RIGOL

Performance Verification Manual

DP800 Series
Programmable Linear DC Power Supply

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RIGOL Technologies, Inc.

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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 use the instrument only specified by this manual.

Use Proper Power Cord.

Only the 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, it is essential to connect the earth terminal of power cord to the Protective Earth terminal before any inputs or outputs.

Connect the Probe Correctly.

If a probe is used, do not connect the ground lead to high voltage since it has the isobaric electric potential as ground.

Observe All Terminal Ratings.

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

Use Proper Overvoltage Protection.

Make sure that no overvoltage (such as that caused by a thunderstorm) can reach the product, or else the operator might expose to danger of electrical shock.

Do Not Operate Without Covers.

Do not operate the instrument with covers or panels removed.

Do Not Insert Anything into the Holes of Fan.

Do not insert anything into the holes of the fan to avoid damaging 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.

Do Not Operate With Suspected Failures.

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

Keep Well Ventilation.

Inadequate ventilation may cause increasing of temperature or damages to the device. So please keep well ventilated and inspect the intake and fan regularly.

Do Not Operate in Wet Conditions.

In order to avoid short circuiting to the interior of the device or electric shock, please do not operate in a humid environment.

Do Not Operate in an Explosive Atmosphere.

In order to avoid damages to the device or personal injuries, it is important to operate the device away from an explosive atmosphere.

Keep Product Surfaces Clean and Dry.

To avoid the influence of dust and/or moisture in air, please keep the surface of device clean and dry.

Electrostatic Prevention.

Operate in an electrostatic discharge protective area environment to avoid damages induced by static discharges. Always ground both the internal and external conductors of the cable to release static before connecting.

Proper Use of Battery.

If a battery is supplied, it must not be exposed to high temperature or in contact with fire. Keep it out of the reach of children. Improper change of battery (note: lithium battery) may cause explosion. Use **RIGOL** specified battery only.

Handling Safety.

Please handle with care during transportation to avoid damages to buttons, knob interfaces and other parts on the panels.

Do Not Provide Power for the Active Load.

In order to avoid the anti-irrigation current which leads to the power control loop out of control and damage to the powered device, this power supply can only provide power for the pure load without the current output function.

Allgemeine Sicherheits Informationen

Überprüfen Sie diefolgenden Sicherheitshinweise sorgfältigumPersonenschädenoderSchäden am Gerätundan damit verbundenen weiteren Gerätenzu vermeiden. Zur Vermeidung vonGefahren, nutzen Sie bitte das Gerät nur so, wiein diesem Handbuchangegeben.

Um Feuer oder Verletzungen zu vermeiden, verwenden Sie ein ordnungsgemäßes Netzkabel.
Verwenden Sie für dieses Gerät nur das für ihr Land zugelassene und genehmigte Netzkabel.

Erden des Gerätes.
Das Gerät ist durch den Schutzleiter im Netzkabel geerdet. Um Gefahren durch elektrischen Schlag zu vermeiden, ist es unerlässlich, die Erdung durchzuführen. Erst dann dürfen weitere Ein- oder Ausgänge verbunden werden.

Anschluss einesTastkopfes.
Die Erdungsklemmen der Sonden sindauf dem gleichen Spannungspegel des Instruments geerdet. SchließenSie die Erdungsklemmen an keine hohe Spannung an.

Beachten Sie alle Anschlüsse.
Zur Vermeidung von Feuer oder Stromschlag, beachten Sie alle Bemerkungen und Markierungen auf dem Instrument. Befolgen Sie die Bedienungsanleitung für weitere Informationen, bevor Sie weitere Anschlüsse an das Instrument legen.

Verwenden Sie einen geeigneten Überspannungsschutz.
Stellen Sie sicher, daß keinerlei Überspannung (wie z.B. durch Gewitter verursacht) das Gerät erreichen kann. Andernfallsbestehtfür den Anwender die GefahreinesStromschlages.

Nicht ohne Abdeckung einschalten.
Betreiben Sie das Gerät nicht mit entfernten Gehäuse-Abdeckungen.

Betreiben Sie das Gerät nicht geöffnet.
Der Betrieb mit offenen oder entfernten Gehäuseteilen ist nicht zulässig. Nichts in entsprechende Öffnungen stecken (Lüfter z.B.)

Passende Sicherung verwenden.
Setzen Sie nur die spezifikationsgemäßen Sicherungen ein.

Vermeiden Sie ungeschützte Verbindungen.
Berühren Sie keine unisolierten Verbindungen oder Baugruppen, während das Gerät in Betrieb ist.

Betreiben Sie das Gerät nicht im Fehlerfall.
Wenn Sie am Gerät einen Defekt vermuten, sorgen Sie dafür, bevor Sie das Gerät wieder betreiben, dass eine Untersuchung durch qualifiziertes Kundendienstpersonal durchgeführt wird. Jedwede Wartung, Einstellarbeiten oder Austausch von Teilen am Gerät, sowie am Zubehör dürfen nur von **RIGOL** autorisiertem Personal durchgeführt werden.

Belüftung sicherstellen.
Unzureichende Belüftung kann zu Temperaturanstiegen und somit zu thermischen Schäden am Gerät führen. Stellen Sie deswegen die Belüftung sicher und kontrollieren regelmäßig Lüfter und Belüftungsöffnungen.

Nicht in feuchter Umgebung betreiben.
Zur Vermeidung von Kurzschluß im Geräteinneren und Stromschlag betreiben Sie das Gerät bitte niemals in feuchter Umgebung.

Nicht in explosiver Atmosphäre betreiben.
Zur Vermeidung von Personen- und Sachschäden ist es unumgänglich, das Gerät ausschließlich fernab jedweder explosiven Atmosphäre zu betreiben.

Geräteoberflächen sauber und trocken halten.
Um den Einfluß von Staub und Feuchtigkeit aus der Luft auszuschließen, halten Sie bitte die Geräteoberflächen sauber und trocken.

Schutz gegen elektrostatische Entladung (ESD).
Sorgen Sie für eine elektrostatisch geschützte Umgebung, um somit Schäden und Funktionsstörungen durch ESD zu vermeiden. Erden Sie vor dem Anschluß immer Innen- und Außenleiter der Verbindungsleitung, um statische Aufladung zu entladen.

Die richtige Verwendung desAkku.
Wenneine Batterieverwendet wird, vermeiden Sie hohe Temperaturen bzw. Feuer ausgesetzt werden. Bewahren Sie es außerhalbder Reichweitevon Kindern auf. UnsachgemäßeÄnderung derBatterie (Anmerkung:Lithium-Batterie)kann zu einer Explosion führen. VerwendenSie nur von RIGOLangegebenenAkkus.

Sicherer Transport.
Transportieren Sie das Gerät sorgfältig (Verpackung!), um Schäden an Bedienelementen, Anschlüssen und anderen Teilen zu vermeiden.

Vermeiden Sie das einprägen von Strom und Spannung an den Testklemmen.
Das DP800 Power Supply kann hierdurch zerstört werden, keine akive Last. Das DP800 kann nur Strom und Spannungen leifern.

Document Overview

DP800 series is a high-performance programmable DC power supply. This manual introduces the performance verification test methods of DP800 series. The performance verification test mainly verifies whether DP800 series programmable linear DC power supply can work normally and is within specifications.

Main topics of this manual

Chapter 1 Test Overview
This chapter introduces the test preparations, the recommended test devices, the test precautions as well as the test result record and so on.

Chapter 2 Constant Voltage Tests
This chapter introduces the specification test methods of DP800 under constant voltage (CV) mode.

Chapter 3 Constant Current Tests
This chapter introduces the specification test methods of DP800 under constant current (CC) mode.

Appendix
Provide the test result record forms and the performance specifications of all models of DP800 series programmable linear DC power supply.

Content Conventions in this Manual

DP800 series programmable linear DC power supply includes the following models. Unless specified otherwise in this manual, DP831A is taken as an example to illustrate the performance verification test methods of DP800 series.

Model	Channel	Output Voltage/Current
DP831A	3	8V/5A, 30V/2A, -30V/2A
DP832A/DP832	3	30V/3A, 30V/3A, 5V/3A
DP821A	2	60V/1A, 8V/10A
DP811A	1	20V/10A (Range 1), 40V/5A (Range 2)

Contents

Chapter 1 Test Overview

Topics of this chapter:

- Test Preparations
- Voltage and Current Values
- Recommended Test Devices
- Test Precautions
- Test Result Record

Test Preparations

You need to finish the following preparations before performing the performance verification test.

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

   Connect the instrument to AC power supply using the power cord provided with the accessories. Press the power switch key at the front panel; the instrument starts and performs self-test. You can press **Utility** → **Test/Cal** after power-on to examine the self-test information (including the top board, bottom board, fan and temperature). If the self-test fails, please turn off and then turn on the instrument to perform the self-test again and examine the self-test information. If the self-test still fails, please contact **RIGOL**. Make sure that the reason that results in the self-test failure are found and solved. Perform the performance verification test only after the instrument passes the self-test.

   Notes:

   - Before connecting the power, make sure that the setting of the voltage selector at the rear panel of the power supply matches the AC power supply to be connected and the fuse currently installed matches the input voltage. The input voltages supported by DP800 series and the matching fuses are as shown in the table below.

DP831A/DP821A	
100 115 230	100Vac ± 10%, 50Hz to 60Hz, T5A fuse 115Vac ± 10%, 50Hz to 60Hz, T5A fuse 230Vac ± 10% (maximum 250Vac), 50Hz to 60Hz, T2.5A fuse
DP832A/DP832/DP811A	
100 115 230	100Vac ± 10%, 50Hz to 60Hz, T6.3A fuse 115Vac ± 10%, 50Hz to 60Hz, T6.3A fuse 230Vac ± 10% (maximum 250Vac), 50Hz to 60Hz, T3.15A fuse

   Note: The upper limit of the input voltage supported by DP800 series is 250Vac.

   - Before performing the self-test, make sure that there is no connection at the front and rear panel terminals of the power supply.

2. Make sure that the power supply is within the calibration period (1 year). If calibration is required, please contact **RIGOL**.

3. Run the instrument for at least 30 minutes.

4. Make sure that the environment temperature is between 20℃ and 30℃ and the relative humidity is less than 80%.

5. The test connecting wires used should be as short as possible. For the channels that support the Sense function, please short-circuit the (S+) and (+) terminals, (S-) and (-) terminals (as shown in Figure 2-2 or Figure 3-2) of the channels respectively and turn on the Sense function of the corresponding channel before performing the test.

Note:

The tests introduced in this manual should be performed by professionals. During the tests, there might be dangerous voltage at the output terminals of the power supply as well as certain test devices.

Voltage and Current Values

During the test, you need to set the voltage and current of the output channels (output ranges) of the power supply to specified values. The rated output values and maximum output values of the voltage and current of each channel of various models of DP800 series are listed in Table 1-1.

Table 1-1 Voltage and Current Values of the Channels (Ranges) of DP800 Series

Channel (Range)	Rated Output Voltage	Max Output Voltage	Rated Output Current	Max Output Current
DP831A				
CH1	8V	8.4V	5A	5.3A
CH2	30V	32V	2A	2.1A
CH3	-30V	-32V	2A	2.1A
DP832A/DP832				
CH1	30V	32V	3A	3.2A
CH2	30V	32V	3A	3.2A
CH3	5V	5.3V	3A	3.2A
DP821A				
CH1	60V	63V	1A	1.05A
CH2	8V	8.4V	10A	10.5A
DP811A				
Range1	20V	21V	10A	10.5A
Range2	40V	42V	5A	5.3A

Recommended Test Devices

It is recommended that you use the test devices listed in the table below or other test devices whose performance specifications satisfy the "Performance Requirement" listed in the table below to test the performance specifications of the DP800 series.

Table 1-2 Recommended Test Devices

Device	Performance Requirement	Recommended Instrument	Use
Digital Oscilloscope	Bandwidth: ≥20MHz Minimum Vertical Scale: ≤2mV/div Bandwidth Limit: ≤20MHz	**RIGOL** DS1102E	Measure ripple and noise, transient response time
Digital Multimeter	Readout Resolution: 6½	**RIGOL** DM3068	Measure dc voltage
RMS Voltmeter	Sensitivity: 1mV Bandwidth: ≥10MHz		Measure rms ripple and noise
Electronic Load	Voltage Range: 80Vdc Current Range: 60Adc Maximum Power: 300W Dynamic frequency: 1kHz	Chroma 63103A	Measure load regulation rate, linear regulation rate, transient response time
AC Power Supply	Regulation Rate: >1%	Chroma 61602	—
Resistive Load R_L	0.8Ω (200W) 1.6Ω (100W) 2Ω (400W) 8Ω (400W) 10Ω (200W) 15Ω (200W) 60Ω (200W)	—	Measure ripple and noise
Current Sampling Resistor R_M	0.022Ω (5W, temperature drift: 10ppm)	—	Measure load regulation rate, linear regulation rate, programming accuracy and readback accuracy
Multimeter Test Probe	—	—	—
USB Cable	USB Device to USB Host, for connecting the power supply and PC	—	—
Short Circuit Device (2)	—	—	Short-circuit the (S+) and (+) terminals, (S-) and (-) terminals of the channel that supports the Sense function

Test Precautions

The output terminal of the power supply is as shown in Figure 1-1. The output terminal is a metal conductor with certain contact resistance (Δr) and when the output current of the power supply is I , the voltage of this terminal is $V_e = \Delta r \times I$. Therefore, during the test process, the voltage test point is always located at A to reduce the error caused by the terminal voltage as far as possible. Besides, the contact resistance between this terminal and the power output wire/the voltage feedback wire inside the instrument chassis can also cause error (about 2mV, called U_{offset}).

When testing the load regulation rate, voltage peak-peak value and transient response time, the test devices are connected to the output terminal via A and the load resistor is connected to the output terminal via B.

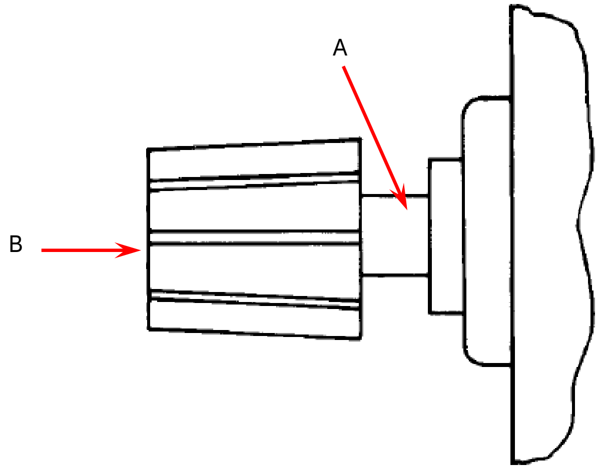


Figure 1-1 Output Terminal

During the test, please pay attention to shield the effect of the environmental space radiation noise on the test effectively.

Test Result Record

Record and keep the test results of each test item. The test result record forms, which provide all the test items and the corresponding performance specification limits as well as spaces for users to record the test results, of all models of DP800 series programmable linear DC power supply are provided in "**Appendix A: Test Result Record Forms**" of this manual.

Tip:

It is recommended that you photocopy the desired test result record form before each test. During the test process, record the test results on the copies so that the forms can be used repeatedly.

Chapter 2 Constant Voltage Tests

Topics of this chapter:

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

Preparations

When the power supply is in CV state, the main parameters to be tested include CV load regulation rate, CV linear regulation rate, CV ripple and noise, transient response time, CV programming and readback accuracy.

Before performing the tests, select the appropriate voltage via the “voltage selector” at the rear panel of the power supply according to the AC line voltage of the country (230V is taken as an example in all the tests in this manual). Under normal temperature (about 25℃), make connections according to Figure 2-1 or Figure 2-2 using the devices recommended in “**Recommended Test Devices**”. During the test process, please set the voltage of the AC power supply according to the voltage selected of the “voltage selector” at the rear panel of the power supply.

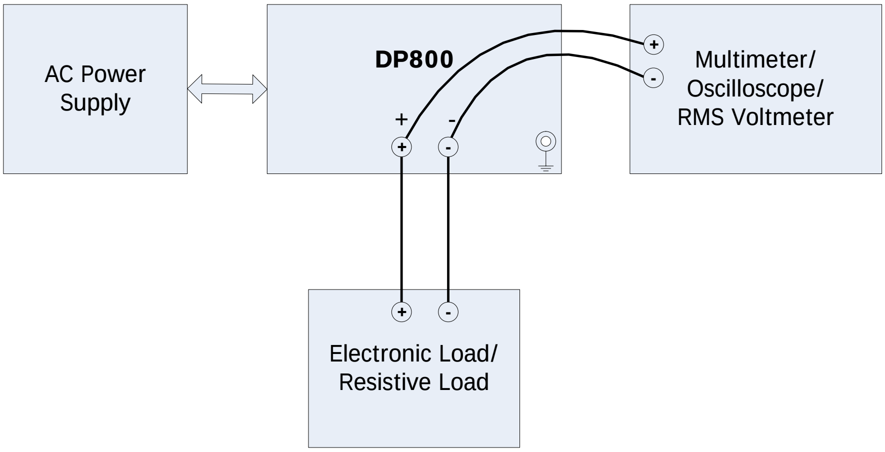


Figure 2-1 CV Test Connections

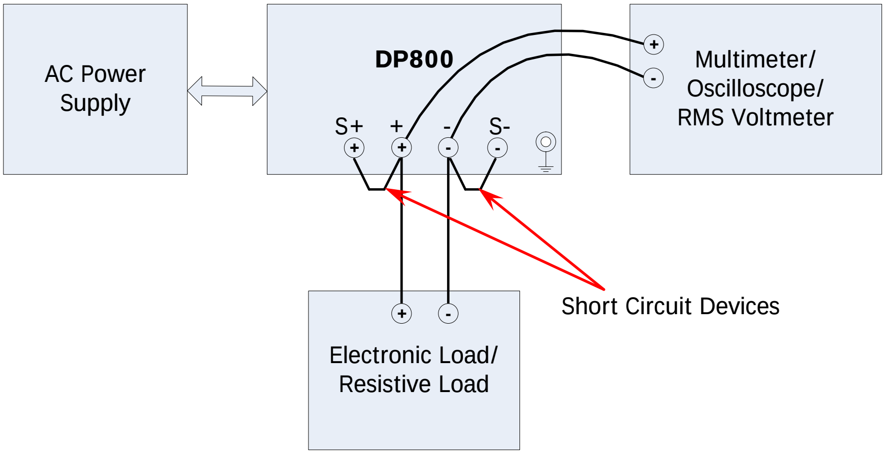


Figure 2-2 CV Test Connections (Sense)

Note:

During the CV tests, make connections according to Figure 2-1 for the normal channels (namely the channels that do not support the Sense function) of the DP800 series power supply. For the channels that support the Sense function (CH2 of DP821A and DP811A), make connections according to Figure 2-2 (note to short-circuit the (S+) and (+) terminals, (S-) and (-) terminals of the channel respectively) and turn on the Sense function of the channel during the test process to measure the specifications under Sense mode.

