Keysight U8030A Series Triple Output DC Power Supply

KEYSIGHT TECHNOLOGIES

Service Guide

Notices

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CAUTION

A CAUTION notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in damage to the product or loss of important data. Do not proceed beyond a CAUTION notice until the indicated conditions are fully understood and met.

WARNING

A WARNING notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in personal injury or death. Do not proceed beyond a WARNING notice until the indicated conditions are fully understood and met.

Safety Symbols

The following symbols on the instrument and in the documentation indicate precautions which must be taken to maintain safe operation of the instrument.

	Caution, risk of danger (refer to this manual for specific Warning or Caution information)		In position of a bi-stable push control
	Direct current (DC)		Terminal is at earth potential. Used for measurement and control circuits designed to be operated with one terminal at earth potential.
	Alternating current (AC)		Positive binding post
	Protective earth (ground) terminal		Negative binding post
	Out position of a bi-stable push control		

Safety Considerations

Read the information below before using this instrument.

The following general safety precautions must be observed during all phases of operation, service, and repair of this instrument. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards for design, manufacture, and intended use of the instrument. Keysight Technologies assumes no liability for the customer's failure to comply with these requirements.

CAUTION

- Use the device with the cables provided with the shipment.
- If the device is used in a manner not specified by the manufacturer, the device protection may be impaired.
- Always use dry cloth to clean the device. Do not use ethyl alcohol or any other volatile liquid to clean the device.
- Do not permit any blockage of the ventilation holes of the device.

WARNING

- Do not use the device if it appears damaged or defective.
- Do not operate the device around flammable gases or fumes, vapor, or wet environments.
- Observe all markings on the device before connecting any wiring to the device.
- Turn off the output of the power supply before connecting to the output terminals.
- When servicing the device, use only the specified replacement parts.
- Do not install substitute parts or perform any unauthorized modification to the device.
- Do not operate the device with the cover removed or loosened.
- Use only the power adapter provided by the manufacturer to avoid any unexpected hazards.

Environmental Conditions

The U8030A Series is designed for indoor use and in an area with low condensation. The table below shows the general environmental requirements for this instrument.

Environmental condition	Requirement
Operating temperature	0 °C to 40 °C
Storage temperature	–40 °C to 70 °C
Humidity	15% RH (relative humidity) to 85% RH at 40 °C (non-condensing)
Altitude	Up to 2000 meters
Installation category	Installation Category II
Pollution degree	Pollution Degree 2

NOTE

The U8030A Series Triple Output DC Power Supply complies with the following safety and EMC requirements:

- IEC61326-1:2005 / EN61326-1:2006
- CISPR 11:2003/ EN55011:2007
- Canada: ICES/NMB-001: Issue 4, June 2006
- Australia / New Zealand: AS/NZS CISPR11:2004
- IEC 61010-1:2001 / EN 61010-1:2001 (2nd Edition)
- Canada: CAN/CSA-C22.2 No. 61010-1-04
- USA: ANSI/UL 61010-1:2004

Regulatory Markings

CE ISM 1-A	The CE mark is a registered trademark of the European Community. This CE mark shows that the product complies with all the relevant European Legal Directives.		The RCM mark is a registered trademark of the Australian Communications and Media Authority.
ICES/NMB-001	ICES/NMB-001 indicates that this ISM device complies with the Canadian ICES-001. Cet appareil ISM est conforme a la norme NMB-001 du Canada.		This instrument complies with the WEEE Directive (2002/96/EC) marking requirement. This affixed product label indicates that you must not discard this electrical or electronic product in domestic household waste.
C US	The CSA mark is a registered trademark of the Canadian Standards Association.		This symbol indicates the time period during which no hazardous or toxic substance elements are expected to leak or deteriorate during normal use. Forty years is the expected useful life of the product.

Waste Electrical and Electronic Equipment (WEEE) Directive 2002/96/EC

This instrument complies with the WEEE Directive (2002/96/EC) marking requirement. This affixed product label indicates that you must not discard this electrical or electronic product in domestic household waste.

Product category:

With reference to the equipment types in the WEEE directive Annex 1, this instrument is classified as a “Monitoring and Control Instrument” product.

The affixed product label is as shown below.

Do not dispose in domestic household waste.

To return this unwanted instrument, contact your nearest Keysight Service Center, or visit http://about.keysight.com/en/companyinfo/environment/takeback.shtml for more information.

Sales and Technical Support

To contact Keysight for sales and technical support, refer to the support links on the following Keysight websites:

- www.keysight.com/find/U8030
  (product-specific information and support, software and documentation updates)
- www.keysight.com/find/assist
  (worldwide contact information for repair and service)

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1 Calibration Procedures

This chapter contains procedures for verifying the instrument performance, as well as procedures for making adjustments (calibration) where necessary.

