

RIGOL

Performance Verification Manual

DP700 Series Programmable Linear DC Power Supply

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RIGOL TECHNOLOGIES, INC

Guaranty and Declaration

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General Safety Summary

Please review the following safety precautions carefully before putting the instrument into operation so as to avoid any personal injury or damage to the instrument and any product connected to it. To prevent potential hazards, please follow the instructions specified in this manual to use the instrument properly.

Use Proper Power Cord.

Only the exclusive power cord designed for the instrument and authorized for use within the local country could be used.

Ground the Instrument.

The instrument is grounded through the Protective Earth lead of the power cord. To avoid electric shock, connect the earth terminal of the power cord to the Protective Earth terminal before connecting any input or output terminals.

Connect the Probe Correctly.

If a probe is used, the probe ground lead must be connected to earth ground. Do not connect the ground lead to high voltage. Improper way of connection could result in dangerous voltages being present on the connectors, controls or other surfaces of the oscilloscope and probes, which will cause potential hazards for operators.

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 the instrument.

Use Proper Overvoltage Protection.

Ensure that no overvoltage (such as that caused by a bolt of lightning) can reach the product. Otherwise, the operator might be exposed to the danger of an electric shock.

Do Not Operate Without Covers.

Do not operate the instrument with covers or panels removed.

Do Not Insert Objects Into the Air Outlet.

Do not insert objects into the air outlet, as doing so may cause damage to the instrument.

Use Proper Fuse.

Please use the specified fuses.

Avoid Circuit or Wire Exposure.

Do not touch exposed junctions and components when the unit is powered on.

Do Not Operate With Suspected Failures.

If you suspect that any damage may occur to the instrument, have it inspected by **RIGOL** authorized personnel before further operations. Any maintenance, adjustment or replacement especially to circuits or accessories must be performed by **RIGOL** authorized personnel.

Provide Adequate Ventilation.

Inadequate ventilation may cause an increase of temperature in the instrument, which would cause damage to the instrument. So please keep the instrument well ventilated and inspect the air outlet and the fan regularly.

Do Not Operate in Wet Conditions.

To avoid short circuit inside the instrument or electric shock, never operate the instrument in a humid environment.

Do Not Operate in an Explosive Atmosphere.

To avoid personal injuries or damage to the instrument, never operate the instrument in an explosive atmosphere.

Keep Product Surfaces Clean and Dry.

To avoid dust or moisture from affecting the performance of the instrument, keep the surfaces of the instrument clean and dry.

Prevent Electrostatic Impact.

Operate the instrument in an electrostatic discharge protective environment to avoid damage induced by static discharges. Always ground both the internal and external conductors of cables to release static before making connections.

Use the Battery Properly.

Do not expose the battery (if available) to high temperature or fire. Keep it out of the reach of children. Improper change of a battery (lithium battery) may cause an explosion. Use the **RIGOL** specified battery only.

Handle with Caution.

Please handle with care during transportation to avoid damage to keys, knobs, interfaces, and other parts on the panels.

Document Overview

DP700 series programmable linear DC power supply (hereinafter referred to as "DP700 series") offers great performance. This manual gives a detailed description of the test method of performance verification for DP700 series. The test is designed to verify whether DP700 series can work normally and whether it can meet with the given specifications.

Main Topics in this Manual:

Chapter 1 Test Overview

This chapter introduces test preparations, voltage and current values, recommended test devices, test precautions, and test result records.

Chapter 2 Constant Voltage Test

This chapter introduces the test method for specifications of DP700 series that works in the constant voltage (CV) mode.

Chapter 3 Constant Current Test

This chapter introduces the test method for specifications of DP700 series that works in the constant current (CC) mode.

Appendix

The appendix provides the test result forms for all the models of DP700 series and its performance verification.

Content Conventions in this Manual:

DP700 series includes the following two models. Unless otherwise specified, this manual takes DP711 as an example to illustrate the test methods for the performance verification of DP700 series.

Model	No. of Channels	Output Voltage/Current
DP711	1	30 V/5 A
DP712	1	50 V/3 A

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Chapter 1 Test Overview

Contents in this chapter:

- Test Preparations
- Voltage and Current Value
- Recommended Test Devices
- Test Precautions
- Test Result Records

Test Preparations

Before performing the performance verification test, make the following preparations.

1. Perform the self-inspection to make sure that the instrument can work normally.

Plug the specified power cord available in the accessories into the AC power supply connector of the instrument, and then connect the instrument to the properly grounded AC power. Press the **Power** key , and then the instrument is launched and begins to perform the self-inspection. Press **System** to enter the system utility function interface. Press the Left/Right arrow key or use the knob to select the "TestCal" tab to view the self-inspection information (including the fan state). If the self-inspection fails, please turn off the instrument and then turn it on again to execute the self-inspection and view the self-inspection information. If the problem still persists, contact **RIGOL**. Ensure that you locate the problem for self-inspection failure and resolve the problem properly. You are not allowed to perform the performance verification test until the instrument passes the self-inspection test.

Note:

- Before connecting to power, make sure that the setting of the voltage selector on the rear panel of DP700 series matches the AC power supply to be connected. Ensure that the fuse currently installed matches the input voltage. The specifications for AC input voltages and their matched fuses supported by DP700 series are as shown in Table 1-1.

Table 1-1 AC Input Voltage and Fuse Rating

AC Selector	AC Input Voltage	Fuse Rating
100 Vac	100 Vac \pm 10%, 50 Hz to 60 Hz	T5 A
120 Vac	120 Vac \pm 10%, 50 Hz to 60 Hz	T5 A
220 Vac	220 Vac \pm 10%, 50 Hz to 60 Hz	T2.5 A
240 Vac	240 Vac \pm 10% (max: 253 Vac), 50 Hz to 60 Hz	T2.5 A

Note: The upper limit of the AC input voltage supported by DP700 series is 253 Vac.

- Before performing the self-inspection, make sure that no load is connected to the terminals on the front and rear panels of the power supply.
2. Make sure that the power supply is used within its calibration period (1 year). If calibration is required, please contact **RIGOL**.
 3. Warm up the instrument for at least 30 minutes.

4. Make sure that the ambient temperature is between 18°C and 28°C, and the relative humidity is less than 80%.
5. Keep the cables of the test probe as short as possible.

**CAUTION**

The tests described in this manual are required to be carried out by the professionals. During the test, dangerous voltages might be present on the output terminals of the power supply and some test devices.

Voltage and Current Value

During the test, you need to set the voltage and current of the output channel of the power supply to a specified value, respectively. The rated output values and maximum output values of the voltage and current of various models of DP700 series are listed in Table 1-2.

Table 1-2 Voltage and Current Values of DP700 Series

Model	Rated Output Voltage (V)	Max. Output Voltage (V)	Rated Output Current (A)	Max. Output Current (A)
DP711	30	32	5	5.3
DP712	50	53	3	3.2

Recommended Test Devices

You are recommended to use the devices listed in Table 1-3 or other devices whose performance specifications meet the "Performance Requirement" listed in Table 1-3.

Table 1-3 Recommended Test Devices

Device	Performance Requirement	Recommended Model	Usage
Digital Oscilloscope	Bandwidth: ≥ 20 MHz Minimum Vertical Scale: ≤ 2 mV/div Bandwidth Limit: ≤ 20 MHz	RIGOL DS1102E	Measures ripple and noise (Vpp), transient response time
Digital Multimeter	Readout Resolution: $6\frac{1}{2}$	RIGOL DM3068	Measures DC voltage
RMS Voltmeter	Sensitivity: 1 mV Bandwidth: ≥ 10 MHz	--	Measures ripple and noise (Vrms)
Electronic Load	Voltage Range: 80 Vdc Current Range: 60 Adc Maximum Power: 300 W Dynamic Frequency: 1 kHz	Chroma 63103A	Measures load regulation, line regulation, and transient response time
Resistance of Resistive Load R_L	6Ω (400 W) 16.7Ω (400 W)	--	Measures ripple and noise
Current Sampling Resistor R_M	0.022Ω (5 W, temperature drift: 10 ppm)	--	Measures CC load regulation, CC line regulation, CC programming accuracy and readback accuracy
9-Pin RS232 Cable	--	RIGOL CB-DB9-DB9-F-F-150	Measures programming accuracy and readback accuracy

Test Precautions

Figure 1-1 shows the output terminals of the power supply. The output terminal is a metal conductor with certain contact resistance Δr , so when the output current of the power supply is I , the voltage of this terminal is $V_e = \Delta r \times I$. In the test, to reduce errors caused by the terminal voltage, we generally choose A as the test point. Besides, the contact resistance between this terminal and the power output wire/the voltage feedback wire inside the instrument chassis can also cause an error of 2 mV, which is called offset (U_{offset}).