CV Load Regulation Rate (CV Load Effect)

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

DP831A is taken as an example to test the CV load regulation rate of DP800 series in the following section.

Note: During the actual test, please select the corresponding test record form according to the model of the DP800 power supply under test to set the corresponding parameters, record and calculate the corresponding specifications.

Specification:

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

Test Procedures:

1. Turn off DP800. Connect DP800, AC power supply, electronic load and multimeter according to Figure 2-1. Both the electronic load and multimeter are connected with the channel output terminals of DP800; please refer to "**Test Precautions**" for the connection method. Here, CH1 is taken as an example and the connection method is also applicable to CH2 and CH3.

2. Turn on the AC power supply; set its voltage to 230V and frequency to 50Hz.

   Note: The voltage setting of the AC power supply in this step should be in accordance with the value selected by the voltage selector at the rear panel of DP800.

3. Turn on DP800 and press the channel selecting key at the front panel to select CH1 as the channel to be tested. Set the voltage and current of the channel under test according to Table 2-1. Then, press the **On/Off** key corresponding to the channel under test to enable the output of the channel.

4. Turn on the electronic load. Adjust the current of the electronic load to 0A or do not connect any load device (no load).

5. Turn on the digital multimeter; select DC voltage measurement function and set the range to "Auto". Make sure that the power supply is in CV mode. Read and record the reading (U_0) of the multimeter.

6. Set the electronic load to work in CC mode and adjust the current of the electronic load to the rated output current (please refer to Table 1-1) of the

channel (range) under test. Make sure that the power supply is in CV mode. Read and record the reading (U_1) of the multimeter.

7. Calculate the voltage variation (namely the CV load effect, $|U_1-U_0|$) and compare it with the specified specification in Table 2-1.

8. Press the **On/Off** key corresponding to the channel under test at the front channel to disable the output of the channel under test.

9. Repeat steps 1 to 8 to test the CV load regulation rates of CH2 and CH3 until finishing the CV load regulation rate tests of all channels.

Notes:

- For the single channel model with multiple ranges of DP800 series (DP811A), please first select a range and set the corresponding parameters of this range in step 3 and then perform steps 4 to 8 to test the CV load regulation rate of this range. Then, repeat steps 3 to 8 to test the CV load regulation rate of the other range.
- For the channels that support the Sense function of DP800 series, please connect DP800, AC power supply, electronic load and multimeter according to Figure 2-2 and turn on the Sense function of the channel after selecting the current channel in step 3.

Test Record Forms:

Table 2-1 DP831A CV Load Regulation Rate Test Record Form

Channel		CH1 (8V/5A)	CH2 (30V/2A)	CH3 (-30V/2A)
Specification		<2.8mV	<5mV	<5mV
DP831A Setting	Voltage	8V	30V	-30V
	Current	5.3A	2.1A	2.1A
Measurement Result	U_0			
	U_1			
	$\|U_1-U_0\|$			

Table 2-2 DP832A CV Load Regulation Rate Test Record Form

Channel		CH1 (30V/3A)	CH2 (30V/3A)	CH3 (5V/3A)
Specification		<5mV	<5mV	<2.5mV
DP832A Setting	Voltage	30V	30V	5V
	Current	3.2A	3.2A	3.2A
Measurement Result	U_0			
	U_1			
	$\|U_1-U_0\|$			

Table 2-3 DP832 CV Load Regulation Rate Test Record Form

Channel		CH1 (30V/3A)	CH2 (30V/3A)	CH3 (5V/3A)
Specification		<5mV	<5mV	<2.5mV
DP832 Setting	Voltage	30V	30V	5V
	Current	3.2A	3.2A	3.2A
Measurement Result	U_0			
	U_1			
	$\|U_1-U_0\|$			

Table 2-4 DP821A CV Load Regulation Rate Test Record Form

Channel		CH1 (60V/1A)	CH2 (8V/10A)
Specification		<8mV	<2.8mV
DP821A Setting	Voltage	60V	8V
	Current	1.05A	10.5A
Measurement Result	U_0		
	U_1		
	$\|U_1-U_0\|$		

Table 2-5 DP811A CV Load Regulation Rate Test Record Form

Range		Range1 (20V/10A)	Range2 (40V/5A)
Specification		<4mV	<6mV
DP811A Setting	Voltage	20V	40V
	Current	10.5A	5.3A
Measurement Result	U_0		
	U_1		
	$\|U_1-U_0\|$		

CV Linear Regulation Rate (CV Source Effect)

CV linear regulation rate refers to the relation 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 under CV output mode.

DP831A is taken as an example to test the CV linear regulation rate of DP800 series in the following section.

Note: During the actual test, please select the corresponding test record form according to the model of the DP800 power supply under test to set the corresponding parameters, record and calculate the corresponding specifications.

Specification:

Linear Regulation Rate, ± (Output Percentage+Offset)	
Voltage	<0.01%+2mV

Test Procedures:

1. Turn off DP800. Connect DP800, AC power supply, electronic load and multimeter according to Figure 2-1. Both the electronic load and multimeter are connected with the channel output terminals of DP800; please refer to "**Test Precautions**" for the connection method. Here, CH1 is taken as an example and the connection method is also applicable to CH2 and CH3.

   Note: Set the voltage selector (100, 115 or 230) at the rear panel of DP800 according to your need and make sure that the fuse currently installed matches the actual input voltage (please refer to Table 2-6). As the test methods when selecting different voltages are the same, 230V is taken as an example for illustration.

2. Turn on the AC power supply; set its voltage to 230V and frequency to 50Hz.

   Note: The voltage setting of the AC power supply in this step should be in accordance with the value selected by the voltage selector at the rear panel of DP800.

3. Turn on DP800 and press the channel selecting key at the front panel to select CH1 as the channel to be tested. Set the voltage and current of the channel under test according to Table 2-7. Then, press the **On/Off** key corresponding to the channel under test to enable the output of the channel.

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 (please refer to Table 1-1) of the channel (range) under test.

5. Turn on the digital multimeter; select DC voltage measurement function and set the range to "Auto". Make sure that the power supply is in CV mode. Read and record the reading (U_0) of the multimeter.

6. Adjust the AC power supply to undervoltage state (namely the amplitude reduces by 10%, refer to Table 2-6); read and record the reading (U_1) of the multimeter. Adjust the AC power supply to overvoltage state (namely the amplitude increases by 10%, refer to Table 2-6); read and record the reading (U_2) of the multimeter.
   Note: The upper limit of the overvoltage of DP800 series is 250Vac.

7. Calculate the voltage variations (namely the CV source effect, $|U_1-U_0|$ and $|U_2-U_0|$) and compare them with the specified specifications in Table 2-7.

8. Press the **On/Off** key corresponding to the channel under test at the front channel to disable the output of the channel under test.

9. Repeat steps 1 to 8 to test the CV linear regulation rates of CH2 and CH3 until finishing the CV linear regulation rate tests of all channels.

Notes:

- For the single channel model with multiple ranges of DP800 series (DP811A), please first select a range and set the corresponding parameters of this range in step 3 and then perform step 4 to step 8 to test the CV linear regulation rate of this range. Then, repeat step 3 to step 8 to test the CV linear regulation rate of the other range.
- For the channels that support the Sense function of DP800 series, please connect DP800, AC power supply, electronic load and multimeter according to Figure 2-2 and turn on the Sense function of the channel after selecting the current channel in step 3.

Table 2-6 AC Power Supply Setting Form

DP831A/DP821A			
Voltage Selector	100	115	230
Fuse	T5A	T5A	T2.5A
Undervoltage (Vac)	90	103	207
Overvoltage (Vac)	110	127	250
DP832A/DP832/DP811A			
Voltage Selector	100	115	230
Fuse	T6.3A	T6.3A	T3.15A
Undervoltage (Vac)	90	103	207
Overvoltage (Vac)	110	127	250

Test Record Forms:

Table 2-7 DP831A CV Linear Regulation Rate Test Record Form

Channel		CH1 (8V/5A)	CH2 (30V/2A)	CH3 (-30V/2A)
Specification		<2.8mV	<5mV	<5mV
DP831A Setting	Voltage	8V	30V	-30V
	Current	5.3A	2.1A	2.1A
Measurement Result	U_0			
	U_1			
	U_2			
	$\lvert U_1-U_0 \rvert$			
	$\lvert U_2-U_0 \rvert$			

Table 2-8 DP832A CV Linear Regulation Rate Test Record Form

Channel		CH1 (30V/3A)	CH2 (30V/3A)	CH3 (5V/3A)
Specification		<5mV	<5mV	<2.5mV
DP832A Setting	Voltage	30V	30V	5V
	Current	3.2A	3.2A	3.2A
Measurement Result	U_0			
	U_1			
	U_2			
	$\lvert U_1-U_0 \rvert$			
	$\lvert U_2-U_0 \rvert$			

Table 2-9 DP832 CV Linear Regulation Rate Test Record Form

Channel		CH1 (30V/3A)	CH2 (30V/3A)	CH3 (5V/3A)
Specification		<5mV	<5mV	<2.5mV
DP832 Setting	Voltage	30V	30V	5V
	Current	3.2A	3.2A	3.2A
Measurement Result	U_0			
	U_1			
	U_2			
	$\lvert U_1-U_0 \rvert$			
	$\lvert U_2-U_0 \rvert$			

Table 2-10 DP821A CV Linear Regulation Rate Test Record Form

Channel		CH1 (60V/1A)	CH2 (8V/10A)
Specification		<8mV	<2.8mV
DP821A Setting	Voltage	60V	8V
	Current	1.05A	10.5A
Measurement Result	U_0		
	U_1		
	U_2		
	$\|U_1-U_0\|$		
	$\|U_2-U_0\|$		

Table 2-11 DP811A CV Linear Regulation Rate Test Record Form

Range		Range1 (20V/10A)	Range2 (40V/5A)
Specification		<4mV	<6mV
DP811A Setting	Voltage	20V	40V
	Current	10.5A	5.3A
Measurement 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) when outputting DC voltage is equivalent to superimposing a residual AC voltage on the DC output voltage. This residual AC voltage, namely the ripple and noise (usually, ripple is periodic offset while noise is random offset), can be expressed in RMS or peak-to-peak value form.

DP831A is taken as an example to test the CV ripple and noise of DP800 series in the following section.

Note: During the actual test, please select the corresponding test record form according to the model of the DP800 power supply under test to set and select the corresponding parameters, record and calculate the corresponding specifications.

Specification:

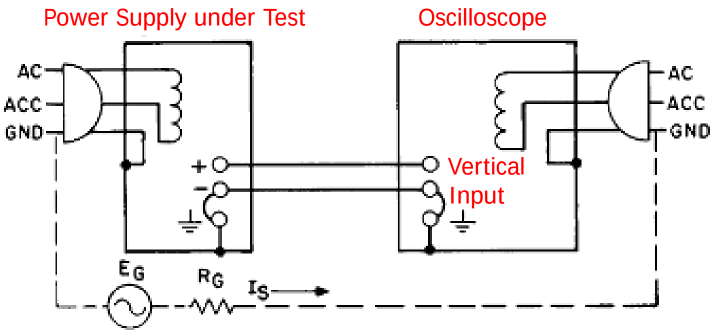
Ripple and Noise (20Hz-20MHz)	
Normal Mode Voltage	<350μVrms/2mVpp

Test Procedures:

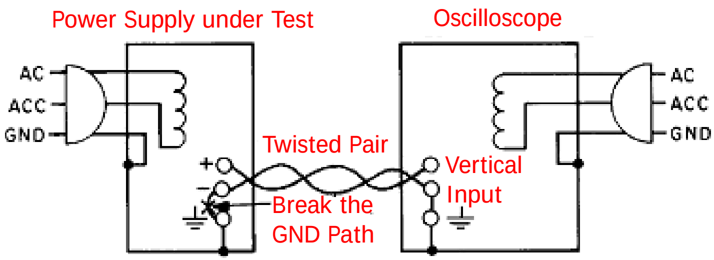
1. Turn off DP800. Connect DP800, AC power supply, resistive load and oscilloscope according to Figure 2-1. Both the resistive load and oscilloscope are connected with the channel output terminals of DP800; please refer to "**Test Precautions**" for the connection method. Here, CH1 is taken as an example and the connection method is also applicable to CH2 and CH3.

   Notes:

   - Do not connect the negative terminal of the output terminal of the channel to be tested to the shielding ground; otherwise, a ground loop would be formed. In Figure 2-3, the connection in figure A forms a ground loop while figure B shows the correct connection.



A. Incorrect Connection



B. Correct Connection

Figure 2-3 Peak-peak Value Measurement Connections

- Please use resistive load instead of electronic load to avoid the effect on the noise measurement of the power supply caused by the electronic load noise. Please refer to Table 2-12 for the resistance of the resistive load.
- Connect the positive terminal of the oscilloscope probe to the positive terminal (+) of the output terminals of the channel under test of the power supply and connect the ground terminal of the oscilloscope probe to the negative terminal (-) of the output terminals of the channel under test of the power supply. During the test, please ensure the effective contact. Note that you are recommended to use ground spring as ground wire so as to minimize the current coupling area between the probe tip and the ground wire and to minimize the space radiation interference.

2. Turn on the AC power supply; set its voltage to 230V and frequency to 50Hz.

   Note: The voltage setting of the AC power supply in this step should be in accordance with the value selected by the voltage selector at the rear panel of DP800.

3. Turn on DP800 and press the channel selecting key at the front panel to select CH1 as the channel to be tested. Set the voltage and current of the channel under test according to Table 2-12. Then, press the **On/Off** key corresponding to the channel under test to enable the output of the channel.

4. Turn on the oscilloscope and set the oscilloscope parameters. Set the timebase to 5ms/div, the vertical scale to 2mV, the sample mode to peak detect, the coupling mode to AC and the trigger source to AC Line. The input impedance is 1MΩ. Enable the 20MHz bandwidth limit and then enable the peak-peak value measurement function of the oscilloscope. Make sure that the power supply is in CV mode. Read and record the peak-peak value (Vpp) measured by the oscilloscope and compare it with the specified specification in Table 2-12.

5. Turn off the oscilloscope and disconnect the connection between DP800 and the oscilloscope. Connect DP800, AC power supply, 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 (Vrms) measured by the RMS voltmeter and compare it with the specified specification in Table 2-12.

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

6. Press the **On/Off** key corresponding to the channel under test at the front channel to disable the output of the channel under test.

7. Repeat steps 1 to 6 to test the CV ripple and noise of CH2 and CH3 until finishing the CV ripple and noise tests of all channels.

Notes:

- During the CV ripple and noise test, please pay attention to shield the effect of the environmental space radiation noise on the test effectively.
- For the single channel model with multiple ranges of DP800 series (DP811A), please first select a range and set the corresponding parameters of this range in step 3 and then perform step 4 to step 6 to test the CV ripple and noise of this range. Then, repeat step 3 to step 6 to test the CV ripple and noise of the other range.
- For the channels that support the Sense function of DP800 series, please connect DP800, AC power supply, resistive load and oscilloscope (RMS voltmeter) according to Figure 2-2 and turn on the Sense function of the channel after selecting the current channel in step 3.

Test Record Forms:

Table 2-12 DP831A CV Ripple and Noise Test Record Form

Channel		CH1 (8V/5A)	CH2 (30V/2A)	CH3 (-30V/2A)
Specification		<350μVrms/3mVpp		
Resistive Load R_L		1.6Ω	15Ω	15Ω
DP831A Setting	Voltage	8V	30V	-30V
	Current	5.3A	2.1A	2.1A
Measurement Result	Peak-peak value (Vpp)			
	RMS value (Vrms)			

Table 2-13 DP832A CV Ripple and Noise Test Record Form

Channel		CH1 (30V/3A)	CH2 (30V/3A)	CH3 (5V/3A)
Specification		<350μVrms/3mVpp		
Resistive Load R_L		10Ω	10Ω	1.6Ω
DP832A Setting	Voltage	30V	30V	5V
	Current	3.2A	3.2A	3.2A
Measurement Result	Peak-peak value (Vpp)			
	RMS value (Vrms)			

Table 2-14 DP832 CV Ripple and Noise Test Record Form

Channel		CH1 (30V/3A)	CH2 (30V/3A)	CH3 (5V/3A)
Specification		<350μVrms/3mVpp		
Resistive Load R_L		10Ω	10Ω	1.6Ω
DP832 Setting	Voltage	30V	30V	5V
	Current	3.2A	3.2A	3.2A
Measurement Result	Peak-peak value (Vpp)			
	RMS value (Vrms)			

Table 2-15 DP821A CV Ripple and Noise Test Record Form

Channel		CH1 (60V/1A)	CH2 (8V/10A)
Specification		<350μVrms/3mVpp	
Resistive Load R_L		60Ω	0.8Ω
DP821A Setting	Voltage	60V	8V
	Current	1.05A	10.5A
Measurement Result	Peak-peak value (Vpp)		
	RMS value (Vrms)		

Table 2-16 DP811A CV Ripple and Noise Test Record Form

Range		Range1 (20V/10A)	Range2 (40V/5A)
Specification		<350μVrms/3mVpp	
Resistive Load R_L		2Ω	8Ω
DP811A Setting	Voltage	20V	40V
	Current	10.5A	5.3A
Measurement Result	Peak-peak value (Vpp)		
	RMS value (Vrms)		

Transient Response Time

Transient response time refers to the time required for the output voltage of the power supply to recover to within 15mV following a transient variation in the load current (50% transient variation, namely the output current changes from full load to half load or vice versa). As shown in Figure 2-4, t is the transient response time.

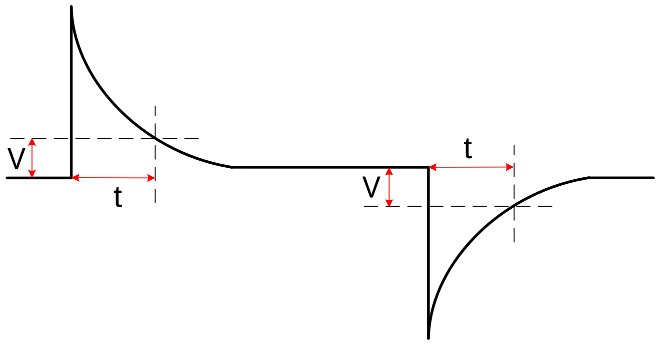


Figure 2-4 Transient Response Time

DP831A is taken as an example to test the transient response time of DP800 series in the following section.

Note: During the actual test, please select the corresponding test record form according to the model of the DP800 power supply under test to set the corresponding parameters, record and calculate the corresponding specifications.

