SPS5000X Series
Wide Range Programmable
Switching DC Power Supplies

Service Manual

SM0505X-E01A

SIGLENT TECHNOLOGIES CO.,LTD

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General Safety Summary

Carefully read the following safety precautions to avoid personal injury and prevent damage to the instrument and any products connected to it. To avoid potential hazards, please use the instrument as specified.

To avoid fire or personal injury, use the proper power cord.

Only use the state/locally approved power cord with the instrument.

Ground the instrument.

The instrument grounds through the protective terra conductor of the power line. To avoid electric shock, the ground conductor must be connected to the earth. Make sure the instrument is grounded correctly before connect its input or output terminals.

Review all terminal ratings before use.

To avoid fire or electrical shock, please look over all ratings and instructions for the instrument. Before connecting the instrument, please read the manual carefully to gain more information about the ratings and important use instructions for safe operation.

Do not operate with suspected failures.

If you suspect that there is damage to the instrument, halt use and contact your local SIGLENT dealer immediately.

Do not operate in wet/damp conditions.

Do not operate in an explosive atmosphere.

Keep the surface of the instrument clean and dry.

Ambient temperature

Operating: 0 ℃ to +50 ℃

Non-operation: -20 ℃ to +60 ℃

Note: Direct sunlight, radiators, and other nearby heat sources should be taken into account when assessing the ambient temperature.

Relative Humidity

Operating: 20% to 85% RH, 40 ℃, 24 hours

Non-operating: 20% to 85% RH, 65 ℃, 24 hours

Altitude

Operating: ≤ 2,000 m

Non-operating: ≤ 15,266 m

Anyone operating this equipment should refer to the instruction manual to understand the protection afforded by the equipment. Please use the instrument only in accordance with regulations.

Safety Terms and Symbols

Terms may appear on the product:

DANGER: Indicates direct injury or hazard that could occur.

WARNING: Indicates potential injury or hazard that could occur

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

Symbols may appear on the product:

	This symbol is used where caution is required. Refer to the accompanying information or documents to protect against personal injury or damage to the instrument.
	This symbol warns of a potential risk of shock hazard.
	This symbol is used to denote the measurement ground connection.
	This symbol is used to denote a safety ground connection.
	This symbol shows that do not put electronic equipment as unsorted municipal waste management. Please separate collection or contact equipment suppliers.
	This symbol is used to represent an alternating current, or "AC".
CAUTION	The "CAUTION" symbol indicates a potential hazard. It calls attention to a procedure, practice, or condition which may be dangerous if not followed. Do not proceed until its conditions are fully understood and met.
WARNING	The "WARNING" symbol indicates a potential hazard. It calls attention to a procedure, practice, or condition which, if not followed, could cause bodily injury or death. If a WARNING is indicated, do not proceed until the safety conditions are fully understood and met.

Content

Chapter 1 General Features and Specifications

The SIGLENT SPS5000X series is a programmable DC switching power supply with single/multiple outputs and constant power features. The series includes 15 models, with 40 V, 50V, 80 V, 160 V rated output voltage values and 180W, 360 W, 720 W, 1080 W maximum output power levels. Users can connect 2 sets of power supplies in series or up-to 3 sets in parallel. This series of products can meet the user's combination selection of 0 ~ 320 V, 0 ~ 270 A, and the maximum combined power can reach up to 3240 W, meeting different application requirements.

SPS5000X series programmable DC switching power supply is equipped with a 2.4-inch high brightness OLED display, friendly human-computer interaction interface, and excellent performance indicators. The minimum resolution is 1mV / 1mA. The output voltage and current rise time is adjustable. It has two output modes: Constant voltage and constant current. It also supports list sequence programming mode. It also has over-voltage, over-current, power limit and over-temperature protection, high-precision, low-noise, and high-reliability.

Performance and Features

- Rated voltage: 40 V, 50V, 80 V, 160 V

  Rated output power: 180W, 360 W, 720 W, 1080 W
- Constant power output, a wide range of voltage and current outputs, high efficiency switching power supply
- CV, CC priority mode selection, better protection for the circuit/DUT
- Fast recovery time, < 1 ms
- Fast output response time, < 1 ms

- Voltage and current rise/fall rate adjustable
- Set and read back resolution 1 mV, 1 mA
- Built-in bleeder current control, the power in the output capacitor can be discharged below the circuit/DUT safe voltage after shutdown
- Support remote voltage compensation Sense function
- Support local list function editing, USB import list sequence file
- External analog voltage and resistance control, voltage and current monitoring output
- Overvoltage, over current, power limit, over-temperature protection, safe and reliable
- 2.4-inch OLED high-brightness display with a wide viewing angle of 170 degrees
- Equipped with USB, LAN standard communication interface, optional USB-GPIB module
- With 1/2, 1/3, 1/6 rack size, flexible assembly
- Embedded web server provides remote computer by web browser without the need to install additional software on the host computer

The SPS series includes the following models:

Model	Output parameters
SPS5041X	40 V/30 A/360 W
SPS5042X	40 V/60 A/720 W
SPS5043X	40 V/90 A/1080 W
SPS5044X	2-channel, 40 V/30 A/360 W/CH
SPS5045X	3-channel, 40 V/30 A/360 W/CH
SPS5051X	50 V/10 A/180 W
SPS5081X	80 V/15 A/360 W
SPS5082X	80 V/30 A/720 W
SPS5083X	80 V/45 A/1080 W
SPS5084X	2-channel, 80 V/15 A/360 W/CH
SPS5085X	3-channel, 80 V/15 A/360 W/CH
SPS5161X	160 V/7.5 A/360 W
SPS5162X	160 V/15 A/720 W
SPS5163X	160 V/22.5 A/1080 W
SPS5164X	2-channel, 160 V/7.5 A/360 W/CH
SPS5165X	3-channel, 160 V/7.5 A/360 W/CH

Specifications

Unless otherwise noted, all specifications are guaranteed within the temperature range of 25°C ± 5 °C with warm-up time of 30 minutes.

Model	SPS5041X	SPS5042X	SPS5043X	SPS5044X	SPS5045X	units
Output channel	1			2	3	CH
Rated output voltage	40					V
Rated output current	30	60	90	30		A
Total rated output power	360	720	1080	720	1080	W
Power Ratio	**3.33**					
C.V Mode						
Line Regulation	18 (From 90 ~ 132Vac or 170 ~ 265Vac, constant load)					mV
Load Regulation	20 (From No load to Full load, constant input voltage)					mV
Ripple and Noise (*1)	(Noise Bandwidth 20MHz; Ripple Bandwidth 1MHz)					
RIPPLE (pk to pk)	60	80	100	60		mV
RMS RIPPLE	7	11	14	7		mV
Voltage programming Accuracy	*0.1%±10					mV
Voltage programming resolution	1					mV
Voltage Readback Accuracy	*0.1%±20					mV
Voltage Readback resolution	1					mV
Temperature coefficient	100ppm/°C from rated output voltage following 30-minute warm-up.					ppm/℃
Remote compensation voltage (single wire)	0.6					V
Rise Time	10% - 90% of rated output voltage, rated resistance load					
Rated Load	50					mS
No Load	50					mS
Fall Time	90% - 10% of rated output voltage, rated resistance load					
Rated Load	50					mS
No Load	500					mS
Transient response time	1 (Time for recovery to within 0.1% + 10mV of its rated output against current of 50% ~ 100%.)					mS
C.C Mode						
Line Regulation	40	75	110	40		mA
Load Regulation	40	75	110	40		mA
Ripple and Noise						
r.m.s	72	144	216	72		mA
Current Setting Accuracy	*0.1%±30	*0.1%±60	*0.1%±100	*0.1%±30		mA
Current programming resolution	1					mA
Current Readback Accuracy	*0.1%±40	*0.1%±70	*0.1%±100	*0.1%±40		mA

Current Readback resolution	1				mA
Temperature coefficient	200ppm/°C from rated output current following 30-minute warm-up.				ppm/℃
Protection Function					
OVP					
Setting Range	4-44				V
Setting Accuracy	± (2% of rated output voltage)				
OCP	The maximum output current limit of the front output terminal is 10A.				
Setting Range	3-30	6-60	9-90	3-30	A
Setting Accuracy	± (2% of rated output current)				
OTP	Over temperature alarm and shut off output.				
Low AC Input Protection	shut off output				
OPP	The over power limit is approximately 105% of the rated output power.				
Rising/Falling Voltage Slew Rate: Only applicable if V-I Mode is set to CV Slew Rate Priority.					
	0.1~80				V/s
Rising/Falling Current Slew Rate: Only applicable if V-I Mode is set to CC Slew Rate Priority.					
	0.01~60.00	0.01~120.00	0.01~180.00	0.01~60.00	A/s
Output resistance setting					
	0~1.5	0~0.75	0~0.5	0~1.5	Ω
Efficiency					
100Vac	>77				%
200Vac	>79				%