When you test the items such as load regulation, ripple and noise, and transient response time, connect the test devices to the output terminal via A and connect the load resistor to the output terminal via B.

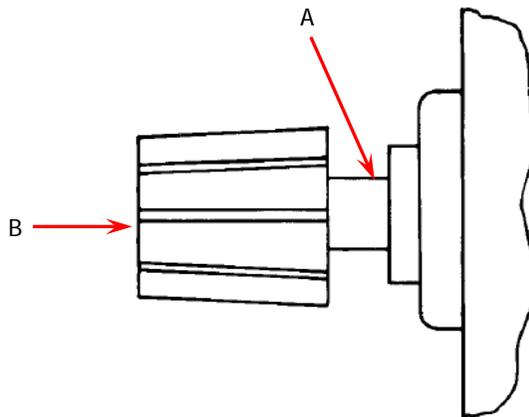


Figure 1-1 Output Terminals

During the test, please shield the space radiation noise in the test environment to avoid its impact on the test.

Test Result Records

Please record and save the test results for each test item. The "**Appendix A: Test Record Forms**" in this manual provides the test result forms for all the models of DP700 series. The form lists the test item and its corresponding performance specification limits. You can record the test results in the form.

Tip

RIGOL recommends that you should print the desired test results record form before each test. During the test, you can record the test results in the printed form to ensure that the form can be repeatedly used.

Chapter 2 Constant Voltage Test

Contents in this chapter:

- Preparations
- CV Load Regulation (CV Load Effect)
- CV Line Regulation (CV Source Effect)
- CV Ripple and Noise
- Transient Response Time
- CV Programming Accuracy and Readback Accuracy

Preparations

When the power supply works in CV mode, the main parameters to be tested include CV load regulation, CV line regulation, CV ripple and noise, transient response time, CV programming and readback accuracy.

Before performing the test, select the appropriate AC voltage via the "AC Selector" on the rear panel of the power supply according to the AC voltage standard of your country (220 Vac is taken as an example in all the tests in this manual). At room temperature (25°C), connect the recommended devices specified in "**Recommended Test Devices**" according to the connection method in Figure 2-1. During the test process, please set the AC voltage according to the selected voltage in "AC Selector" on the rear panel of the power supply.

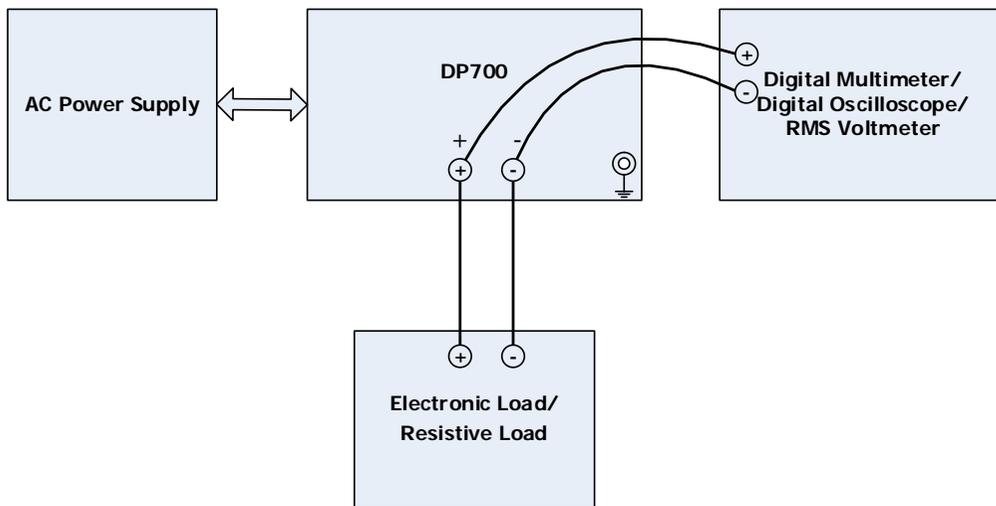


Figure 2-1 CV Test Connection

CV Load Regulation (CV Load Effect)

CV load regulation refers to the relationship between the variation of the output voltage (caused by the load effect) and the rated output voltage when the power supply is in the CV output mode.

The following section takes DP711 as an example to test the CV load regulation of DP700 series.

Note: During the test, please select the corresponding test record form according to the model of the DP700 power supply under test to set the corresponding parameters, record and calculate the corresponding specifications.

Specification:

Load Regulation, ±(% of Output + Offset)	
Voltage	<0.01% + 2 mV

Test Procedures:

1. Power off DP711. Connect DP711, AC power supply, an electronic load, and a digital multimeter according to Figure 2-1. The electronic load and the digital multimeter are connected with the channel output terminals of DP711. Please refer to "**Test Precautions**" for the connection method.
2. Turn on the AC power supply, and then set its voltage to 220 V, the frequency to 50 Hz. Then, turn on the output.

Note: The voltage setting of the AC power supply should be matched with the AC voltage selector on the rear panel of DP711.

3. Power on DP711, and then set the voltage and current of the output channel according to Table 2-1. Then press **On/Off** on the front panel of DP711 to turn on the channel output.
4. Turn on the electronic load. Adjust the current of the electronic load to 0 A or do not connect any load device (no load).
5. Turn on the digital multimeter. Select the DC voltage (DCV) measurement function and set the range to "Auto". Make sure that the power supply works in CV mode. Read the digital multimeter and record the reading (U_0) of the digital multimeter.
6. Set the electronic load to work in CC mode and adjust the current of the electronic load to the rated output current of the output channel (refer to Table 1-2). Make sure that the power supply works in CV mode. Read the digital

multimeter and record the reading (U_1) of the digital multimeter.

7. Press **On/Off** on the front panel of DP711 to turn off the channel output.
8. Calculate the voltage variation (namely the CV load effect): $|U_1 - U_0|$. Then compare it with the specified specification in Table 2-1.

Test Record Forms:

Table 2-1 Test Record Form of DP711 CV Load Regulation

Model		DP711 (30 V/5 A)
Specification		<5 mV
DP711 Setting	Voltage	30 V
	Current	5.3 A
Test Result	U_0	
	U_1	
	$ U_1 - U_0 $	

Table 2-2 Test Record Form of DP712 CV Load Regulation

Model		DP712 (50 V/3 A)
Specification		<7 mV
DP712 Setting	Voltage	50 V
	Current	3.2 A
Test Result	U_0	
	U_1	
	$ U_1 - U_0 $	

CV Line Regulation (CV Source Effect)

CV line regulation refers to the relationship between the variation of the output voltage (caused by the variation of the input power) and the rated output voltage when the power supply is in the CV output mode.

The following section takes DP711 as an example to test the CV line regulation of DP700 series.

Note: During the test, please select the corresponding test record form according to the model of the DP700 power supply under test to set the corresponding parameters, record and calculate the corresponding specifications.

Specification:

Line Regulation, \pm (% of Output + Offset)	
Voltage	<0.01% + 2 mV

Test Procedures:

1. Power off DP711. Connect DP711, AC power supply, an electronic load, and a digital multimeter according to Figure 2-1. The electronic load and the digital multimeter are connected with the channel output terminals of DP711. Please refer to "**Test Precautions**" for the connection method.