Specification:

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

Test Procedures:

1. Turn off DP800. Connect DP800, AC power supply, electronic load and oscilloscope according to Figure 2-1. Both the electronic load and oscilloscope are connected with the channel output terminals of DP800; please refer to "**Test Precautions**" for the connection method. Here, CH1 is taken as an example and the connection method is also applicable to CH2 and CH3

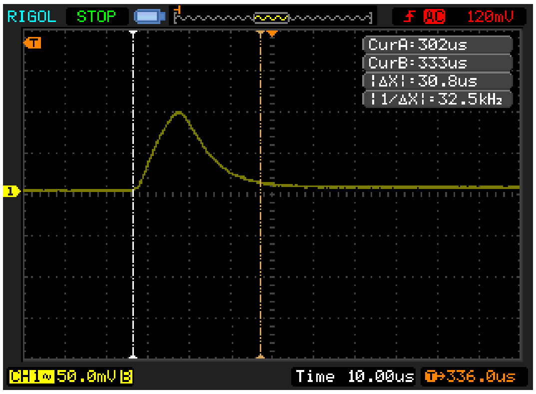
2. Turn on the AC power supply; set its voltage to 230V and frequency to 50Hz.

   Note: The voltage setting of the AC power supply in this step should be in accordance with the value selected by the voltage selector at the rear panel of DP800.

3. Turn on DP800 and press the channel selecting key at the front panel to select CH1 as the channel to be tested. Set the voltage and current of the channel under test according to Table 2-17. Then, press the **On/Off** key corresponding to the channel under test to enable the output of the channel.

4. Turn on the electronic load and set the electronic load parameters. Select the CC dynamic response mode (CCDH mode); set CCDH1 to the rated current value of the channel (range) under test, CCDH2 to the current value of the channel (range) under test with half load (for the CCDH1 and CCDH2 values, please refer to Table 2-17), CCDHT1 and CCDHT2 to 500μs (namely 1kHz frequency and 50% duty cycle), the rising edge time and falling edge time to 250mA/μs. Turn on the electronic load and make sure that the programmable electronic load is in CC mode.

5. Turn on the oscilloscope and set the oscilloscope parameters. Set the coupling mode to AC, the trigger source to AC Line and enable the 20MHz bandwidth limit. Enable the cursor measurement function and measure the transient response time (namely △X) displayed on the screen of the oscilloscope, as shown in the figure below, and compare it with the specified specification in Table 2-17.



6. Press the **On/Off** key corresponding to the channel under test at the front channel to disable the output of the channel under test.

7. Repeat steps 1 to 6 to test the transient response time of CH2 and CH3 until finishing the transient response time tests of all channels.

Notes:

- For the single channel model with multiple ranges of DP800 series (DP811A), please first select a range and set the corresponding parameters of this range in step 3 and then perform step 4 to step 6 to test the transient response time of this range. Then, repeat step 3 to step 6 to test the transient response time of the other range.
- For the channels that support the Sense function of DP800 series, please connect DP800, AC power supply, electronic load and oscilloscope according to Figure 2-2 and turn on the Sense function of the channel after selecting the current channel in step 3.

Test Record Forms:

Table 2-17 DP831A Transient Response Time Test Record Form

Channel		CH1 (8V/5A)	CH2 (30V/2A)	CH3 (-30V/2A)
Specification		<50μs		
DP831A Setting	Voltage	8V	30V	-30V
	Current	5.3A	2.1A	2.1A
Electronic Load Current Setting	CCDH1	5A	2A	2A
	CCDH2	2.5A	1A	1A
Measurement Result	t			

Table 2-18 DP832A Transient Response Time Test Record Form

Channel		CH1 (30V/3A)	CH2 (30V/3A)	CH3 (5V/3A)
Specification		<50μs		
DP832A Setting	Voltage	30V	30V	5V
	Current	3.2A	3.2A	3.2A
Electronic Load Current Setting	CCDH1	3A	3A	3A
	CCDH2	1.5A	1.5A	1.5A
Measurement Result	t			

Table 2-19 DP832 Transient Response Time Test Record Form

Channel		CH1 (30V/3A)	CH2 (30V/3A)	CH3 (5V/3A)
Specification		<50μs		
DP832 Setting	Voltage	30V	30V	5V
	Current	3.2A	3.2A	3.2A
Electronic Load Current Setting	CCDH1	3A	3A	3A
	CCDH2	1.5A	1.5A	1.5A
Measurement Result	t			

Table 2-20 DP821A Transient Response Time Test Record Form

Channel		CH1 (60V/1A)	CH2 (8V/10A)
Specification		<50μs	
DP821A Setting	Voltage	60V	8V
	Current	1.05A	10.5A
Electronic Load Current Setting	CCDH1	1A	10A
	CCDH2	0.5A	5A
Measurement Result	t		

Table 2-21 DP811A Transient Response Time Test Record Form

Range		Range1 (20V/10A)	Range2 (40V/5A)
Specification		<50μs	
DP811A Setting	Voltage	20V	40V
	Current	10.5A	5.3A
Electronic Load Current Setting	CCDH1	10A	5A
	CCDH2	5A	2.5A
Measurement Result	t		

CV Programming 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 actual output voltage value and the readback voltage value when the power supply is in CV mode.

DP831A is taken as an example to test the CV programming and readback accuracy of DP800 series in the following section.

Note: During the actual test, please select the corresponding test record form according to the model of the DP800 power supply under test to set the corresponding parameters, record and calculate the corresponding specifications.

Specification:

Annual Accuracy[1] (25℃±5℃)± (Output Percentage+Offset)			
Channel		**Programming**	**Readback**
DP831A	CH1 CH2 CH3	0.1%+5mV 0.05%+20mV 0.05%+20mV	0.1%+5mV 0.05%+10mV 0.05%+10mV
DP832A	CH1 CH2 CH3	0.05%+20mV 0.05%+20mV 0.1%+5mV	0.05%+10mV 0.05%+10mV 0.1%+5mV
DP832	CH1 CH2 CH3	0.05%+10mV 0.05%+10mV 0.05%+10mV	0.05%+5mV 0.05%+5mV 0.05%+5mV
DP821A	CH1 CH2	0.1%+25mV 0.05%+10mV	0.1%+25mV 0.05%+5mV
DP811A	CH1	0.05%+10mV	0.05%+10mV

Note[1]: The accuracy parameters are acquired via calibration under 25℃ after 1-hour warm-up.

Test Procedures:

1. Turn off DP800. Connect DP800, AC power supply and multimeter according to Figure 2-1. The multimeter is connected with the channel output terminals of DP800; please refer to "**Test Precautions**" for the connection method. Here, CH1 is taken as an example and the connection method is also applicable to CH2 and CH3. Then, connect the power supply with PC (take the connection via USB cable as an example) via the remote interfaces (USB, GPIB, LAN).

2. Turn on the AC power supply; set its voltage to 230V and frequency to 50Hz.

   Note: The voltage setting of the AC power supply in this step should be in accordance with the value selected by the voltage selector at the rear panel of DP800.

3. Measure the CV programming and readback accuracy (take CH1 as an example in this place) when the output voltage is 0V.

   1) Turn on DP800. Send the following commands via the remote interface to select the channel to be tested (namely the current channel), set the voltage and current of this channel (please refer to Table 2-22) as well as enable the output of this channel.

   :APPL CH1,0,5.3 /*Select CH1 as the current channel and set the voltage and current of this channel to 0V and 5.3A respectively*/
   :OUTP CH1,ON /*Enable the output of CH1*/

   Notes:

   - The above commands are only applicable to the multi-channel models of DP800. You can also send the :INST:NSEL 1 (or :INST CH1) command to select CH1 as the current channel, the :SOUR1:VOLT 0 command to set the voltage of CH1 to 0V and the :SOUR1:CURR 5.3 command to set the current of CH1 to 5.3A.
   - For the single channel model with multiple ranges of DP800 series (DP811A), you can send the :OUTP:RANG P20V (or :OUTP:RANG LOW, or :VOLT:RANG P20V, or :VOLT:RANG LOW) command to select Range1 as the current range and then send the :VOLT 0 command to set the voltage of the channel to 0V and the :CURR 10.5 command to set the current of the channel to 10.5A.

   2) Turn on the digital multimeter; select DC voltage measurement function and set the range to “Auto”. Make sure that the power supply is in CV mode. Read and record the reading (U_1) of the 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 ($|U_1\text{-}0|$) and the CV readback accuracy ($|U_2\text{-}U_1|$). Compare them with the specified specifications in Table 2-22.

4. Measure the CV programming and readback accuracy (take CH1 as an example in this place) when the output voltage is the rated output value.

   1) Send the following command via the remote interface to select the channel to be tested (namely the current channel) and set the voltage and current

of this channel (please refer to Table 2-22).

:APPL CH1,8,5.3 /*Select CH1 as the current channel and set the voltage and current of this channel to 8V and 5.3A respectively*/

Notes:

- The above command is only applicable to the multi-channel models of DP800. You can also send the :INST:NSEL 1 (or :INST CH1) command to select CH1 as the current channel, the :SOUR1:VOLT 8 command to set the voltage of CH1 to 8V and the :SOUR1:CURR 5.3 command to set the current of CH1 to 5.3A.
- For the single channel model with multiple ranges of DP800 series (DP811A), you can send the :OUTP:RANG P20V (or :OUTP:RANG LOW, or :VOLT:RANG P20V, or :VOLT:RANG LOW) command to select Range1 as the current range and then send the :VOLT 20 command to set the voltage of the channel to 20V and the :CURR 10.5 command to set the current of the channel to 10.5A.

2) Make sure that the power supply is in CV mode. Read and record the reading (U_3) of the 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 2-22. Wherein, U_R is the rated output voltage of the channel under test.

5) Send the following command via the remote interface to disable the output of the channel under test.

:OUTP CH1,OFF /*Disable the output of CH1*/

5. Repeat steps 1 to 4 to test the CV programming and readback accuracy of CH2 and CH3 until finishing the CV programming and readback accuracy tests of all channels.

Note: For the multi-channel models of DP800 series, please replace the “CH1” in the remote commands in steps 3 and 4 with “CH2” or “CH3” to select and set the corresponding channel.

Notes:

- For the single channel model with multiple ranges of DP800 series (DP811A), please first select Range1, set the parameters of Range1 and measure the CV programming and readback accuracy of this range in steps 3 and 4. Then, repeat step 3 and step 4 to test the CV programming and readback accuracy of Range2 (please replace the “P20V” or “LOW” in the remote commands in steps 3 and 4 with “P40V” or “HIGH”).
- For the channels that support the Sense function of DP800 series, please connect DP800, AC power supply and multimeter according to Figure 2-2 and send the remote command (DP821A: :OUTP:SENS CH2,ON; DP811A: :OUTP:SENS CH1,ON) to turn on the Sense function of the channel under test before turning on the output of the channel under test in step 3.

Test Record Forms:

Table 2-22 DP831A CV Programming and Readback Accuracy Test Record Form

Channel		CH1 (8V/5A)	CH2 (30V/2A)	CH3 (-30V/2A)
Specification	Programming	<13mV	<35mV	<35mV
	Readback	<13mV	<25mV	<25mV
The output voltage is 0				
DP831A Setting	Voltage	0V	0V	0V
	Current	5.3A	2.1A	2.1A
Measurement Result	U_1			
	U_2			
	Programming: $\lvert U_1-0 \rvert$			
	Readback: $\lvert U_2-U_1 \rvert$			
The output voltage is U_R[1]				
DP831A Setting	Voltage	8V	30V	-30V
	Current	5.3A	2.1A	2.1A
Measurement Result	U_3			
	U_4			
	Programming: $\lvert U_3-U_R \rvert$[1]			
	Readback: $\lvert U_4-U_3 \rvert$			

Note[1]: The rated voltage of the specified channel.

Table 2-23 DP832A CV Programming and Readback Accuracy Test Record Form

<table>
<tr><th colspan="2">Channel</th><th>CH1 (30V/3A)</th><th>CH2 (30V/3A)</th><th>CH3 (5V/3A)</th></tr>
<tr><td rowspan="2">Specification</td><td>Programming</td><td><35mV</td><td><35mV</td><td><10mV</td></tr>
<tr><td>Readback</td><td><25mV</td><td><25mV</td><td><10mV</td></tr>
<tr><td colspan="5">The output voltage is 0</td></tr>
<tr><td rowspan="2">DP832A Setting</td><td>Voltage</td><td>0V</td><td>0V</td><td>0V</td></tr>
<tr><td>Current</td><td>3.2A</td><td>3.2A</td><td>3.2A</td></tr>
<tr><td rowspan="4">Measurement Result</td><td>U_1</td><td></td><td></td><td></td></tr>
<tr><td>U_2</td><td></td><td></td><td></td></tr>
<tr><td>Programming: $|U_1-0|$</td><td></td><td></td><td></td></tr>
<tr><td>Readback: $|U_2-U_1|$</td><td></td><td></td><td></td></tr>
<tr><td colspan="5">The output voltage is U_R[1]</td></tr>
<tr><td rowspan="2">DP832A Setting</td><td>Voltage</td><td>30V</td><td>30V</td><td>5V</td></tr>
<tr><td>Current</td><td>3.2A</td><td>3.2A</td><td>3.2A</td></tr>
<tr><td rowspan="4">Measurement Result</td><td>U_3</td><td></td><td></td><td></td></tr>
<tr><td>U_4</td><td></td><td></td><td></td></tr>
<tr><td>Programming: $|U_3-U_R|$[1]</td><td></td><td></td><td></td></tr>
<tr><td>Readback: $|U_4-U_3|$</td><td></td><td></td><td></td></tr>
</table>

Note[1]: The rated voltage of the specified channel.

Table 2-24 DP832 CV Programming and Readback Accuracy Test Record Form

Channel		CH1 (30V/3A)	CH2 (30V/3A)	CH3 (5V/3A)
Specification	Programming	<25mV	<25mV	<12.5mV
	Readback	<20mV	<20mV	<7.5mV
The output voltage is 0				
DP832 Setting	Voltage	0V	0V	0V
	Current	3.2A	3.2A	3.2A
Measurement Result	U_1			
	U_2			
	Programming: $\|U_1-0\|$			
	Readback: $\|U_2-U_1\|$			
The output voltage is U_R[1]				
DP832 Setting	Voltage	30V	30V	5V
	Current	3.2A	3.2A	3.2A
Measurement Result	U_3			
	U_4			
	Programming: $\|U_3-U_R\|$[1]			
	Readback: $\|U_4-U_3\|$			

Note[1]: The rated voltage of the specified channel.

Table 2-25 DP821A CV Programming and Readback Accuracy Test Record Form

Channel		CH1 (60V/1A)	CH2 (8V/10A)
Specification	Programming	<85mV	<14mV
	Readback	<85mV	<9mV
The output voltage is 0			
DP821A Setting	Voltage	0V	0V
	Current	1.05A	10.5A
Measurement Result	U_1		
	U_2		
	Programming: $\|U_1-0\|$		
	Readback: $\|U_2-U_1\|$		
The output voltage is U_R[1]			
DP821A Setting	Voltage	60V	8V
	Current	1.05A	10.5A
Measurement Result	U_1		
	U_2		
	Programming: $\|U_3-U_R$[1]$\|$		
	Readback: $\|U_4-U_3\|$		

Note[1]: The rated voltage of the specified channel.

Table 2-26 DP811A CV Programming and Readback Accuracy Test Record Form

Range		Range1 (20V/10A)	Range2 (40V/5A)
Specification	Programming	<20mV	<30mV
	Readback	<20mV	<30mV
The output voltage is 0			
DP811A Setting	Voltage	0V	0V
	Current	10.5A	5.3A
Measurement Result	U_1		
	U_2		
	Programming: $\|U_1-0\|$		
	Readback: $\|U_2-U_1\|$		
The output voltage is U_R[1]			
DP811A Setting	Voltage	20V	40V
	Current	10.5A	5.3A
Measurement Result	U_1		
	U_2		
	Programming: $\|U_3-U_R\|$[1]		
	Readback: $\|U_4-U_3\|$		

Note[1]: The rated voltage of the specified range.

Chapter 3 Constant Current Tests

Topics of this chapter:

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

Preparations

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

Before performing the tests, select the appropriate voltage via the "voltage selector" at the rear panel of the power supply according to the AC line voltage of the country (230V is taken as an example in all the tests in this manual). Under normal temperature (about 25℃), make connections according to Figure 3-1 or Figure 3-2 using the devices recommended in "**Recommended Test Devices**" (for CC ripple and noise test, please connect the desired devices according to Figure 2-1 or Figure 2-2). During the test process, please set the voltage of the AC power supply according to the voltage selected of the "voltage selector" at the rear panel of the power supply.

In CC tests (not including CC ripple and noise test), a current sampling resistor should be connected between the power supply under test and the electronic load serially to convert the current signal under test to voltage signal for the measurement of related parameters.

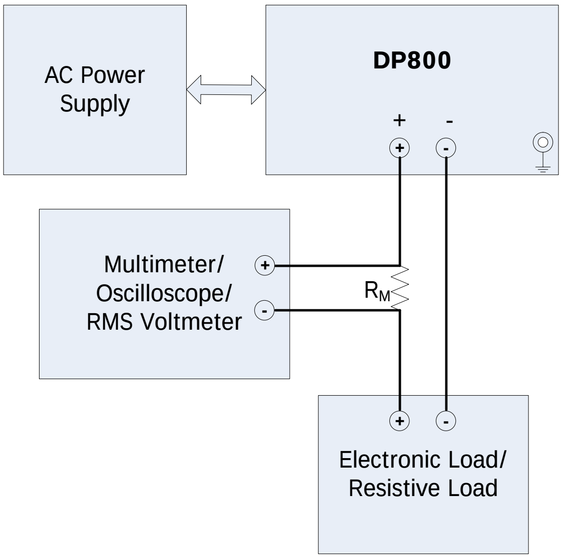


Figure 3-1 CC Test Connections

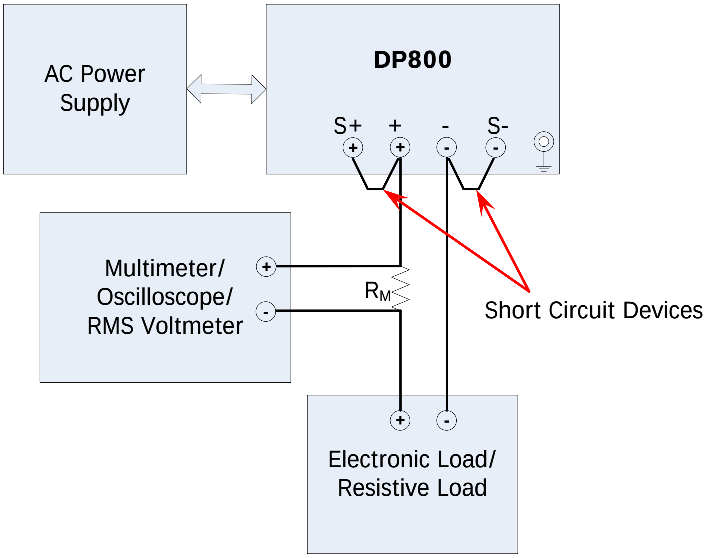


Figure 3-2 CC Test Connections (Sense)

Notes:

- During the CC tests, make connections according to Figure 3-1 for the normal channels (namely the channels that do not support the Sense function) of the DP800 series power supply. For the channels that support the Sense function (CH2 of DP821A and DP811A), make connections according to Figure 3-2 (note to short-circuit the (S+) and (+) terminals, (S-) and (-) terminals of the channel respectively) and turn on the Sense function of the channel during the test process to measure the specifications under Sense mode.
- The R_M in the figures above is a 4-wire current sampling resistor (please select current sampling resistor with suitable resistance according to the test item and the channel to be tested). As shown in Figure 3-3, **C** represents the current measurement terminal and **S** represents the voltage measurement terminal. During the test, please make the correct connections.