Model	SPS5081X	SPS5082X	SPS5083X	SPS5084X	SPS5085X	units
Output channel	1			2	3	CH
Rated output voltage	80					V
Rated output current	15	30	45	15		A
Total rated output power	360	720	1080	720	1080	W
Power Ratio	**3.33**					
C.V Mode						
Line Regulation	40 (From 90 ~ 132Vac or 170 ~ 265Vac, constant load)					mV
Load Regulation	40 (From No load to Full load, constant input voltage)					mV
Ripple and Noise (*1)	(Noise Bandwidth 20MHz; Ripple Bandwidth 1MHz)					
RIPPLE (pk to pk)	60	80	100	60		mV
RMS RIPPLE	7	11	14	7		mV
Voltage programming Accuracy	*0.1%±10					mV
Voltage programming resolution	1					mV
Voltage Readback Accuracy	*0.1%±20					mV
Voltage Readback resolution	1					mV
Temperature coefficient	100ppm/°C from rated output voltage following 30-minute warm-up.					ppm/℃

Remote compensation voltage (single wire)	0.6				V
Rise Time	10% - 90% of rated output voltage, rated resistance load				
Rated Load	50				mS
No Load	50				mS
Fall Time	90% - 10% of rated output voltage, rated resistance load				
Rated Load	50				mS
No Load	500				mS
Transient response time	1 (Time for recovery to within 0.1% + 10mV of its rated output against current of 50% ~ 100%.)				mS
C.C Mode					
Line Regulation	18	32	45	18	mA
Load Regulation	18	32	45	18	mA
Ripple and Noise					
r.m.s	27	54	81	27	mA
Current Setting Accuracy	*0.1%±10	*0.1%±30	*0.1%±40	*0.1%±10	mA
Current programming resolution	1				mA
Current Readback Accuracy	*0.1%±20	*0.1%±40	*0.1%±50	*0.1%±20	mA
Current Readback resolution	1				mA
Temperature coefficient	200ppm/°C from rated output current following 30-minute warm-up.				ppm/℃
Protection Function					
OVP					
Setting Range	8-88				V
Setting Accuracy	± (2% of rated output voltage)				
OCP	The maximum output current limit of the front output terminal is 10A.				
Setting Range	1.5-16.5	3-33	4.5-49.5	1.5-16.5	A
Setting Accuracy	± (2% of rated output current)				
OTP	Over temperature alarm and shut off output.				
Low AC Input Protection	shut off output				
OPP	The over power limit is approximately 105% of the rated output power.				
Rising/Falling Voltage Slew Rate: Only applicable if V-I Mode is set to CV Slew Rate Priority.					
	0.1~160				V/s
Rising/Falling Current Slew Rate: Only applicable if V-I Mode is set to CC Slew Rate Priority.					
	0.01~30.00	0.01~60.00	0.01~90.00	0.01~30.00	A/s
Output resistance setting					
	0~6	0~3	0~2	0~6	Ω
Efficiency					
100Vac	>77				%
200Vac	>79				%

Model	SPS5161X	SPS5162X	SPS5163X	SPS5164X	SPS5165X	units
Output channel	1			2	3	CH
Rated output voltage	160					V
Rated output current	7.5	15	22.5	7.5		A
Total rated output power	360	720	1080	720	1080	W
Power Ratio	**3.33**					
C.V Mode						
Line Regulation	80 (From 90 ~ 132Vac or 170 ~ 265Vac, constant load)					mV
Load Regulation	80 (From No load to Full load, constant input voltage)					mV
Ripple and Noise (*1)	(Noise Bandwidth 20MHz; Ripple Bandwidth 1MHz)					
RIPPLE(pk to pk)	60	80	100	60		mV
RMS RIPPLE	12	15	20	12		mV
Voltage programming Accuracy	*0.1%±100					mV
Voltage programming resolution	1					mV
Voltage Readback Accuracy	*0.1%±100					mV
Voltage Readback resolution	1					mV
Temperature coefficient	100ppm/°C from rated output voltage following 30-minute warm-up.					ppm/℃
Remote compensation voltage (single wire)	0.6					V
Rise Time	10% - 90% of rated output voltage, rated resistance load					
Rated Load	100					mS
No Load	100					mS
Fall Time	90% - 10% of rated output voltage, rated resistance load					
Rated Load	100					mS
No Load	1000					mS
Transient response time	2 (Time for recovery to within 0.1% + 10mV of its rated output against current of 50% ~ 100%.)					mS
C.C Mode						
Line Regulation	12	19	26	12		mA
Load Regulation	12	19	26	12		mA
Ripple and Noise						
r.m.s	15	30	45	15		mA
Current Setting Accuracy	*0.1%±5	*0.1%±15	*0.1%±20	*0.1%±5		mA
Current programming resolution	1					mA
Current Readback Accuracy	*0.1%±5	*0.1%±15	*0.1%±20	*0.1%±5		mA
Current Readback resolution	1					mA
Temperature coefficient	200ppm/°C from rated output current following 30-minute warm-up.					ppm/℃
Protection Function						
OVP						
Setting Range	16-176					V

Setting Accuracy	± (2% of rated output voltage)				
OCP	The maximum output current limit of the front output terminal is 10A.				
Setting Range	0.75-8.25	1.5-16.5	4.5-24.75	0.75-8.25	A
Setting Accuracy	± (2% of rated output current)				
OTP	Over temperature alarm and shut off output.				
Low AC Input Protection	shut off output				
OPP	The over power limit is approximately 105% of the rated output power.				
Rising/Falling Voltage Slew Rate: Only applicable if V-I Mode is set to CV Slew Rate Priority.					
	0.1~320				V/s
Rising/Falling Current Slew Rate: Only applicable if V-I Mode is set to CC Slew Rate Priority.					
	0.01~15.00	0.01~30.00	0.01~45.00	0.01~15.00	A/s
Output resistance setting					
	0~24	0~12	0~8	0~24	Ω
Efficiency					
100Vac	>80				%
200Vac	>82				%

Prepare Information

Before doing performance verification, 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 the SPS's operation, please refer to the Quick Guide for the SPS5000X.

Power-on Inspection

Verify that the power supply is working properly by performing a power-on check. The power supply voltage of the SPS5000X series is 100 VAC to 240 VAC. Please select a suitable power cord to connect 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 (a) connect the power cord

Figure 1-1 (b) connect the power cord

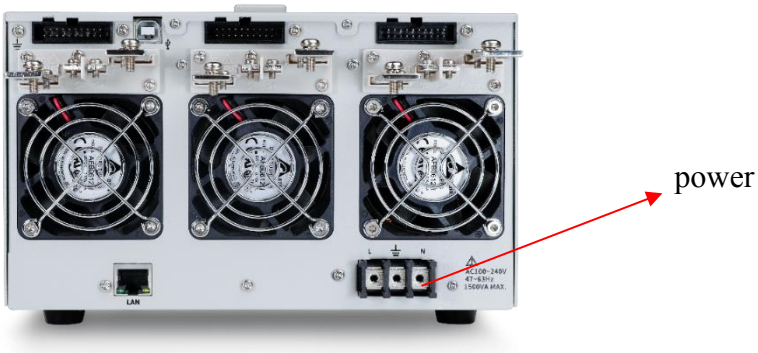


Figure 1-1 (c) connect the power cord

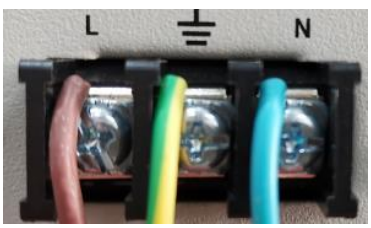
Connection methods:

1) Turn off the power switch;
2) Connect the AC input terminal to the AC power cord;

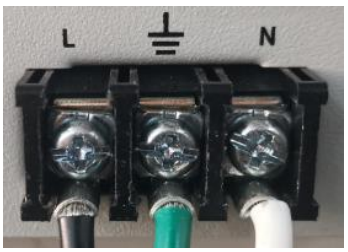
   Brown/Black: The live/hot wire, connected to port L.

   Yellow-green/Green: The ground wire is connected to the terminal with a grounding mark.

   Blue/White: The neutral/zero line, connected to port N.
3) Install the protective cover.



European standard



American Standard

Interface test

The SPS5000X 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 NI-VISA to test whether the USB Device interface is working properly.

