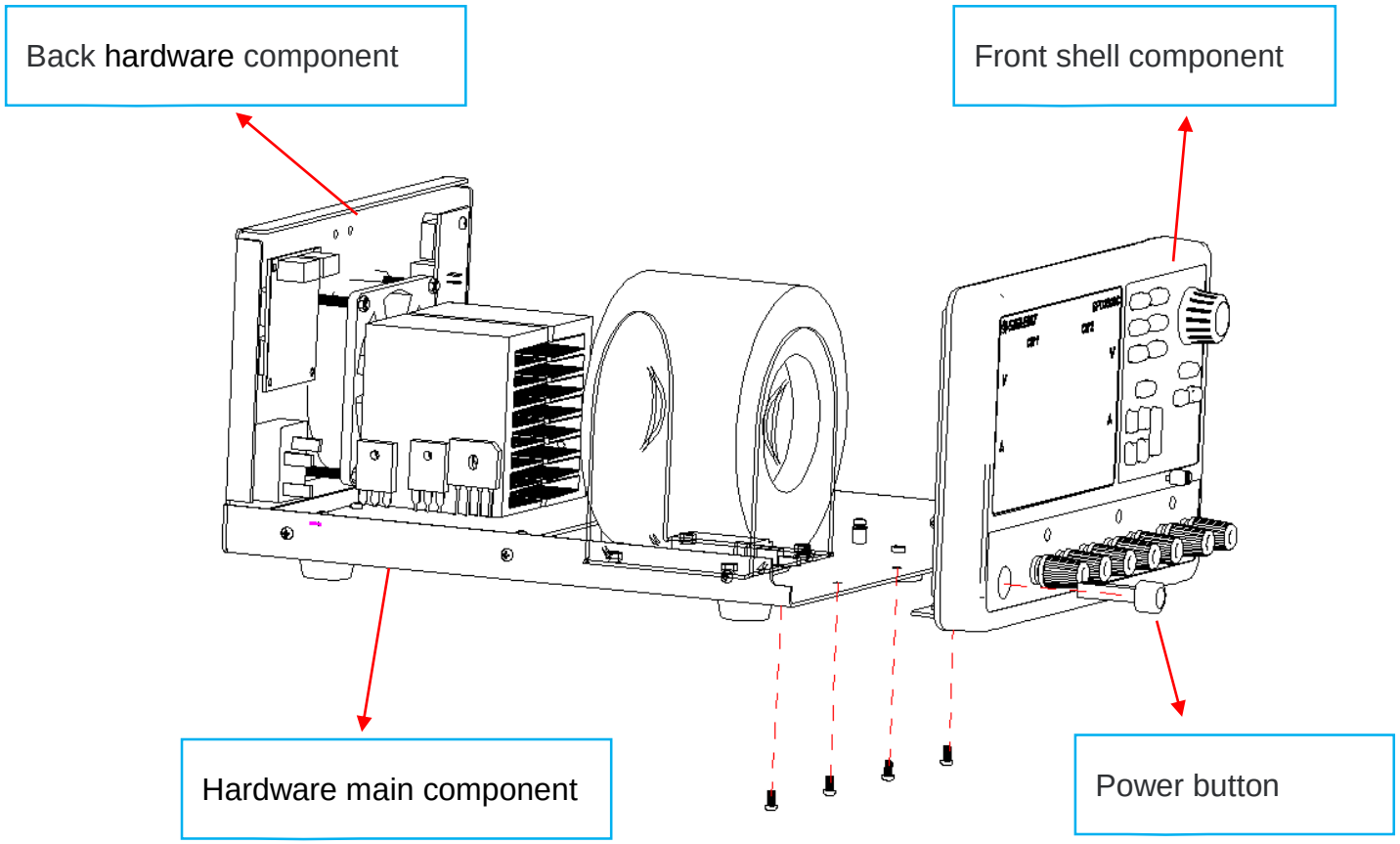

Figure 4-4 apart the front shell component

Step 5: open the front shell components

Remove the 4 PCS PM3 * 6 screws on the main control board, 7 PCS M4 * 10 combination screw, screen ribbon cable, can remove the main control board, wave button cap and 7 PCS terminal; Remove the metal front panel with plastic shell before 4 PCS PC3 * 8 screw, can remove the metal front panel;