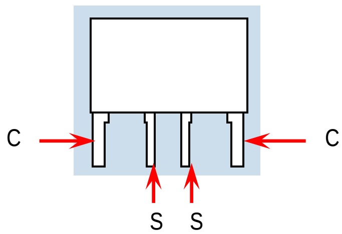


Figure 3-3 4-wire Current Sampling Resistor

CC Load Regulation Rate (CC Load Effect)

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

DP831A is taken as an example to test the CC load regulation rate of DP800 series in the following section.

Note: During the actual test, please select the corresponding test record form according to the model of the DP800 power supply under test to set the corresponding parameters, record and calculate the corresponding specifications.

Specification:

Load Regulation Rate, ± (Output Percentage+Offset)	
Current	<0.01%+250μA

Test Procedures:

1. Turn off DP800. Connect DP800, AC power supply, current sampling resistor (the resistance R_M is 0.022Ω), electronic load and multimeter according to Figure 3-1. Please pay attention to the connection method of the current sampling resistor, electronic load and the channel output terminals of DP800 as well as the connection method of the current sampling resistor and multimeter. Here, CH1 is taken as an example and the connection method is also applicable to CH2 and CH3.

2. Turn on the AC power supply; set its voltage to 230V and frequency to 50Hz.

   Note: The voltage setting of the AC power supply in this step should be in accordance with the value selected by the voltage selector at the rear panel of DP800.

3. Turn on DP800 and press the channel selecting key at the front panel to select CH1 as the channel to be tested. Set the voltage and current of the channel under test according to Table 3-1. Then, press the **On/Off** key corresponding to the channel under test to enable the output of the channel.

4. Turn on the electronic load. Set the electronic load to short circuit mode. At this point, the channel under test of the power supply is in CC mode.

5. Turn on the digital multimeter; select DC voltage measurement function and set the range to "Auto". Make sure that the power supply is in CC mode. Read and record the reading (U_0, namely the voltage of the current sampling resistor) of the multimeter.

6. Set the electronic load to work in CV mode and adjust the voltage of the electronic load to the rated output voltage (please refer to Table 1-1) of the channel (range) under test. At this point, the channel under test of the power supply is still in CC mode and is near full load output. Read and record the reading (U_1) of the multimeter.

7. Calculate the current variation ($|U_1/R_M-U_0/R_M|$) and compare it with the specified specification in Table 3-1.

8. Press the **On/Off** key corresponding to the channel under test at the front channel to disable the output of the channel under test.

9. Repeat steps 1 to 8 to test the CC load regulation rates of CH2 and CH3 until finishing the CC load regulation rate tests of all channels.

Notes:

- For the single channel model with multiple ranges of DP800 series (DP811A), please first select a range and set the corresponding parameters of this range in step 3 and then perform steps 4 to 8 to test the CC load regulation rate of this range. Then, repeat steps 3 to 8 to test the CC load regulation rate of the other range.
- For the channels that support the Sense function of DP800 series, please connect DP800, AC power supply, current sampling resistor, electronic load and multimeter according to Figure 3-2 and turn on the Sense function of the channel after selecting the current channel in step 3.

Test Record Forms:

Table 3-1 DP831A CC Load Regulation Rate Test Record Form

Channel		CH1 (8V/5A)	CH2 (30V/2A)	CH3 (-30V/2A)
Specification		<750μA	<450μA	<450μA
DP831A Setting	Voltage	8.4V	32V	-32V
	Current	5A	2A	2A
Measurement Result	U_0			
	U_1			
	$\|U_1/R_M$[1]$-U_0/R_M$[1]$\|$			

Note[1]: R_M=0.022Ω.

Table 3-2 DP832A CC Load Regulation Rate Test Record Form

Channel		CH1 (30V/3A)	CH2 (30V/3A)	CH3 (5V/3A)
Specification		<550μA		
DP832A Setting	Voltage	32V	32V	5.3V
	Current	3A	3A	3A
Measurement Result	U_0			
	U_1			
	$\lvert U_1/R_M^{[1]}-U_0/R_M^{[1]}\rvert$			

Note[1]: R_M=0.022Ω.

Table 3-3 DP832 CC Load Regulation Rate Test Record Form

Channel		CH1 (30V/3A)	CH2 (30V/3A)	CH3 (5V/3A)
Specification		<550μA		
DP832 Setting	Voltage	32V	32V	5.3V
	Current	3A	3A	3A
Measurement Result	U_0			
	U_1			
	$\lvert U_1/R_M^{[1]}-U_0/R_M^{[1]}\rvert$			

Note[1]: R_M=0.022Ω.

Table 3-4 DP821A CC Load Regulation Rate Test Record Form

Channel		CH1 (60V/1A)	CH2 (8V/10A)
Specification		<350μA	<1.25mA
DP821A Setting	Voltage	63V	8.4V
	Current	1A	10A
Measurement Result	U_0		
	U_1		
	$\lvert U_1/R_M^{[1]}-U_0/R_M^{[1]}\rvert$		

Note[1]: R_M=0.022Ω.

Table 3-5 DP811A CC Load Regulation Rate Test Record Form

Range		Range1 (20V/10A)	Range2 (40V/5A)
Specification		<1.25mA	<750μA
DP811A Setting	Voltage	21V	42V
	Current	10A	5A
Measurement Result	U_0		
	U_1		
	$\lvert U_1/R_M^{[1]}-U_0/R_M^{[1]}\rvert$		

Note[1]: R_M=0.022Ω.

CC Linear Regulation Rate (CC Source Effect)

CC linear regulation rate refers to the relation 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 under CC output mode.

DP831A is taken as an example to test the CC linear regulation rate of DP800 series in the following section.

Note: During the actual test, please select the corresponding test record form according to the model of the DP800 power supply under test to set the corresponding parameters, record and calculate the corresponding specifications.

Specification:

Linear Regulation Rate, ± (Output Percentage+Offset)	
Current	<0.01%+250μA

Test Procedures:

1. Turn off DP800. Connect DP800, AC power supply, current sampling resistor (the resistance R_M is 0.022Ω), electronic load and multimeter according to Figure 3-1. Please pay attention to the connection method of the current sampling resistor, electronic load and the channel output terminals of DP800 as well as the connection method of the current sampling resistor and multimeter. Here, CH1 is taken as an example and the connection method is also applicable to CH2 and CH3.

   Note: Set the voltage selector (100, 115 or 230) at the rear panel of DP800 according to your need and make sure that the fuse currently installed matches the actual input voltage (please refer to Table 2-6). As the test methods when selecting different voltages are the same, 230V is taken as an example for illustration.

2. Turn on the AC power supply; set its voltage to 230V and frequency to 50Hz.

   Note: The voltage setting of the AC power supply in this step should be in accordance with the value selected by the voltage selector at the rear panel of DP800.

3. Turn on DP800 and press the channel selecting key at the front panel to select CH1 as the channel to be tested. Set the voltage and current of the channel under test according to Table 3-6. Then, press the **On/Off** key corresponding to the channel under test to enable the output of the channel.

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 (please refer to Table 1-1) of the channel (range) under test.

5. Turn on the digital multimeter; select DC voltage measurement function and set the range to "Auto". Make sure that the power supply is in CC mode. Read and record the reading (U_0, namely the voltage of the current sampling resistor) of the multimeter.

6. Adjust the AC power supply to undervoltage state (namely the amplitude reduces by 10%, refer to Table 2-6); read and record the reading (U_1) of the multimeter. Adjust the AC power supply to overvoltage state (namely the amplitude increases by 10%, refer to Table 2-6); read and record the reading (U_2) of the multimeter.

   Note: The upper limit of the overvoltage of DP800 series is 250Vac.

7. Calculate the voltage variations (namely the CC source effect, $|U_1-U_0|/R_M$ and $|U_2-U_0|/R_M$) and compare them with the specified specifications in Table 3-6.

8. Press the **On/Off** key corresponding to the channel under test at the front channel to disable the output of the channel under test.

9. Repeat steps 1 to 8 to test the CC linear regulation rates of CH2 and CH3 until finishing the CC linear regulation rate tests of all channels.

Notes:

- For the single channel model with multiple ranges of DP800 series (DP811A), please first select a range and set the corresponding parameters of this range in step 3 and then perform step 4 to step 8 to test the CC linear regulation rate of this range. Then, repeat step 3 to step 8 to test the CC linear regulation rate of the other range.
- For the channels that support the Sense function of DP800 series, please connect DP800, AC power supply, current sampling resistor, electronic load and multimeter according to Figure 3-2 and turn on the Sense function of the channel after selecting the current channel in step 3.

Test Record Forms:

Table 3-6 DP831A CC Linear Regulation Rate Test Record Form

Channel		CH1 (8V/5A)	CH2 (30V/2A)	CH3 (-30V/2A)
Specification		<750μA	<450μA	<450μA
DP831A Setting	Voltage	8.4V	32V	-32V
	Current	5A	2A	2A
Measurement 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=0.022Ω.

Table 3-7 DP832A CC Linear Regulation Rate Test Record Form

Channel		CH1 (30V/3A)	CH2 (30V/3A)	CH3 (5V/3A)
Specification		<550μA		
DP832A Setting	Voltage	32V	32V	5.3V
	Current	3A	3A	3A
Measurement 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=0.022Ω.

Table 3-8 DP832 CC Linear Regulation Rate Test Record Form

Channel		CH1 (30V/3A)	CH2 (30V/3A)	CH3 (5V/3A)
Specification		<550μA		
DP832 Setting	Voltage	32V	32V	5.3V
	Current	3A	3A	3A
Measurement 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=0.022Ω.

Table 3-9 DP821A CC Linear Regulation Rate Test Record Form

Channel		CH1 (60V/1A)	CH2 (8V/10A)
Specification		<350μA	<1.25mA
DP821A Setting	Voltage	63V	8.4V
	Current	1A	10A
Measurement 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=0.022Ω.

Table 3-10 DP811A CC Linear Regulation Rate Test Record Form

Range		Range1 (20V/10A)	Range2 (40V/5A)
Specification		<1.25mA	<750μA
DP811A Setting	Voltage	21V	42V
	Current	10A	5A
Measurement 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=0.022Ω.

CC Ripple and Noise (Normal Mode)

When the power supply is working in CC mode, the ripple and noise are usually expressed in RMS value form.

DP831A is taken as an example to test the CC ripple and noise of DP800 series in the following section.

Note: During the actual test, please select the corresponding test record form according to the model of the DP800 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	<2mArms

Test Procedures:

1. Turn off DP800. Connect DP800, AC power supply, resistive load and RMS voltmeter according to Figure 2-1. Both the resistive load and RMS voltmeter are connected with the channel output terminals of DP800; please refer to "**Test Precautions**" for the connection method. Here, CH1 is taken as an example and the connection method is also applicable to CH2 and CH3.

   Note:
   - Do not connect the negative terminal of the output terminal of the channel to be tested to the shielding ground; otherwise, a ground loop would be formed. In Figure 2-3, the connection in figure A forms a ground loop while figure B shows the correct connection.
   - Please ensure to test the CC ripple and noise of DP800 under full load condition. Refer to Table 3-11 for the resistance of the resistive load.

2. Turn on the AC power supply; set its voltage to 230V and frequency to 50Hz.

   Note: The voltage setting of the AC power supply in this step should be in accordance with the value selected by the voltage selector at the rear panel of DP800.

3. Turn on DP800 and press the channel selecting key at the front panel to select CH1 as the channel to be tested. Set the voltage and current of the channel under test according to Table 3-11. Then, press the **On/Off** key corresponding to the channel under test to enable the output of the channel.

4. Turn on the RMS voltmeter and select the AC voltage random measurement mode (SETACV RNDM). Make sure that the power supply is in CC mode. Read

and record the RMS value (Vrms) measured by the RMS voltmeter.

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

5. Calculate the CC ripple and noise (Vrms/R_L) and compare it with the specified specification in Table 3-11.

6. Press the **On/Off** key corresponding to the channel under test at the front channel to disable the output of the channel under test.

7. Repeat steps 1 to 6 to test the CC ripple and noise (normal mode) of CH2 and CH3 until finishing the CC ripple and noise tests of all channels.

Notes:

- During the CC ripple and noise test, please pay attention to shield the effect of the environmental space radiation noise on the test effectively.
- For the single channel model with multiple ranges of DP800 series (DP811A), please first select a range and set the corresponding parameters of this range in step 3 and then perform step 4 to step 6 to test the CC ripple and noise of this range. Then, repeat step 3 to step 6 to test the CC ripple and noise of the other range.
- For the channels that support the Sense function of DP800 series, please connect DP800, AC power supply, resistive load and RMS voltmeter according to Figure 2-2 and turn on the Sense function of the channel after selecting the current channel in step 3.

Test Record Forms:

Table 3-11 DP831A CC Ripple and Noise Test Record Form

Channel		CH1 (8V/5A)	CH2 (30V/2A)	CH3 (-30V/2A)
Specification		<2mArms		
Resistive Load R_L		1.6Ω	15Ω	15Ω
DP831A Setting	Voltage	8.4V	32V	-32V
	Current	5A	2A	2A
Measurement Result	RMS value (Vrms)			
	Vrms/R_L			

Table 3-12 DP832A CC Ripple and Noise Test Record Form

Channel		CH1 (30V/3A)	CH2 (30V/3A)	CH3 (5V/3A)
Specification		<2mArms		
Resistive Load R_L		10Ω	10Ω	1.6Ω
DP832A Setting	Voltage	32V	32V	5.3V
	Current	3A	3A	3A
Measurement Result	RMS value (Vrms)			
	$Vrms/R_L$			

Table 3-13 DP832 CC Ripple and Noise Test Record Form

Channel		CH1 (30V/3A)	CH2 (30V/3A)	CH3 (5V/3A)
Specification		<2mArms		
Resistive Load R_L		10Ω	10Ω	1.6Ω
DP832 Setting	Voltage	32V	32V	5.3V
	Current	3A	3A	3A
Measurement Result	RMS value (Vrms)			
	$Vrms/R_L$			

Table 3-14 DP821A CC Ripple and Noise Test Record Form

Channel		CH1 (60V/1A)	CH2 (8V/10A)
Specification		<2mArms	
Resistive Load R_L		60Ω	0.8Ω
DP821A Setting	Voltage	63V	8.4V
	Current	1A	10A
Measurement Result	RMS value (Vrms)		
	$Vrms/R_L$		

Table 3-15 DP811A CC Ripple and Noise Test Record Form

Range		Range1 (20V/10A)	Range2 (40V/5A)
Specification		<2mArms	
Resistive Load R_L		2Ω	8Ω
DP811A Setting	Voltage	21V	42V
	Current	10A	5A
Measurement Result	RMS value (Vrms)		
	$Vrms/R_L$		

CC Programming and Readback Accuracy

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

DP831A is taken as an example to test the CC programming and readback accuracy of DP800 series in the following section.

Note: During the actual test, please select the corresponding test record form according to the model of the DP800 power supply under test to set the corresponding parameters, record and calculate the corresponding specifications.

Specification:

Annual Accuracy[1] (25℃±5℃)± (Output Percentage+Offset)			
Channel		**Programming**	**Readback**
DP831A	CH1 CH2 CH3	0.2%+10mA 0.2%+5mA 0.2%+5mA	0.2%+10mA 0.1%+5mA 0.1%+5mA
DP832A	CH1 CH2 CH3	0.2%+5mA 0.2%+5mA 0.2%+5mA	0.15%+5mA 0.15%+5mA 0.15%+5mA
DP832	CH1 CH2 CH3	0.2%+10mA 0.2%+10mA 0.2%+10mA	0.15%+5mA 0.15%+5mA 0.15%+5mA
DP821A	CH1 CH2	0.2%+10mA 0.2%+10mA	0.15%+10mA 0.15%+10mA
DP811A	CH1	0.1%+10mA	0.1%+10mA

Note[1]: The accuracy parameters are acquired via calibration under 25℃ after 1-hour warm-up.

Test Procedures:

1. Turn off DP800. Connect DP800, AC power supply, current sampling resistor (the resistance R_M is 0.022Ω) and multimeter according to Figure 3-1. Please pay attention to the connection method of the current sampling resistor and the channel output terminals of DP800 as well as the connection method of the current sampling resistor and multimeter. Here, CH1 is taken as an example and the connection method is also applicable to CH2 and CH3. Then, connect the power supply with PC (take the connection via USB cable as an example) via the remote interfaces (USB, GPIB, LAN).

2. Turn on the AC power supply; set its voltage to 230V and frequency to 50Hz.

   Note: The voltage setting of the AC power supply in this step should be in accordance with the value selected by the voltage selector at the rear panel of DP800.

3. Measure the CC programming and readback accuracy (take CH1 as an example in this place) when the output current is 0A.

   1) Turn on DP800. Send the following commands via the remote interface to select the channel to be tested (namely the current channel), set the voltage and current of this channel (please refer to Table 3-16) as well as enable the output of this channel.

```
:APPL CH1,8.4,0      /*Select CH1 as the current channel and set the
                       voltage and current of this channel to 8.4V and
                       0A respectively*/
:OUTP CH1,ON         /*Enable the output of CH1*/
```

   Notes:

   - The above commands are only applicable to the multi-channel models of DP800. You can also send the :INST:NSEL 1 (or :INST CH1) command to select CH1 as the current channel, the :SOUR1:VOLT 8.4 command to set the voltage of CH1 to 8.4V and the :SOUR1:CURR 0 command to set the current of CH1 to 0A.
   - For the single channel model with multiple ranges of DP800 series (DP811A), you can send the :OUTP:RANG P20V (or :OUTP:RANG LOW, or :VOLT:RANG P20V, or :VOLT:RANG LOW) command to select Range1 as the current range and then send the :VOLT 21 command to set the voltage of the channel to 21V and the :CURR 0 command to set the current of the channel to 0A.