Tools:

- One SPS5000X series power supply;
- One PC with USB interface;
- Standard USB cable (AB type);
- PC software NI-VISA;

step：

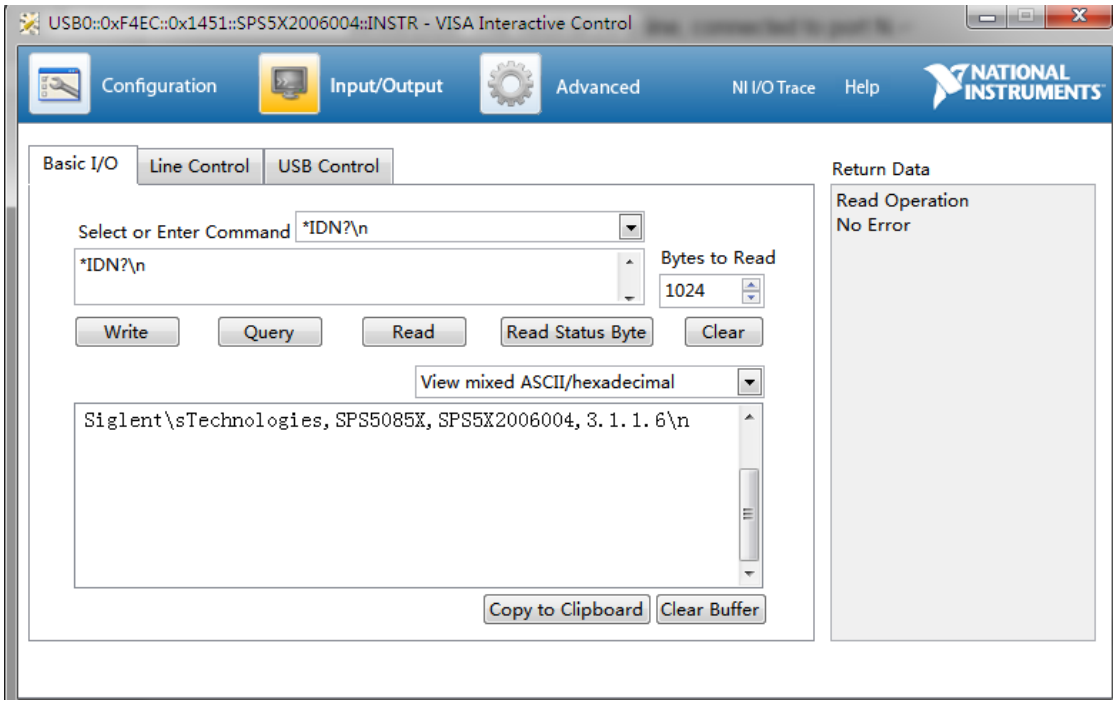
1. Install the NI-VISA on the PC.

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

Figure 1-2 USB Device interface

3. After opening the NI-VISA to identify the SPS equipment, turn on the device resource to send "*IDN?", return the device information and test the

connection successfully.



LAN test

Use Web server to test whether the LAN interface is working properly.

Tools:

- One SPS5000X series power supply
- One PC with a network cable interface
- One standard network cable
- Google Chrome downloaded on the PC

Step：

1. Install and open Google Chrome.

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

Figure 1-3 LAN interface

3. Enter the SPS IP in the browser search bar and go in (See the user manual or quick guide for IP address settings).
4. The parameter configuration of SPS can be realized in the web interface.

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	
Electronic load	Voltage and current power is greater than the power supply parameters	
Connection cable	Power supply cable	
Adjustable transformer	80V-240V voltage adjustable	
Oscilloscope		SDS3022

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

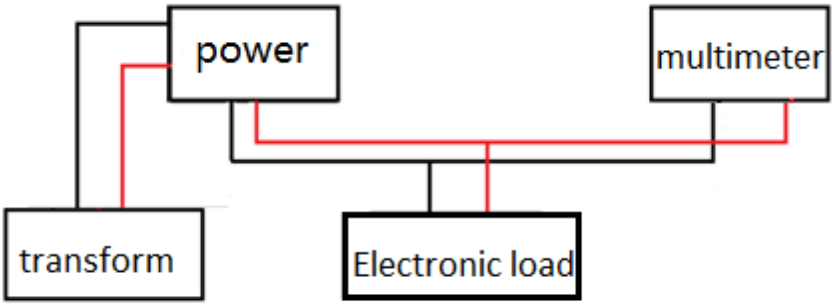


Figure 2-1 Connect the test equipment

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 voltage that the output voltage deviates from the setting voltage. This test verifies the power regulation of the power supply in constant voltage mode.

Preset conditions: room temperature

Test instrument: adjustable transformer, multimeter, electronic load

Test methods and steps:

(a) Take SPS5081X as an example : The input of the SPS5081X 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 SPS5081X 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 SPS5081X set to 5V/15A. At this time, the electronic load is set to 14.96A, and record the reading value of the multimeter.

(d) SPS5081X set to 5V/15A, 12V/15A, 24V/15A, 36V/10A, 48V/7.5A, 60V/6A, 80V/4.5A, the electronic load set 40mA below SPS5081X, and record the reading value of the multimeter in each case.

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

(f) Take the maximum value in the result to determine whether the SPS5081X has reached the predetermined specification.

Table 2-2

Model	SPS5081X							
Vo / Vin	5V	12V	24V	36V	48V	60V	80V	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 current that output current deviates from the setting current.

Preset conditions: room temperature

Test instrument: adjustable transformer, multimeter, electronic load

Test methods and steps:

(a) Take SPS5081X as an example :The input of the SPS5081X is powered by a variable transformer, turn on the power of each device, the electronic load set to constant voltage mode, the multimeter set to 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 SPS5081X set to 2A/80V, the electronic load set to 79.96V, the SPS5081X works in constant current mode after power-on, and record the reading value of the multimeter.

(c) SPS5081X set to 2A/80V, 6A/60V, 9A/40V, 12A/30V, 15A/24V, 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).

(e) Take the maximum value in the result to determine whether the SPS5081X has reached the predetermined specification.

Table 2-3

Model	SPS5081X					
Vo / Vin	2A	6A	9A	12A	15A	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 fluctuation of the output voltage at this time. It reflect the ability of the circuit to maintain a predetermined output voltage when change the load.

Preset conditions: room temperature

Test instrument: adjustable transformer, multimeter, electronic load

Test methods and steps:

(a) Take SPS5081X as an example :The input of the SPS5081X 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 SPS5081X set to 5V/15A. Turn on the output and note the reading of the multimeter when the SPS5081X is without loading.

(d)Set the current of the electronic load to 2A、6A、9A、12A、15A, 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 SPS5081X to 5V/15A, 12V/15A, 24V/15A, 40V/9A, 60V/6A, 80V/4.5A in each setting, repeat step (d) separately.

(f) Take the max-min value in the calculation result to determine whether the SPS5081X has reached the predetermined specification.

Table 2-4

Model	SPS5081X								
Io / Vo	0A	1A	3A	4.5A	6A	9A	12A	15A	regulation rate
5V									
12V									
24V									
40V									
60V									
80V									

（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 fluctuation of the output current at this time.It reflect the ability of the circuit to maintain a predetermined output current when change the load.

Preset conditions: room temperature

Test instrument: adjustable transformer, multimeter, electronic load

Test methods and steps:

(a) Take SPS5081X as an example :The input of the SPS5081X 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 SPS5081X set to 2A/80V, turn on the output, and the electronic load set to 79.5V，record the current reading value of the multimeter at this time.

(c) Set the voltage of the electronic load to 5V, 12V, 24V, 40V, 60V, 80V 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 SPS5081X 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 SPS5081X works in the constant current mode)

(d) Set the SPS5081X to 2A/80V, 6A/60V, 9A/40V, 15A/24V in each setting, repeat step (b)、（c）separately.

(f) Take the max-min value in the calculation result to determine whether the SPS5081X has reached the predetermined specification.

Table 2-5

Model	SPS5081X					
Vo / Io	5V	12V	40V	60V	80V	regulation rate
2A						
6A						
9A						
15A						

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.

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

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

Preset conditions: room temperature

Test instrument: adjustable transformer, multimeter

Test methods and steps:

(a) Take SPS5081X as an example :The input of the SPS5081X 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 SPS5081X set to 80V/0.1A. Turn on the output and note the reading of the multimeter and the voltage readback value of the power when the SPS5081X is without loading.

(d) Set the SPS5081X to 60V/0.1A, 48V/0.1A, 36V/0.1A, 24V/0.1A, 18V/0.1A, 12V/0.1A, 5V/0.1A, 1V/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 SPS5081X has reached the predetermined specification.

Table 2-6

Model	SPS5081X			
Mode	Set Volt (V)	Measured Volt (V)	Readback Volt (V)	Pass / Fail
2 wire	80V			
	60V			
	48V			
	36V			
	24V			
	18V			
	12V			
	5V			

	1V			
4 wire	80V			
	60V			
	48V			
	36V			
	24V			
	18V			
	12V			
	5V			
	1V			

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.