Note: Set the AC Selector on the rear panel of DP711 to 100 Vac, 120 Vac, 220 Vac, or 240 Vac, and ensure that the currently installed fuse matches the actual input voltage (refer to Table 2-3). No matter what specifications you select for the voltage, the test method is the same. Let's take 220 Vac as an example.

2. Turn on the AC power supply, and then set its voltage to 220 V, the frequency to 50 Hz. Then, turn on the output.

Note: The voltage setting of the AC power supply should be matched with the AC voltage selector on the rear panel of DP711.

3. Power on DP711, and then set the voltage and current of the output channel according to Table 2-4. Then press **On/Off** on the front panel of DP711 to turn on the channel output.
4. Turn on the electronic load. Set the electronic load to work in CC mode and adjust the current of the electronic load to the rated output current of the output channel (refer to Table 1-2).
5. Turn on the digital multimeter. Select the DC voltage (DCV) measurement function and set the range to "Auto". Make sure that the power supply works in

CV mode. Read the digital multimeter and record the reading (U_0) of the digital multimeter.

6. Adjust the AC power supply to the undervoltage state (namely reducing the amplitude by 10%, refer to Table 2-3), Read the digital multimeter and record the reading (U_1) of the digital multimeter. Adjust the AC power supply to the overvoltage state (namely increasing the amplitude by 10%, refer to Table 2-3), read the digital multimeter and record the reading (U_2) of the digital multimeter.
7. Press **On/Off** on the front panel of DP711 to turn off the channel output.
8. Calculate the voltage variation (namely the CV source effect): $|U_1 - U_0|$ and $|U_2 - U_0|$. Then compare it with the specified specification in Table 2-4.

Table 2-3 AC Power Supply Parameter Setting Form

DP711/DP712				
AC Selector (Vac)	100	120	220	240
Fuse (A)	T5		T2.5	
Undervoltage (Vac)	90	108	198	216
Overvoltage (Vac)	110	132	242	264

Test Record Forms:

Table 2-4 Test Record Form of DP711 CV Line Regulation

Model		DP711 (30 V/5 A)
Specification		< 5 mV
DP711 Setting	Voltage	30 V
	Current	5.3 A
Test Result	U_0	
	U_1	
	U_2	
	$ U_1 - U_0 $	
	$ U_2 - U_0 $	

Table 2-5 Test Record Form of DP712 CV Line Regulation

Model		DP712 (50 V/3 A)
Specification		<7 mV
DP712 Setting	Voltage	50 V
	Current	3.2 A
Test Result	U_0	
	U_1	
	U_2	
	$ U_1 - U_0 $	
	$ U_2 - U_0 $	

CV Ripple and Noise

When the power supply is working in CV mode, the combination of the periodic and random deviations (PARD) during outputting DC voltage indicates superimposing a residual AC voltage on the DC output voltage. This residual AC voltage, namely the ripple and noise (usually, ripple is a periodic offset, whereas noise is a random offset), can be expressed in RMS or peak-peak value.

The following section takes DP711 as an example to test the CV ripple and noise of DP700 series.

Note: During the test, please select the corresponding test record form according to the model of the DP700 power supply under test to set the corresponding parameters, record and calculate the corresponding specifications.

Specification:

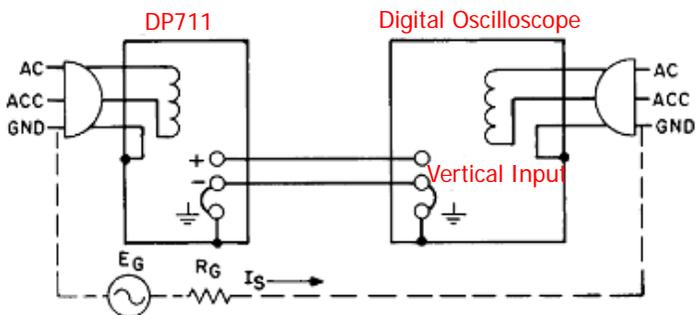
Ripple and Noise (20 Hz to 20 MHz)	
Normal Mode Voltage	DP711: <math><500 \mu\text{Vrms}/3 \text{ mVpp}</math>
	DP712: <math><500 \mu\text{Vrms}/4 \text{ mVpp}</math>

Test Procedures:

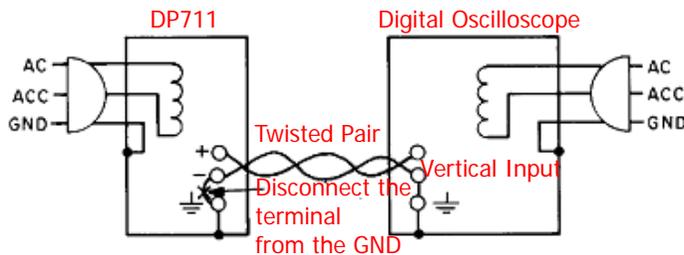
1. Power off DP711. Connect DP711, AC power supply, a resistive load, and a digital multimeter according to Figure 2-1. The resistive load and the digital multimeter are connected with the channel output terminals of DP711. Please refer to "Test Precautions" for the connection method.

Note:

- Do not connect the negative terminal of the channel output terminal of the power supply to the shielding ground; otherwise, it may result in a ground loop. In Figure 2-2, the connection in Figure A will result in a ground loop. Figure B shows the correct connection.



A. Incorrect Connection



B. Correct Connection

Figure 2-2 Peak-Peak Value Measurement Connection

- To avoid the impact of the electronic load noise on the noise measurement of the power supply, please use the resistive load instead of the electronic load. For the resistance of the resistive load, please refer to Table 2-6.
 - Connect the positive terminal of the oscilloscope probe to that of the channel output terminal. Connect the ground terminal of the oscilloscope probe to the negative terminal (-) of the channel output terminal. During the test, please ensure that they are properly connected and keep good contact. Note that **RIGOL** recommends you to use the ground spring as the ground wire to minimize the current coupling area between the probe tip and the ground wire, so that the space radiation interference will be minimized.
2. Turn on the AC power supply, and then set its voltage to 220 V, the frequency to 50 Hz. Then, turn on the output.

Note: The voltage setting of the AC power supply should be matched with the AC voltage selector on the rear panel of DP711.
 3. Power on DP711, and then set the voltage and current of the output channel according to Table 2-6. Then press **On/Off** on the front panel of DP711 to turn on the channel output.
 4. Power on the digital oscilloscope and set the following parameters: time base (5 ms/div), vertical scale (2 mV/div), sampling mode (peak detect), coupling mode (AC), trigger source (AC line), input impedance (1 MΩ). Enable the 20 MHz bandwidth limit and then enable the peak-peak value measurement function. Make sure that the power supply is in CV mode. Read and record the peak-peak value (V_{pp}) measured by the oscilloscope and compare it with the specified specification in Table 2-6.
 5. Power off the oscilloscope and disconnect it from DP711. Connect DP711, AC

power supply, the resistive load, and RMS voltmeter according to Figure 2-1.

- Turn on the RMS voltmeter and select the AC voltage random measurement mode (SETACV RNDM). Make sure that the power supply is in CV mode. Read and record the RMS value (V_{rms}) measured by the RMS voltmeter and compare it with the specified specification in Table 2-6.

Note: The measurement wires of the RMS voltmeter should be twisted together to minimize the impact of the space radiation noise on the test.

- Press **On/Off** on the front panel of DP711 to turn off the channel output.



CAUTION

During the CV ripple and noise test, please shield the space radiation noise in the test environment to avoid its impact on the test.

Test Record Forms:

Table 2-6 Test Record Form of DP711 CV Ripple and Noise

Model		DP711 (30 V/5 A)
Specification		<500 μV_{rms} /3 mVpp
Resistance of Resistive Load R_L		6 Ω
DP711 Setting	Voltage	30 V
	Current	5.3 A
Test Result	Peak-Peak value (Vpp)	
	RMS value (V_{rms})	

Table 2-7 Test Record Form of DP712 CV Ripple and Noise

Model		DP712 (50 V/3 A)
Specification		<500 μV_{rms} /4 mVpp
Resistance of Resistive Load R_L		16.7 Ω
DP712 Setting	Voltage	50 V
	Current	3.2 A
Test Result	Peak-Peak value (Vpp)	
	RMS value (V_{rms})	

Transient Response Time

Transient response time refers to the time required for the output voltage of the power supply to recover to within 15 mV following a transient variation in the load current (50% transient variation, namely the output current changes from full load to half load or from half load to full load). As shown in Figure 2-3, "t" indicates the transient response time.