   2) Turn on the digital multimeter; select DC voltage measurement function and set the range to “Auto”. Make sure that the power supply is in CC mode. Read and record the reading (U_1) of the 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 3-16.

4. Measure the CC programming and readback accuracy (take CH1 as an example in this place) when the output current is the rated output value.

   1) Send the following command via the remote interface to select the channel to be tested (namely the current channel) and set the voltage and current of this channel (please refer to Table 3-16).

      :APPL CH1,8.4,5 /* Select CH1 as the current channel and set the voltage and current of this channel to 8.4V and 5A respectively*/

      Notes:

      - The above command is only applicable to the multi-channel models of DP800. You can also send the :INST:NSEL 1 (or :INST CH1) command to select CH1 as the current channel, the :SOUR1:VOLT 8.4 command to set the voltage of CH1 to 8.4V and the :SOUR1:CURR 5 command to set the current of CH1 to 5A.
      - For the single channel model with multiple ranges of DP800 series (DP811A), you can send the :OUTP:RANG P20V (or :OUTP:RANG LOW, or :VOLT:RANG P20V, or :VOLT:RANG LOW) command to select Range1 as the current range and then send the :VOLT 21 command to set the voltage of the channel to 21V and the :CURR 10 command to set the current of the channel to 10A.

   2) Make sure that the power supply is in CC mode. Read and record the reading (U_3) of the 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 3-16. Wherein, I_R is the rated output current of the channel under test.

   5) Send the following command via the remote interface to disable the output of the channel under test.

      :OUTP CH1,OFF /*Disable the output of CH1*/

5. Repeat steps 1 to 4 to test the CC programming and readback accuracy of CH2 and CH3 until finishing the CC programming and readback accuracy tests of all channels.

   Note: For the multi-channel models of DP800 series, please replace the “CH1” in the remote commands in steps 3 and 4 with “CH2” or “CH3” to select and set the corresponding channel.

Notes:

- For the single channel model with multiple ranges of DP800 series (DP811A), please first select Range1, set the parameters of Range1 and measure the CC programming and readback accuracy of this range in steps 3 and 4. Then, repeat steps 3 and 4 to test the CC programming and readback accuracy of Range2 (please replace the "P20V" or "LOW" in the remote commands in steps 3 and 4 with "P40V" or "HIGH").
- For the channels that support the Sense function of DP800 series, please connect DP800, AC power supply, current sampling resistor and multimeter according to Figure 3-2 and send the remote command (DP821A: :OUTP:SENS CH2,ON; DP811A: :OUTP:SENS CH1,ON) to turn on the Sense function of the channel under test before turning on the output of the channel under test in step 3.

Test Record Forms:

Table 3-16 DP831A CC Programming and Readback Accuracy Test Record Form

Channel		CH1 (8V/5A)	CH2 (30V/2A)	CH3 (-30V/2A)
Specification	Programming	<20mA	<9mA	<9mA
	Readback	<20mA	<7mA	<7mA
The output current is 0				
DP831A Setting	Voltage	8.4V	32V	-32V
	Current	0A	0A	0A
Measurement Result	U_1			
	$I_1=U_1/R_M$[1]			
	I_2			
	Programming: $\|I_1-0\|$			
	Readback: $\|I_2-I_1\|$			
The output current is I_R[2]				
DP831A Setting	Voltage	8.4V	32V	-32V
	Current	5A	2A	2A
Measurement Result	U_3			
	$I_3=U_3/R_M$[1]			
	I_4			
	Programming: $\|I_3-I_R\|$[2]			
	Readback: $\|I_4-I_3\|$			

Note[1]: R_M=0.022Ω.
Note[2]: The rated current of the specified channel.

Table 3-17 DP832A CC Programming and Readback Accuracy Test Record Form

Channel		CH1 (30V/3A)	CH2 (30V/3A)	CH3 (5V/3A)
Specification	Programming	<11mA		
	Readback	<9.5mA		
The output current is 0				
DP832A Setting	Voltage	32V	32V	5.3V
	Current	0A	0A	0A
Measurement Result	U_1			
	$I_1=U_1/R_M$[1]			
	I_2			
	Programming: $\|I_1-0\|$			
	Readback: $\|I_2-I_1\|$			
The output current is I_R[2]				
DP832A Setting	Voltage	32V	32V	5.3V
	Current	3A	3A	3A
Measurement Result	U_3			
	$I_3=U_3/R_M$[1]			
	I_4			
	Programming: $\|I_3-I_R$[2]$\|$			
	Readback: $\|I_4-I_3\|$			

Note[1]: R_M=0.022Ω.
Note[2]: The rated current of the specified channel.

Table 3-18 DP832 CC Programming and Readback Accuracy Test Record Form

Channel		CH1 (30V/3A)	CH2 (30V/3A)	CH3 (5V/3A)
Specification	Programming	<16mA		
	Readback	<9.5mA		
The output current is 0				
DP832 Setting	Voltage	32V	32V	5.3V
	Current	0A	0A	0A
Measurement Result	U_1			
	$I_1=U_1/R_M$[1]			
	I_2			
	Programming: $\lvert I_1-0\rvert$			
	Readback: $\lvert I_2-I_1\rvert$			
The output current is I_R[2]				
DP832 Setting	Voltage	32V	32V	5.3V
	Current	3A	3A	3A
Measurement Result	U_3			
	$I_3=U_3/R_M$[1]			
	I_4			
	Programming: $\lvert I_3-I_R\rvert$[2]			
	Readback: $\lvert I_4-I_3\rvert$			

Note[1]: R_M=0.022Ω.
Note[2]: The rated current of the specified channel.

Table 3-19 DP821A CC Programming and Readback Accuracy Test Record Form

Channel		CH1 (60V/1A)	CH2 (8V/10A)
Specification	Programming	<12mA	<30mA
	Readback	<11.5mA	<25mA
The output current is 0			
DP821A Setting	Voltage	63V	8.4V
	Current	0A	0A
Measurement Result	U_1		
	$I_1=U_1/R_M$[1]		
	I_2		
	Programming: $\|I_1-0\|$		
	Readback: $\|I_2-I_1\|$		
The output current is I_R[2]			
DP821A Setting	Voltage	63V	8.4V
	Current	1A	10A
Measurement Result	U_3		
	$I_3=U_3/R_M$[1]		
	I_4		
	Programming: $\|I_3-I_R\|$[2]		
	Readback: $\|I_4-I_3\|$		

Note[1]: $R_M=0.022\Omega$.
Note[2]: The rated current of the specified channel.

Table 3-20 DP811A CC Programming and Readback Accuracy Test Record Form

Range		Range1 (20V/10A)	Range2 (40V/5A)
Specification	Programming	<20mA	<15mA
	Readback	<20mA	<15mA
The output current is 0			
DP811A Setting	Voltage	21V	42V
	Current	0A	0A
Measurement Result	U_1		
	$I_1=U_1/R_M$[1]		
	I_2		
	Programming: $\lvert I_1-0\rvert$		
	Readback: $\lvert I_2-I_1\rvert$		
The output current is I_R[2]			
DP811A Setting	Voltage	21V	42V
	Current	10A	5A
Measurement Result	U_3		
	$I_3=U_3/R_M$[1]		
	I_4		
	Programming: $\lvert I_3-I_R$[2]$\rvert$		
	Readback: $\lvert I_4-I_3\rvert$		

Note[1]: R_M=0.022Ω.
Note[2]: The rated current of the specified range.

Appendix

Appendix A: Test Result Record Forms

DP831A Performance Verification Test Record Form

RIGOL DP831A Programmable Linear DC Power Supply
Performance Verification Test Record Form

CV Load Regulation Rate

Channel		CH1 (8V/5A)	CH2 (30V/2A)	CH3 (-30V/2A)
Specification		<2.8mV	<5mV	<5mV
DP831A Setting	Voltage	8V	30V	-30V
	Current	5.3A	2.1A	2.1A
Measurement Result	U_0			
	U_1			
	$\|U_1-U_0\|$			

CV Linear Regulation Rate

Channel		CH1 (8V/5A)	CH2 (30V/2A)	CH3 (-30V/2A)
Specification		<2.8mV	<5mV	<5mV
DP831A Setting	Voltage	8V	30V	-30V
	Current	5.3A	2.1A	2.1A
Measurement Result	U_0			
	U_1			
	U_2			
	$\|U_1-U_0\|$			
	$\|U_2-U_0\|$			

CV Ripple and Noise

Channel		CH1 (8V/5A)	CH2 (30V/2A)	CH3 (-30V/2A)
Specification		<350μVrms/3mVpp		
Resistive Load R_L		1.6Ω	15Ω	15Ω
DP831A Setting	Voltage	8V	30V	-30V
	Current	5.3A	2.1A	2.1A
Measurement Result	Peak-peak value (Vpp)			
	RMS value (Vrms)			

Transient Response Time

Channel		CH1 (8V/5A)	CH2 (30V/2A)	CH3 (-30V/2A)
Specification		<50μs		
DP831A Setting	Voltage	8V	30V	-30V
	Current	5.3A	2.1A	2.1A
Electronic Load Current Setting	CCDH1	5A	2A	2A
	CCDH2	2.5A	1A	1A
Measurement Result	t			

CV Programming and Readback Accuracy

Channel		CH1 (8V/5A)	CH2 (30V/2A)	CH3 (-30V/2A)
Specification	Programming	<13mV	<35mV	<35mV
	Readback	<13mV	<25mV	<25mV
The output voltage is 0				
DP831A Setting	Voltage	0V	0V	0V
	Current	5.3A	2.1A	2.1A
Measurement Result	U_1			
	U_2			
	Programming: $\lvert U_1-0\rvert$			
	Readback: $\lvert U_2-U_1\rvert$			
The output voltage is U_R[1]				
DP831A Setting	Voltage	8V	30V	-30V
	Current	5.3A	2.1A	2.1A
Measurement Result	U_3			
	U_4			
	Programming: $\lvert U_3-U_R\rvert$[1]			
	Readback: $\lvert U_4-U_3\rvert$			

CC Load Regulation Rate

Channel		CH1 (8V/5A)	CH2 (30V/2A)	CH3 (-30V/2A)
Specification		<750μA	<450μA	<450μA
DP831A Setting	Voltage	8.4V	32V	-32V
	Current	5A	2A	2A
Measurement Result	U_0			
	U_1			
	$\lvert U_1/R_M - U_0/R_M\rvert$ [2]			

CC Linear Regulation Rate

Channel		CH1 (8V/5A)	CH2 (30V/2A)	CH3 (-30V/2A)
Specification		<750μA	<450μA	<450μA
DP831A Setting	Voltage	8.4V	32V	-32V
	Current	5A	2A	2A
Measurement 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

Channel		CH1 (8V/5A)	CH2 (30V/2A)	CH3 (-30V/2A)
Specification		<2mArms		
Resistive Load R_L		1.6Ω	15Ω	15Ω
DP831A Setting	Voltage	8.4V	32V	-32V
	Current	5A	2A	2A
Measurement Result	RMS value (Vrms)			
	Vrms/R_L			

CC Programming and Readback Accuracy

Channel		CH1 (8V/5A)	CH2 (30V/2A)	CH3 (-30V/2A)
Specification	Programming	<20mA	<9mA	<9mA
	Readback	<20mA	<7mA	<7mA
The output current is 0				
DP831A Setting	Voltage	8.4V	32V	-32V
	Current	0A	0A	0A
Measurement Result	U_1			
	$I_1=U_1/R_M$[2]			
	I_2			
	Programming: $\lvert I_1-0\rvert$			
	Readback: $\lvert I_2-I_1\rvert$			
The output current is I_R[3]				
DP831A Setting	Voltage	8.4V	32V	-32V
	Current	5A	2A	2A
Measurement Result	U_3			
	$I_3=U_3/R_M$[2]			
	I_4			
	Programming: $\lvert I_3-I_R$[3]$\rvert$			
	Readback: $\lvert I_4-I_3\rvert$			

Note[1]: The rated voltage of the specified channel.
Note[2]: R_M=0.022Ω.
Note[3]: The rated current of the specified channel.

DP832A Performance Verification Test Record Form

RIGOL DP832A Programmable Linear DC Power Supply
Performance Verification Test Record Form

CV Load Regulation Rate

Channel		CH1 (30V/3A)	CH2 (30V/3A)	CH3 (5V/3A)
Specification		<5mV	<5mV	<2.5mV
DP832A Setting	Voltage	30V	30V	5V
	Current	3.2A	3.2A	3.2A
Measurement Result	U_0			
	U_1			
	$\|U_1-U_0\|$			

CV Linear Regulation Rate

Channel		CH1 (30V/3A)	CH2 (30V/3A)	CH3 (5V/3A)
Specification		<5mV	<5mV	<2.5mV
DP832A Setting	Voltage	30V	30V	5V
	Current	3.2A	3.2A	3.2A
Measurement Result	U_0			
	U_1			
	U_2			
	$\|U_1-U_0\|$			
	$\|U_2-U_0\|$			

CV Ripple and Noise

Channel		CH1 (30V/3A)	CH2 (30V/3A)	CH3 (5V/3A)
Specification		<350μVrms/3mVpp		
Resistive Load R_L		10Ω	10Ω	1.6Ω
DP832A Setting	Voltage	30V	30V	5V
	Current	3.2A	3.2A	3.2A
Measurement Result	Peak-peak value (Vpp)			
	RMS value (Vrms)			

Transient Response Time

Channel		CH1 (30V/3A)	CH2 (30V/3A)	CH3 (5V/3A)
Specification		<50μs		
DP832A Setting	Voltage	30V	30V	5V
	Current	3.2A	3.2A	3.2A
Electronic Load Current Setting	CCDH1	3A	3A	3A
	CCDH2	1.5A	1.5A	1.5A
Measurement Result	t			

CV Programming and Readback Accuracy

Channel		CH1 (30V/3A)	CH2 (30V/3A)	CH3 (5V/3A)
Specification	Programming	<35mV	<35mV	<10mV
	Readback	<25mV	<25mV	<10mV
The output voltage is 0				
DP832A Setting	Voltage	0V	0V	0V
	Current	3.2A	3.2A	3.2A
Measurement Result	U_1			
	U_2			
	Programming: $\lvert U_1-0 \rvert$			
	Readback: $\lvert U_2-U_1 \rvert$			
The output voltage is U_R[1]				
DP832A Setting	Voltage	30V	30V	5V
	Current	3.2A	3.2A	3.2A
Measurement Result	U_3			
	U_4			
	Programming: $\lvert U_3-U_R \rvert$[1]			
	Readback: $\lvert U_4-U_3 \rvert$			

CC Load Regulation Rate

<table>
<tr><th colspan="2">Channel</th><td>CH1 (30V/3A)</td><td>CH2 (30V/3A)</td><td>CH3 (5V/3A)</td></tr>
<tr><th colspan="2">Specification</th><td colspan="3"><550μA</td></tr>
<tr><th rowspan="2">DP832A Setting</th><td>Voltage</td><td>32V</td><td>32V</td><td>5.3V</td></tr>
<tr><td>Current</td><td>3A</td><td>3A</td><td>3A</td></tr>
<tr><th rowspan="3">Measurement Result</th><td>U_0</td><td></td><td></td><td></td></tr>
<tr><td>U_1</td><td></td><td></td><td></td></tr>
<tr><td>$|U_1/R_M$[2]$-U_0/R_M$[2]$|$</td><td></td><td></td><td></td></tr>
</table>

CC Linear Regulation Rate

<table>
<tr><th colspan="2">Channel</th><td>CH1 (30V/3A)</td><td>CH2 (30V/3A)</td><td>CH3 (5V/3A)</td></tr>
<tr><th colspan="2">Specification</th><td colspan="3"><550μA</td></tr>
<tr><th rowspan="2">DP832A Setting</th><td>Voltage</td><td>32V</td><td>32V</td><td>5.3V</td></tr>
<tr><td>Current</td><td>3A</td><td>3A</td><td>3A</td></tr>
<tr><th rowspan="5">Measurement Result</th><td>U_0</td><td></td><td></td><td></td></tr>
<tr><td>U_1</td><td></td><td></td><td></td></tr>
<tr><td>U_2</td><td></td><td></td><td></td></tr>
<tr><td>$|U_1-U_0|/R_M$[2]</td><td></td><td></td><td></td></tr>
<tr><td>$|U_2-U_0|/R_M$[2]</td><td></td><td></td><td></td></tr>
</table>

CC Ripple and Noise

<table>
<tr><th colspan="2">Channel</th><td>CH1 (30V/3A)</td><td>CH2 (30V/3A)</td><td>CH3 (5V/3A)</td></tr>
<tr><th colspan="2">Specification</th><td colspan="3"><2mArms</td></tr>
<tr><th colspan="2">Resistive Load R_L</th><td>10Ω</td><td>10Ω</td><td>1.6Ω</td></tr>
<tr><th rowspan="2">DP832A Setting</th><td>Voltage</td><td>32V</td><td>32V</td><td>5.3V</td></tr>
<tr><td>Current</td><td>3A</td><td>3A</td><td>3A</td></tr>
<tr><th rowspan="2">Measurement Result</th><td>RMS value (Vrms)</td><td></td><td></td><td></td></tr>
<tr><td>$Vrms/R_L$</td><td></td><td></td><td></td></tr>
</table>

CC Programming and Readback Accuracy

Channel		CH1 (30V/3A)	CH2 (30V/3A)	CH3 (5V/3A)
Specification	Programming	<11mA		
	Readback	<9.5mA		
The output current is 0				
DP832A Setting	Voltage	32V	32V	5.3V
	Current	0A	0A	0A
Measurement Result	U_1			
	$I_1=U_1/R_M$[2]			
	I_2			
	Programming: $\lvert I_1-0\rvert$			
	Readback: $\lvert I_2-I_1\rvert$			
The output current is I_R[3]				
DP832A Setting	Voltage	32V	32V	5.3V
	Current	3A	3A	3A
Measurement Result	U_3			
	$I_3=U_3/R_M$[2]			
	I_4			
	Programming: $\lvert I_3-I_R\rvert$[3]			
	Readback: $\lvert I_4-I_3\rvert$			

Note[1]: The rated voltage of the specified channel.
Note[2]: R_M=0.022Ω.
Note[3]: The rated current of the specified channel.