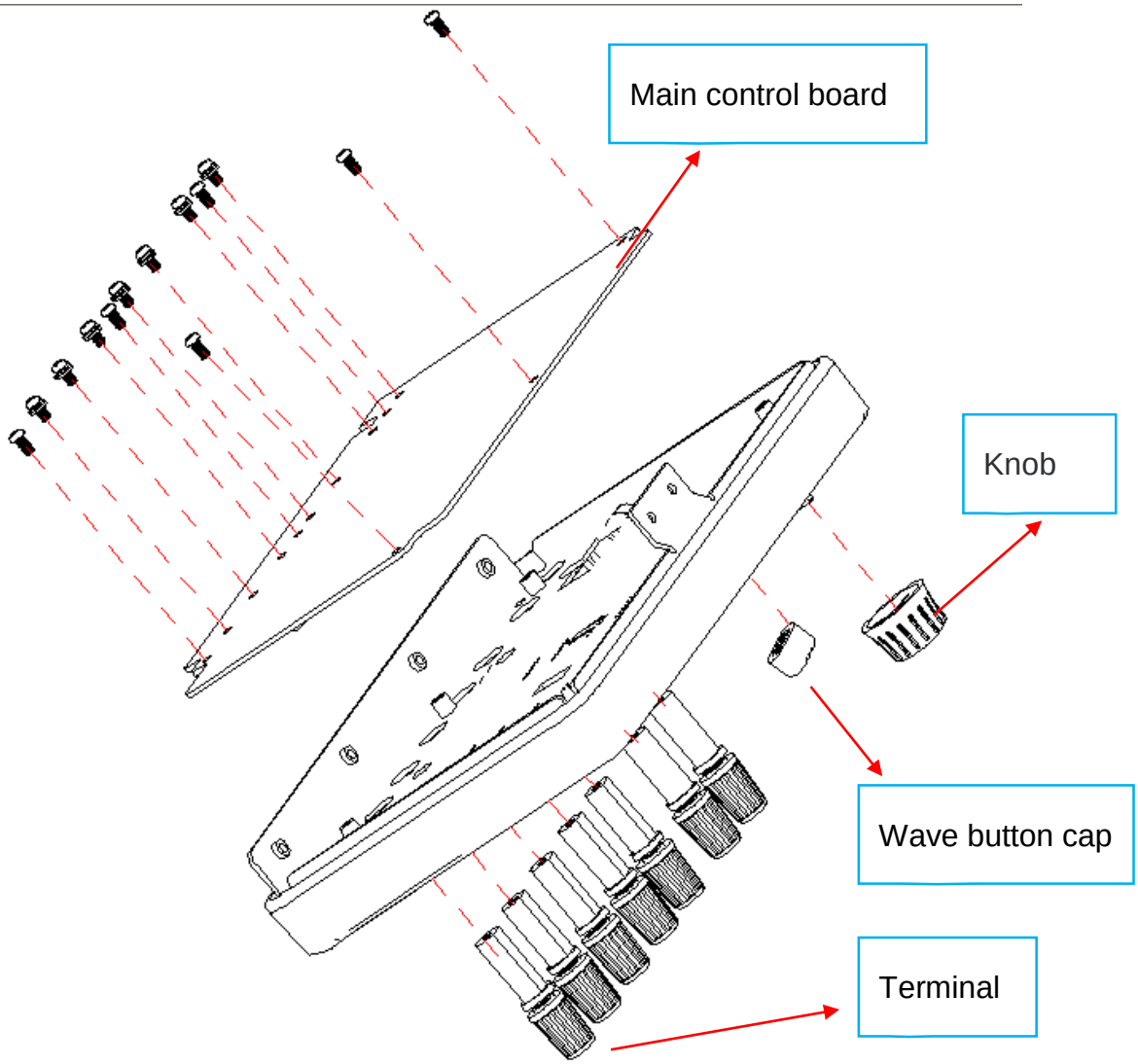

Figure 4-5 open the front shell component

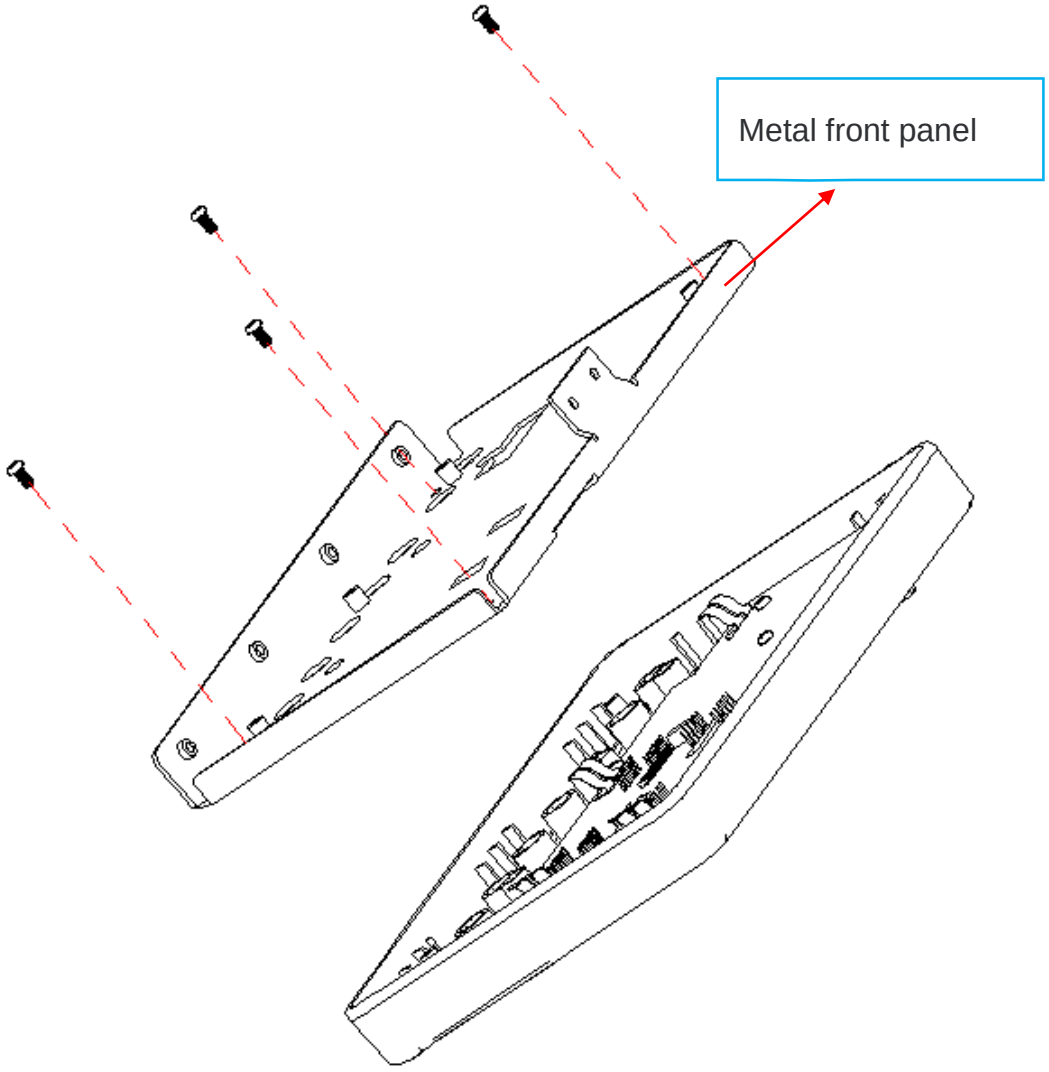

Figure 4-6 open the front shell component

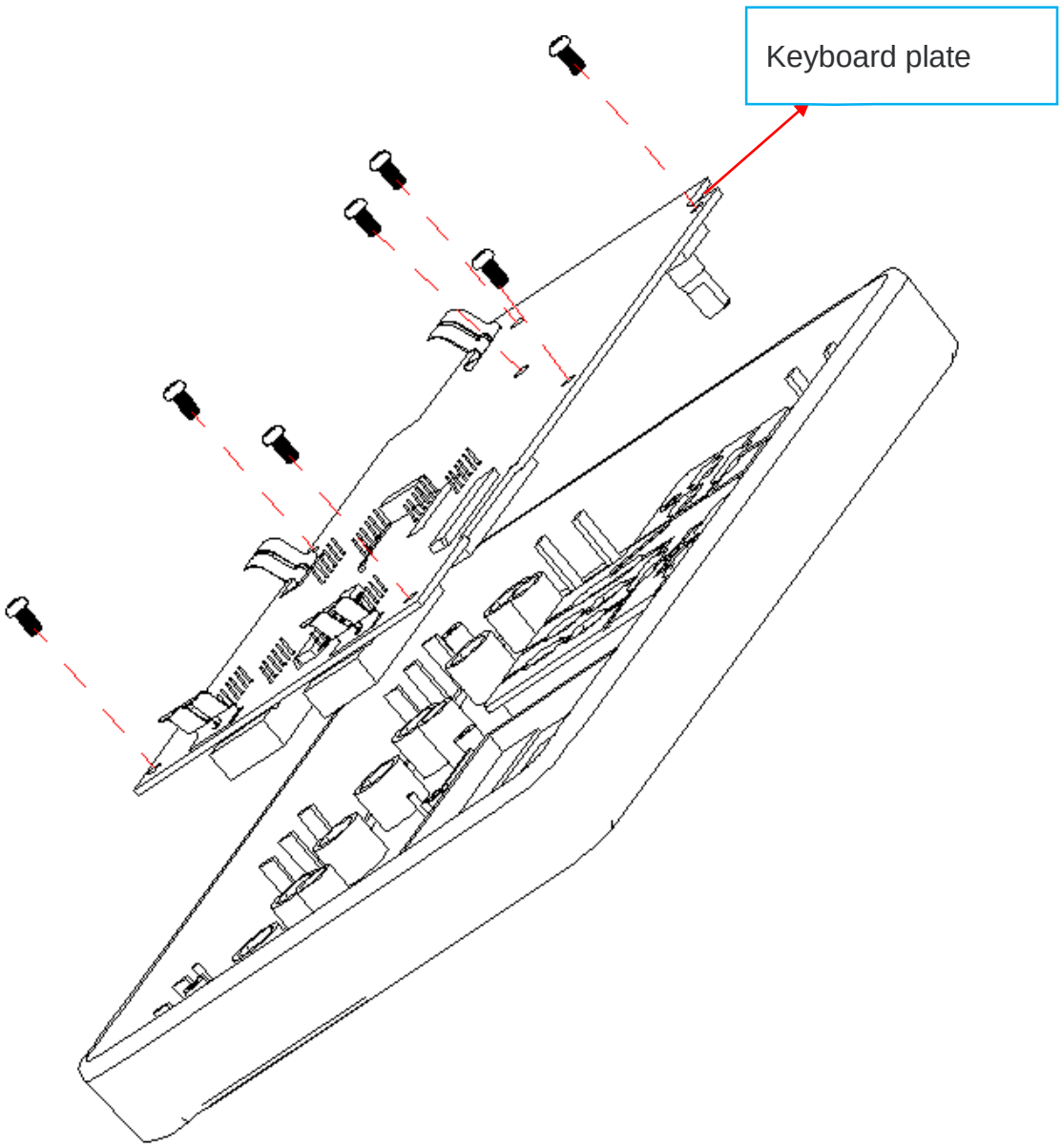