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

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

Preset conditions: room temperature

Test instrument: adjustable transformer, multimeter, electronic load

Test methods and steps:

(a) Take SPS5081X as an example :The input of the SPS5081X 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 DCI gear, and the multimeter pen connect to the electronic load in series.

(b) Set the SPS5081X to 0A/80V, turn on the output, and set the electronic load to 79.5V.record the reading of the multimeter and the current readback value of the power.

(c) Set the SPS5081X to 0.1A/80V，1A/80V，2A/80V，4A/80V，6A/60V, 9A/40V, 12A/30V, 15A/24V, 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 SPS5081X has reached the predetermined specification.

Table 2-7

Model	Set Curr (A)	Measured Curr (A)	Readback Curr (A)	Pass / Fail
SPS5081X	0.1A			
	1A			
	2A			
	4A			
	6A			
	9A			
	12A			
	15A			

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 switching power supply, the noise is mainly related to the switching process of the system.
Preset conditions: room temperature
Test instrument: oscilloscope, common probe (with 1:10 probe),electronic load
Test environment: 220V power supply, SPS5081X set output to 24V/15A ,full load output, electronic load set to 14.96A .
Test methods and steps:
(a). The probe is grounded in the shortest grounding manner. It is recommended to use a grounding spring well connected to the SPS5081X sense terminal.
(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.

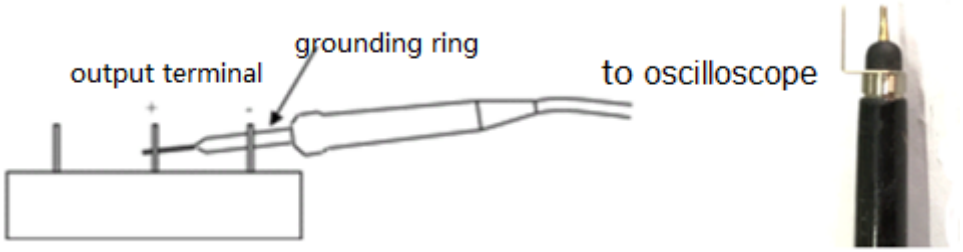


Figure2- 2 Grounding method

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 half load to full load, the output voltage is restored to within 0.1%Vset+10mV for less than 1ms.

Test instrument: oscilloscope, 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 SPS5081X 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, set level A=4.5A, level B=2.25A, set the frequency to 10Hz, set the SPS5081X to 80V/5A, and the screenshot retains the test result;

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. 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 determine 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 or Query to make the command take effect. As shown in Figure 3-2 below.

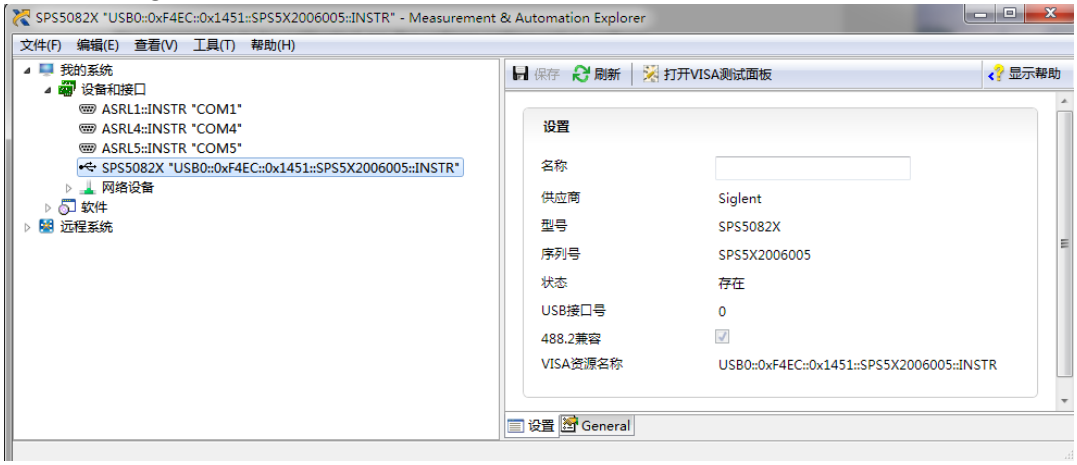


Figure 3-1

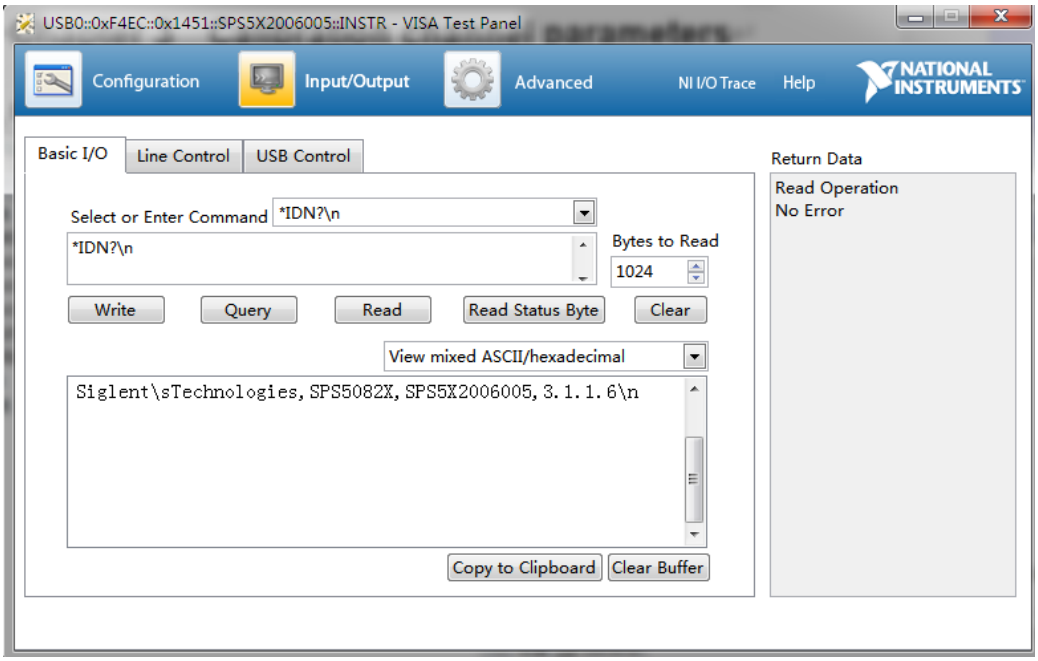


Figure 3-2

Calibration instrument: high precision multimeter, electronic load.

SCPI calibration command description

1) CALibrate:STATe <CHn>,<State>
   This command is used to set the calibration mode status.
   CHn:
   CH1 Select to calibrate channel 1
   CH2 Select to calibrate channel 2
   CH3 Select to calibrate channel 3

   State:
   1 Calibration mode is on
   0 Calibration mode is off
   E.g: CALibrate:STATe CH1,1

2) CALibrate:CLEAn <CHn>,<type>
   This command is used to clear the specified type of calibration data.
   type:
   VSET Setting voltage
   VMEAS Measuring voltage
   CSET Setting current
   CMEAS Measuring current

3) CALibrate:MEAS:<type> <CHn>,<Start>,<End>,<X1>,<Y1>,<X2>,<Y2>
   This command is used to calibrate readback voltage.

type:
CURR Current
VOLT Voltage

Start: the starting point for the calibration to take effect
End: the end point for the calibration to take effect
X1: the first SPS readback value
Y1: the first multimeter measured value
X2: the second SPS readback value
Y2: the second multimeter measured value

4) CALibrate:SET:<type> <CHn>,<Start>,<End>,<X1>,<Y1>,<X2>,<Y2>
This command is used to calibrate setting voltage.
X1: the first multimeter measured value
Y1: The first value set by SPS
X2: the second multimeter measured value
Y2: The second value set by SPS

5) CALibrate:SAVE <CHn>,<type>
This command is used to save the specified type of calibration data.
type:
VSET Setting voltage
VMEAS Measuring voltage
CSET Setting current
CMEAS Measuring current

Specific method steps:

Voltage calibration

Take SPS5081X channel 1 as an example. Calibration equipments are SPS and multimeter.

(1) Send command CALibrate:STATe CH1,1 to enter calibration mode.
(2) Send command CALibrate:CLEAn VSET to clear calibration data.
(3) Send command CALibrate:CLEAn VMEAS to clear calibration data.
(4) Set SPS current 1A, voltage Vset1 = 0.5V, turn on the output.
(5) The measured value of the multimeter is Vm1, and the value displayed by SPS is Vsps1. Record the values of Vm1 and Vsps1.
(6) Change SPS voltage to Vset2 = 35V.
(7) The measured value of the multimeter is Vm2, and the value displayed by SPS is Vsps2. Record the values of Vm2 and Vsps2.
(8) Change SPS voltage to Vset3 = 75V.