DP832 Performance Verification Test Record Form

RIGOL DP832 Programmable Linear DC Power Supply
Performance Verification Test Record Form

CV Load Regulation Rate

Channel		CH1 (30V/3A)	CH2 (30V/3A)	CH3 (5V/3A)
Specification		<5mV	<5mV	<2.5mV
DP832 Setting	Voltage	30V	30V	5V
	Current	3.2A	3.2A	3.2A
Measurement Result	U_0			
	U_1			
	$\|U_1-U_0\|$			

CV Linear Regulation Rate

Channel		CH1 (30V/3A)	CH2 (30V/3A)	CH3 (5V/3A)
Specification		<5mV	<5mV	<2.5mV
DP832 Setting	Voltage	30V	30V	5V
	Current	3.2A	3.2A	3.2A
Measurement Result	U_0			
	U_1			
	U_2			
	$\|U_1-U_0\|$			
	$\|U_2-U_0\|$			

CV Ripple and Noise

Channel		CH1 (30V/3A)	CH2 (30V/3A)	CH3 (5V/3A)
Specification		<350μVrms/3mVpp		
Resistive Load R_L		10Ω	10Ω	1.6Ω
DP832 Setting	Voltage	30V	30V	5V
	Current	3.2A	3.2A	3.2A
Measurement Result	Peak-peak value (Vpp)			
	RMS value (Vrms)			

Transient Response Time

Channel		CH1 (30V/3A)	CH2 (30V/3A)	CH3 (5V/3A)
Specification		<50μs		
DP832 Setting	Voltage	30V	30V	5V
	Current	3.2A	3.2A	3.2A
Electronic Load Current Setting	CCDH1	3A	3A	3A
	CCDH2	1.5A	1.5A	1.5A
Measurement Result	t			

CV Programming and Readback Accuracy

Channel		CH1 (30V/3A)	CH2 (30V/3A)	CH3 (5V/3A)
Specification	Programming	<25mV	<25mV	<12.5mV
	Readback	<20mV	<20mV	<7.5mV
The output voltage is 0				
DP832 Setting	Voltage	0V	0V	0V
	Current	3.2A	3.2A	3.2A
Measurement Result	U_1			
	U_2			
	Programming: $\|U_1-0\|$			
	Readback: $\|U_2-U_1\|$			
The output voltage is U_R[1]				
DP832 Setting	Voltage	30V	30V	5V
	Current	3.2A	3.2A	3.2A
Measurement Result	U_3			
	U_4			
	Programming: $\|U_3-U_R\|$[1]			
	Readback: $\|U_4-U_3\|$			

CC Load Regulation Rate

Channel		CH1 (30V/3A)	CH2 (30V/3A)	CH3 (5V/3A)
Specification		<550μA		
DP832 Setting	Voltage	32V	32V	5.3V
	Current	3A	3A	3A
Measurement Result	U_0			
	U_1			
	$\lvert U_1/R_M$[2]$-U_0/R_M$[2]$\rvert$			

CC Linear Regulation Rate

Channel		CH1 (30V/3A)	CH2 (30V/3A)	CH3 (5V/3A)
Specification		<550μA		
DP832 Setting	Voltage	32V	32V	5.3V
	Current	3A	3A	3A
Measurement Result	U_0			
	U_1			
	U_2			
	$\lvert U_1-U_0\rvert/R_M$[2]			
	$\lvert U_2-U_0\rvert/R_M$[2]			

CC Ripple and Noise

Channel		CH1 (30V/3A)	CH2 (30V/3A)	CH3 (5V/3A)
Specification		<2mArms		
Resistive Load R_L		10Ω	10Ω	1.6Ω
DP832 Setting	Voltage	32V	32V	5.3V
	Current	3A	3A	3A
Measurement Result	RMS value (Vrms)			
	$Vrms/R_L$			

CC Programming and Readback Accuracy

Channel		CH1 (30V/3A)	CH2 (30V/3A)	CH3 (5V/3A)
Specification	Programming	<16mA		
	Readback	<9.5mA		
The output current is 0				
DP832 Setting	Voltage	32V	32V	5.3V
	Current	0A	0A	0A
Measurement Result	U_1			
	$I_1=U_1/R_M$[2]			
	I_2			
	Programming: $\|I_1-0\|$			
	Readback: $\|I_2-I_1\|$			
The output current is I_R[3]				
DP832 Setting	Voltage	32V	32V	5.3V
	Current	3A	3A	3A
Measurement Result	U_3			
	$I_3=U_3/R_M$[2]			
	I_4			
	Programming: $\|I_3-I_R\|$[3]			
	Readback: $\|I_4-I_3\|$			

Note[1]: The rated voltage of the specified channel.
Note[2]: R_M=0.022Ω.
Note[3]: The rated current of the specified channel.

DP821A Performance Verification Test Record Form

RIGOL DP821A Programmable Linear DC Power Supply
Performance Verification Test Record Form

CV Load Regulation Rate

Channel		CH1 (60V/1A)	CH2 (8V/10A)
Specification		<8mV	<2.8mV
DP821A Setting	Voltage	60V	8V
	Current	1.05A	10.5A
Measurement Result	U_0		
	U_1		
	$\|U_1-U_0\|$		

CV Linear Regulation Rate

Channel		CH1 (60V/1A)	CH2 (8V/10A)
Specification		<8mV	<2.8mV
DP821A Setting	Voltage	60V	8V
	Current	1.05A	10.5A
Measurement Result	U_0		
	U_1		
	U_2		
	$\|U_1-U_0\|$		
	$\|U_2-U_0\|$		

CV Ripple and Noise

Channel		CH1 (60V/1A)	CH2 (8V/10A)
Specification		<350μVrms/3mVpp	
Resistive Load R_L		60Ω	0.8Ω
DP821A Setting	Voltage	60V	8V
	Current	1.05A	10.5A
Measurement Result	Peak-peak value (Vpp)		
	RMS value (Vrms)		

Transient Response Time

Channel		CH1 (60V/1A)	CH2 (8V/10A)
Specification		<50μs	
DP821A Setting	Voltage	60V	8V
	Current	1.05A	10.5A
Electronic Load Current Setting	CCDH1	1A	10A
	CCDH2	0.5A	5A
Measurement Result	t		

CV Programming and Readback Accuracy

Channel		CH1 (60V/1A)	CH2 (8V/10A)
Specification	Programming	<85mV	<14mV
	Readback	<85mV	<9mV
The output voltage is 0			
DP821A Setting	Voltage	0V	0V
	Current	1.05A	10.5A
Measurement Result	U_1		
	U_2		
	Programming: $\|U_1-0\|$		
	Readback: $\|U_2-U_1\|$		
The output voltage is U_R[1]			
DP821A Setting	Voltage	60V	8V
	Current	1.05A	10.5A
Measurement Result	U_1		
	U_2		
	Programming: $\|U_3-U_R\|$[1]		
	Readback: $\|U_4-U_3\|$		

CC Load Regulation Rate

Channel		CH1 (60V/1A)	CH2 (8V/10A)
Specification		<350μA	<1.25mA
DP821A Setting	Voltage	63V	8.4V
	Current	1A	10A
Measurement Result	U_0		
	U_1		
	$\lvert U_1/R_M$[2]$-U_0/R_M$[2]$\rvert$		

CC Linear Regulation Rate

Channel		CH1 (60V/1A)	CH2 (8V/10A)
Specification		<350μA	<1.25mA
DP821A Setting	Voltage	63V	8.4V
	Current	1A	10A
Measurement Result	U_0		
	U_1		
	U_2		
	$\lvert U_1-U_0\rvert /R_M$[2]		
	$\lvert U_2-U_0\rvert /R_M$[2]		

CC Ripple and Noise

Channel		CH1 (60V/1A)	CH2 (8V/10A)
Specification		<2mArms	
Resistive Load R_L		60Ω	0.8Ω
DP821A Setting	Voltage	63V	8.4V
	Current	1A	10A
Measurement Result	RMS value (Vrms)		
	$Vrms/R_L$		

CC Programming and Readback Accuracy

Channel		CH1 (60V/1A)	CH2 (8V/10A)
Specification	Programming	<12mA	<30mA
	Readback	<11.5mA	<25mA
The output current is 0			
DP821A Setting	Voltage	63V	8.4V
	Current	0A	0A
Measurement Result	U_1		
	$I_1=U_1/R_M$[2]		
	I_2		
	Programming: $\|I_1-0\|$		
	Readback: $\|I_2-I_1\|$		
The output current is I_R[3]			
DP821A Setting	Voltage	63V	8.4V
	Current	1A	10A
Measurement Result	U_3		
	$I_3=U_3/R_M$[2]		
	I_4		
	Programming: $\|I_3-I_R\|$[3]		
	Readback: $\|I_4-I_3\|$		

Note[1]: The rated voltage of the specified channel.
Note[2]: $R_M=0.022\Omega$.
Note[3]: The rated current of the specified channel.

DP811A Performance Verification Test Record Form

RIGOL DP811A Programmable Linear DC Power Supply
Performance Verification Test Record Form

CV Load Regulation Rate

Range		Range1 (20V/10A)	Range2 (40V/5A)
Specification		<4mV	<6mV
DP811A Setting	Voltage	20V	40V
	Current	10.5A	5.3A
Measurement Result	U_0		
	U_1		
	$\|U_1-U_0\|$		

CV Linear Regulation Rate

Range		Range1 (20V/10A)	Range2 (40V/5A)
Specification		<1.25mA	<750μA
DP811A Setting	Voltage	21V	42V
	Current	10A	5A
Measurement Result	U_0		
	U_1		
	U_2		
	$\|U_1-U_0\|/R_M$[1]		
	$\|U_2-U_0\|/R_M$[1]		

CV Ripple and Noise

Range		Range1 (20V/10A)	Range2 (40V/5A)
Specification		<350μVrms/3mVpp	
Resistive Load R_L		2Ω	8Ω
DP811A Setting	Voltage	20V	40V
	Current	10.5A	5.3A
Measurement Result	Peak-peak value (Vpp)		
	RMS value (Vrms)		

Transient Response Time

Range		Range1 (20V/10A)	Range2 (40V/5A)
Specification		<50μs	
DP811A Setting	Voltage	20V	40V
	Current	10.5A	5.3A
Electronic Load Current Setting	CCDH1	10A	5A
	CCDH2	5A	2.5A
Measurement Result	t		

CV Programming and Readback Accuracy

Range		Range1 (20V/10A)	Range2 (40V/5A)
Specification	Programming	<20mV	<30mV
	Readback	<20mV	<30mV
The output voltage is 0			
DP811A Setting	Voltage	0V	0V
	Current	10.5A	5.3A
Measurement Result	U_1		
	U_2		
	Programming: $\lvert U_1-0\rvert$		
	Readback: $\lvert U_2-U_1\rvert$		
The output voltage is U_R[1]			
DP811A Setting	Voltage	20V	40V
	Current	10.5A	5.3A
Measurement Result	U_1		
	U_2		
	Programming: $\lvert U_3-U_R\rvert$[1]		
	Readback: $\lvert U_4-U_3\rvert$		

CC Load Regulation Rate

Range		Range1 (20V/10A)	Range2 (40V/5A)
Specification		<1.25mA	<750μA
DP811A Setting	Voltage	21V	42V
	Current	10A	5A
Measurement Result	U_0		
	U_1		
	$\|U_1/R_M$[2]$-U_0/R_M$[2]$\|$		

CC Linear Regulation Rate

Range		Range1 (20V/10A)	Range2 (40V/5A)
Specification		<1.25mA	<750μA
DP811A Setting	Voltage	21V	42V
	Current	10A	5A
Measurement 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

Range		Range1 (20V/10A)	Range2 (40V/5A)
Specification		<2mArms	
Resistive Load R_L		2Ω	8Ω
DP811A Setting	Voltage	21V	42V
	Current	10A	5A
Measurement Result	RMS value (Vrms)		
	$Vrms/R_L$		

CC Programming and Readback Accuracy

Range		Range1 (20V/10A)	Range2 (40V/5A)
Specification	Programming	<20mA	<15mA
	Readback	<20mA	<15mA
The output current is 0			
DP811A Setting	Voltage	21V	42V
	Current	0A	0A
Measurement Result	U_1		
	$I_1=U_1/R_M$[2]		
	I_2		
	Programming: $\lvert I_1-0\rvert$		
	Readback: $\lvert I_2-I_1\rvert$		
The output current is I_R[3]			
DP811A Setting	Voltage	21V	42V
	Current	10A	5A
Measurement Result	U_3		
	$I_3=U_3/R_M$[2]		
	I_4		
	Programming: $\lvert I_3-I_R$[3]$\rvert$		
	Readback: $\lvert I_4-I_3\rvert$		

Note[1]: The rated voltage of the specified range.
Note[2]: R_M=0.022Ω.
Note[3]: The rated current of the specified range.

Appendix B: Specifications

The following parameters can only be guaranteed when the instrument has been operated continuously for more than 30 minutes under the specified operating temperature.

Note: Unless otherwise noted, the specifications below apply to all channels (ranges) of the specified model.

DC Output (0℃-40℃)					
Channel		**Rated Value**		**Maximum Settable Range**	
		Voltage	**Current**	**Overvoltage Protection**	**Overcurrent Protection**
DP831A	CH1 CH2 CH3	0V~8V 0V~30V -30V~0V	0A~5A 0A~2A 0A~2A	1mV~8.8V 1mV~33V -1mV~-33V	0.1mA~5.5A 0.1mA~2.2A 0.1mA~2.2A
DP832A	CH1 CH2 CH3	0V~30V 0V~30V 0V~5V	0A~3A 0A~3A 0A~3A	1mV~33V 1mV~33V 1mV~5.5V	1mA~3.3A 1mA~3.3A 1mA~3.3A
DP832	CH1 CH2 CH3	0V~30V 0V~30V 0V~5V	0A~3A 0A~3A 0A~3A	10mV~33V 10mV~33V 10mV~5.5V	1mA~3.3A 1mA~3.3A 1mA~3.3A
DP821A	CH1 CH2	0V~60V 0V~8V	0A~1A 0A~10A	1mV~66V 1mV~8.8V	0.1mA~1.1A 1mA~11A
DP811A	Range1 Range2	0V~20V 0V~40V	0A~10A 0A~5A	1mV~22V 1mV~44V	0.1mA~11A 0.1mA~5.5A

Load Regulation rate, ±(Output Percentage+Offset)	
Voltage	<0.01%+2mV
Current	<0.01%+250μA

Linear Regulation Rate, ±(Output Percentage+Offset)	
Voltage	<0.01%+2mV
Current	<0.01%+250μA

Ripple and Noise (20 Hz to 20 MHz)	
Normal Mode Voltage	<350μVrms/2mVpp
Normal Mode Current	<2mArms

Annual Accuracy[1] (25℃±5℃) ±(Output Percentage+Offset)					
Channel		**Programming**		**Readback**	
		Voltage	**Current**	**Voltage**	**Current**
DP831A	CH1 CH2 CH3	0.1%+5mV 0.05%+20mV 0.05%+20mV	0.2%+10mA 0.2%+5mA 0.2%+5mA	0.1%+5mV 0.05%+10mV 0.05%+10mV	0.2%+10mA 0.1%+5mA 0.1%+5mA
DP832A	CH1 CH2 CH3	0.05%+20mV 0.05%+20mV 0.1%+5mV	0.2%+5mA 0.2%+5mA 0.2%+5mA	0.05%+10mV 0.05%+10mV 0.1%+5mV	0.15%+5mA 0.15%+5mA 0.15%+5mA
DP832	CH1 CH2 CH3	0.05%+10mV 0.05%+10mV 0.05%+10mV	0.2%+10mA 0.2%+10mA 0.2%+10mA	0.05%+5mV 0.05%+5mV 0.05%+5mV	0.15%+5mA 0.15%+5mA 0.15%+5mA
DP821A	CH1 CH2	0.1%+25mV 0.05%+10mV	0.2%+10mA 0.2%+10mA	0.1%+25mV 0.05%+5mV	0.15%+10mA 0.15%+10mA
DP811A	CH1	0.05%+10mV	0.1%+10mA	0.05%+10mV	0.1%+10mA

Resolution							
Channel		**Programming**		**Readback**		**Display**	
		Voltage	**Current**	**Voltage**	**Current**	**Voltage**	**Current**
DP831A	CH1 CH2 CH3	1mV 1mV 1mV	0.3mA 0.1mA 0.1mA	0.1mV 0.1mV 0.1mV	0.1mA 0.1mA 0.1mA	1mV 1mV 1mV	1mA 1mA 1mA
DP832A	CH1 CH2 CH3	1mV 1mV 1mV	1mA 1mA 1mA	0.1mV 0.1mV 0.1mV	0.1mA 0.1mA 0.1mA	1mV 1mV 1mV	1mA 1mA 1mA
DP832[2]	CH1 CH2 CH3	10mV 10mV 10mV	1mA 1mA 1mA	10mV 10mV 10mV	1mA 1mA 1mA	10mV 10mV 10mV	10mA 10mA 10mA
DP821A	CH1 CH2	10mV 1mV	0.1mA 1mA	1mV 1mV	0.1mA 1mA	1mV 1mV	0.1mA 1mA
DP811A	CH1	1mV	0.5mA	0.1mV	0.1mA	1mV	1mA

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

Command Processing Time[3]
<118ms

Temperature Coefficient per℃ (Output Percentage+Offset)			
Channel		**Voltage**	**Current**
DP831A	CH1	0.01%+2mV	0.02%+3mA
	CH2	0.01%+2mV	0.02%+3mA
	CH3	0.01%+2mV	0.02%+3mA
DP832A	CH1	0.01%+5mV	0.01%+2mA
	CH2	0.01%+5mV	0.01%+2mA
	CH3	0.01%+2mV	0.01%+2mA
DP832	CH1	0.01%+5mV	0.01%+2mA
	CH2	0.01%+5mV	0.01%+2mA
	CH3	0.01%+2mV	0.01%+2mA
DP821A	CH1	0.01%+3mV	0.02%+3mA
	CH2	0.01%+3mV	0.02%+3mA
DP811A	CH1	0.01%+3mV	0.02%+3mA

Stability[4], ± (Output Percentage+Offset)			
Channel		**Voltage**	**Current**
DP831A	CH1	0.03%+1mV	0.1%+3mA
	CH2	0.02%+2mV	0.05%+1mA
	CH3	0.02%+2mV	0.05%+1mA
DP832A	CH1	0.02%+2mV	0.05%+2mA
	CH2	0.02%+2mV	0.05%+2mA
	CH3	0.01%+1mV	0.05%+2mA
DP832	CH1	0.02%+2mV	0.05%+2mA
	CH2	0.02%+2mV	0.05%+2mA
	CH3	0.01%+1mV	0.05%+2mA
DP821A	CH1	0.02%+1mV	0.1%+1mA
	CH2	0.02%+1mV	0.1%+1mA
DP811A	CH1	0.02%+1mV	0.1%+1mA

Voltage Programming Control Speed (1% within the total variation range)					
Channel		**Rise**		**Fall**	
		Full Load	**No Load**	**Full Load**	**No Load**
DP831A	CH1	<18ms	<17ms	<20ms	<200ms
	CH2	<33ms	<36ms	<44ms	<400ms
	CH3	<35ms	<42ms	<45ms	<400ms
DP832A	CH1	<50ms	<33ms	<46ms	<400ms
	CH2	<50ms	<38ms	<46ms	<400ms
	CH3	<15ms	<14ms	<24ms	<100ms
DP832	CH1	<50ms	<33ms	<46ms	<400ms
	CH2	<50ms	<38ms	<46ms	<400ms
	CH3	<15ms	<14ms	<24ms	<100ms
DP821A	CH1	<92ms	<30ms	<90ms	<486ms
	CH2	<11ms	<15ms	<17ms	<154ms
DP811A	CH1	<45ms	<42ms	<51ms	<1089ms

OVP/OCP	
Accuracy ±(Output Percentage+Offset)	0.5%+0.5V/0.5%+0.5A
Activation Time	1.5ms (OVP≥3V) <10ms (OVP<3V) <10ms (OCP)

Mechanical	
Dimensions	239mm (W) x 157mm (H) x 418mm (D)
Weight	DP831A: 9.75kg DP832A: 10.5kg DP832: 9.0kg DP821A: 10.0kg DP811A: 10.3kg

Power	
AC Input (50Hz to 60Hz)	100Vac±10%, 115Vac±10%, 230Vac±10% (maximum 250Vac)

I/O	
USB Device	1
USB Host	1
LAN	1 (Option)
RS232	1 (Option)
Digital IO	1 (Option)
USB-GPIB	1 (Option)
Rear output interface	Only DP811A has one

Environment	
Working Temperature	DP831A/DP832A/DP832/DP811A: Full rated value output: 0℃~40℃ Under relatively higher temperature: the linearity of the output current reduces to 50% at the highest temperature 55℃ DP821A: Full rated value output: 0℃~40℃ Under relatively higher temperature: the linearity of the output current reduces to 50% at the highest temperature 55℃ or the fuse is blown out
Storage Temperature	-40℃~70℃
Humidity	5%~80%
Altitude	Operating: below 3 000 meters

	Non-operating: below 15 000 meters
Cooling Method	Fan Cooling

Note[1]: The accuracy parameters are acquired via calibration under 25℃ after 1-hour warm-up.
Note[2]: When DP832 is installed with the accuracy option, its resolution is the same as that of DP832A.
Note[3]: The maximum time required for the output to change accordingly after receiving the APPLy and SOURce commands.
Note[4]: The variation of the output within 8 hours after 30-minute warm-up when the load circuit and environment temperature are constant.