Figure 4-7 open the front shell component

Step 6: open hardware components

Remove between back hardware shell and metal plate 4 PCS PM3 * 6 screws and the corresponding cable, can remove the hardware shell components

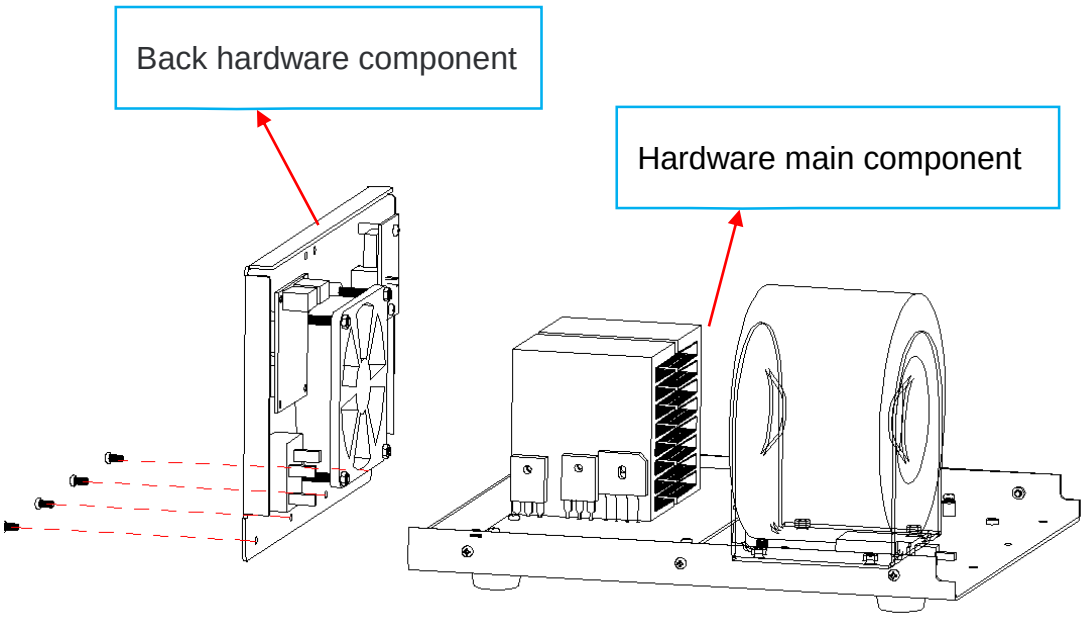

Figure 4-8 open hardware component

Step 7: open back hardware components

Take 6 PCS PM3 *6 screw, can remove the power AC switch board and a USB plate, remove the 4 PCS PM4 * 30 screw, desirable under a fan