(9) The measured value of the multimeter is Vm3, and the value displayed by SPS is Vsps3. Record the values of Vm3 and Vsps3.

(10) Write the following two commands to calibrate the voltage setting value

Format: CALibrate:SET:VOLTage point1,point2,Vm1,Vset1,Vm2,Vset2

(Eg: CALibrate:SET:VOLTage 0,35,0.3227,0.5,34.636,35)

Format: CALibrate:SET:VOLTage point2,point3,Vm2,Vset2,Vm3,Vset3

(Eg: CALibrate:SET:VOLTage 35,80,34.636,35,74.428,75)

Note: if Vm2 >= point2, point2 = Vm2 + 0.1

(11) Send command CALibrate:SAVE CH1,VSET to save the calibration data.

(12) Write the following two commands to calibrate the voltage measured value

Format: CALibrate:MEAS:VOLTage point1,point2,Vsps1,Vm1,Vsps2,Vm2

(Eg: CALibrate:MEAS:VOLTage 0,35,1.531,0.3227,36.318,34.636)

Format: CALibrate:MEAS:VOLTage point2,point3,Vsps2,Vm2,Vsps3,Vm3

(Eg: CALibrate:MEAS:VOLTage 35,80,36.318,34.636,76.753,74.428)

Note: if Vm2 >= point2 or Vsps2 >= point2, if Vm2 > Vsps2, then point2 = Vm2 + 0.1, otherwise point2 = Vsps2 + 0.1

(13) Send command CALibrate:SAVE CH1,VMEAS to save the calibration data.

(14) Send command CALibrate:STATe CH1,0 to exit calibration mode.

(15) Voltage calibration completed.

The parameters corresponding to the different SPS models with the above codes are shown in the following table

Mode	Rated voltage(V)	Vset1	Vset2	Vset3	point1	point2	point3
SPS5041X	40	0.25	18	38	0	18	45
SPS5042X							
SPS5043X							
SPS5044X							
SPS5045X							
SPS5051X	50	0.3	23	46	0	23	70
SPS5081X	80	0.5	35	75	0	35	90
SPS5082X							
SPS5083X							
SPS5084X							

SPS5085X							
SPS5161X	160	1	70	180	0	70	180
SPS5162X							
SPS5163X							
SPS5164X							
SPS5165X							

Current calibration

Take SPS5081X channel 1 as an example.

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

(1) Send command CALibrate:STATe CH1,1 to enter calibration mode.

(2) Send command CALibrate:CLEAn CSET to clear calibration data.

(3) Send command CALibrate:CLEAn CMEAS to clear calibration data.

(4) Set the electronic load short-circuit mode, set the SPS voltage to 10V, set SPS current Iset1 = 0.2 A, and turn on the output.

(5) The measured value of the multimeter is Im1, and the value displayed by SPS is Isps1. Record the values of Vm1 and Vsps1.

(6) Change SPS current to Iset2 = 3A.

(7) The measured value of the multimeter is Im2, and the value displayed by SPS is Isps2. Record the values of Im2 and Isps2.

(8) Change SPS current to Iset3 = 14A.

(9) The measured value of the multimeter is Im3, and the value displayed by SPS is Isps3. Record the values of Im3 and Isps3.

(10) Write the following two commands to calibrate the current setting value

Format: CALibrate:SET:CURRent point1,point2,Im1,Iset1,Im2,Iset2

(Eg: CALibrate:SET:CURRent 0,3,0.1934,0.2,3.314,3)

Format: CALibrate:SET:CURRent point2,point3,Im2,Iset2,Im3,Iset3

(Eg: CALibrate:SET:CURRent 3,18,3.314,3,15.580,14)

Note: if Im2 >= point2, point2 = Im2 + 0.1

(11) Send command CALibrate:SAVE CH1,CSET to save the calibration data.

(12) Write the following two commands to calibrate the current measured value

Format: CALibrate:MEAS:CURRent point1,point2, Isps1,Im1,Isps2,Im2

(Eg: CALibrate:MEAS:CURRent 0,3.662,0.414,0.1934,3.562,3.314)

Format: CALibrate:MEAS:CURRent point2,point3,Im2,Iset2,Im3,Iset3

(Eg: CALibrate:MEAS:CURRent 3.662,18,3.562,3.314,15.976,15.590)

Note: if Im2 >= point2 or Isps2 >= point2, if Im2 > Isps2, then point2 = Im2 + 0.1, otherwise point2 = Isps2 + 0.1

(13) Send command CALibrate:SAVE CH1,CMEAS to save the calibration data.

(14) Send command CALibrate:STATe CH1,0 to exit calibration mode.

(15) Current calibration completed.

The parameters corresponding to the different SPS models with the above codes are shown in the following table

Mode	Rated current(A)	Iset1	Iset2	Iset3	point1	point2	point3
SPS5161X	7.5	0.1	1.5	7	0	1.5	9
SPS5164X							
SPS5165X							
SPS5051X	10	0.2	2	9	0	3	18
SPS5081X	15	0.2	3	14	0	3	18
SPS5084X							
SPS5085X							
SPS5162X							
SPS5163X	22.5	0.3	4.5	21	0	4.5	27
SPS5041X	30	0.4	6	28	0	6	36
SPS5044X							
SPS5045X							
SPS5082X							
SPS5083X	45	0.6	9	42	0	9	54
SPS5042X	60	0.8	12	56	0	12	64
SPS5043X	90	1.2	18	84	0	18	108

Chapter 4 Disassembly and assembly

This chapter mainly introduces how to disassemble and assemble the module unit of SPS5000X series power supply. Please refer to the given steps to remove or replace the corresponding power supply unit.
The following are the main contents of this chapter:

- **Safety considerations** include safety factors to be considered when performing disassembly operations
- **Module list** contains all detachable modular units of the power supply
- **Preparation tools** Contains the tools to be used during the disassembly process
- **Teardown steps** 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 electronic load, be sure to disconnect the power supply before disassembling and wait for about three minutes until the internal capacitor of the electronic load 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 electronic load on an antistatic mat and wear antistatic gloves.

Module list

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

Module serial number	Module name
1	Upper cover
2	Main control board module
3	Rear panel and fan
4	DC board and PFC board
5	Base plate PCBA
6	Front panel assembly

Preparation tools:

1. Anti-static gloves;
2. Torx socket head screwdriver
3. The screwdriver or long nose pliers.

Teardown steps:

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

4.1 Remove the upper cover

Step1 Remove 15 KM3 * 6 screws from the upper cover
Step2 Take out the upper cover upwards

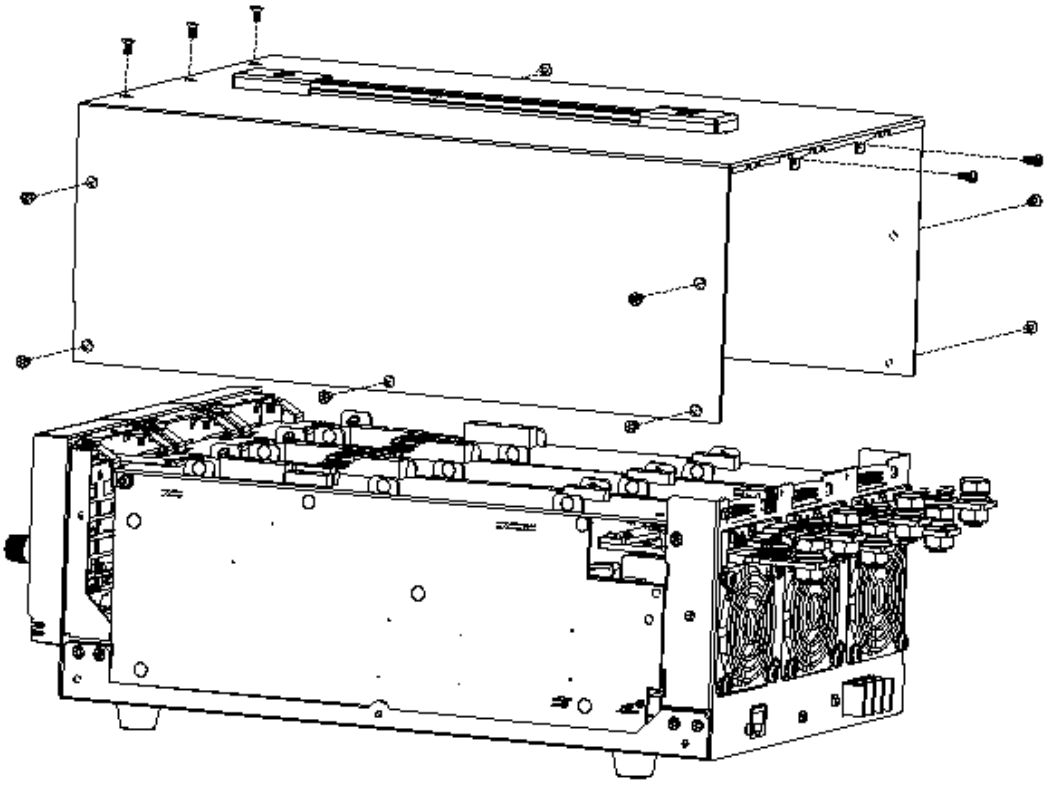


Figure 4-1

4.2 Remove the main control panel module

Step1 Pull out the cable ① ② as shown in the figure.
Step2 Remove 18 plastic nails fixing the main control panel.
Step3 Remove the 3 bolts that lock the main control panel.
Step4 Remove the main control panel vertically upward.