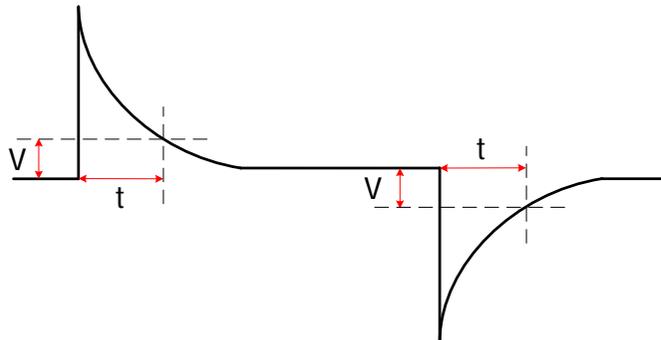


Figure 2-3 Transient Response Time

The following section takes DP711 as an example to test the transient response time of DP700 series.

Note: During the test, please select the corresponding test record form according to the model of the DP700 power supply under test to set the corresponding parameters, record and calculate the corresponding specifications.

Specification:

Transient Response Time
Less than 50 μ s for the output voltage to recover to within 15 mV following a change in output current from full load to half load or from half load to full load.

Test Procedures:

1. Power off DP711. Connect DP711, AC power supply, an electronic load, and a digital oscilloscope according to Figure 2-1. The electronic load and the digital multimeter are connected with the channel output terminals of DP711. Please refer to "**Test Precautions**" for the connection method.
2. Turn on the AC power supply, and then set its voltage to 220 V, the frequency to 50 Hz. Then, turn on the output.

Note: The voltage setting of the AC power supply should be matched with the AC voltage selector on the rear panel of DP711.

3. Power on DP711, and then set the voltage and current of the output channel

according to Table 2-8. Then press **On/Off** on the front panel of DP711 to turn on the channel output.

- Turn on the electronic load and set the following parameters: CCDH (CC dynamic response mode), CCDH1 (rated current value of the output channel; for the CCDH1 value, refer to Table 2-8), CCDH2 (current value of the output channel with half load; for the CCDH2 value, refer to Table 2-8), CCDHT1 and CCDHT2 (500 μs , namely 1 kHz frequency and 50% duty cycle), rising edge time (250 $\text{mA}/\mu\text{s}$), and falling edge time (250 $\text{mA}/\mu\text{s}$). Turn on the electronic load and make sure that the power supply works in CV mode.
- Power on the digital oscilloscope and set the following parameters: coupling mode (AC), trigger source (AC line), 20 MHz bandwidth limit (On). Enable the cursor measurement function and measure the transient response time (namely ΔX) displayed on the screen of the oscilloscope, as shown in Table 2-4, and compare it with the specified specification in Table 2-8.

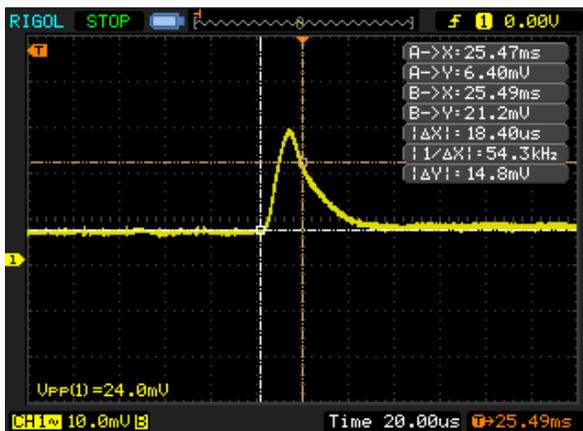


Figure 2-4 Measuring Transient Response Time with the Digital Oscilloscope

- Press **On/Off** on the front panel of DP711 to turn off the channel output.

Test Record Forms:

Table 2-8 Test Record Form of DP711 Transient Response Time

Model		DP711 (30 V/5 A)
Specification		<50 μ s
DP711 Setting	Voltage	30 V
	Current	5.3 A
Current Setting Value of the Electronic Load	CCDH1	5 A
	CCDH2	2.5 A
Test Result	t	

Table 2-9 Test Record Form of DP712 Transient Response Time

Model		DP712 (50 V/3 A)
Specification		<50 μ s
DP712 Setting	Voltage	50 V
	Current	3.2 A
Current Setting Value of the Electronic Load	CCDH1	3 A
	CCDH2	1.5 A
Test Result	t	

CV Programming Accuracy and Readback Accuracy

CV programming accuracy refers to the error between the voltage setting of the channel and the actual output voltage value when the power supply is in CV mode; CV readback accuracy refers to the error between the readback voltage value and the actual output voltage value when the power supply is in CV mode.

The following section takes DP711 as an example to test the CV programming accuracy and readback accuracy of DP700 series.

Note: During the test, please select the corresponding test record form according to the model of the DP700 power supply under test to set the corresponding parameters, record and calculate the corresponding specifications.

Specification:

Annual Accuracy ^[1] (25°C ± 5°C), ±(% of Output + Offset)	
Programming	0.05% + 20 mV
Readback	0.05% + 20 mV

Note^[1]: The accuracy specifications are acquired through calibration under 25°C after 1-hour warm-up.

Test Procedures:

1. Power off DP711. Connect DP711, AC power supply, and a digital multimeter according to Figure 2-1. The digital multimeter are connected with the channel output terminals of DP711. Please refer to "**Test Precautions**" for the connection method. Then, use the 9-pin RS232 cable (female-to-female, straight-through type) to connect DP711 with PC via the RS232 interface on the rear panel of DP711.
2. Turn on the AC power supply, and then set its voltage to 220 V, the frequency to 50 Hz. Then, turn on the output.

Note: The voltage setting of the AC power supply should be matched with the AC voltage selector on the rear panel of DP711.

3. Measure the CV programming accuracy and readback accuracy when the voltage setting value is 0 V.
 - 1) Power on DP711. Send the following commands via the remote interface to set the voltage and current of the output channel (refer to Table 2-10), and then enable the channel output.

```
:APPL CH1,0,5.3 /*Sets the voltage and current of the output channel  
to 0 V and 5.3 A respectively*/  
:OUTP CH1,ON /*Enable the channel output*/
```

Note: You can send the `:INST:NSEL 1` (or `:INST CH1`) command to select CH1 as the current channel, then send the `:SOUR1:VOLT 0` command to set the voltage of the output channel to 0 V, and send the `:SOUR1:CURR 5.3` command to set the current of output channel to 5.3 A.

- 2) Turn on the digital multimeter. Select the DC voltage (DCV) measurement function and set the range to "Auto". Make sure that the power supply works in CV mode. Read the digital multimeter and record the reading (U_1) of the digital multimeter.
 - 3) Send the `:MEAS:VOLT? CH1` command via the remote interface, read and record the returned voltage value (U_2) of the query command.
 - 4) Calculate the CV programming accuracy ($|U_1 - 0|$) and the CV readback accuracy ($|U_2 - U_1|$). Compare them with the specified specifications in Table 2-10.
4. Measure the CV programming accuracy and readback accuracy when the voltage setting value is the rated output value.
- 1) Send the following commands via the remote interface to set the voltage and current of the output channel (refer to Table 2-10).

```
:APPL CH1,30,5.3 /*Sets the voltage and current of the output  
channel to 30 V and 5.3 A respectively*/
```

Note: You can send the `:INST:NSEL 1` (or `:INST CH1`) command to select CH1 as the current channel, then send the `:SOUR1:VOLT 30` command to set the voltage of output channel to 30 V, and send the `:SOUR1:CURR 5.3` command to set the current of output channel to 5.3 A.