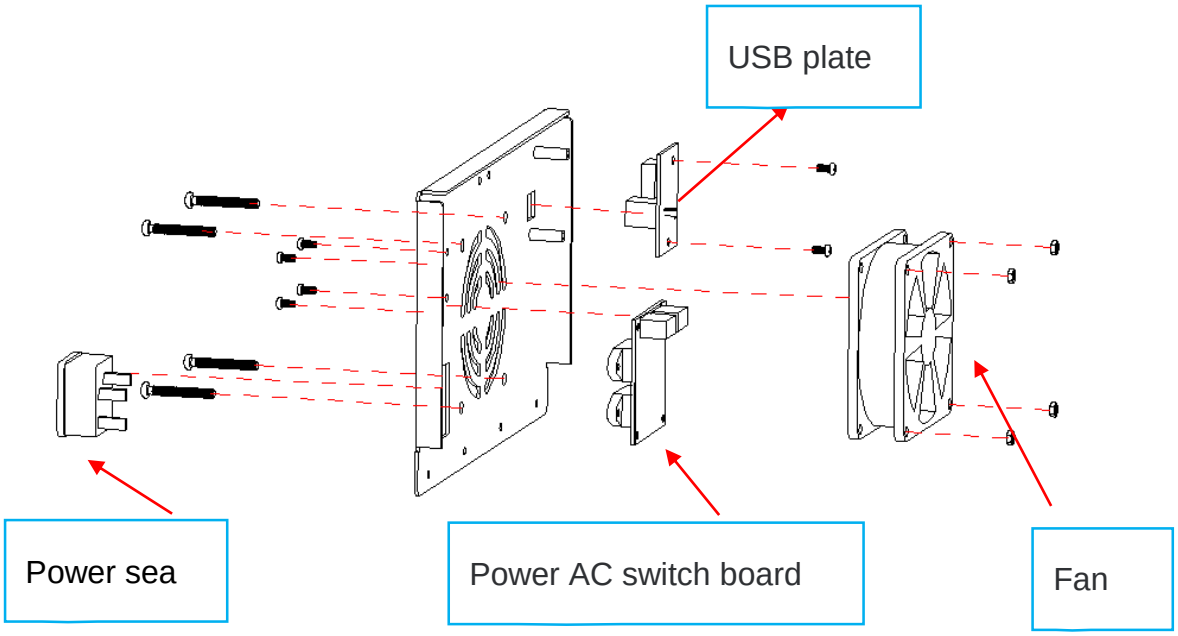

Figure 4-9 open back hardware component

Step 8: open hardware main component

Take 6 PCS PWM3 * 8 screws, 4 PCS PM3 * 6 screws, and remove the corresponding lines, can remove the small power board and power switch board, remove the 4 PCS TM5 * 10 screws, 4 PCS PWM3 * 8 screws under the desirable transformer and floor mats.

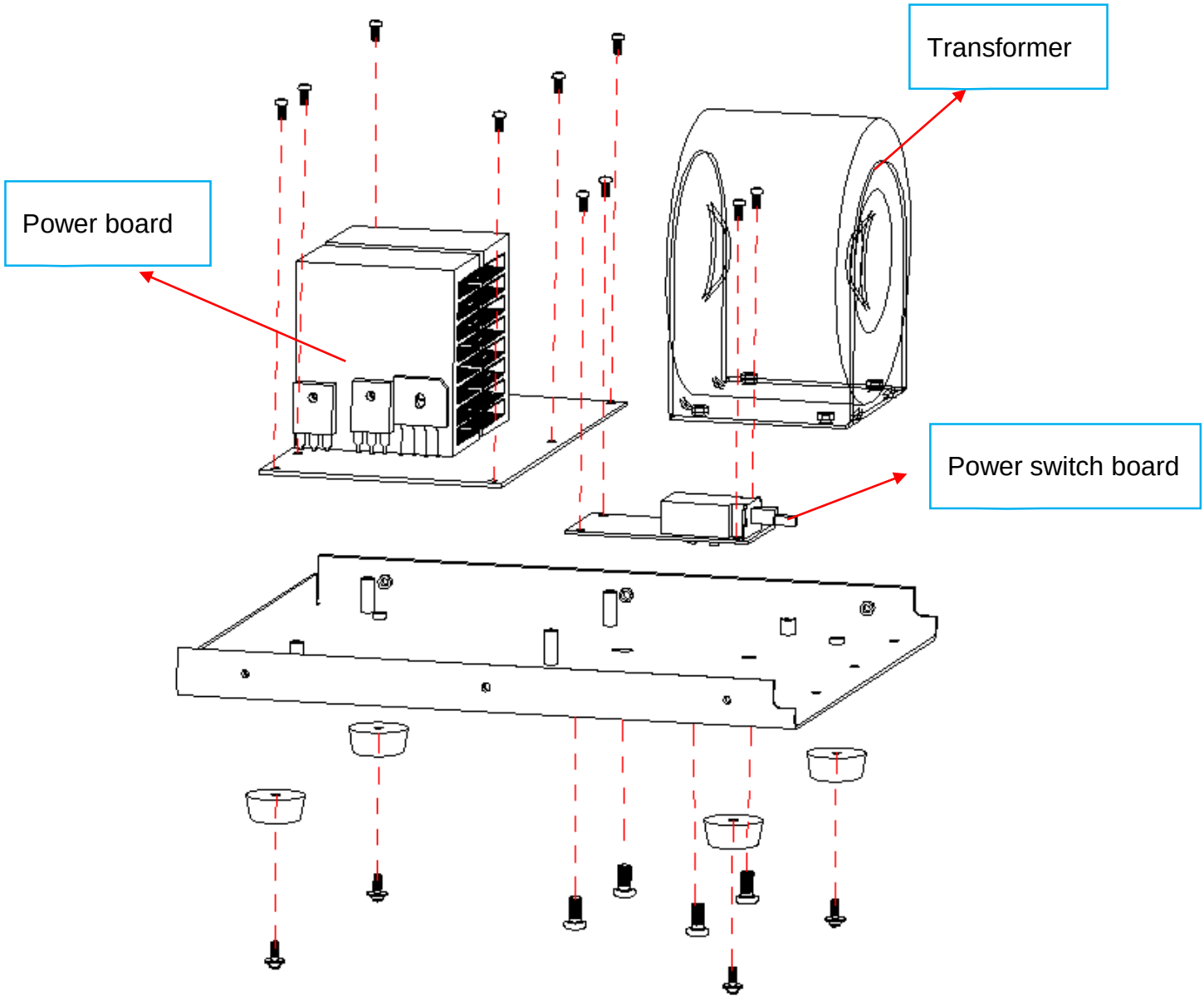

Figure 4-10 open hardware main component

Host assembly according to the above instead step!