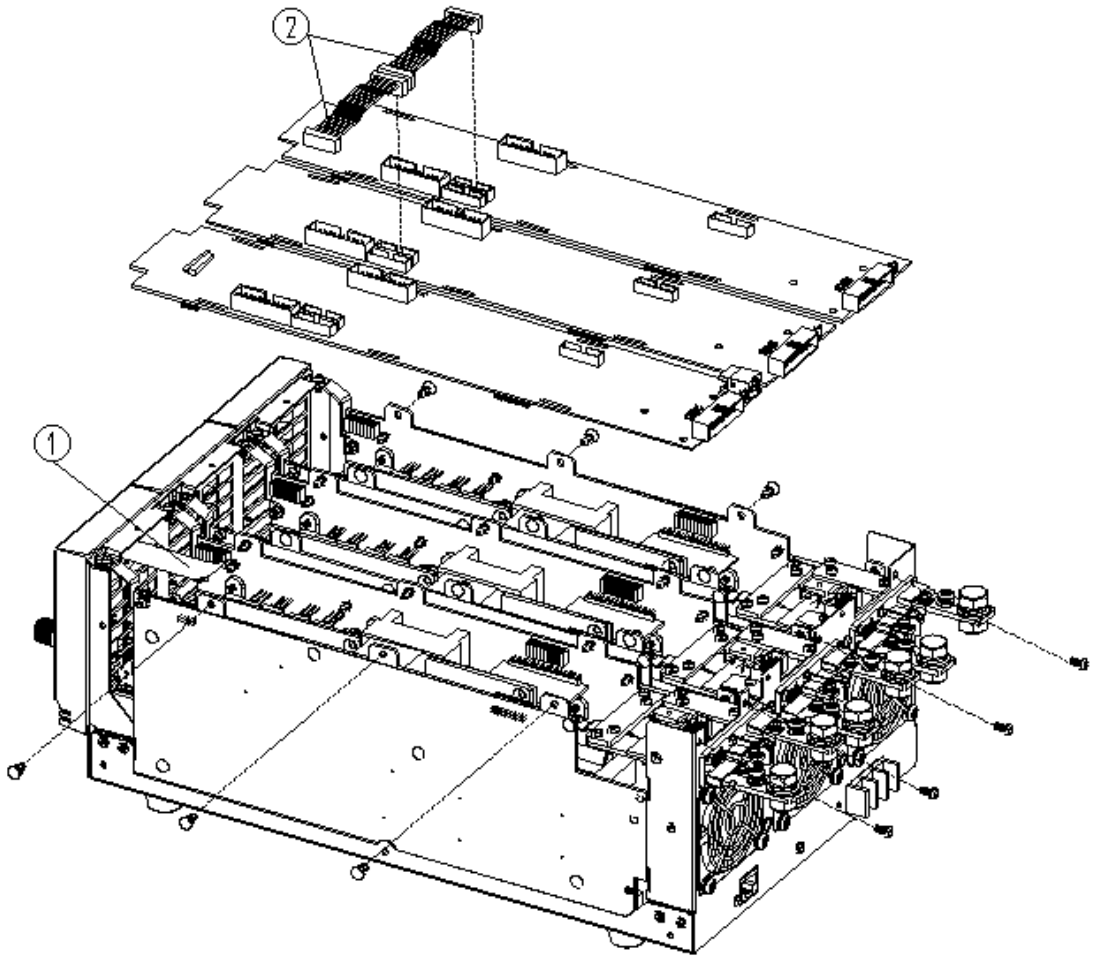


Figure 4-2

4.3 Remove the rear panel and fan

Step1 Remove 18 PM3*10 screws and 6pcs copper sheets as shown in Figure 4-3

Step2 Pull out ① ② ③ fan connecting cable

Step3 Remove four PM3 * 6 screws and four KM3 * 6 screws fixing the rear panel

Step4 Separate the rear panel assembly horizontally

Step5 Remove the fan

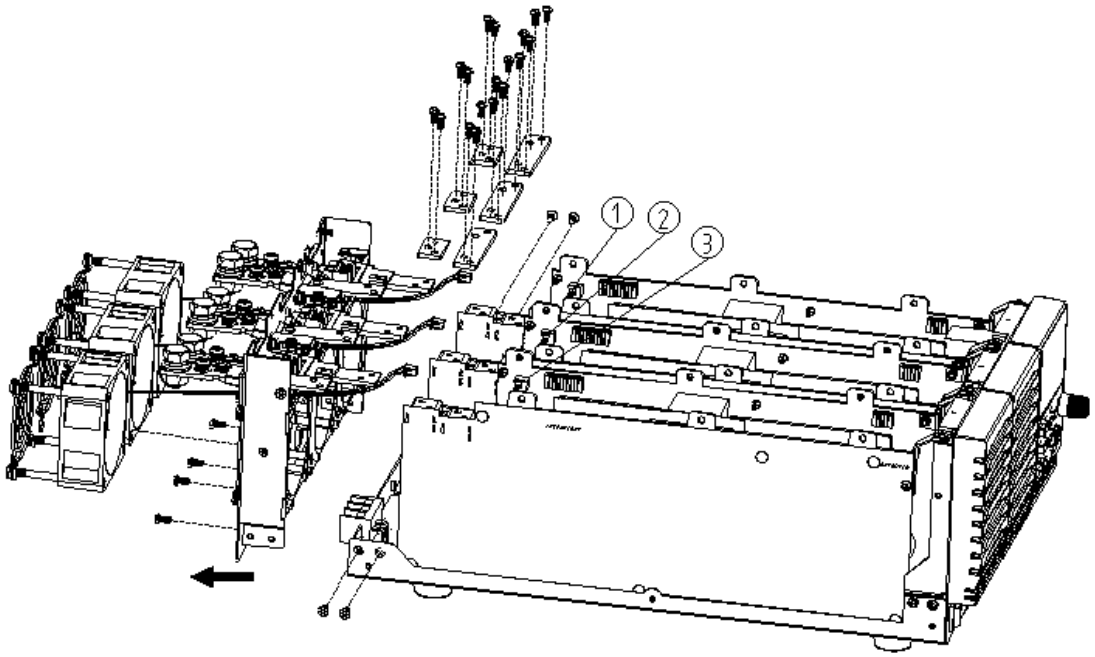


Figure 4-3

4.4 Remove the DC board and PFC board

Step1 Remove six PM3 * 6 screws
Step2 Remove the DC board module and PFC board module vertically

