

SPD1000X Series

Programmable Linear DC Power Supply

Service Manual

SM0501X-E01A

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

Avoid Electric Shock. To avoid injury or loss 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 has occurred 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 the 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 injury 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 a hazard that may occur.

WARNING: Indicates potential injury or a 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 Siglent SPD1000X Programmable DC Power Supply has a 2.8 inch TFT-LCD screen, programmable output, and real time graphical trending display. The SPD1168X has maximum output values of 16 V/8 A and the SPD1305X has maximum output values of 30 V/5 A. Both feature remote sensing as well as output short circuit and overload protection. The SPD1000X is suitable for a variety of applications in research and development, production and repair.

Features and benefits

- Single high-precision programmable output:
 - SPD1168X: 16 V/8 A, total power available is 128 W
 - SPD1305X: 30 V/5 A, total power available is 150 W
- Compact and easy to use, ideal for bench power supply
- Stable, reliable and low noise: $\leq 350 \mu\text{Vrms}/3 \text{ mVpp}$
- Fast Transient Response Time: $< 50 \mu\text{s}$
- Maximum resolution of 1 mV, 1 mA with 5-digit voltage and 4-digit current display.
- Timer function sequences preset output values
- High resolution 2.8 inch TFT LCD (240*320 pixels)
- Two output modes: two-wire output and remote sense compensation function (maximum compensation up to 1 V)
- Four input/line voltage selection choices includes 100 V, 110 V, 220 V and 230 V to satisfy different requirements

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- Intelligent temperature controlled fan, effectively reduces noise
- Bright, clear graphical interface, with waveform display
- Five internal system parameters save / recall, support for data storage space expansion
- Comes with EasyPower PC software. Real-time control via USB, LAN. Support SCPI command set and Labview driver package to meet the remote control and communication requirements

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		SPD1168X	SPD1305X
Chanel output		output voltage: 0~16 V output current: 0~8 A	output voltage: 0~30 V output current: 0~5 A
Display		2.8-inch true color TFT-LCD 5-digit voltage, 4-digit current display	
Resolution		1 mV/1 mA	
Setting accuracy		Voltage \pm (0.03% of reading + 10 mV)	
		Current \pm (0.3% of reading + 10 mA)	
Readback accuracy		Voltage \pm (0.03% of reading + 10 mV)	
		Current \pm (0.3% of reading + 10 mA)	
Temperature Coefficient per°C (Output Percentage+Offset)		Voltage \pm (0.01% of reading + 3 mV)	
		Current \pm (0.01% of reading + 3 mA)	
Constant voltage mode	Load regulation rate	$\leq 0.01\% + 2$ mV	
	Ripple and noise	≤ 350 uVrms/3 mVpp (20 Hz~20 MHz)	
	Recovery Time	< 50 us (Load change 50%, minimum load 0.5 A)	
Constant current mode	Line regulation rate	$\leq 0.2\% + 3$ mA	
	Load regulation rate	$\leq 0.2\% + 3$ mA	
	Ripple and noise	≤ 2 mArms	
Lock key		YES	
Save/call		5 sets	
Maximum output power		128 W	150 W
Input power		AC100 V/120 V/220 V/230 V \pm 10% 50/60Hz	

Standard interface	USB Device、LAN
Insulation	Base to terminal $\geq 20 \text{ M}\Omega$ (DC 500 V) Base to AC line $\geq 30 \text{ M}\Omega$ (DC 500 V)
Operating environment	Outdoor use: Elevation $\leq 2000\text{m}$ Environment temperature 0~40°C Relative humidity $\leq 80\%$ Installation level: II Pollution level: 2
Storage environment	Environment temperature: -10~70 °C Relative humidity $\leq 80\%$
Dimension	154.6 (W) \times 144.5 (H) \times 280 (D) mm
Weight	About 5.5 kg

Prepare Information

Before verifying the performance of the SPD1000X, you should master the following operations to make the power supply is working properly. The following chapter includes the basics, including:

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

For more detailed information about Power supply operation, please refer to the Quick Guide for the SPD1000X series available on the Siglent website.

Power-on Inspection

Verify that the power supply is working by performing a power-on check. The SPD1000X series has a supply voltage of 100 VACrms to 240 VACrms. Before connecting 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 power supply.

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

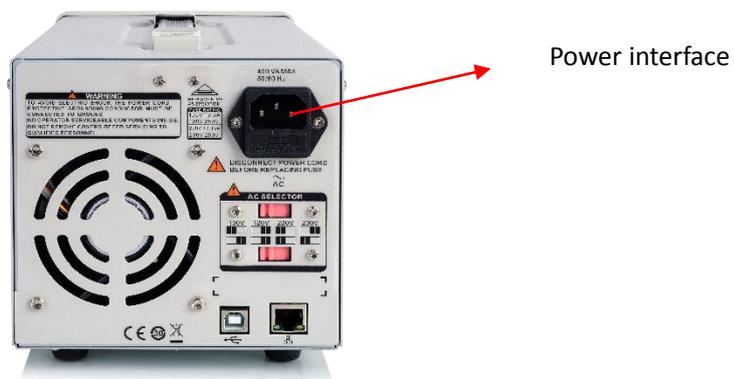


Figure 1-1 connect the power cord

Interface test

The SPD1000X series power supply supports two standard interfaces: A USB Device and a 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 the EasyPower software (available on the Siglent website) to test whether the USB Device interface is working properly.

Tools:

- One SPD1000X series power supply
- One PC with USB interface and compatible Windows OS
- Standard USB cable (AB type)
- EasyPower PC software

Test Steps:

1. Install the EasyPower software on the PC and follow the prompts to install the driver.
2. Connect the power supply to the PC with a USB cable.

USB interface



Figure 1-2 USB Device interface
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-
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 software to test whether the LAN interface is working properly.

Tools:

- One SPD1000X series power supply
- One PC with a network cable interface (Windows OS)
- One standard network cable
- EasyPower PC software

Step:

1. Install the EasyPower software onto 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

- 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 “Connect Type” window will pop up, continue to click the “VXI11” option on the window, and then input the 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 power supply meets published specifications. To ensure the accuracy of the measurements, ensure that all instruments have been powered on for at least 30 minutes to ensure they are at specified operating temperature.