Chapter 5 Hardware troubleshooting

This chapter describes how to handle common hardware failures encountered during power operation. Before handling such fault, ensure that the power supply meets the following prerequisites.

1. If one voltage value is found to be different from the nominal value when measuring voltage, turn off the power immediately.

2. Turn off the power before unpacking the connecting wire of the mainboard and the screen backlight.

3. During the process of taking apart the instrument for measurement, take measures to prevent static electricity from damaging the internal components.

ESD prevention

While performing any internal test of the power supply, please refer to the following precautions to avoid damages to its internal modules or components result from ESD.

- Touch circuit boards by the edges as possible as you can.
- Reduce handling of static-sensitive modules when necessary. .
- Wear a grounded antistatic wrist strap to insulate the static voltage from your body while touching these modules.
- Operate static-sensitive modules only at static-free areas. Avoid handling modules in areas that allow anything capable of generating or holding a static charge.

Required Equipments

The equipments listed in the table are required to troubleshoot the power.
Table 5-1 required equipments

equipment	specification	example
Digital Multimeter	Accuracy ±0.05% 1 mV resolution	Siglent SDM3065X
Oscilloscope	200MHz Bandwidth	Siglent SDS1202X-E

Main Board Drawing

Main board is used to control and manage the whole internal system of the power. Please refer to the following drawing to quickly locate the test points on the main board for easy resolution of the failures you encounter.

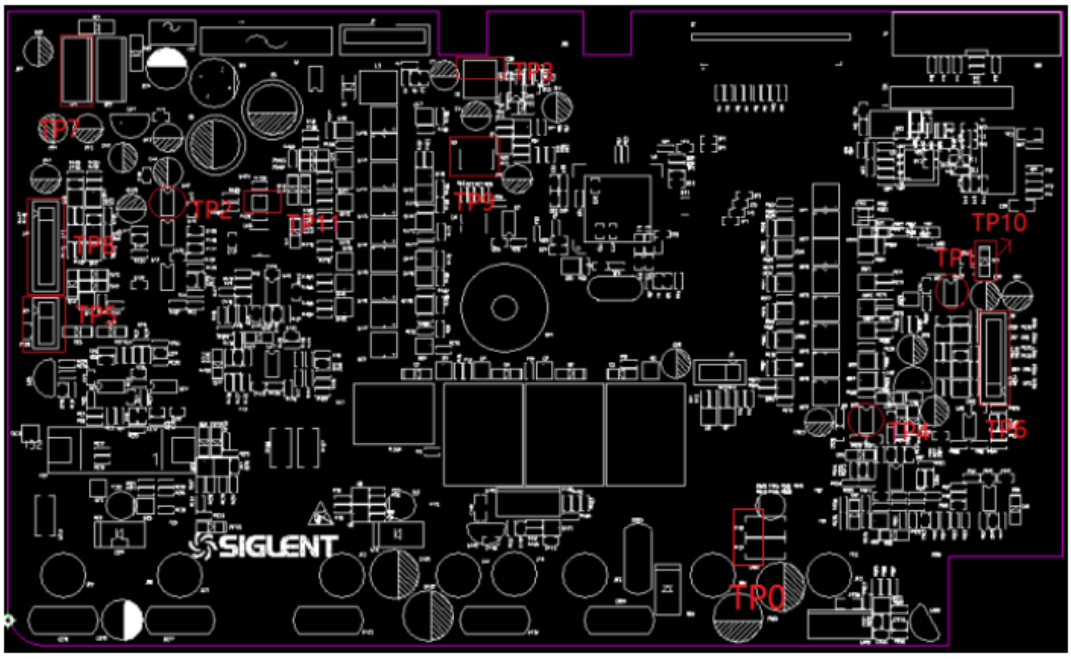

Figure 5-1 main board drawing

Power Board Drawing

Power board is used to provide various input voltages for the internal device and output voltage to the users. Please refer to the following drawing to quickly locate the test points on the main board for easy resolution of the failures you encounter.