- 2) Make sure that the power supply works in CV mode. Read the digital multimeter and record the reading (U_3) of the digital multimeter.
- 3) Send the `:MEAS:VOLT? CH1` command via the remote interface, read and record the returned voltage value (U_4) of the query command.
- 4) Calculate the CV programming accuracy ($|U_3 - U_R|$) and the CV readback accuracy ($|U_4 - U_3|$). Compare them with the specified specifications in Table 2-10. Wherein, U_R is the rated output voltage of the output channel.

- Send the following command via the remote interface to disable the channel output.

```
:OUTP CH1,OFF /*Disables the channel output*/
```

Test Record Forms:

Table 2-10 Test Record Form of DP711 CV Programming Accuracy and Readback Accuracy

Model		DP711 (30 V/5 A)
Specification	Programming Accuracy	<35 mV
	Readback Accuracy	<35 mV
The output voltage is 0 V.		
DP711 Setting	Voltage	0 V
	Current	5.3 A
Test Result	U_1	
	U_2	
	Programming Accuracy: $ U_1 - 0 $	
	Readback Accuracy: $ U_2 - U_1 $	
The output voltage is $U_R^{[1]}$.		
DP711 Setting	Voltage	30 V
	Current	5.3 A
Test Result	U_3	
	U_4	
	Programming Accuracy: $ U_3 - U_R^{[1]} $	
	Readback Accuracy: $ U_4 - U_3 $	

Note^[1]: The rated voltage value.

Table 2-11 Test Record Form of DP712 CV Programming Accuracy and Readback Accuracy

Model		DP712 (50 V/3 A)
Specification	Programming Accuracy	<45 mV
	Readback Accuracy	<45 mV
The output voltage is 0 V.		
DP712 Setting	Voltage	0 V
	Current	3.2 A
Test Result	U_1	
	U_2	
	Programming Accuracy: $ U_1 - 0 $	
	Readback Accuracy: $ U_2 - U_1 $	
The output voltage is $U_R^{[1]}$.		
DP712 Setting	Voltage	50 V
	Current	3.2 A
Test Result	U_3	
	U_4	
	Programming Accuracy: $ U_3 - U_R^{[1]} $	
	Readback Accuracy: $ U_4 - U_3 $	

Note^[1]: The rated voltage value.

Chapter 3 Constant Current Test

Contents in this chapter:

- Preparations
- CC Load Regulation (CC Load Effect)
- CC Line Regulation (CC Source Effect)
- CC Ripple and Noise (Normal Mode)
- CC Programming Accuracy and Readback Accuracy

Preparations

When the power supply works in the CC mode, the main parameters to be tested include CC load regulation, CC line regulation, CC ripple and noise, CC programming accuracy and readback accuracy.

Before performing the test, select the appropriate AC voltage via the "AC Selector" on the rear panel of the power supply according to the AC voltage standard of your country (220 Vac is taken as an example in all the tests in this manual). At room temperature (25°C), connect the recommended devices specified in "Recommended Test Devices" according to Figure 3-1 (For the CC ripple and noise test, connect the required devices according to Figure 2-1). During the test process, please set the AC voltage according to the selected voltage in "AC Selector" on the rear panel of the power supply.

In the CC tests (excluding CC ripple and noise test), a current sampling resistor should be serially connected between the power supply under test and the electronic load to convert the current signal under test to the voltage signal for the measurement of related parameters.

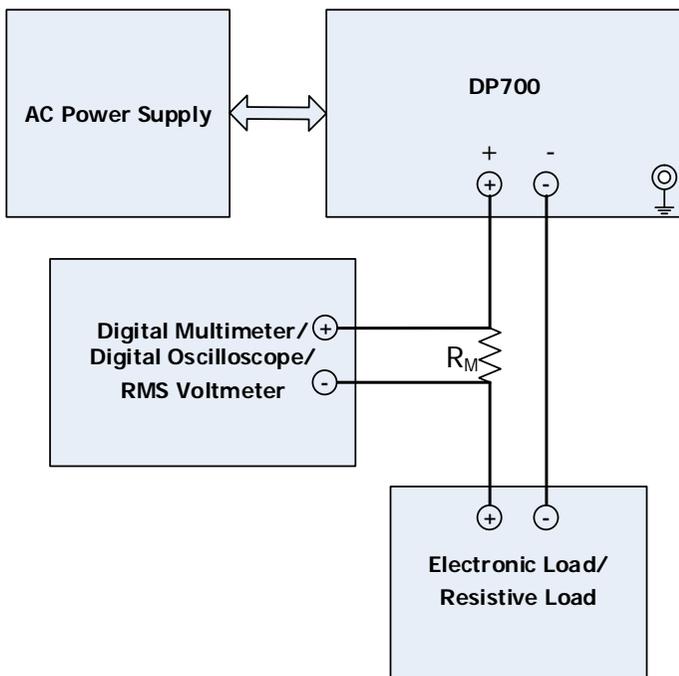


Figure 3-1 CC Test Connection

Note: The R_M in Figure 3-1 is a 4-wire current sampling resistor (please select a current sampling resistor with a proper resistance according to the test item and the output channel), as shown in Figure 3-2. C indicates the current measurement

terminal and S indicates the voltage measurement terminal. During the test, please make the correct connections.

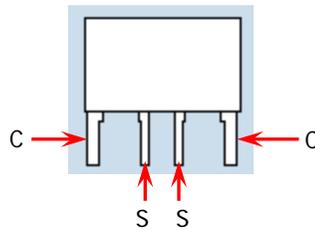


Figure 3-2 Current Sampling Resistor

CC Load Regulation (CC Load Effect)

CC load regulation refers to the relationship between the variation of the output current (caused by the load effect) and the rated output current when the power supply is in the CC output mode.

The following section takes DP711 as an example to test the CC load regulation of DP700 series.

Note: During the test, please select the corresponding test record form according to the model of the DP700 power supply under test to set the corresponding parameters, record and calculate the corresponding specifications.

Specification:

Load Regulation, \pm (% of Output + Offset)	
Current	<0.01% + 2 mA

Test Procedures:

1. Power off DP711. Connect DP711, AC power supply, a current sampling resistor (the resistance R_M is 0.022Ω), an electronic load, and a digital multimeter according to Figure 3-1. Please pay attention to the connection method for the current sampling resistor, the electronic load, and the channel output terminals of DP711; as well as the connection method for the current sampling resistor and the digital multimeter.
2. Turn on the AC power supply, and then set its voltage to 220 V, the frequency to 50 Hz. Then, turn on the output.

Note: The voltage setting of the AC power supply should be matched with the AC voltage selector on the rear panel of DP711.

3. Power on DP711, and then set the voltage and current of the output channel according to Table 3-1. Then press **On/Off** on the front panel of DP711 to turn on the channel output.
4. Turn on the electronic load. Set the electronic load to short circuit mode. At this time, the output channel of the power supply works in CC mode.
5. Turn on the digital multimeter. Select the DC voltage (DCV) measurement function and set the range to "Auto". Make sure that the power supply works in CC mode. Read the digital multimeter and record the reading (U_0 , namely the voltage of the current sampling resistor) of the digital multimeter.
6. Set the electronic load to work in CV mode and adjust the voltage of the electronic load to the rated output voltage of the output channel (refer to Table

1-2). At this time, the output channel of the power supply is in CC mode and close to full load output. Read the digital multimeter and record the reading (U_1) of the digital multimeter.

7. Press **On/Off** on the front panel of DP711 to turn off the channel output.
8. Calculate the current variation: $|U_1/R_M - U_0/R_M|$. Then compare it with the specified specification in Table 3-1.

Test Record Forms:

Table 3-1 Test Record Form of DP711 CC Load Regulation

Model		DP711 (30 V/5 A)
Specification		<2.5 mA
DP711 Setting	Voltage	32 V
	Current	5 A
Test Result	U_0	
	U_1	
	$ U_1/R_M^{[1]} - U_0/R_M^{[1]} $	

Note^[1]: $R_M = 0.022 \Omega$.