RIGOL

Performance Verification Guide

MSO5000 Series Digital Oscilloscope

Aug. 2019
RIGOL (SUZHOU) TECHNOLOGIES INC.

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If you have any problem or requirement when using our products or this manual, please contact **RIGOL**.

E-mail: service@rigol.com

Website: www.rigol.com

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 anything into the holes of the fan to avoid damaging 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.

Safety Notices and Symbols

Safety Notices in this Manual:

WARNING
Indicates a potentially hazardous situation or practice which, if not avoided, will result in serious injury or death.

CAUTION
Indicates a potentially hazardous situation or practice which, if not avoided, could result in damage to the product or loss of important data.

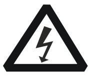
Safety Terms on the Product:

DANGER It calls attention to an operation, if not correctly performed, could result in injury or hazard immediately.

WARNING It calls attention to an operation, if not correctly performed, could result in potential injury or hazard.

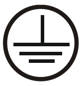
CAUTION It calls attention to an operation, if not correctly performed, could result in damage to the product or other devices connected to the product.

Safety Symbols on the Product:

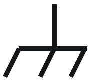


Hazardous Voltage

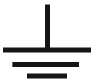
Safety Warning



Protective Earth Terminal



Chassis Ground



Test Ground

Document Overview

This manual is designed to guide you to properly test the performance specifications of **RIGOL** MSO5000 series digital oscilloscope. For the operation methods mentioned in the test procedures, refer to User Guide of this product.

Main Topics in this Manual:

Chapter 1 Overview
This chapter introduces the preparations before performing the performance verification tests and the notices.

Chapter 2 Performance Verification Test
This chapter introduces the limit, test devices required as well as the test method and procedures of each performance specification.

Appendix Test Record Form
The appendix provides a test record form for users to record the test results and judge whether each performance specification can meet the requirement.

Format Conventions in this Manual:

1. **Key**
   The key on the front panel is denoted by the format of "Key Name (Bold) + Text Box" in the manual. For example, **Utility** denotes the "Utility" key.

2. **Menu**
   The menu items are denoted by the format of "Menu Word (Bold) + Character Shading". For example, **System** denotes the "System" menu item under **Utility**.

3. **Operation Procedures:**
   → denotes the next step of operation. For example, **Utility** → **System** denotes that first press **Utility**, and then press the **System** softkey.

Content Conventions in this Manual:

MSO5000 series includes the following models. Unless otherwise specified, this manual takes MSO5354 as an example to illustrate the test methods for the performance verification of the MSO5000 series.

Model	Analog Bandwidth	No. of Analog Channels	No. of Channels of Function/AWG	No. of Digital Channels
MSO5072	70 MHz	2	2 (option)	16 (required to purchase the probe)
MSO5074	70 MHz	4	2 (option)	16 (required to purchase the probe)
MSO5102	100 MHz	2	2 (option)	16 (required to purchase the probe)
MSO5104	100 MHz	4	2 (option)	16 (required to purchase the probe)
MSO5204	200 MHz	4	2 (option)	16 (required to purchase the probe)
MSO5354	350 MHz	4	2 (option)	16 (required to purchase the probe)

Contents

Chapter 1 Overview

Test Preparations

Before performing the test, make the following preparations.

1. Self-test
2. Warm-up (make sure that the instrument has been running for at least 30 minutes)
3. Self-calibration

Self-test

When the oscilloscope is connected to power, press the Power key at the lower-left corner of the front panel to start the oscilloscope. (You can also press **Utility** → **System** →**Power status**, and select "Switch On". After the instrument is connected to power source, it will start directly.) During the start-up process, the oscilloscope performs a series of self-tests. After the self-test, the welcome screen is displayed.

If the oscilloscope cannot start normally, refer to "Troubleshooting" section in MSO5000 User Guide to locate the problem and resolve it. Do not perform self-calibration or performance tests until the instrument passes the self-test.

Self-calibration

Make sure that the oscilloscope has been warmed up or operating for more than 30 minutes before performing self-calibration.

1. Disconnect all the input channels.
2. Press **Utility** → **System** → **SelfCal**, and the press **Start** to execute self-calibration. The self-calibration lasts for about 45 minutes.
3. Restart the oscilloscope, and then press **Acquire** → **Acquisition** to select "Average", and then press **Averages** to set it to 16.
4. Set the vertical scale of each channel to 2 mV/div and view the offset of the waveform of each channel. If the offset is greater than 0.5 div, check whether there are interference signals around you and whether the power source is well grounded. If yes, perform self-calibration again.

Test Result Record

Record and keep the test result of each test. In the Appendix of this manual, a test result record form which lists all the test items and their corresponding performance limits as well as spaces for users to record the test results, is provided.

Tip:
It is recommended that users photocopy the test record form before each test and record the test results in the copy so that the form can be used repeatedly.

Specifications

The specification of each test item is provided in Chapter 2. For other technical parameters, refer to *MSO5000 DataSheet* (available to download them from **RIGOL** website: http://www.rigol.com)

Tip:
All the specifications are only valid when the oscilloscope has been warmed up for more than 30 minutes.

Chapter 2 Performance Verification Test

This chapter takes MSO5354 as an example to illustrate the performance verification test methods and procedures of MSO5000 series digital oscilloscope. Fluke 9500B is used in this manual for the tests. You can also use other devices that fulfill the "Specification" in Table 2-1.

Table 2-1 Test Devices Required

Device	Specification	Recommended Model
Oscilloscope Calibrator	DC output voltage range: 1 MΩ: 1 mV to 200 V 50 Ω: 1 mV to 5 V Fast edge signal rise time: ≤ 150 ps	Fluke 9500B

Note:

1. Make sure that the oscilloscope passes the self-test and self-calibration before executing the performance verification tests.
2. Make sure that the oscilloscope has been warmed up for at least 30 minutes before executing any of the following tests.
3. Please reset the instrument to the factory setting before or after executing any of the following tests.

Impedance Test

Specification

Input Impedance	
Analog Channel	1 MΩ: 0.99 MΩ to 1.01 MΩ

Test Connection Diagram

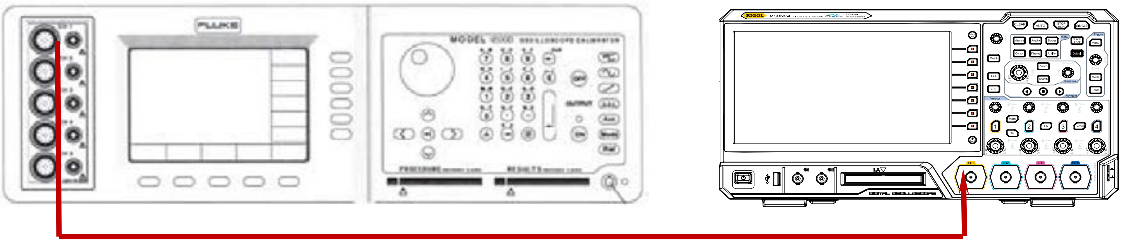


Figure 2-1 Impedance Test Connection Diagram

Test Procedures

1. Connect the active head of Fluke 9500B to CH1 of the oscilloscope, as shown in the figure above.

2. Configure the oscilloscope:
   1) Press **1** in the vertical control area (Vertical) on the front panel to enable CH1.
   2) Press **1** → **Impedance** to set the input impedance of CH1 to 1 MΩ.
   3) Set the vertical scale of CH1 to 100 mV/div.

3. Turn on Fluke 9500B; set its impedance to 1 MΩ and select the resistance measurement function. Read and record the resistance measured.

4. Adjust the vertical scale of CH1 of the oscilloscope to 500 mV/div; read and record the resistance measured.

5. Turn off CH1. Measure the resistances of CH2, CH3, and CH4 respectively using the method above and record the measurement results.

Test Record Form

Channel	Vertical Scale	Test Result	Limit	Pass/Fail
CH1	100 mV/div		0.99 MΩ to 1.01 MΩ	
	500 mV/div			
CH2	100 mV/div			
	500 mV/div			
CH3	100 mV/div			
	500 mV/div			
CH4	100 mV/div			
	500 mV/div			

DC Gain Accuracy Test

Specification

DC Gain Accuracy	
Specification	±3% of Full Scale [1]

Note[1]: Full scale = 8 × Current Vertical Scale. 500 uV/div1, 1 mV/div, and 2 mV/div are a magnification of 4 mV/div setting. For vertical accuracy calculations, use full scale of 32 mV for 500 uV/div1, 1 mV/div, and 2 mV/div vertical sensitivity setting.

Test Connection Diagram

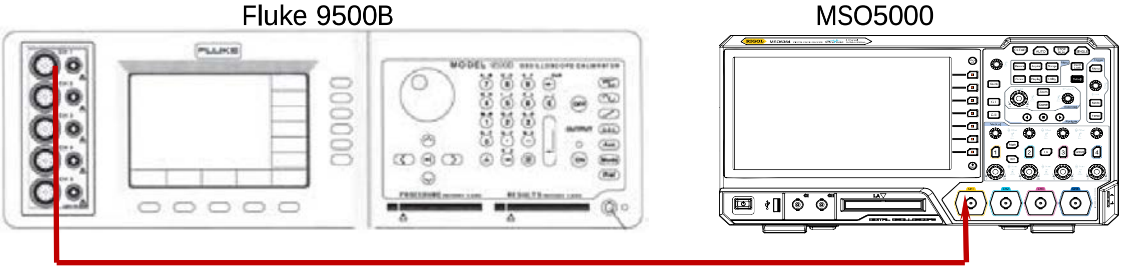


Figure 2-2 DC Gain Accuracy Test Connection Diagram

Test Procedures

1. Connect the active head of Fluke 9500B to CH1 of the oscilloscope, as shown in the figure above.

2. Set the impedance of Fluke 9500B to 1 MΩ.

3. Output a DC signal with +3 mV_{DC} voltage (Vout1) via Fluke 9500B.

4. Configure the oscilloscope:
   1) Press **1** in the vertical control area (Vertical) on the front panel to enable CH1.
   2) Press **1** → **Attenuation** to set the probe attenuation ratio to "1X".
   3) Press **1** → **Impedance** to set the input impedance of CH1 to 1 MΩ.
   4) Set the vertical scale to 1 mV/div.
   5) Set the horizontal timebase to 1 μs/div.
   6) Set the vertical offset to 0.
   7) Press **Acquire** → **Acquisition** to select "Average", and then press **Averages** to set it to 32.
   8) Adjust the trigger level to avoid that the signals are being triggered by mistake.

5. Press **Measure** → **Add** → **Category** to select "Vertical". Then, select "Vavg" measurement parameter to enable the average measurement function. Read and record Vavg1.

6. Adjust Fluke 9500B to make it output a DC signal with -3 mV_{DC} voltage (Vout2).

7. Enable the average measurement function. Read and record Vavg2.

8. Calculate the relative error of this vertical scale: **|(Vavg1 - Vavg2) - (Vout1 - Vout2)|/Full Scale × 100%**.

9. Keep the other settings of the oscilloscope unchanged.
   1) Set the vertical scale to 500 uV/div, 2 mV/div, 5 mV/div, 10 mV/div, 20 mV/div, 50 mV/div, 100 mV/div, 200 mV/div, 500 mV/div, 1 V/div, 2 V/div, 5 V/div, and 10 V/div respectively.
   2) Adjust the output voltage of Fluke 9500B to 3 × the current vertical scale and -3 × the

current vertical scale respectively.

3) Repeat Step 3-7 and record the test results.

4) Calculate the relative error of each vertical scale: **|(Vavg1 - Vavg2) - (Vout1 - Vout2)|/Full Scale × 100%**.

10. Turn off CH1. Test the relative error of each scale of CH2, CH3, and CH4 respectively using the method above and record the test results.

Test Record Form

Channel	Vertical Scale	Test Result			Limit	Pass/Fail
		Vavg1	Vavg2	Calculation Result[1]		
CH1	500 uV/div				≤3%	
	1 mV/div					
	2 mV/div					
	5 mV/div					
	10 mV/div					
	20 mV/div					
	50 mV/div					
	100 mV/div					
	200 mV/div					
	500 mV/div					
	1 V/div					
	2 V/div					
	5 V/div					
	10 V/div					
CH2	500 uV/div					
	1 mV/div					
	2 mV/div					
	5 mV/div					
	10 mV/div					
	20 mV/div					
	50 mV/div					
	100 mV/div					
	200 mV/div					
	500 mV/div					
	1 V/div					
	2 V/div					
	5 V/div					
	10 V/div					
CH3	500 uV/div					
	1 mV/div					
	2 mV/div					
	5 mV/div					
	10 mV/div					
	20 mV/div					
	50 mV/div					
	100 mV/div					
	200 mV/div					
	500 mV/div					
	1 V/div					
	2 V/div					

	5 V/div					
	10 V/div					
CH4	500 uV/div					
	1 mV/div					
	2 mV/div					
	5 mV/div					
	10 mV/div					
	20 mV/div					
	50 mV/div					
	100 mV/div					
	200 mV/div					
	500 mV/div					
	1 V/div					
	2 V/div					
	5 V/div					
	10 V/div					

Note[1]: The calculation formula is |(Vavg1 - Vavg2) - (Vout1 - Vout2)|/Full Scale × 100%; wherein, Vout1 and Vout2 are 3 × the current vertical scale and -3 × the current vertical scale respectively.

Bandwidth Test

The bandwidth test verifies the bandwidth performance of the oscilloscope by testing the amplitude loss of the oscilloscope under test at full bandwidth.

Specification

Bandwidth		
Amplitude Loss[1]	350 MHz	-3 dB, all-channel mode
	200 MHz	-3 dB, all-channel mode
	100 MHz	-3 dB, all-channel mode
	70 MHz	-3 dB, all-channel mode

Note[1]: Amplitude Loss (dB) = 20 × lg (Vrms2/Vrms1); wherein, Vrms1 is the measurement result of amplitude effective value at 1 MHz and Vrms2 is the measurement result of amplitude effective value at full bandwidth.

Test Connection Diagram

Figure 2-3 Bandwidth Test Connection Diagram

Test Procedures

1. Connect the active head of Fluke 9500B to CH1 of the oscilloscope, as shown in the figure above.

2. Turn on Fluke 9500B; set its impedance to 1 MΩ.

3. Configure the oscilloscope:
   1) Press **1** in the vertical control area (Vertical) on the front panel to enable CH1.
   2) Press **1** → **Attenuation** to set the probe attenuation ratio to "1X".
   3) Press **1** → **Impedance** to set the input impedance of CH1 to 1 MΩ.
   4) Set the horizontal timebase to 500 ns/div.
   5) Set the vertical scale to 100 mV/div.
   6) Set the horizontal position and vertical offset to 0.
   7) Set the trigger level to 0 V.

4. Output a Sine with 1 MHz frequency and 600 mVpp amplitude via Fluke 9500B.

5. Press **Measure** → **Add** → **Category** to select "Vertical". Then, select "VRMS" measurement parameter to enable the effective value measurement function. Read and record Vrms1.

6. Output a Sine with 500 MHz frequency (the setting value is different for different models of the oscilloscope under test; 1 GHz please refer to Table 2-2) and 600 mVpp amplitude via Fluke 9500B.

Table 2-2 Setting Value of the Oscilloscope under Test

Model	Full Bandwidth	Horizontal Timebase
MSO5072	70 MHz	5 ns/div
MSO5074	70 MHz	5 ns/div
MSO5102	100 MHz	5 ns/div
MSO5104	100 MHz	5 ns/div
MSO5204	200 MHz	2 ns/div
MSO5354	350 MHz	2 ns/div

7. Set the horizontal timebase to 1 ns/div (the setting value is different for different models of the oscilloscope under test; please refer to Table 2-2).

8. Enable the effective value measurement function. Read and record Vrms2.

9. Calculate the amplitude loss: **Amplitude Loss (dB) = 20 × lg (Vrms2/Vrms1).**

10. Keep the other settings of the oscilloscope in Step 3 unchanged and set the vertical scale to 500 mV/div.

11. Output a Sine with 1 MHz frequency and 3 Vpp amplitude via Fluke 9500B.

12. Repeat Step 5.

13. Output a Sine with 500 MHz frequency (the setting value is different for different models of the oscilloscope under test; please refer to Table 2-2) and 3 Vpp amplitude via Fluke 9500B.

14. Repeat Step 7-9.

15. Turn off CH1. Test CH2, CH3, and CH4 using the method above respectively and record the test results.

Test Record Form

Channel	Vertical Scale	Test Result			Limit	Pass/Fail
		Vrms1	Vrms2	Amplitude Loss[1]		
CH1	100 mV/div				-3 dB to 3 dB	
	500 mV/div					
CH2	100 mV/div					
	500 mV/div					
CH3	100 mV/div					
	500 mV/div					
CH4	100 mV/div					
	500 mV/div					

Note [1]: Amplitude Loss (dB) = 20 × lg (Vrms2/Vrms1).