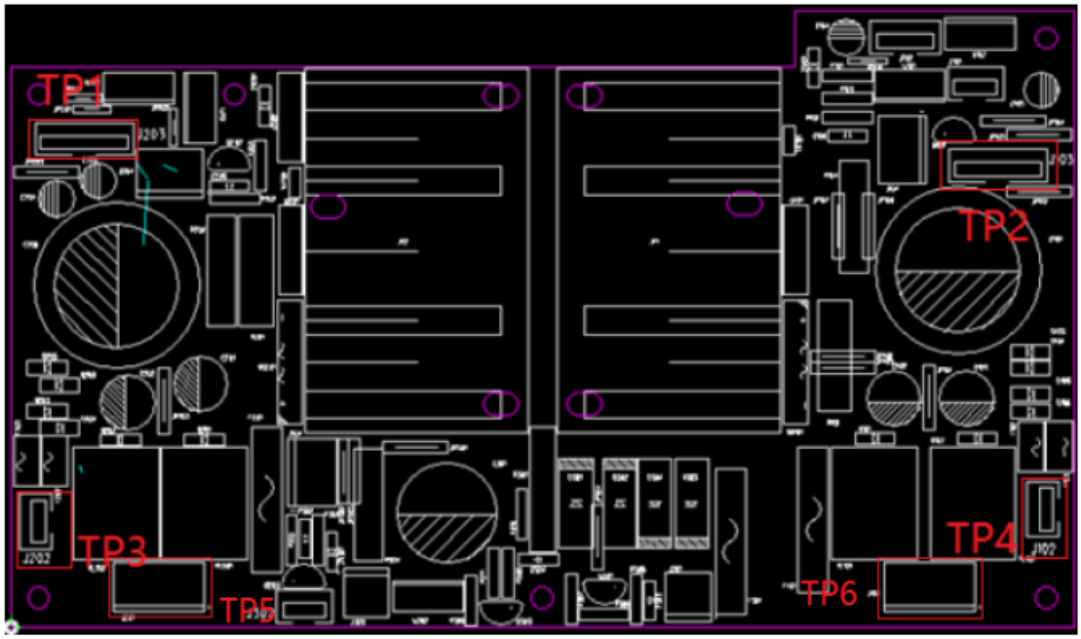

Figure 5-2 power board drawing

Troubleshooting flowchart

The following is a flow chart of the power hardware failure. The following figure can help you quickly locate and handle related hardware failures.

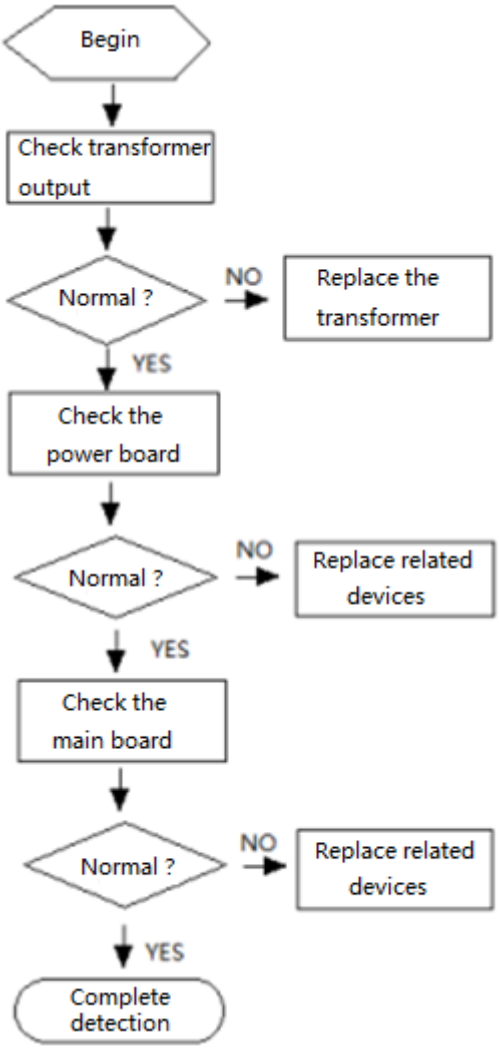

Figure 5-3 Troubleshooting flowchart

Check the power supply

Make sure that the power supply is properly grounded through the protective grounding end of the power cord. Be careful not to touch or disassemble the power board to avoid electric shock or burns. Please check the power supply as follows:

1. Disconnect the power cord, pry the groove out of the power socket, remove the fuse, and check if the fuse is burnt. If it burn out, please replace it in time.
2. After checking the fuse, reconnect the power cord and check if the transformer output voltage is normal.
3. View the voltage of the transformer output terminal on the power board. There are 2 groups of black, brown, red and orange 4Pin cables, 1 group of yellow and yellow 2Pin cables, 2 groups of blue, white and blue 3Pin cables, and 1 group of gray and gray 2Pin cables. 1 group of blue 2Pin cable, 1 group of brown-brown 2Pin cable, 1 group of orange-orange 2Pin cable, use the digital multimeter of AC voltage gear to check whether the voltage output of the transformer is normal. The voltage parameters are as follows:

Table 5-2: Power supply voltage parameter table

Voltage	Pin	Error limit
0V	black	no
6.9V	brown	±5%
20.4V	red	±5%
33.6V	orange	±5%

Voltage	Pin	Error limit
10.8V	yellow to yellow	±5%

Voltage	Pin	Error limit
18.8V-0V-18.8V	blue to white to blue	±5%

Voltage	Pin	Error limit
18.6V	gray to gray	±5%

Voltage	Pin	Error limit
18.6V	blue to blue	±5%

Voltage	Pin	Error limit

7.4V	brown to brown	±5%

Voltage	Pin	Error limit
8.9V	orange to orange	±5%

If the measured voltage value is consistent with the corresponding parameter in the table, use the oscilloscope to check the ripple of the voltage. If the ripple is small, the transformer is working properly;

If the measured voltage value does not match the corresponding parameter in the table, proceed to the next step.