Here is a list of the equipment needed to perform the test:

Table 2-1 equipment required for performance verification:

Description	Specification	Example
Digital multimeter	6.5 digit resolution	SDM3065X
Electronic load	Voltage and current power is greater than the power supply	SDL1020X-E

	parameters	
Connection cable	output test cord	SPD1000X standard configure
Adjustable transformer	80 V-240 V voltage adjustable	None
Digital oscilloscope	200MHz bandwidth	SDS1202X-E
DC power supply	Output DC voltage exceeding 40 V	36105B

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

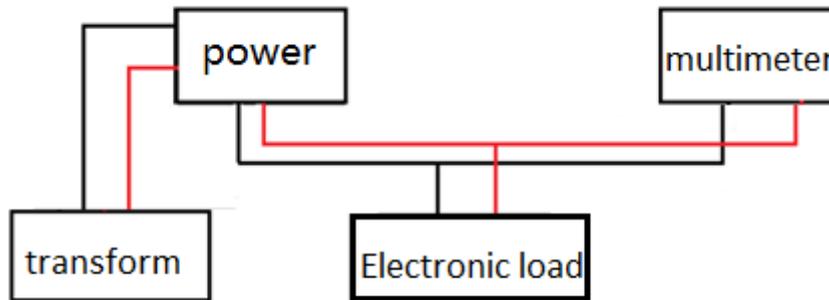


Figure 2-1 Test equipment connections

Testing report

In order to verify that the test results meet the specifications, please record the test data in the following table:

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.

$$\text{Formula: Power regulation rate} = \frac{\Delta V_o}{V_{set}} * 100\% \quad (1)$$

Specification: 0.03% + 10 mV

Preset conditions: Room temperature

Test instrument: Adjustable transformer, multimeter, electronic load

Test methods and steps:

- (a) Take the SPD1168X as an example: The input of the SPD1168X is powered by a variable transformer, the output terminal is connected to the electronic load, and the multimeter probes are connected to the positive and negative terminals of the power output terminal.
 - (b) Turn on the power of each device and set the output of the variable transformer to 100 VAC. The SPD1168X works in constant voltage mode after power-on, the electronic load set to constant current mode, and the multimeter should be set to the DCV mode.
 - (c) Set the output of the SPD1168X to 2 V/8 A. Set the electronic load to 7.998 A, and record the reading value of the multimeter.
 - (d) Set the SPD1168X to 5 V/8 A with the the electronic load set to 7.99A, and record the reading value of the multimeter. Then, continue by adjusting the SPD1168X output to the following: 8 V/8 A, 11 V/8 A, 14 V/8 A, and 16 V/8 A, recording the reading value of the multimeter in each case.
 - (e) Then set the output of the adjustable transformer to 110 VAC, 120VAC, 200 VAC, 220 VAC, 230 VAC, 240 VAC. repeating steps (c) and (d) at each value.
- (Note: the SPD1000X's rear case input power should be switched to the correct corresponding position, otherwise the fuse will burn out)
- (f) Calculate the corresponding power regulation rate by formula (1). Take the maximum value in the calculation result to determine whether the SPD1000X has reached the predetermined specification.

Table 2-2

Model	SPD1168X						SPD1305X					regulation rate
Vo Vin	2V	5V	8V	11V	14V	16V	20V	23V	26V	29V	32V	
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 $= \frac{\Delta I_o}{I_{set}} * 100\%$ **(2)**

Specification: 0.3% + 10 mA

Preset conditions: Room temperature

Test instrument: Adjustable transformer, multimeter, electronic load

Test methods and steps:

(a) Take the SPD1168X as an example :The input of the SPD1168X is powered by a variable transformer, turn on the power of each device, the electronic load should be set to constant current mode, the multimeter set to the 10 A range in DCI measurement mode, and the multimeter leads connected to the electronic load in series.

(b) Set the output of the transformer to 100 VAC, the output of the SPD1168X should be set to 1 A/16 V, and the electronic load should be set to 15 V. The SPD1168X should be in constant current mode after power-on. Record the reading value of the multimeter.

(c) Set the SPD1168X output to 2 A/16 V and record the multimeter DCI reading. Change the SPD set point to 4A/16V, 6A/16V, 8A/16V, and record the reading value of the multimeter in each case.

(d) Then set the output of the adjustable transformer to 110 VAC and repeat steps (b) and (c). Repeat for the following transformer values: 120 VAC, 200 V, 220 V, 230 V, 240 V, repeat steps (b) and (c).

(Note: The SPD1000X's rear case input power should be switched to the corresponding positions, 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 SPD1000X has reached the predetermined specification.

Table 2-3

Model	SPD1305X				SPD1168X		regulation rate
Vo Vin	1A	2A	4A	5A	6A	8A	
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 reflects the ability of the power supply to maintain a predetermined output voltage with a changing load.

$$\text{Formula: Load regulation rate} = \frac{\Delta V_o}{V_{set}} * 100\% \quad (3)$$

Specifications: 0.03% + 10 mV

Preset conditions: Room temperature

Test instrument: Adjustable transformer, multimeter, electronic load

Test methods and steps:

(a) Take the SPD1168X as an example: Set the input of the SPD1168X to 220 V on the variable transformer, connect the output terminals to the electronic load, and connect the multimeter positive and negative terminals of the power supply output terminals in parallel.

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

(c) Set the output of SPD1168X to 1 V/8 A. Turn on the output and note the

- reading of the multimeter when the SPD1168X is without a load (open).
- (d) Set the current of the electronic load to 1A and record the reading value of the multimeter. Then, set it to 3 A, 5 A, 7 A, 8 A, 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 SPD1168X to 5 V/8 A and repeat step (d). Continue by testing the SPD at the following: 9V/8A, 13V/8A, 16V/A, 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 SPD1000X has reached the predetermined specification.

Table 2-4

Model	SPD1168X						
Vo \ Io	0A	1A	3A	5A	7A	8A	regulation rate
1V							
5V							
9V							
13V							
16V							

Model	SPD1305X				
Vo \ Io	0A	1A	3A	5A	regulation rate
1V					
5V					
9V					
13V					
16V					
19V					
22V					
25V					
30V					

2) Constant current mode

Test Overview: For 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. This reflects the ability of the circuit to maintain a predetermined output current with a change in the load.

$$\text{Formula: Load regulation rate} = \frac{\Delta I_o}{I_{set}} * 100\% \quad (4)$$

Specifications: 0.3% + 10 mA

Preset conditions: Room temperature

Test instrument: Adjustable transformer, multimeter, electronic load

Test methods and steps:

(a) Take the SPD1168X as an example: Set the input of the SPD1168X to 220 V by the variable transformer and turn on the power of each device. Set the electronic load to constant voltage mode, the multimeter to the 10 A range of the DCI mode, and connect the multimeter to the electronic load in series.

(b) Set the output of the SPD1168X to 1 A/16 V, turn on the output, and set the electronic load to 15 V. Record the current reading value of the multimeter at this time.

(c) Set the voltage of the electronic load to 1 V and record the multimeter reading. Then set the load to 5 V, 9 V, 13 V and 16 V. record the reading value of the multimeter at each setting. (Consider that current flow through the wire connecting the electronic load and the SPD1168X. This will create a voltage drop which will add error. The voltage of the electronic load should be adjusted according to the actual wire loss to ensure the SPD1168X is operating inconstant current mode)

(d) Set the SPD1168X to 3 A/16 V and repeat steps (b) and (c). Continue for 5 A/16 V, 7 A/16 V, 8 A/16 V. For each setting, repeat step (b) and (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 SPD1000X has reached the predetermined specification.