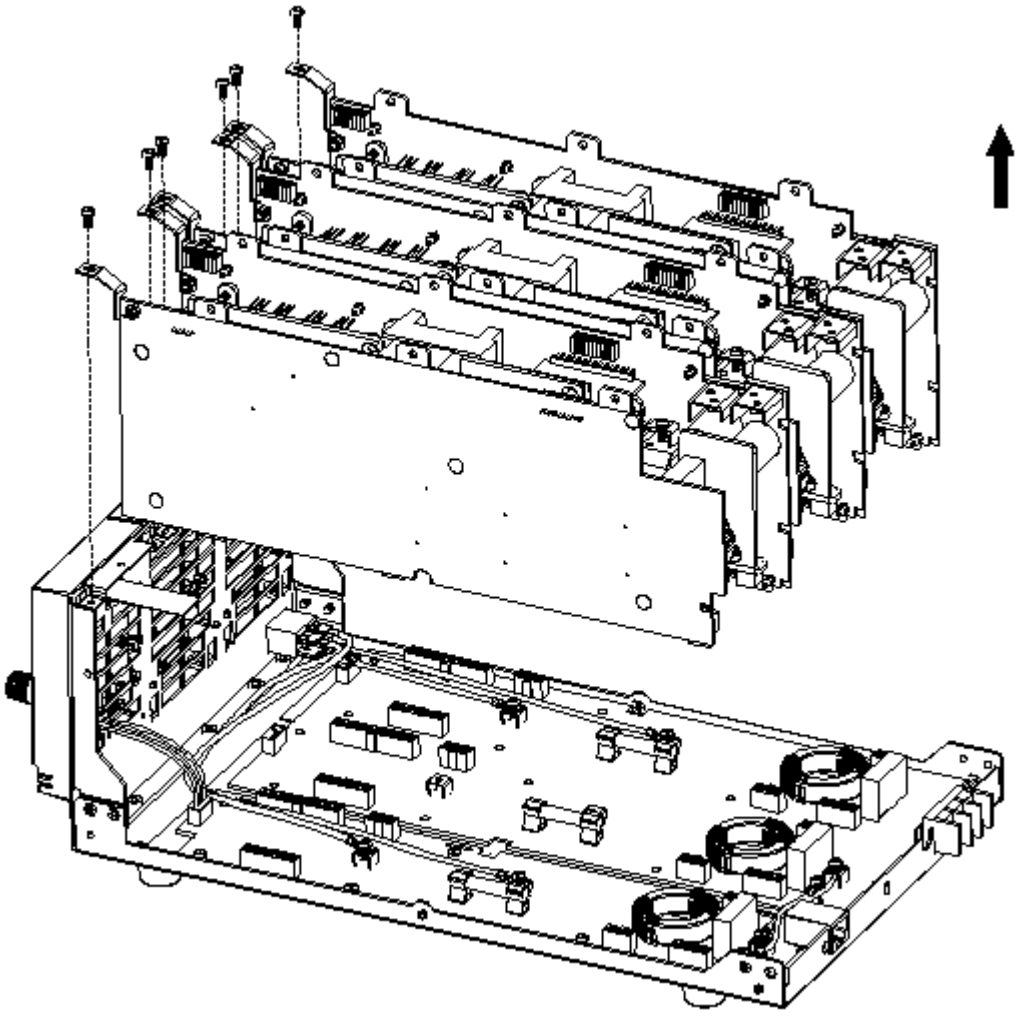


Figure 4-4

4.5 Remove the base plate PCBA

Step1 Remove ① ~ ⑦ cables as shown in the figure 4-4

Step2 Remove 21 PM3 * 6 screws from the lock bottom plate and take out the bottom plate PCB upward

Step3 Remove 7 KM3 * 6 screws fixing the bottom plate and the front panel, and separate the front panel assembly from the hardware base.

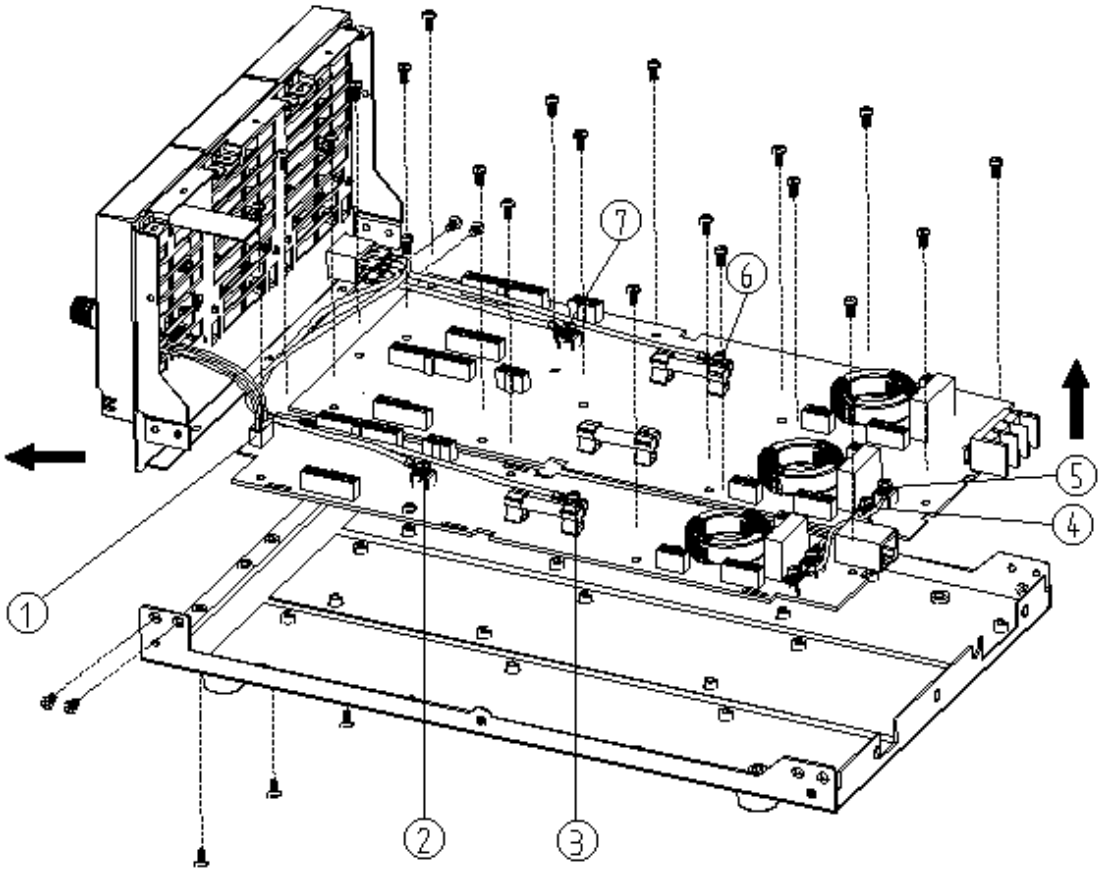


Figure 4-5

4.6 Remove the front panel assembly

Step1 Pull out the knob

Step2 Remove 4 KM3 * 6 screws and 2 PM3 * 6 screws fixing the front hardware plate

Step3 Remove the key board PCB, LCD holder, LCD, key and front shell in turn

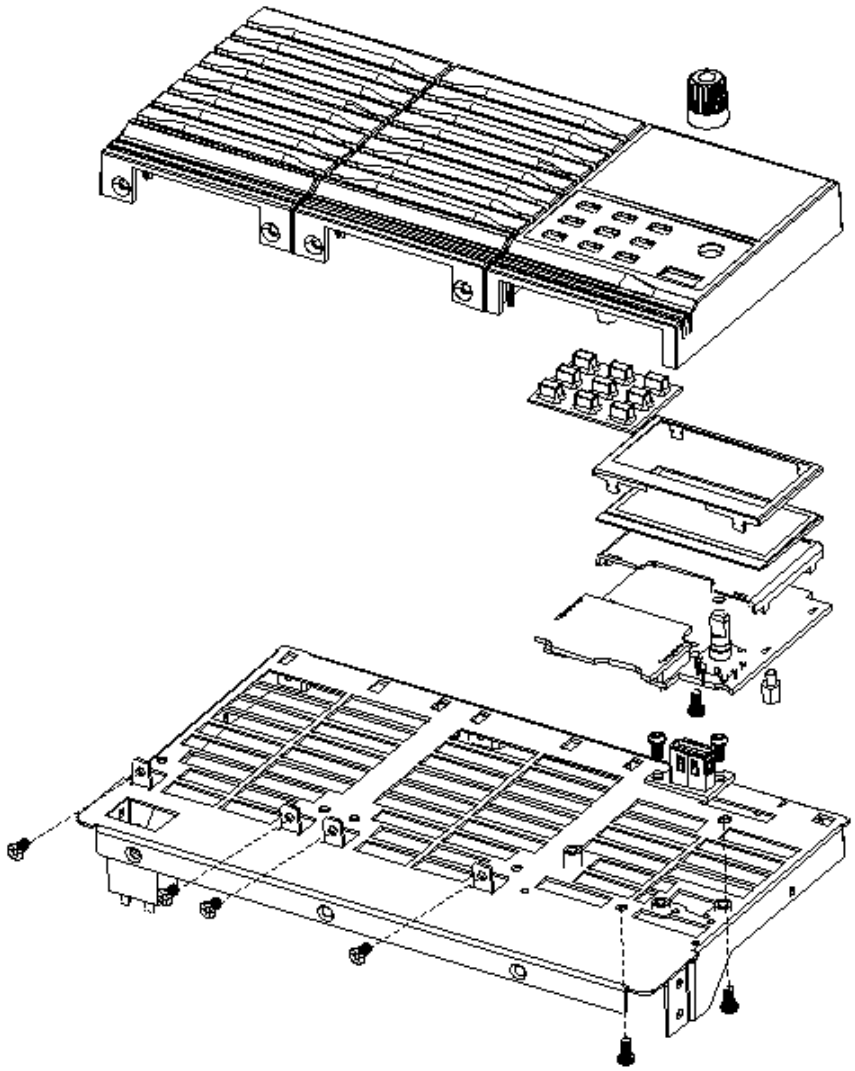


Figure 4-6

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 Precautions

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 Equipment

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

Table 5-1required equipment

equipment	specification	example
Digital Multimeter	Accuracy ±0.05%	Siglent SDM3045X

	1 mV resolution	
Oscilloscope	200MHz Bandwidth	Siglent SDS2102X

MainBoard 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.