Table 3-2 Test Record Form of DP712 CC Load Regulation

Model		DP712 (50 V/3 A)
Specification		<2.3 mA
DP712 Setting	Voltage	53 V
	Current	3 A
Test Result	U_0	
	U_1	
	$ U_1/R_M^{[1]} - U_0/R_M^{[1]} $	

Note^[1]: $R_M = 0.022 \Omega$.

CC Line Regulation (CC Source Effect)

CC line regulation refers to the relationship between the variation of the output current (caused by the variation of the input power) and the rated output current when the power supply is in the CC output mode.

The following section takes DP711 as an example to test the CC line regulation of DP700 series.

Note: During the test, please select the corresponding test record form according to the model of the DP700 power supply under test to set the corresponding parameters, record and calculate the corresponding specifications.

Specification:

Line Regulation, ±(% of Output + Offset)	
Current	<0.01% + 2 mA

Test Procedures:

1. Power off DP711. Connect DP711, AC power supply, a current sampling resistor (the resistance R_M is 0.022 Ω), an electronic load, and a digital multimeter according to Figure 3-1. Please pay attention to the connection method for the current sampling resistor, the electronic load, and the channel output terminals of DP711; as well as the connection method for the current sampling resistor and the digital multimeter.

Note: Set the AC Selector on the rear panel of DP711 to 100 Vac, 120 Vac, 220 Vac, or 240 Vac, and ensure that the currently installed fuse matches the actual input voltage (refer to Table 2-3). No matter what specifications you select for the voltage, the test method is the same. Let's take 220 Vac as an example.

2. Turn on the AC power supply, and then set its voltage to 220 V, the frequency to 50 Hz. Then, turn on the output.

Note: The voltage setting of the AC power supply should be matched with the AC voltage selector on the rear panel of DP711.

3. Power on DP711, and then set the voltage and current of the output channel according to Table 3-3. Then press **On/Off** on the front panel of DP711 to turn on the channel output.
4. Turn on the electronic load. Set the electronic load to work in CV mode and adjust the voltage of the electronic load to the rated output voltage of the output channel (refer to Table 1-2).
5. Turn on the digital multimeter. Select the DC voltage (DCV) measurement

function and set the range to "Auto". Make sure that the power supply works in CC mode. Read the digital multimeter and record the reading (U_0 , namely the voltage of the current sampling resistor) of the digital multimeter.

6. Adjust the AC power supply to the undervoltage state (namely reducing the amplitude by 10%, refer to Table 2-3), read the digital multimeter and record the reading (U_1) of the digital multimeter. Adjust the AC power supply to the overvoltage state (namely increasing the amplitude by 10%, refer to Table 2-3), read the digital multimeter and record the reading (U_2) of the digital multimeter.
7. Press **On/Off** on the front panel of DP711 to turn off the channel output.
8. Calculate the current variation (namely the CC source effect): $|U_1 - U_0|/R_M$ and $|U_2 - U_0|/R_M$. Then compare it with the specified specification in Table 3-3.

Test Record Forms:

Table 3-3 Test Record Form of DP711 CC Line Regulation

Model		DP711 (30 V/5 A)
Specification		<2.5 mA
DP711 Setting	Voltage	32 V
	Current	5 A
Test Result	U_0	
	U_1	
	U_2	
	$ U_1 - U_0 /R_M^{[1]}$	
	$ U_2 - U_0 /R_M^{[1]}$	

Note^[1]: $R_M = 0.022 \Omega$.

Table 3-4 Test Record Form of DP712 CC Line Regulation

Model		DP712 (50 V/3 A)
Specification		<2.3 mA
DP712 Setting	Voltage	53 V
	Current	3 A
Test Result	U_0	
	U_1	
	U_2	
	$ U_1 - U_0 /R_M^{[1]}$	
	$ U_2 - U_0 /R_M^{[1]}$	

Note^[1]: $R_M = 0.022 \Omega$.

CC Ripple and Noise (Normal Mode)

When the power supply works in CC mode, the ripple and noise are usually expressed in RMS.

The following section takes DP711 as an example to test the CC ripple and noise of DP700 series.

Note: During the test, please select the corresponding test record form according to the model of the DP700 power supply under test to set the corresponding parameters, record and calculate the corresponding specifications.

Specification:

Ripple and Noise (20 Hz to 20 MHz)	
Normal Mode Current	<2 mArms

Test Procedures:

1. Power off DP711. Connect DP711, AC power supply, a resistive load, and an RMS voltmeter according to Figure 2-1. Wherein, the resistive load and the RMS voltmeter are connected with the channel output terminals of DP711. Please refer to "**Test Precautions**" for the connection method.

Note:

- Do not connect the negative terminal of the channel output terminal of the power supply to the shielding ground; otherwise, it may result in a ground loop. In Figure 2-2, the connection method in Figure A will result in a ground loop. Figure B shows the correct connection.
 - Please ensure to test the CC ripple and noise of DP711 under the full-load condition. For the resistance of the resistive load, please refer to Table 3-5.
2. Turn on the AC power supply, and then set its voltage to 220 V, the frequency to 50 Hz. Then, turn on the output.

Note: The voltage setting of the AC power supply should be matched with the AC voltage selector on the rear panel of DP711.

3. Power on DP711, and then set the voltage and current of the output channel according to Table 3-5. Then press **On/Off** on the front panel of DP711 to turn on the channel output.
4. Turn on the RMS voltmeter and select the AC voltage random measurement mode (SETACV RNDM). Make sure that the power supply works in CC mode. Read and record the RMS value (V_{rms}) measured by the RMS voltmeter.

Note: The measurement wires of the RMS voltmeter should be twisted together to minimize the impact of the space radiation noise on the test.

5. Press **On/Off** on the front panel of DP711 to turn off the channel output.
6. Calculate the CC ripple and noise (V_{rms}/R_L) and compare it with the specified specification in Table 3-5.



CAUTION

During the CC ripple and noise test, please shield the space radiation noise in the test environment to avoid its impact on the test.

Test Record Forms:

Table 3-5 Test Record Form of DP711 CC Ripple and Noise

Model		DP711 (30 V/5 A)
Specification		<2 mArms
Resistance of Resistive Load R_L		6 Ω
DP711 Setting	Voltage	32 V
	Current	5 A
Test Result	RMS value (V_{rms})	
	V_{rms}/R_L	

Table 3-6 Test Record Form of DP712 CC Ripple and Noise

Model		DP712 (50 V/3 A)
Specification		<2 mArms
Resistance of Resistive Load R_L		16.7 Ω
DP712 Setting	Voltage	53 V
	Current	3 A
Test Result	RMS value (V_{rms})	
	V_{rms}/R_L	

CC Programming Accuracy and Readback Accuracy

CC programming accuracy refers to the error between the current setting of the channel and the actual output current value when the power supply is in CC mode; CC readback accuracy refers to the error between the readback current value and the actual output current value when the power supply is in CC mode.

The following section takes DP711 as an example to test the CC programming accuracy and readback accuracy of DP700 series.

Note: During the test, please select the corresponding test record form according to the model of the DP700 power supply under test to set the corresponding parameters, record and calculate the corresponding specifications.

Specification:

Annual Accuracy ^[1] (25°C ± 5°C), ±(% of Output + Offset)	
Programming	0.2% + 10 mA
Readback	0.2% + 20 mA

Note^[1]: The accuracy specifications are acquired through calibration under 25°C after 1-hour warm-up.

Test Procedures:

1. Power off DP711. Connect DP711, AC power supply, a current sampling resistor (with a resistance R_M 0.022 Ω), and a digital multimeter according to Figure 3-1 (Pay attention to the connection method for the current sampling resistor, the channel output terminals of DP711, and the digital multimeter). Use the 9-pin RS232 cable (female-to-female, straight-through type) to connect DP711 with PC via the RS232 interface on the rear panel of DP711.
2. Turn on the AC power supply, and then set its voltage to 220V, the frequency to 50 Hz. Then, turn on the output.

Note: The voltage setting of the AC power supply should be matched with the AC voltage selector on the rear panel of DP711.