Table 2-5

Model	SPD1168X					
Vo \ Io	1V	5V	9V	13V	16V	regulation rate
1A						
3A						
5A						
7A						
8A						

Model	SPD1305X										
o l o	V	1 V	5 V	9 V	13 V	16 V	21 V	25 V	29 V	32 V	regulatio n rate
1A											
3A											
5A											

Verify output voltage accuracy

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

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

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

Specifications: 0.03% + 10 mV

Preset conditions: Room temperature

Test instrument: Adjustable transformer, multimeter

Test methods and steps:

(a) Take the SPD1168X as an example: The input power to the SPD1168X is set to 220 V by the variable transformer, the output terminal connect to the electronic load, and the multimeter is connected to the positive and negative terminals of the power supply output terminal in parallel.

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

(c) Set the output of SPD1168X to 16 V/0.1 A. Turn on the output and note the reading of the multimeter and the voltage readback value of the power supply when the SPD1000X is without a load (open).

(d) Set the SPD1168X to 13 V/0.1 A and repeat step (c). Then, repeat for each of the following set points: 10 V/0.1 A, 7 V/0.1 A, 4 V/0.1 A, 1 V/0.1 A, 0.1 V/0.1 A, 0.01 V/0.1 A, and 0 V/0.1 A.

(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 SPD1000X has reached the predetermined specification.

Table 2-6

Model	SPD1168X			
Mode	Set Volt (V)	Measured Volt (V)	Readback Volt (V)	Pass / Fail
2 wire	16V			
	13V			
	10V			
	7V			
	4V			
	1V			
	0.1V			
	0.01V			
	0V			
4 wire	16V			
	13V			
	10V			
	7V			
	4V			
	1V			
	0.1V			
	0.01V			
	0V			

Model	SPD1305X			
Mode	Set Volt (V)	Measured Volt (V)	Readback Volt (V)	Pass / Fail
2 wire	30V			
	28V			
	22V			
	15V			
	10V			
	1V			
	0.1V			
	0.01V			
	0V			
4 wire	30V			
	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 and readback current value relative to the set current and determine the current accuracy of the power supply.

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

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

Specifications: 0.3% + 10 mA

Preset conditions: Room temperature

Test instruments: Adjustable transformer, multimeter, electronic load

Test methods and steps:

(a) Take the SPD1168X as an example :The input of the SPD1168X is set to 220 V by the variable transformer,

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

(b) Set the SPD1168X to 0 A/16 V, turn on the output, and set the electronic load to 15 V. Record the reading of the multimeter and the current readback value of the power supply.

(c) Set the SPD1168X to 0.01 A/16 V and repeat step (b). Then, repeat the process for the following set points: 0.1 A/16 V, 1 A/16 V, 3 A/16 V, 5 A/16 V, and 8 A/16 V

(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 SPD1000X has reached the predetermined specification.

Table 2-7

Model	Set Curr (A)	Measured Curr (A)	Readback Curr (A)	Pass / Fail
SPD1168X	0A			
	0.01A			
	0.1A			
	1A			
	3A			
	5A			
	8A			

Model	Set Curr (A)	Measured Curr (A)	Readback Curr (A)	Pass / Fail
SPD1305X	0A			
	0.01A			
	0.1A			
	1A			
	3A			
	5A			

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 typically specified as the peak-to-peak value of this AC component.

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 supplies, 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: 1 mVrms

Preset conditions: Room temperature

Test instruments: Oscilloscope, passive probe (with 1:10 attenuation), electronic load

Test environment: Room temperature

DC power supply: SPD1168X set output to 16V/8A, SPD1305X set output to 30V/5A.

Electronic load: in constant current mode Set to 7.998A when test SPD1168X; 4.998A when test SPD1305X.

Test methods and steps:

(a). The probe is grounded in the shortest grounding manner. It is recommended to use a grounding spring instead of the ground lead (alligator clip). In addition, a 10 uF 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). Turn on the 20 MHz bandwidth limit of the oscilloscope, set the appropriate time base and storage depth to ensure the sampling rate is at least 100 MSa/s, set the probe amplification factor to 1:1, the coupling mode to 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.

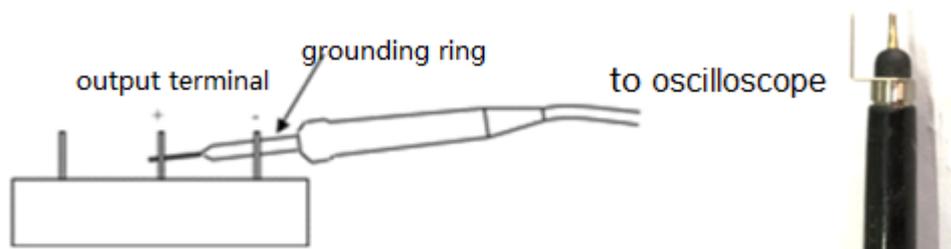


Figure2- 2 Grounding method

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. Test instruments: Oscilloscope, passive probe

Specifications: No overshoot

Preset conditions: Room temperature

Test environment: Local grid voltage, the probe is grounded in the shortest way (spring clip is preferable as the alligator ground clip leads can introduce environmental noise).

Test methods and steps:

- (a). Set the oscilloscope to single trigger mode, select the appropriate trigger level, and enable the oscilloscope's voltage measurement function.
- (b) Test the voltage waveform of the output of the SPD1168X or SPD1305X under no-load and full-load conditions. When the SPD1000X from power off to power on

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. 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

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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 15 mV of the set point in less than 50 μ s.

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

Preset conditions: Room temperature

Test environment: Local grid voltage, 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, connect the probe tip to the positive terminal of the supply and connect the ground spring of the probe to the negative terminal.
- (b). Connect the power supply output terminals to the electronic load. Set the electronic load set to the dynamic test mode. The relevant settings are as follows: Set the load to continuous mode with rising and falling slopes of 10 A/ μ s. For the SPD1168X, set level A = 7.998 A, level B = 3.999 A. When testing the SPD1305X, set level A = 4.998 A, level B = 2.499 A, set the frequency to 50 Hz, Show screenshot examples of Good and Bad performance, then save the picture.

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 should resume normal output.

Test instrument: SPD1000X

Preset conditions: Room temperature

Test methods and steps:

- (a) Connect the device, 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: The SPD1000X power supply includes an overvoltage protection circuit. When the output of SPD1168X exceeds 21 V (± 1 V) or the output of SPD1305X exceeds 36 V (± 2 V), the output will automatically short and the current will be limited to 0.5 A. After a short circuit, the channel output needs to be turned off to reset, and then it will work normally after being turned back on.