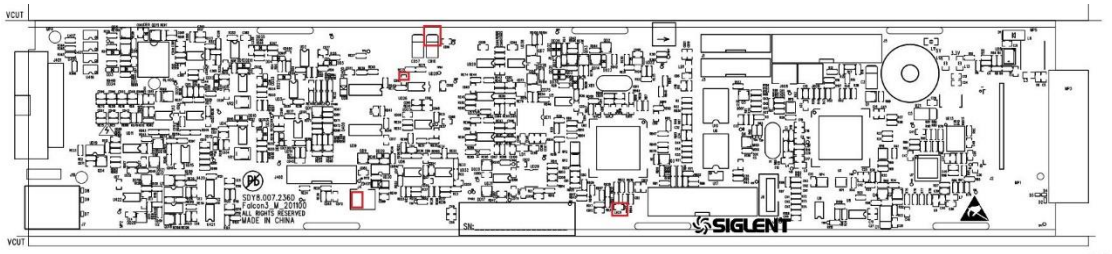


Figure 5-1 main board drawing

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.

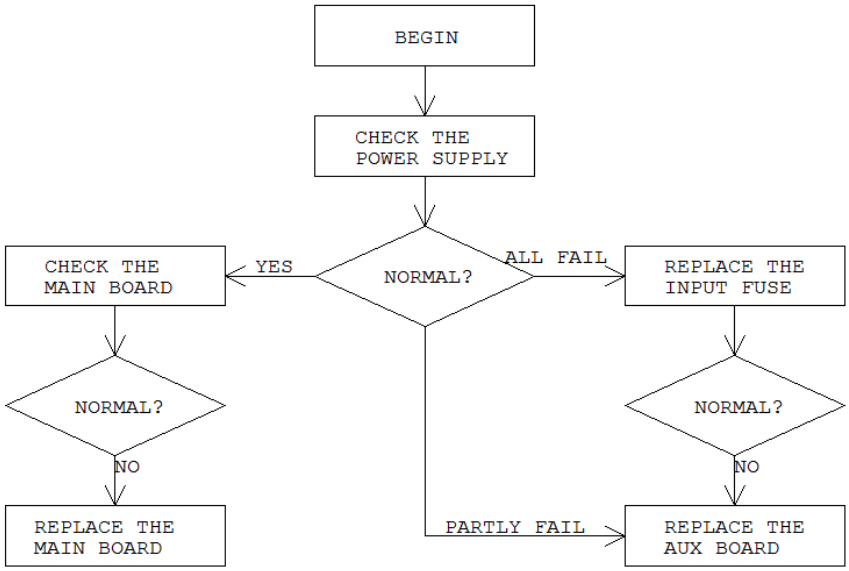


Figure 5-3 Troubleshooting flowchart

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 main board to avoid electric shock or burns. Please check the power supply as follows:

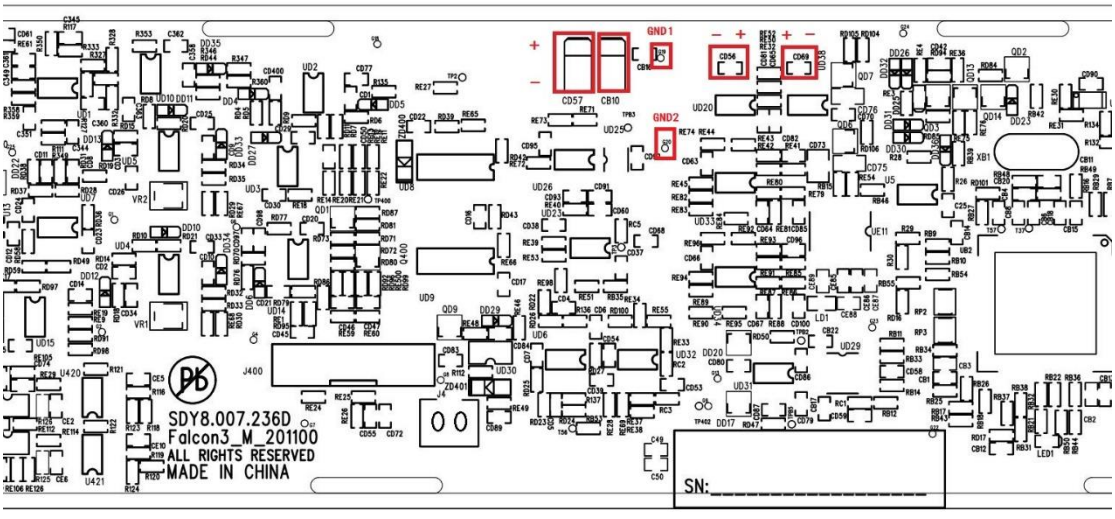


Figure 5-4 main board drawing (part 1)

In Figure 5-4 there are 4 capacitors marked with red rectangle. The power supply voltage can be measured between two terminals of these 4 capacitors, CD57, CB10, CD56, CD69. Voltage parameters are showed in Table 5-2.

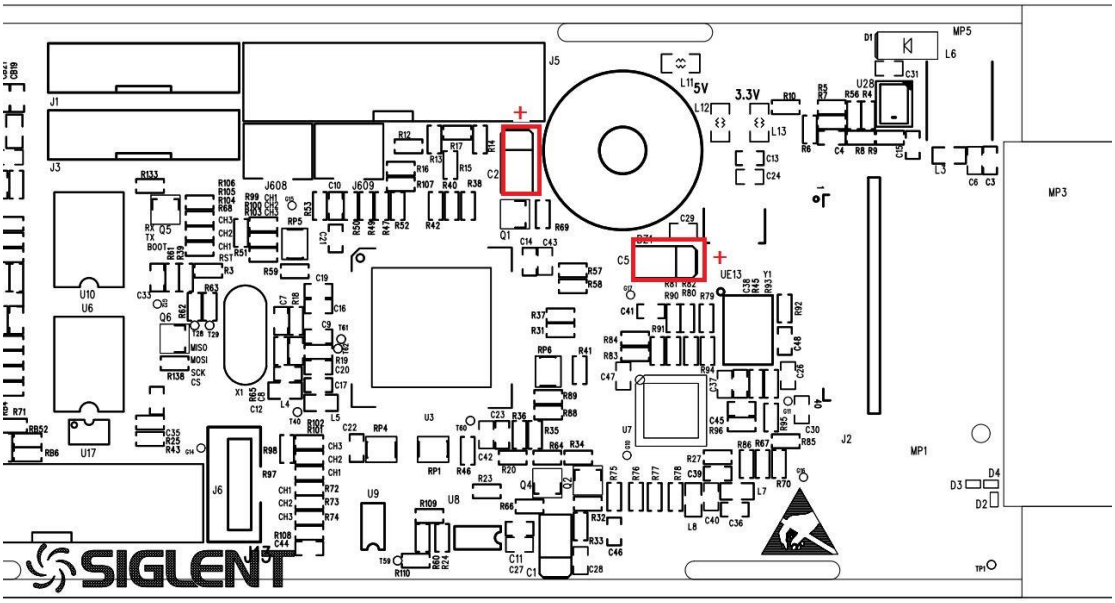


Figure 5-5 main board drawing (part 2)

In Figure 5-5 there are 2 capacitors marked with red rectangle. The power supply voltage can be measured between two terminals of these 2 capacitors, C2, C5. Voltage parameters are showed in Table 5-2.

Table 5-2: Power supply voltage parameter table

Ref Ground	Capacitor	Voltage	Error limit
GND1	CD57	5V	±5%
	CB10	3.3V	±5%
GND2	CD56	15V	±5%
	CD69	-15V	±5%
GND_EARTH	C2	5V	±5%
	C5	3.3V	±5%

CAUTION: DIFFERENT GROUND CAN NOT BE CONNECTED

If the measured voltage value is consistent with the corresponding parameter in the table, use the oscilloscope to check the waveform of the voltage. If the waveform is flat, the power supply works well.

If the measured voltage value does not match the corresponding parameter in the table, proceed to the next step. Besides, if the power supply voltages are all 0V, the fuse on the bottom board also should be checked (need disassembling).

4. Turn off the SPS5000X and wait for several minutes, then measure the resistance between the capacitors mentioned above, to exclude circuit-short on main board. If there is no circuit-short, you need to replace a new AUX board.

To ensure safety, do not disassemble the main board and the isolation slice on the side unauthorizedly.

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 burnt out. If the fuse needs to be changed, please contact SIGLENT as soon as possible and return the instrument to the factory to have it repaired by qualified personnel.
(4) Check if the power connector is properly connected to 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 if the two end of the connector between the keypad circuit board and the main board is properly connected.
(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

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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