4. Disconnect the transformer from the power board and measure the output voltage of the transformer again according to the data in the above table. If the measured voltage value is consistent with the corresponding parameter in the table, it indicates that the power board is faulty, resulting in abnormal transformer output voltage, and further testing or replacing the power board;

If the measured voltage value does not match the corresponding parameter in the table, it indicates that the transformer is faulty and needs to replace a new transformer. To ensure safety, do not disassemble the transformer and power board unauthorizedly.

Check the main board

After determining the normal output voltage of the transformer, remove the whole main board to a position that is suitable for measuring the voltage of the device, keep the connection, plug in the input power line, turn on the power switch, and use the digital multimeter of DC voltage gear to check whether the voltage of each test point is noraml.

The voltage parameters are shown in the following table:

Table 5-3: Voltage parameters on the main board

Test point	name	Test pin	Voltage value（V）	Error limit(V)
TP1	UB1	6	2.5	±0.2
TP2	UA2	6	2.5	±0.2
TP3	L6	2	6	±0.4
TP4	UB9	7	15	±1
TP5	JC1	1	15	±1
TP6	UA2	2	15	±1
TP7	JB1	6	-15	±1
TP8	UC1	3	-15	±1
TP9	JA1	1	-15	±1
TP10	U2	4	3.3	±0.2
TP11	DB2	negative	5.0	±0.3

		electrode		
TP0	RT91	GND	0	no

If the measured voltage does not match the corresponding parameters in the above table, turn off the power immediately and cut off the power input to prevent some chips from being damaged due to improper operation. Then you need to replace a new main board;

If the measured voltage value exactly matches the corresponding parameter in the above table, please proceed to the next step.

Check the power board

After confirming that the transformer output voltage is normal, plug in the input power cord, turn on the power switch, and use the digital multimeter of DC voltage gear to check whether the voltage at each test point is normal. To ensure safety, do not disassemble the power board unauthorizedly.

The voltage parameters are shown in the following table:
TP1 takes TP3 as the reference ground, TP2 takes TP4 as the reference ground.

Table 5-4: Voltage parameters on the power board

Test point	name	Test pin	Voltage value（V）	Error limit(V)
TP1	J203	3	15	±1
TP1	J203	1	-15	±1
TP3	J202	2	GND1	
TP2	J103	3	15	±1
TP2	J103	1	-15	±1
TP4	J102	2	GND2	

Quick Guide for General Failures

The general hardware failures are described in the following. Reading the following information can help you quickly handle some easy hardware failures with more convenience.

1. No start-up after pressing the Power button:

(1) Check if the power cord is correctly connected.
(2) Check if the power button is usable.
(3) Check whether the fuse has been burned out. If the fuse is burnt out please replace with a fuse of the same rating.
(4) Check the connection between the power supply and the main board.
(5) If the instrument still does not work normally, please contact SIGLENT.

2. The instrument starts up with a dark screen:

(1) Check the connection between the screen backlight circuit board and the mainboard.
(2) If the instrument still does not work normally, please contact SIGLENT.

3. No response after pressing any button or abnormal display of the screen:

(1) Check the connection between the Screen backlight circuit board and the mainboard.
(2) If the instrument still does not work normally, please contact SIGLENT.

4. Constant voltage output is not normal

(1)Check if the output power of the power supply is satisfied.
(2) Check if there is a short circuit between the load and the power supply or contacted poorly.
(3) Check if the current setting value is low.

5. Constant current output is not normal

(1)Check if the output power of the power supply is satisfied.
(2)Check if the load and the power supply are open or connected poorly.
(3) Check if the voltage setting is low.

Chapter 6 Service and Support

Maintain summary

SIGLENT warrants that the products it manufactures and sells are free from defects in materials and workmanship for a period of three years from the date of shipment from an authorized **SIGLENT** distributor. If a product proves defective within the respective period, **SIGLENT** will provide repair or replacement as described in the complete warranty statement.

To arrange for service or obtain a copy of the complete warranty statement, please contact your nearest **SIGLENT** sales and service office.

Except that as provided in this summary or the applicable warranty Statement, **SIGLENT** makes no warranty of any kind, express or implied, including without limitation the implied warranties of merchantability and fitness for a particular purpose. In no case shall **SIGLENT** be liable for indirect, special or consequential damages.

Repackaging for Shipment

If the unit needs to be shipped to **SIGLENT** for service or repair, be sure:

1. Attach a tag to the unit identifying the owner and indicating the required service or repair.
2. Place the unit in its original container with appropriate packaging material for shipping.
3. Secure the container with strong tape or metal bands.

If the original shipping container is not available, place your unit in a container which will ensure at least 4 inches of compressible packaging material around all sides for the instrument. Use static-free packaging materials to avoid additional damage to your unit.

Contact SIGLENT

SIGLENT Technologies Co., Ltd

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