Test instrument: Local grid voltage

Preset conditions: none

Test environment: Room temperature

Test methods and steps:

- (b) Connect the SPD1000X power output to the switching power supply.

- (b) Turn on the power of the SPD. For the SPD1168X, set the output voltage of the switching power supply near 21 V. For the SPD1305X, set the output voltage of the switching power supply near 36V. Increase the output voltage of the switching power supply gradually. When the overvoltage point is reached, the SPD1000X power supply output is short-circuited.

Chapter 3 Calibration channel parameters

Calibration instructions:

The parameters to be calibrated are the voltage setting value, displayed voltage value, current setting value and displayed current value. All parameters are determined by linear calibration, and the fitting function is $Y = aX + b$, Where “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 that can be sent using a communications tool like National instruments Measurement and Automation Explorer (NI-MAX).

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.

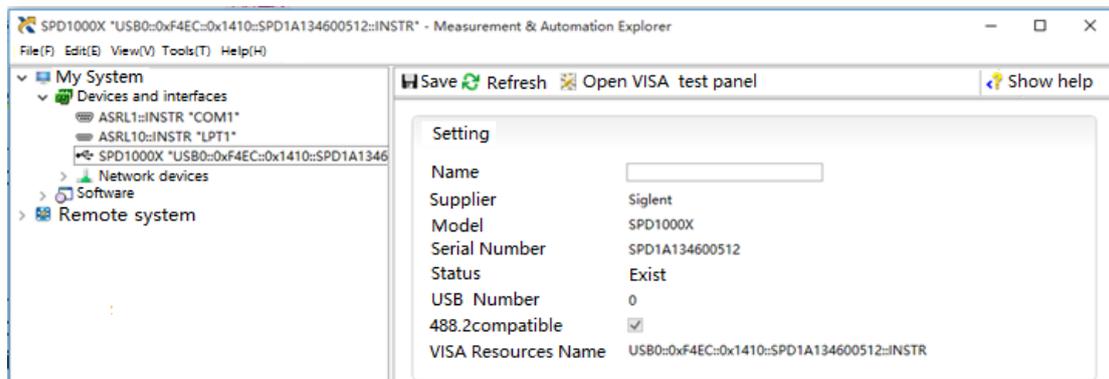


Figure 3-1

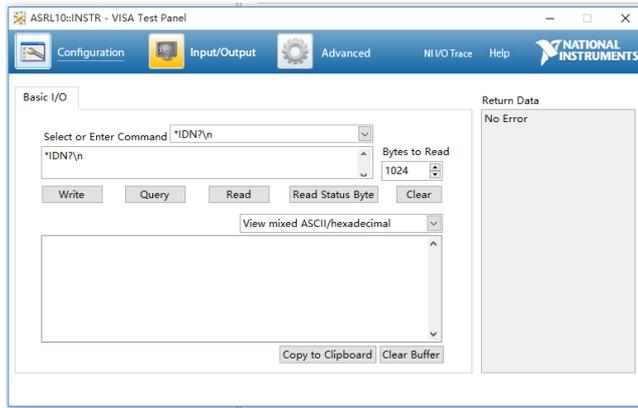


Figure 3-2

Calibration instrument: 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 displayed voltage calibration coefficients “a” and “b” of channel 1.;
- 2: Clear the current setting calibration coefficients “a” and “b” of channel 1.;
- 3: Clear the displayed current calibration coefficients “a” and “b” of channel 1.
- 4: Clear the “a” and “b” values of all calibration coefficients for channels 1

Voltage calibration

Calibrate the setting voltage value and displayed voltage value of channel 1

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.

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 1 V, then enable the output of its channel. Use a multimeter to measure the actual output voltage value of the channel and record it 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 15 V, then enable the output of the channel, use a multimeter to measure the actual output voltage value of the channel and record it as the value of NR3.

(4) Enter the command CALibration:VOLTage CH<x>,2,<NR3> (eg CALibration:VOLTage ch1,2,15.0234)

(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.

Test equipment: An electronic load and a high-precision multimeter connected in series to the output channel of the power supply. The Multimeter should be in DCI measurement mode.

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

This command is used to calibrate related voltage values.

NR1:

CH1 Select to calibrate the parameters of channel 1.

NR3:

The actual measured value with multimeter. It is an input parameter.

NR2:

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

2 At this time, NR3 is the input displayed current 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 100 mA.

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

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

(4) Set the electronic load to constant current mode, set the constant current value to 2.5 A, 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 send the command:
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 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 3 A.

(2) Set the voltage of the channel to be calibrated to a value, such as 10 V, etc., set the current value to 100 mA, 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 send the command:
CALibration:CURRent ch1,3,NR3

(4) The electronic load setting remains unchanged, and the setting current value of the power supply set to 2.5 A.

(5) Read the displayed current value of the multimeter as the value of NR3, input the calibration parameter of the second point and send the command:
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 disassemble and assemble the module units of the SPD1000X 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:** Includes safety factors to be considered when performing disassembly operations
- **Module unit:** Contains all detachable modular units of the power supply
- **Preparation tools:** 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

Tools:

1. Anti-static gloves
2. The multifunctional screwdriver
3. Needle nose pliers.

Teardown steps:

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

Step 1: Open handle components

Remove the 2 pcs KM4 * 16 screw, and remove the handle attachment covers (2 pcs) and the handle.