3. Measure the CC programming accuracy and readback accuracy when the current setting value is 0 A.
 - 1) Power on DP711. Send the following commands via the remote interface to set the voltage and current of the output channel (refer to Table 3-7), and then enable the channel output.

```

:APPL CH1,32,0 /*Sets the voltage and current of the output
                channel to 32 V and 0 A respectively*/
:OUTP CH1,ON /*Enables the channel output*/

```

Note: You can send the `:INST:NSEL 1` (or `:INST CH1`) command to select CH1 as the current channel, then send the `:SOUR1:VOLT 32` command to set the voltage of the output channel to 32 V, and send the `:SOUR1:CURR 0` command to set the current of the output channel to 0 A.

- 2) Turn on the digital multimeter. Select the DC voltage (DCV) measurement function and set the range to "Auto". Make sure that the power supply works in CC mode. Read the digital multimeter and record the reading (U_1) of the digital multimeter. Calculate the current value ($I_1 = U_1/R_M$).
 - 3) Send the `:MEAS:CURR? CH1` command via the remote interface, read and record the returned current value (I_2) of the query command.
 - 4) Calculate the CC programming accuracy ($|I_1 - 0|$) and the CC readback accuracy ($|I_2 - I_1|$). Compare them with the specified specifications in Table 3-7.
4. Measure the CC programming accuracy and readback accuracy when the current setting value is rated output value.

- 1) Send the following commands via the remote interface to set the voltage and current of the output channel (refer to Table 3-7).

```

:APPL CH1,32,5 /*Sets the voltage and current of the output
                channel to 32 V and 5 A respectively*/

```

Note: You can send the `:INST:NSEL 1` (or `:INST CH1`) command to select CH1 as the current channel, then send the `:SOUR1:VOLT 32` command to set the voltage of the output channel to 32 V, and send the `:SOUR1:CURR 5` command to set the current of the output channel to 5 A.

- 2) Make sure that the power supply works in CC mode. Read the digital multimeter and record the reading (U_3) of the digital multimeter. Calculate the current value ($I_3 = U_3/R_M$).
- 3) Send the `:MEAS:CURR? CH1` command via the remote interface, read and record the returned current value (I_4) of the query command.
- 4) Calculate the CC programming accuracy ($|I_3 - I_R|$) and the CC readback accuracy ($|I_4 - I_3|$). Compare them with the specified specifications in Table 3-7. Wherein, I_R is the rated output current of the output channel.

- Send the following command via the remote interface to disable the channel output.

`:OUTP CH1,OFF` /*Disables the channel output*/

Test Record Forms:

Table 3-7 Test Record Form of DP711 CC Programming Accuracy and Readback Accuracy

Model		DP711 (30 V/5 A)
Specification	Programming Accuracy	<20 mA
	Readback Accuracy	<30 mA
The output current is 0 A.		
DP711 Setting	Voltage	32 V
	Current	0 A
Test Result	U_1	
	$I_1 = U_1/R_M^{[1]}$	
	I_2	
	Programming Accuracy: $ I_1 - 0 $	
	Readback Accuracy: $ I_2 - I_1 $	
The output current is $I_R^{[2]}$.		
DP711 Setting	Voltage	32 V
	Current	5 A
Test Result	U_3	
	$I_3 = U_3/R_M^{[1]}$	
	I_4	
	Programming Accuracy: $ I_3 - I_R^{[2]} $	
	Readback Accuracy: $ I_4 - I_3 $	

Note^[1]: $R_M = 0.022 \Omega$.

Note^[2]: The rated current value of the output channel.

Table 3-8 Test Record Form of DP712 CC Programming Accuracy and Readback Accuracy

Model		DP712 (50 V/3 A)
Specification	Programming Accuracy	<16 mA
	Readback Accuracy	<26 mA
The output current is 0 A.		
DP712 Setting	Voltage	53 V
	Current	0 A
Test Result	U_1	
	$I_1 = U_1/R_M^{[1]}$	
	I_2	
	Programming Accuracy: $ I_1 - 0 $	
	Readback Accuracy: $ I_2 - I_1 $	
The output current is $I_R^{[2]}$.		
DP712 Setting	Voltage	53 V
	Current	3 A
Test Result	U_3	
	$I_3 = U_3/R_M^{[1]}$	
	I_4	
	Programming Accuracy: $ I_3 - I_R^{[2]} $	
	Readback Accuracy: $ I_4 - I_3 $	

Note^[1]: $R_M = 0.022 \Omega$.

Note^[2]: The rated current value of the output channel.

Appendix

Appendix A: Test Record Forms

DP711 Performance Verification Test Record Form

RIGOL DP711 Programmable Linear DC Power Supply
Performance Verification Test Record Form

CV Load Regulation

Model		DP711 (30 V/5 A)
Specification		<5 mV
DP711 Setting	Voltage	30 V
	Current	5.3 A
Test Result	U_0	
	U_1	
	$ U_1 - U_0 $	

CV Line Regulation

Model		DP711 (30 V/5 A)
Specification		<5 mV
DP711 Setting	Voltage	30 V
	Current	5.3 A
Test Result	U_0	
	U_1	
	U_2	
	$ U_1 - U_0 $	
	$ U_2 - U_0 $	

CV Ripple and Noise

Model		DP711 (30 V/5 A)
Specification		<500 μ Vrms/3 mVpp
Resistance of Resistive Load R_L		6 Ω
DP711 Setting	Voltage	30 V
	Current	5.3 A
Test Result	Peak-Peak value (Vpp)	
	RMS value (Vrms)	

Transient Response Time

Model		DP711 (30 V/5 A)
Specification		<50 μ s
DP711 Setting	Voltage	30 V
	Current	5.3 A
Current Setting Value of the Electronic Load	CCDH1	5 A
	CCDH2	2.5 A
Test Result	t	

CV Programming Accuracy and Readback Accuracy

Model		DP711 (30 V/5 A)
Specification	Programming Accuracy	<35 mV
	Readback Accuracy	<35 mV
The output voltage is 0 V.		
DP711 Setting	Voltage	0 V
	Current	5.3 A
Test Result	U_1	
	U_2	
	Programming Accuracy: $ U_1 - 0 $	
	Readback Accuracy: $ U_2 - U_1 $	
The output voltage is $U_R^{[1]}$.		
DP711 Setting	Voltage	30 V
	Current	5.3 A
Test Result	U_3	
	U_4	
	Programming Accuracy: $ U_3 - U_R^{[1]} $	
	Readback Accuracy: $ U_4 - U_3 $	

CC Load Regulation

Model		DP711 (30 V/5 A)
Specification		<2.5 mA
DP711 Setting	Voltage	32 V
	Current	5 A
Test Result	U_0	
	U_1	
	$ U_1/R_M^{[2]} - U_0/R_M^{[2]} $	

CC Line Regulation

Model		DP711 (30 V/5 A)
Specification		<2.5 mA
DP711 Setting	Voltage	32 V
	Current	5 A
Test Result	U_0	
	U_1	
	U_2	
	$ U_1 - U_0 /R_M^{[2]}$	
	$ U_2 - U_0 /R_M^{[2]}$	

CC Ripple and Noise

Model		DP711 (30 V/5 A)
Specification		<2 mArms
Resistance of Resistive Load R_L		6 Ω
DP711 Setting	Voltage	32 V
	Current	5 A
Test Result	RMS value (V_{rms})	
	V_{rms}/R_L	

CC Programming Accuracy and Readback Accuracy

Model		DP711 (30 V/5 A)
Specification	Programming Accuracy	<20 mA
	Readback Accuracy	<30 mA
The output current is 0 A.		
DP711 Setting	Voltage	32 V
	Current	0 A
Test Result	U_1	
	$I_1 = U_1/R_M^{[2]}$	
	I_2	
	Programming Accuracy: $ I_1 - 0 $	
	Readback Accuracy: $ I_2 - I_1 $	
The output current is $I_R^{[3]}$.		
DP711 Setting	Voltage	32 V
	Current	5 A
Test Result	U_3	
	$I_3 = U_3/R_M^{[2]}$	
	I_4	
	Programming Accuracy: $ I_3 - I_R^{[3]} $	
	Readback Accuracy: $ I_4 - I_3 $	

Note^[1]: The rated voltage value of the output channel.