Bandwidth Limit Test

The bandwidth limit test verifies the 20 MHz bandwidth limit function, 100 MHz bandwidth limit function and 200MHz bandwidth limit function of the oscilloscope by testing the amplitude losses of the oscilloscope under test at the bandwidth limits.

Table 2-3 Bandwidth Limit

Input Impedance of the Oscilloscope	Available Bandwidth Limit
1 MΩ	20 MHz, 100 MHz, 200 MHz

Specification

Bandwidth Limit	
Amplitude Loss[1]	-3 dB, all-channel mode

Note[1]: Amplitude Loss (dB) = 20 × lg (Vrms2/Vrms1); wherein, Vrms1 is the measurement result of amplitude effective value at 1 MHz and Vrms2 is the measurement result of amplitude effective value at the bandwidth limit.

Test Connection Diagram

Figure 2-4 Bandwidth Limit Test Connection Diagram

Test Procedures

1. 20 MHz bandwidth limit test

1) Connect the active head of Fluke 9500B to CH1 of the oscilloscope, as shown in the figure above.
2) Turn on Fluke 9500B; set its impedance to 1 MΩ.
3) Configure the oscilloscope:
   a) Press **1** in the vertical control area (Vertical) on the front panel to enable CH1.
   b) Press **1** → **Attenuation** to set the probe attenuation ratio to "1X".
   c) Press **1** → **Impedance** to set the input impedance to 1 MΩ.
   d) Set the vertical scale to 100 mV/div.
   e) Set the horizontal timebase to 500 ns/div.
   f) Set the horizontal position and vertical offset to 0.
   g) Set the trigger level to 0 V.
4) Output a Sine with 1 MHz frequency and 600 mVpp amplitude via Fluke 9500B.
5) Press **Measure** → **Add** → **Category** to select "Vertical". Then, select "VRMS" measurement parameter to enable the effective value measurement function. Read and record Vrms1.
6) Press **1** → **BW Limit** to set the bandwidth limit to "20 M".
7) Output a Sine with 20 MHz frequency and 600 mVpp amplitude via Fluke 9500B.
8) Set the horizontal timebase to 20 ns/div.
9) Enable the effective value measurement function. Read and record Vrms2.
10) Calculate the amplitude loss: **Amplitude Loss (dB) = 20 × lg (Vrms2/Vrms1)**, and compare the result with the specification. At this point, the amplitude loss should be within the specification range.
11) Keep the other settings of the oscilloscope in Step 3 unchanged and set the vertical scale to 500 mV/div.

12) Output a Sine with 1 MHz frequency and 3 Vpp amplitude via Fluke 9500B.
13) Repeat Step 5.
14) Output a Sine with 20 MHz frequency and 3 Vpp amplitude via Fluke 9500B.
15) Repeat Step 8-10.
16) Turn off CH1. Test CH2, CH3, and CH4 using the method above respectively.

2. 100 MHz bandwidth limit test

1) Connect the active head of Fluke 9500B to CH1 of the oscilloscope, as shown in the figure above.
2) Turn on Fluke 9500B; set its impedance to 1 MΩ.
3) Configure the oscilloscope:
   a) Press **1** in the vertical control area (Vertical) on the front panel to enable CH1.
   b) Press **1** → **Attenuation** to set the probe attenuation ratio to "1X".
   c) Press **1** → **Impedance** to set the input impedance to 1 MΩ.
   d) Set the vertical scale to 100 mV/div.
   e) Set the horizontal timebase to 500 ns/div.
   f) Set the horizontal position and vertical offset to 0.
   g) Set the trigger level to 0 V.
4) Output a Sine with 1 MHz frequency and 600 mVpp amplitude via Fluke 9500B.
5) Press **Measure** → **Add** → **Category** to select "Vertical". Then, select "VRMS" measurement parameter to enable the effective value measurement function. Read and record Vrms1.
6) Press **1** → **BW Limit** to set the bandwidth limit to "100 M".
7) Output a Sine with 100 MHz frequency and 600 mVpp amplitude via Fluke 9500B.
8) Set the horizontal timebase to 5 ns/div.
9) Enable the effective value measurement function. Read and record Vrms2.
10) Calculate the amplitude loss: **Amplitude Loss (dB) = 20 × lg (Vrms2/Vrms1)**, and compare the result with the specification. At this point, the amplitude loss should be within the specification range.
11) Keep the other settings of the oscilloscope in Step 3 unchanged and set the vertical scale to 500 mV/div.
12) Output a Sine with 1 MHz frequency and 3 Vpp amplitude via Fluke 9500B.
13) Repeat Step 5.
14) Output a Sine with 100 MHz frequency and 3 Vpp amplitude via Fluke 9500B.
15) Repeat Step 8-10.
16) Turn off CH1. Test CH2, CH3, and CH4 using the method above respectively.

3. 200 MHz bandwidth limit test

1) Connect the active head of Fluke 9500B to CH1 of the oscilloscope, as shown in the figure above.
2) Turn on Fluke 9500B; set its impedance to 1 MΩ.
3) Configure the oscilloscope:
   a) Press **1** in the vertical control area (Vertical) on the front panel to enable CH1.
   b) Press **1** → **Attenuation** to set the probe attenuation ratio to "1X".
   c) Press **1** → **Impedance** to set the input impedance to 1 MΩ.
   d) Set the vertical scale to 100 mV/div.
   e) Set the horizontal timebase to 500 ns/div.
   f) Set the horizontal position and vertical offset to 0.
   g) Set the trigger level to 0 V.
4) Output a Sine with 1 MHz frequency and 600 mVpp amplitude via Fluke 9500B.
5) Press **Measure** → **Add** → **Category** to select "Vertical". Then, select "VRMS" measurement parameter to enable the effective value measurement function. Read and record Vrms1.
6) Press **1** → **BW Limit** to set the bandwidth limit to "200 M".
7) Output a Sine with 200 MHz frequency and 600 mVpp amplitude via Fluke 9500B.
8) Set the horizontal timebase to 2 ns/div.
9) Enable the effective value measurement function. Read and record Vrms2.

10) Calculate the amplitude loss: **Amplitude Loss (dB) = 20 × lg (Vrms2/Vrms1)**, and compare the result with the specification. At this point, the amplitude loss should be within the specification range.
11) Keep the other settings of the oscilloscope in Step 3 unchanged and set the vertical scale to 500 mV/div.
12) Output a Sine with 1 MHz frequency and 3 Vpp amplitude via Fluke 9500B.
13) Repeat Step 5.
14) Output a Sine with 200 MHz frequency and 3 Vpp amplitude via Fluke 9500B.
15) Repeat Step 8-10.
16) Turn off CH1. Test CH2, CH3, and CH4 using the method above respectively.

Test Record Form

20 MHz bandwidth limit test

Channel	Vertical Scale	Test Result			Limit	Pass/Fail
		Vrms1	Vrms2	Amplitude Loss[1]		
CH1	100 mV/div				-3 dB to 3 dB	
	500 mV/div					
CH2	100 mV/div					
	500 mV/div					
CH3	100 mV/div					
	500 mV/div					
CH4	100 mV/div					
	500 mV/div					

Note [1]: Amplitude Loss (dB) = 20 × lg (Vrms2/Vrms1).

100 MHz bandwidth limit test

Channel	Vertical Scale	Test Result			Limit	Pass/Fail
		Vrms1	Vrms2	Amplitude Loss[1]		
CH1	100 mV/div				-3 dB to 3 dB	
	500 mV/div					
CH2	100 mV/div					
	500 mV/div					
CH3	100 mV/div					
	500 mV/div					
CH4	100 mV/div					
	500 mV/div					

Note [1]: Amplitude Loss (dB) = 20 × lg (Vrms2/Vrms1).

200 MHz bandwidth limit test

Channel	Vertical Scale	Test Result			Limit	Pass/Fail
		Vrms1	Vrms2	Amplitude Loss[1]		
CH1	100 mV/div				-3 dB to 3 dB	
	500 mV/div					
CH2	100 mV/div					
	500 mV/div					
CH3	100 mV/div					
	500 mV/div					
CH4	100 mV/div					
	500 mV/div					

Note [1]: Amplitude Loss (dB) = 20 × lg (Vrms2/Vrms1).

Timebase Accuracy Test

Specification

Timebase Accuracy[1]	
Specification	≤ ±(10 ppm + Clock Drift[2] × Number of years that the instrument has been used[3])

Note[1]: Typical.
Note[2]: Clock drift≤ ±10 ppm/year.
Note[3]: For the number of years that the instrument has been used, please calculate according to the date in the verification certificate provided when the instrument leaves factory.

Test Connection Diagram

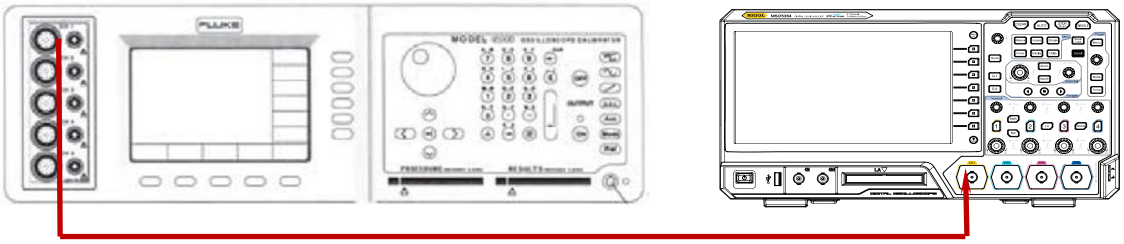


Figure 2-5 Timebase Accuracy Test Connection Diagram

Test Procedures

1. Connect the active head of Fluke 9500B to CH1 of the oscilloscope, as shown in the figure above.

2. Turn on Fluke 9500B; set its impedance to 1 MΩ.

3. Output a Sine with 10 MHz frequency and 1 Vpp amplitude via Fluke 9500B.

4. Configure the oscilloscope:
   1) Press **1** in the vertical control area (Vertical) on the front panel to enable CH1.
   2) Press **1** → **Attenuation** to set the probe attenuation ratio to "1X".
   3) Press **1** → **Impedance** to set the input impedance to 1 MΩ.
   4) Set the vertical scale to 50 mV/div.
   5) Set the vertical offset to 0.
   6) Set the horizontal timebase to 1 ns/div.
   7) Set the horizontal position to 1 ms.

5. Observe the screen of the oscilloscope. Press **Cursor** → **Mode**, then select "Manual" to enable the manual mode of cursor measurement. Measure the offset (ΔT) of the middle point of the signal (namely the crossing point of the rising edge of the current signal and the trigger level line) relative to the screen center using manual cursor measurement and record the measurement result.

6. Calculate the timebase accuracy; namely the ratio of ΔT to the horizontal position of the oscilloscope. For example, if the offset measured is 1 ns, then the timebase accuracy is 1 ns/1 ms=1 ppm.

7. Calculate the timebase accuracy limit by using the formula ±(10 ppm + 10 ppm/year × Number of years that the instrument has been used).

Test Record Form

Channel	Test Result ΔT	Calculation Result[1]	Limit	Pass/Fail
CH1			±(10 ppm + 10 ppm/year × Number of years that the instrument has been used[2])	

Note[1]: Calculation Result = Test Result ΔT/1 ms.

Note[2]: For the number of years that the instrument has been used, please calculate according to the date in the verification certificate provided when the instrument leaves factory.

Appendix Test Record Form

RIGOL MSO5000 Series Digital Oscilloscope Performance Verification Test Record Form

Model:________________ Tested by:________________ Test Date:_______________

Impedance Test

Channel	Vertical Scale	Test Result	Limit	Pass/Fail
CH1	100 mV/div		0.99 MΩ to 1.01 MΩ	
	500 mV/div			
CH2	100 mV/div			
	500 mV/div			
CH3	100 mV/div			
	500 mV/div			
CH4	100 mV/div			
	500 mV/div			

DC Gain Accuracy Test

Channel	Vertical Scale	Test Result			Limit	Pass/Fail
		Vavg1	Vavg2	Calculation Result[1]		
CH1	500 uV/div				≤3%	
	1 mV/div					
	2 mV/div					
	5 mV/div					
	10 mV/div					
	20 mV/div					
	50 mV/div					
	100 mV/div					
	200 mV/div					
	500 mV/div					
	1 V/div					
	2 V/div					
	5 V/div					
	10 V/div					
CH2	500 uV/div					
	1 mV/div					
	2 mV/div					
	5 mV/div					
	10 mV/div					
	20 mV/div					
	50 mV/div					
	100 mV/div					
	200 mV/div					
	500 mV/div					
	1 V/div					
	2 V/div					
	5 V/div					
	10 V/div					
CH3	500 uV/div					
	1 mV/div					
	2 mV/div					
	5 mV/div					
	10 mV/div					
	20 mV/div					
	50 mV/div					

	100 mV/div					
	200 mV/div					
	500 mV/div					
	1 V/div					
	2 V/div					
	5 V/div					
	10 V/div					
CH4	500 uV/div					
	1 mV/div					
	2 mV/div					
	5 mV/div					
	10 mV/div					
	20 mV/div					
	50 mV/div					
	100 mV/div					
	200 mV/div					
	500 mV/div					
	1 V/div					
	2 V/div					
	5 V/div					
	10 V/div					

Note[1]: The calculation formula is |(Vavg1 - Vavg2) - (Vout1 - Vout2)|/Full Scale × 100%; wherein, Vout1 and Vout2 are 3 × the current vertical scale and -3 × the current vertical scale respectively.

Bandwidth Test

Channel	Vertical Scale	Test Result			Limit	Pass/Fail
		Vrms1	Vrms2	Amplitude Loss[1]		
CH1	100 mV/div				-3 dB to 3 dB	
	500 mV/div					
CH2	100 mV/div					
	500 mV/div					
CH3	100 mV/div					
	500 mV/div					
CH4	100 mV/div					
	500 mV/div					

Note [1]: Amplitude Loss (dB) = 20 × lg (Vrms2/Vrms1).

Bandwidth Limit Test

20 MHz bandwidth limit test

Channel	Vertical Scale	Test Result			Limit	Pass/Fail
		Vrms1	Vrms2	Amplitude Loss[1]		
CH1	100 mV/div				-3 dB to 3 dB	
	500 mV/div					
CH2	100 mV/div					
	500 mV/div					
CH3	100 mV/div					
	500 mV/div					
CH4	100 mV/div					
	500 mV/div					

Note [1]: Amplitude Loss (dB) = 20 × lg (Vrms2/Vrms1).

100 MHz bandwidth limit test

Channel	Vertical Scale	Test Result			Limit	Pass/Fail
		Vrms1	Vrms2	Amplitude Loss[1]		
CH1	100 mV/div				-3 dB to 3 dB	
	500 mV/div					
CH2	100 mV/div					
	500 mV/div					
CH3	100 mV/div					
	500 mV/div					
CH4	100 mV/div					
	500 mV/div					

Note [1]: Amplitude Loss (dB) = 20 × lg (Vrms2/Vrms1).

200 MHz bandwidth limit test

Channel	Vertical Scale	Test Result			Limit	Pass/Fail
		Vrms1	Vrms2	Amplitude Loss[1]		
CH1	100 mV/div				-3 dB to 3 dB	
	500 mV/div					
CH2	100 mV/div					
	500 mV/div					
CH3	100 mV/div					
	500 mV/div					
CH4	100 mV/div					
	500 mV/div					

Note [1]: Amplitude Loss (dB) = 20 × lg (Vrms2/Vrms1).

Timebase Accuracy Test

Channel	Test Result ΔT	Calculation Result[1]	Limit	Pass/Fail
CH1			±(10 ppm + 10 ppm/year × Number of years that the instrument has been used[2])	

Note[1]: Calculation Result = Test Result ΔT/1 ms.

Note[2]: For the number of years that the instrument has been used, please calculate according to the date in the verification certificate provided when the instrument leaves factory.

CERTIFICATE

TÜVRheinland®

of Conformity
Low Voltage Directive 2014/35/EU

Registration No.: AN 50408799 0001

Report No.: 50049338 004

Holder: UNI-TREND TECHNOLOGY (CHINA) CO., LTD.
No 6, Gong Ye Bei 1st Road
Songshan Lake National High-Tech
Industrial Development Zone
Dongguan City, Guangdong Province
P. R. China

Product: Multimeter
(Professional Multimeter)

Identification: Type Designation: UT195E UT195M UT195DS UT195E-EU UT195M-EU UT195DS-EU UT195E-US UT195M-US UT195DS-US (UNI-T)
VC-440 E VC-450 E VC-460 E (VOLTCRAFT)
Serial No.: n.a.
Remark: Issued in conjunction with TÜV Rheinland license S 50358726 page 0003

This certificate of conformity is based on an evaluation of a sample of the above mentioned product. Technical Report and documentation are at the Licence Holder's disposal. This is to certify that the tested sample is in conformity with Annex I of Council Directive 2014/35/EU, referred to as the Low Voltage Directive. This certificate does not imply assessment of the series-production of the product and does not permit the use of a TÜV Rheinland mark of conformity. The holder of the certificate is authorized to use this certificate in connection with the EC declaration of conformity according to Annex IV of the Directive.

TÜV Rheinland LGA Products GmbH Zertifizierungsstelle TÜVRheinland®

Certification Body

Date 07.06.2018

Dipl.-Ing. Univ. S. O. Steinke

TÜV Rheinland LGA Products GmbH - Tillystraße 2 - 90431 Nürnberg

CE The CE marking may be used if all relevant and effective EC Directives are complied with. CE

TÜV Rheinland (China) Ltd.
Member of TÜV Rheinland Group

TÜVRheinland®
Precisely Right.

UNI-TREND TECHNOLOGY (CHINA) CO., LTD.
Ms. Rita Zhuang
-
No 6, Gong Ye Bei 1st Road
Songshan Lake National High-Tech
Industrial Development Zone
Dongguan City, Guangdong Province
P. R. China

Date : 07.06.2018
Our ref. : YANGLAU 02
Your ref.: R.Z

Ref : AN Certificate of Conf. Low Voltage D.

Type of Equipment : Professional Multimeter
Model Designation : See Certificate
Certificate No. : AN 50408799 0001
Report No. : 50049338 004

Dear Ms. Rita Zhuang,

We herewith confirm that a sample of the above mentioned technical equipment has been tested and was found to be in accordance with the relevant requirements.

Enclosed please find your Certificate of Conformity.

We appreciate your kind support and would like to offer our assistance and continuous services in the future.

With kind regards,

Certification Body

Dipl.-Ing. Univ. S. O. Steinke

Enclosure

TÜV Rheinland (China) Ltd.
莱茵检测认证服务（中国）有限公司

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