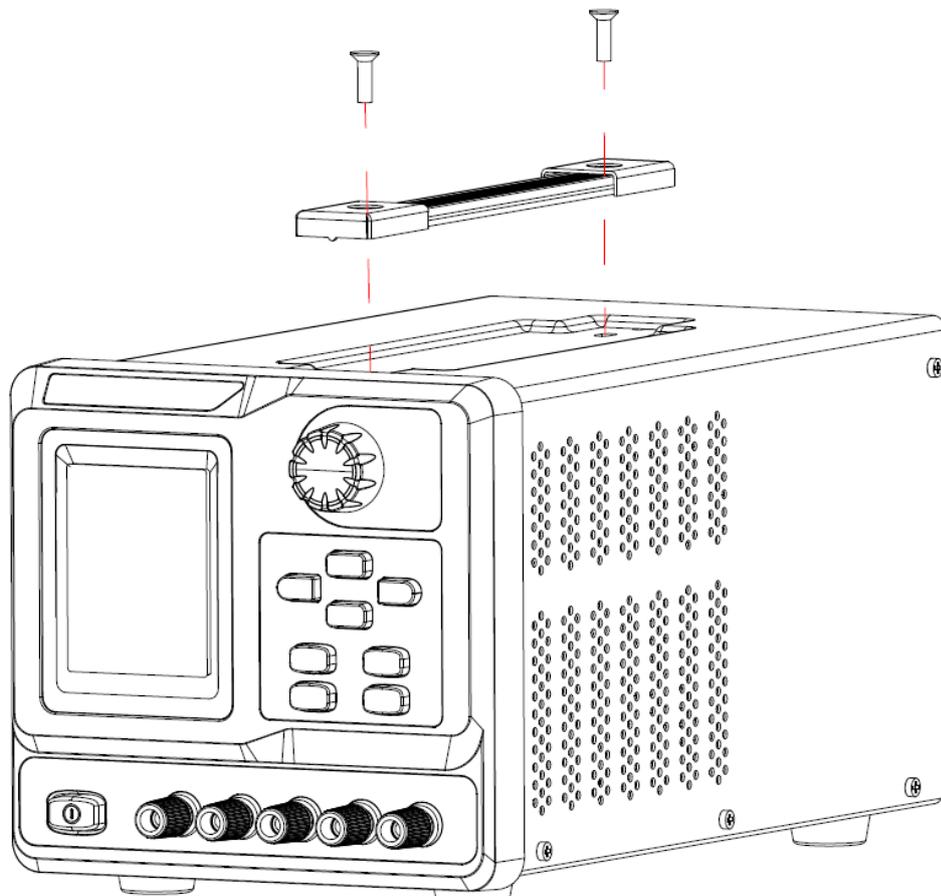


Figure 4-1 Handle components

Step 2: Remove the metal plate

Remove 8 pcs PM3 * 6 on either side of the supply and slide the metal cover to remove

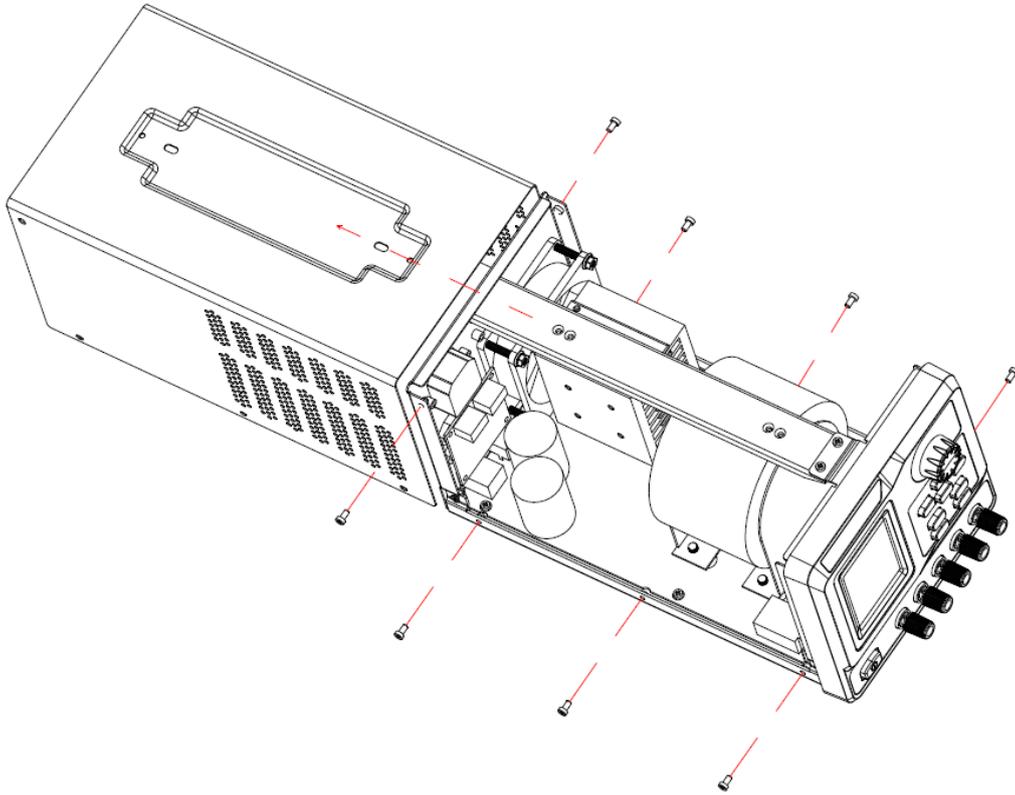


Figure 4-2 Remove the metal cover

Step 3: Open the handle support

Remove the 4 pcs PM3 * 6 screws as shown in the figure below and remove the handle support:

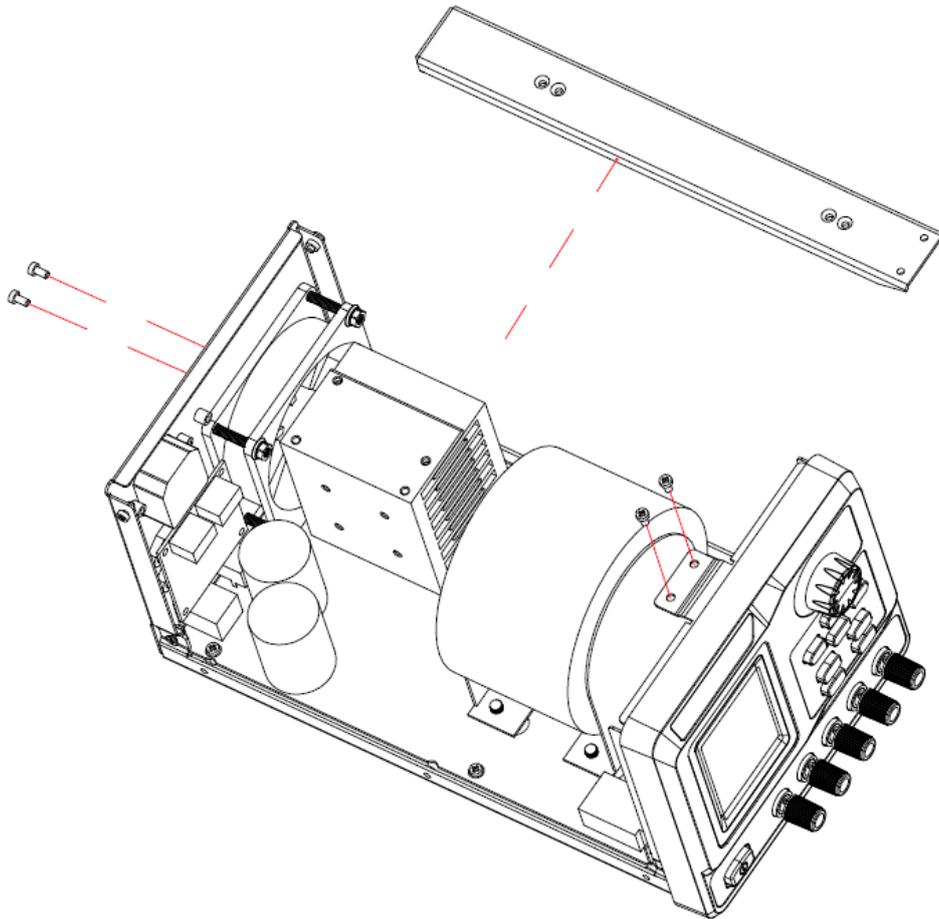


Figure 4-3 Remove the handle support

Step 4: Font Panel Removal

Unscrew 3 pcs PM3 * 6 screws and the corresponding cable to remove the front panel components and power button.