Note^[2]: $R_M = 0.022 \Omega$.

Note^[3]: The rated current value of the output channel.

DP712 Performance Verification Test Record Form

RIGOL DP712 Programmable Linear DC Power Supply Performance Verification Test Record Form

CV Load Regulation

Model		DP712 (50 V/3 A)
Specification		<7 mV
DP712 Setting	Voltage	50 V
	Current	3.2 A
Test Result	U_0	
	U_1	
	$ U_1 - U_0 $	

CV Line Regulation

Model		DP712 (50 V/3 A)
Specification		<7 mV
DP712 Setting	Voltage	50 V
	Current	3.2 A
Test Result	U_0	
	U_1	
	U_2	
	$ U_1 - U_0 $	
	$ U_2 - U_0 $	

CV Ripple and Noise

Model		DP712 (50 V/3 A)
Specification		<500 μ Vrms/4 mVpp
Resistance of Resistive Load R_L		16.7 Ω
DP712 Setting	Voltage	50 V
	Current	3.2 A
Test Result	Peak-Peak value (Vpp)	
	RMS value (Vrms)	

Transient Response Time

Model		DP712 (50 V/3 A)
Specification		<50 μ s
DP712 Setting	Voltage	50 V
	Current	3.2 A
Current Setting Value of the Electronic Load	CCDH1	3 A
	CCDH2	1.5 A
Test Result	t	

CV Programming Accuracy and Readback Accuracy

Model		DP712 (50 V/3 A)
Specification	Programming Accuracy	<45 mV
	Readback Accuracy	<45 mV
The output voltage is 0 V.		
DP712 Setting	Voltage	0 V
	Current	3.2 A
Test Result	U_1	
	U_2	
	Programming Accuracy: $ U_1 - 0 $	
	Readback Accuracy: $ U_2 - U_1 $	
The output voltage is $U_R^{[1]}$.		
DP712 Setting	Voltage	50 V
	Current	3.2 A
Test Result	U_3	
	U_4	
	Programming Accuracy: $ U_3 - U_R^{[1]} $	
	Readback Accuracy: $ U_4 - U_3 $	

CC Load Regulation

Model		DP712 (50 V/3 A)
Specification		<2.3 mA
DP712 Setting	Voltage	53 V
	Current	3 A
Test Result	U_0	
	U_1	
	$ U_1/R_M^{[2]} - U_0/R_M^{[2]} $	

CC Line Regulation

Model		DP712 (50 V/3 A)
Specification		<2.3 mA
DP712 Setting	Voltage	53 V
	Current	3 A
Test Result	U_0	
	U_1	
	U_2	
	$ U_1 - U_0 /R_M^{[2]}$	
	$ U_2 - U_0 /R_M^{[2]}$	

CC Ripple and Noise

Model		DP712 (50 V/3 A)
Specification		<2 mArms
Resistance of Resistive Load R_L		16.7 Ω
DP712 Setting	Voltage	53 V
	Current	3 A
Test Result	RMS value (Vrms)	
	Vrms/ R_L	

CC Programming Accuracy and Readback Accuracy

Channel		DP712 (50 V/3 A)
Specification	Programming Accuracy	<16 mA
	Readback Accuracy	<26 mA
The output current is 0 A.		
DP712 Setting	Voltage	53 V
	Current	0 A
Test Result	U_1	
	$I_1 = U_1/R_M^{[2]}$	
	I_2	
	Programming Accuracy: $ I_1 - 0 $	
	Readback Accuracy: $ I_2 - I_1 $	
The output current is $I_R^{[3]}$.		
DP712 Setting	Voltage	53 V
	Current	3 A
Test Result	U_3	
	$I_3 = U_3/R_M^{[2]}$	
	I_4	
	Programming Accuracy: $ I_3 - I_R^{[3]} $	
	Readback Accuracy: $ I_4 - I_3 $	

Note^[1]: The rated voltage value of the output channel.

Note^[2]: $R_M = 0.022 \Omega$.

Note^[3]: The rated current value of the output channel.

Appendix B: Specifications

All the technical specifications are guaranteed when the instrument has been working for more than 30 minutes under the specified operating temperature.

Model	No. of Channels
DP711	1
DP712	1

DC Output (0°C to 40°C)				
Model	Rated Value		Maximum Settable Range	
	Voltage	Current	Overvoltage Protection	Overcurrent Protection
DP711	0 V to 30 V	0 A to 5 A	0.01 V to 33 V	0.01 A to 5.5 A
DP712	0 V to 50 V	0 A to 3 A	0.01 V to 55 V	0.01 A to 3.3 A

Load Regulation, \pm (% of Output + Offset)	
Voltage	<0.01% + 2 mV
Current	<0.01% + 2 mA

Line Regulation, \pm (% of Output + Offset)	
Voltage	<0.01% + 2 mV
Current	<0.01% + 2 mA

Ripple and Noise (20 Hz to 20 MHz)	
Normal Mode Voltage	DP711: <500 μ Vrms/3 mVpp
	DP712: <500 μ Vrms/4 mVpp
Normal Mode Current	<2 mArms

Annual Accuracy ^[1] (25°C \pm 5°C), \pm (% of Output + Offset)		
Programming	Voltage	0.05% + 20 mV
	Current	0.2% + 10 mA
Readback	Voltage	0.05% + 20 mV
	Current	0.2% + 20 mA

Resolution		
Programming	Voltage	Standard: 10 mV High resolution option installed: 1 mV
	Current	Standard: 10 mA High resolution option installed: 1 mA
Readback	Voltage	Standard: 10 mV High resolution option installed: 1 mV
	Current	Standard: 10 mA High resolution option installed: 1 mA
Display	Voltage	Standard: 10 mV High resolution option installed: 1 mV
	Current	Standard: 10 mA High resolution option installed: 1 mA

Transient Response Time

Less than 50 μ s for the output voltage to recover to within 15 mV following a change in output current from full load to half load or from half load to full load.

Command Processing Time^[2]

<100 ms

Temperature Coefficient^[3], (% of Output + Offset)

Voltage	0.01% + 2 mV
Current	0.02% + 3 mA

Stability^[4], \pm (% of Output + Offset)

Voltage	0.02% + 2 mV
Current	0.1% + 3 mA

Voltage Programming Speed^[5] (within 1% of the total variation range)

Rise	Full Load	150 ms
	No Load	100 ms
Fall	Full Load	30 ms
	No Load	450 ms

OVP/OCP

Accuracy, \pm (% of Output + Offset)	0.5% + 0.5 V/0.5% + 0.5 A
OVP Activation Time	<10 ms (OVP>1 V)

Mechanical

Dimensions	140 mm (W) x 202 mm (H) x 332 mm (D)
Weight	Net weight: 6.9 kg

Power	
AC Input (50 Hz to 60 Hz)	100 Vac \pm 10%, 120 Vac \pm 10%, 220 Vac \pm 10%, and 240 Vac \pm 10% (max: 253 Vac)
Maximum Input Power	400 VA

Interface	
RS232	1 (male)

Environment	
Operating Temperature	0°C to 40°C for full rated output
Storage Temperature	-40°C to +70°C
Humidity	5% to 80%
Altitude	Below 2,000 m
Cooling Method	Fan Cooled
Maximum Output Floating Voltage-to-Earth	\pm 240 Vdc

Note^[1]: The accuracy specifications are acquired through calibration under 25°C after 1-hour warm-up.

Note^[2]: The maximum time required for the output to begin to change after receiving the **APPL** and **SOUR** commands.

Note^[3]: Following a 30-minute warm-up, maximum change of the output/readback value with the change of 1°C.

Note^[4]: Following a 30-minute warm-up, change in output over 8 hours under constant load, line, and ambient temperature.

Note^[5]: Exclude the command processing time.