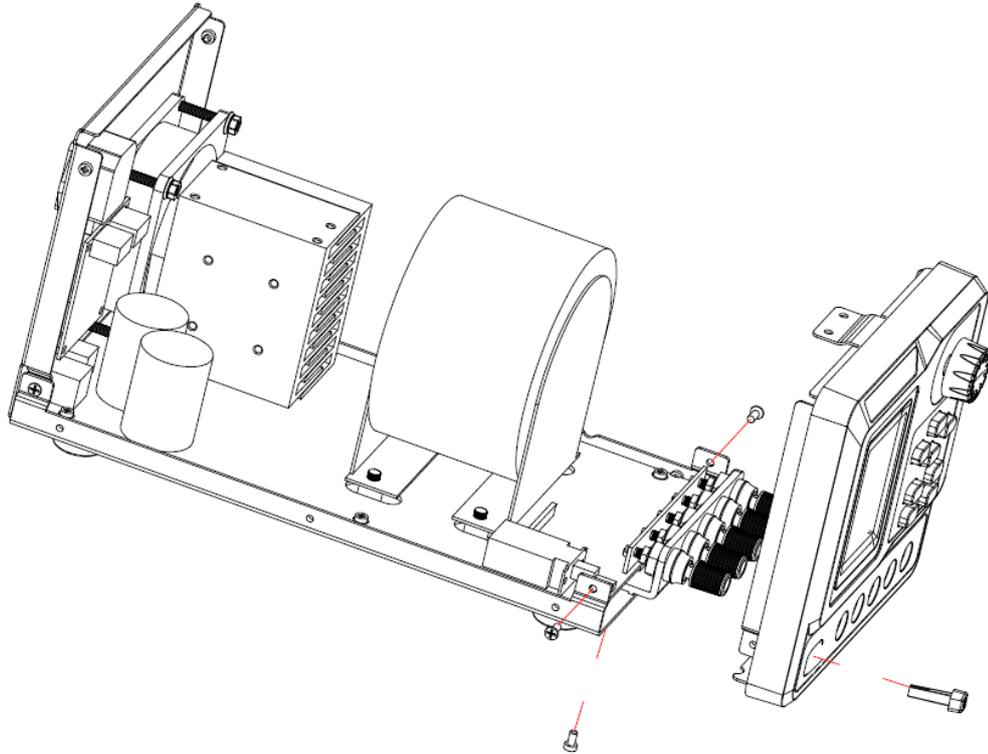


Figure 4-4 Removing the front panel

Step 5: Disassemble the front panel

Remove the 6 pcs PC3*8 screws from the hardware board and remove the front panel cover. Remove the 6 pcs PC 3*8 screw on the keyboard and remove the keyboard assembly. Remove the front panel knob manually.

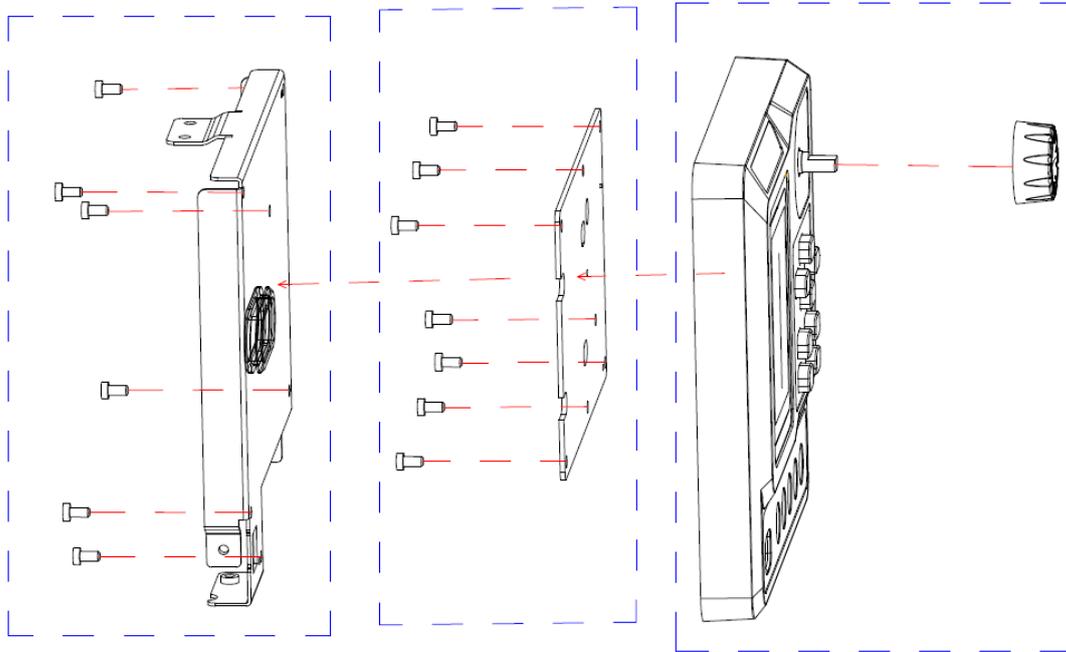


Figure 4-5 Front panel components

Step 6: Disassemble the frame

Remove 4 pcs PM3 * 6 screws and the corresponding cable between the back hardware shell and metal plate.

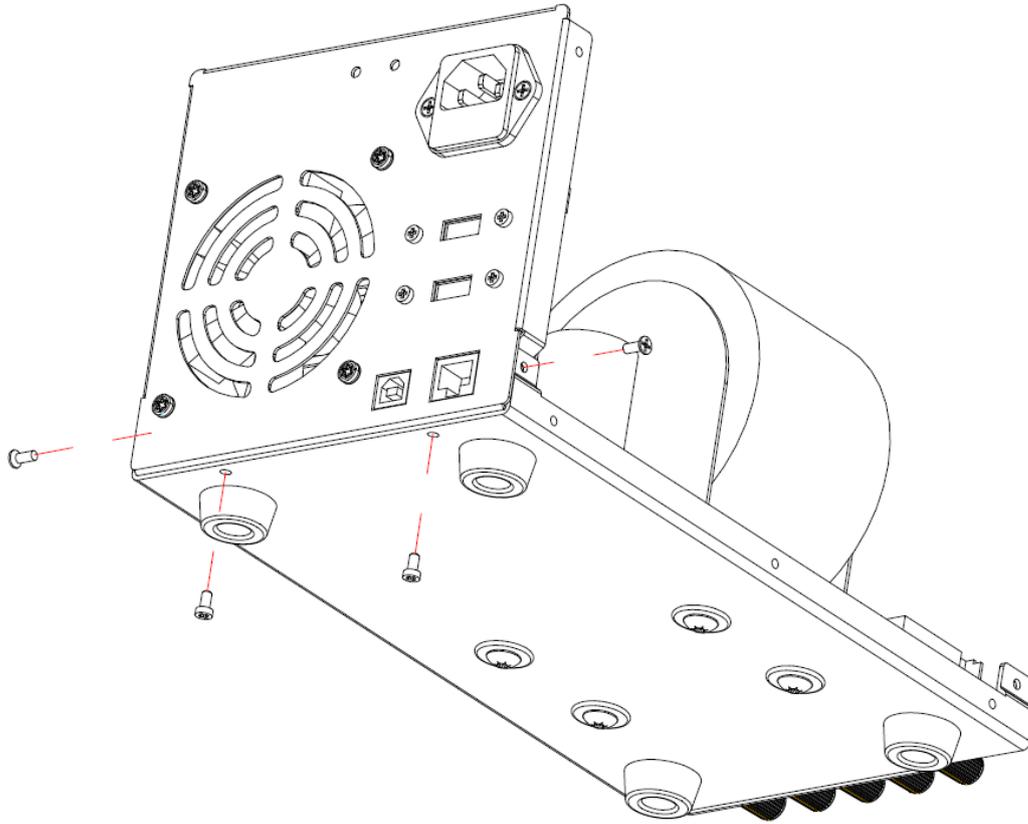


Figure 4-6 Frame disassembly

Step 7: Remove rear panel components

Remove 4 pcs PM3*6 screw, remove AC switch board of power supply.

Remove 4 pcs PM4*30 screw and nut, remove fan.

Remove 2 pcs KM3*6 screw, and remove 1 pcs PWM3*8 grounding screw to remove power cord base.

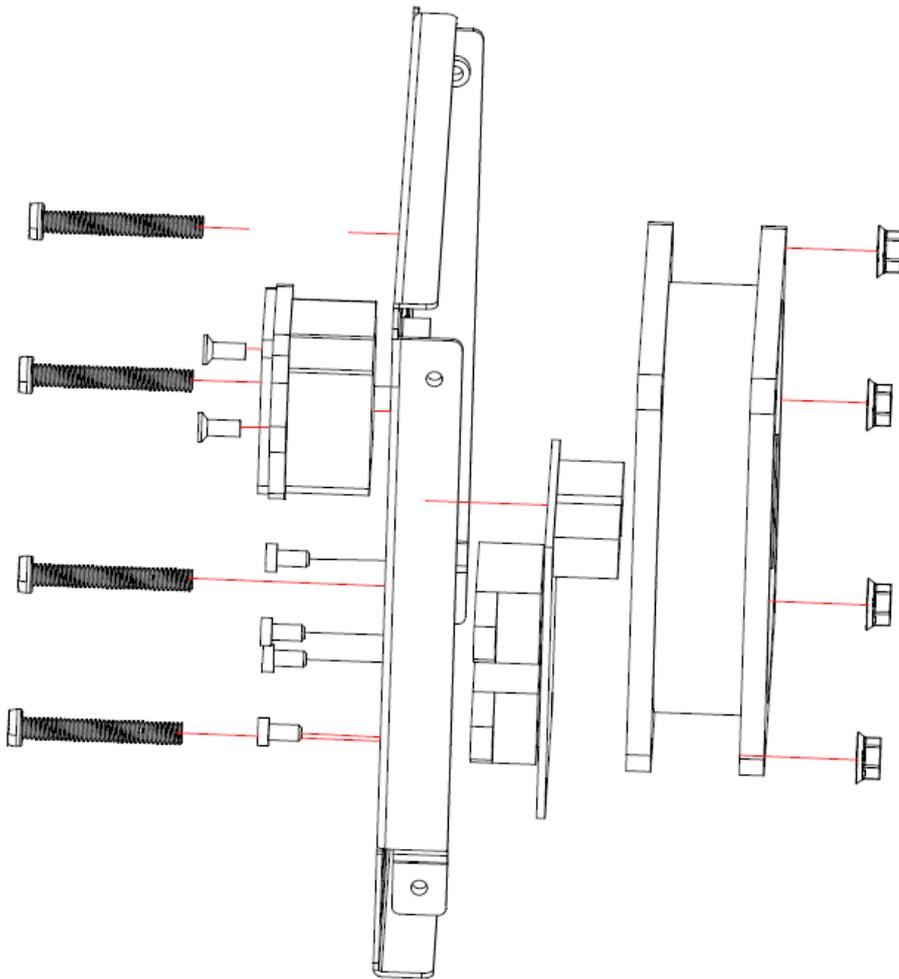


Figure 4-7 Rear panel components

Step 8: Open main hardware

First remove the 4 pcs TM5*10 screw and 4 pcs gasket and pull the transformer and the supporting copper pillar. Remove the 6 pcs PM3*6 screw, which can be used to separate the hardware floor and the main board PCB. Remove the 4 pcs PWM3*8 screw, which can remove the bottom 4 pcs footpad.

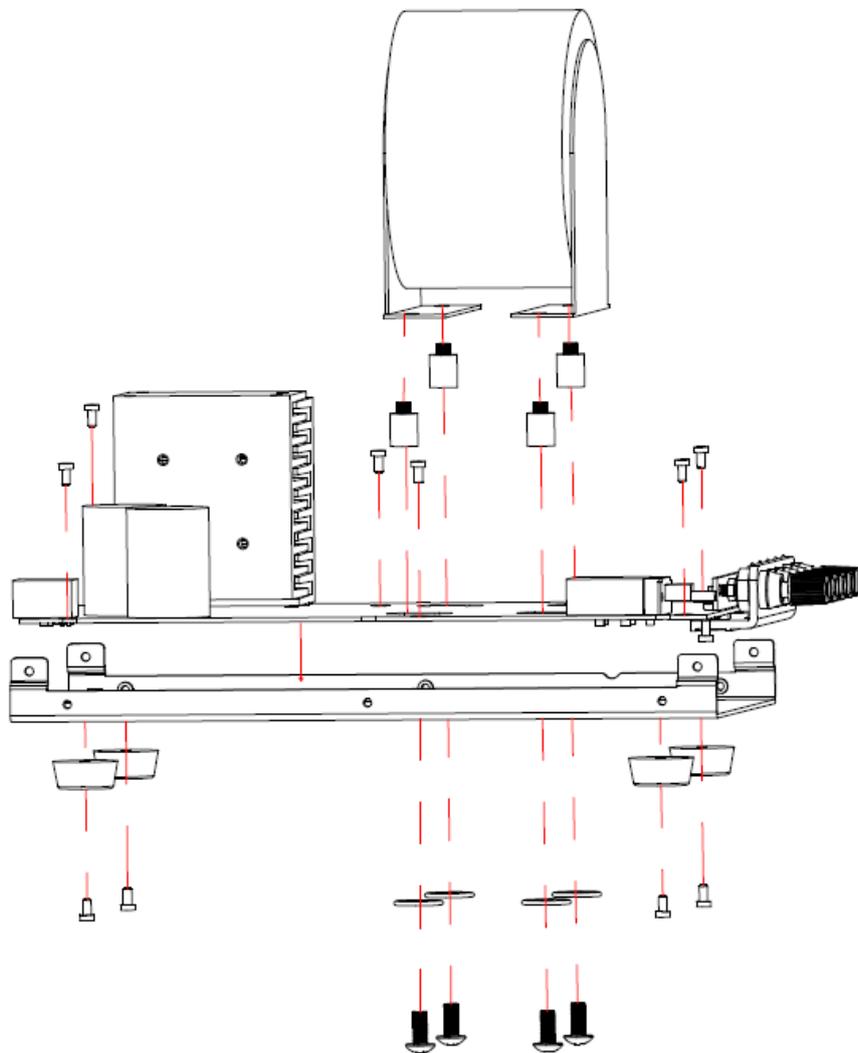


Figure 4-8 Main hardware components

Chapter 5 Hardware troubleshooting

This chapter describes how to handle common hardware failures encountered during power operation. Before handling such faults, 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 unplugging 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 damage to its internal modules or components resulting from ESD.

- Only touch circuit boards by the edges.
- Minimize handling of static-sensitive modules .
- Wear a grounded antistatic wrist strap to insulate the static voltage from your body while touching any 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 Equipment

The equipment listed in the table are required to troubleshoot the power supply.

Table 5-1 Required equipment

Equipment	Specification	Example
Digital Multimeter	6.5 digit resolution	SDM3065X
Digital oscilloscope	200 MHz Bandwidth	SDS1202X-E

Main Board Drawing

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

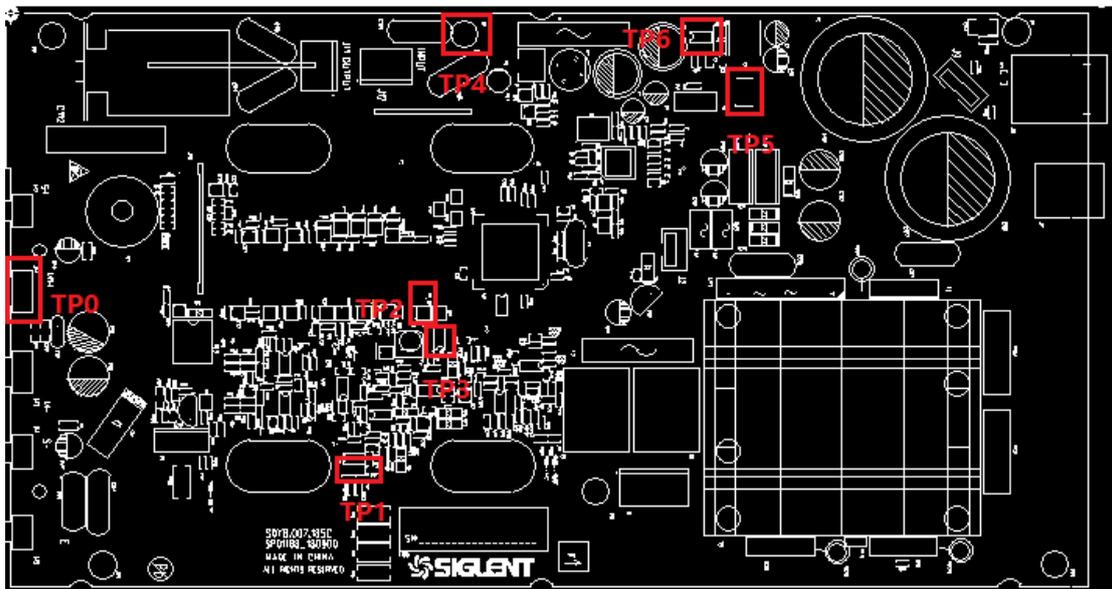


Figure 5-1 Main board drawing

Troubleshooting flowchart

The following is a flow chart for testing the power supply if a hardware failure is suspected. The following figure can help you quickly locate and handle related hardware failures.

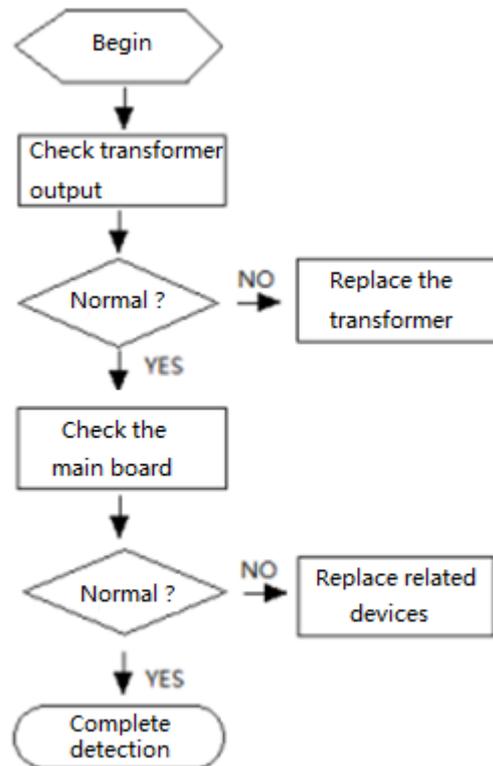


Figure 5-3 Troubleshooting flowchart

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 with the proper equivalent fuse.

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 1 group of black, brown, red and orange 4 Pin cables, 1 group of blue, white and blue 3 Pin cables, 1 group of brown-brown 2 Pin cables. Use the digital multimeter in AC voltage mode 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

Model	SPD1168X	SPD1305X	
Pin	Voltage	Voltage	Error limit
black	0V	0V	no
brown	4V	6V	±5%
red	13V	20V	±5%
orange	20.5V	33V	±5%

Voltage	Pin	Error limit
18V-0V-18V	blue to white to blue	±5%

Model	SPD1168X	SPD1305X	
Pin	Voltage	Voltage	Error limit
brown to brown	8.5V	8V	±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.

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 in DC voltage mode to check whether the voltage of each test point is normal.

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)
TP0	JA1		GND	
TP1	U25	8	15	±1
TP1	U25	4	-15	±1
TP2	Q4	2	5	±0.4
TP3	U16	6	2.5	±0.2

TP4	JB7		GND_EARTH	
TP5	U2	2	3.3	±0.3
TP5	U2	3	5	±0.4
TP6	U1	1	9	±1

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 the main board.

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

Quick Guide for General Failures

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 poor contact/connections.
- (3) Check if the current setting value is too 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 too low.

Chapter 6 Service and Support

Warranty

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 to:

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

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