Keysight Calibration Services

When your instrument is due for calibration, contact your local Keysight Service Center for recalibration. See "Types of Service Available" on page 57 for more information on the various calibration services offered.

Calibration interval

The instrument should be calibrated on a regular interval determined by the measurement accuracy requirements of your application.

A one-year interval is adequate for most applications.

Accuracy specifications are warranted only if calibration is performed at regular intervals. Accuracy specifications are not warranted beyond the one-year calibration interval. Keysight does not recommend extending calibration intervals beyond two years for any application.

Other recommendations for calibration

Specifications are only guaranteed within the specified period from the last calibration. Keysight recommends that readjustment should always be performed at whatever calibration interval you select. This will ensure that the instrument remains within its specifications until the next calibration. This calibration criterion provides the best long-term stability.

During performance verification tests, only the performance data is collected; these tests do not guarantee that the instrument will remain within the specified limits. The tests are only for identifying which functions need adjustment.

Recommended Test Equipment

The test equipment recommended for the performance verification and adjustment procedures is listed below in Table 1-1. If the exact instrument is not available, substitute with another calibration standard of equivalent accuracy.

Table 1-1 Recommended test equipment

Equipment	Requirement(s)	Recommended model	Purpose	Used[a]
Digital multimeter (DMM)	8½ digits resolution	Keysight 3458A	Measures accurate DC voltage	PV C

Oscilloscope	– Sensitivity: 1 mV
	– Bandwidth limit: 20 MHz
	– Probe:
	  – 1:1 with RF tip
	  – 10:1 with RF tip for > 50 V
		Keysight DSO8064A or Infiniium equivalent	Displays transient response. Displays ripple and noise waveform.	PV

Differential amplifier	– Bandwidth > 20 MHz (bandwidth limit: 20 MHz) – AC coupling – Amplifier × 10	LeCroy DA1855A	Signal conditioning preamplifiers	PV
RMS volt meter	20 Hz to 20 MHz	R&S URE3	Measures RMS noise	PV
50 Ω feed-through termination	-	Pomona	Loads termination to match output impedance of the differential amplifier	PV
AC/DC current converter	-	Tektronix TCP305 and Tektronix TCPA300	Converts current to voltage	PV
Electronic load	– Voltage range: 60 Vdc – Current range: 6 A – Open and Short switches – Transient On/Off	Keysight 6060B	Measures load and line regulations and transient response time	PV
AC power source	Capable of supplying 90 Vac to 250 Vac	Keysight 6813B	Functions as variable voltage transformer	PV

Table 1-1 Recommended test equipment (continued)

Equipment	Requirement(s)	Recommended model	Purpose	Used[a]
Resistive load (R_L)	– 5 Ω/180 W (for U8031A) – 20 Ω/180 W (for U8032A) – 1.67 Ω/15 W (for 5 V Output 3)	-	Measures ripple and noise	PV
Current monitoring resistor (shunt) (R_M)	– 0.01 Ω ± 0.1% – TCR less than 20 ppm/°C	ISOTEK Co. Model A-H	Current monitoring resistor	PV C

[a] PV: Performance Verification, see page 24 for more information.
C: Calibration, see page 43 for more information.

Test Considerations

For optimum performance, all procedures should comply with the following recommendations:

- Ensure that the calibration ambient temperature is stable and is recommended at 23 °C ± 2 °C.
- Ensure that the ambient relative humidity is less than 80%.
- Allow a warm-up period of 1 hour by powering on the power supply. During the warm-up period, set the power supply to its maximum programmable voltage and current. Then, enable the output.
- Keep the test setup connection cables as short as possible.

Measurement Techniques

Test setup

Most tests are performed at the front terminals as shown below. Measure the DC voltage directly at the positive (+) and negative (–) terminals on the front panel.

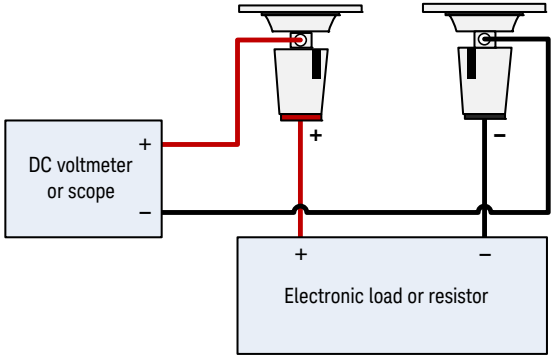

Figure 1-1 Test setup (A)

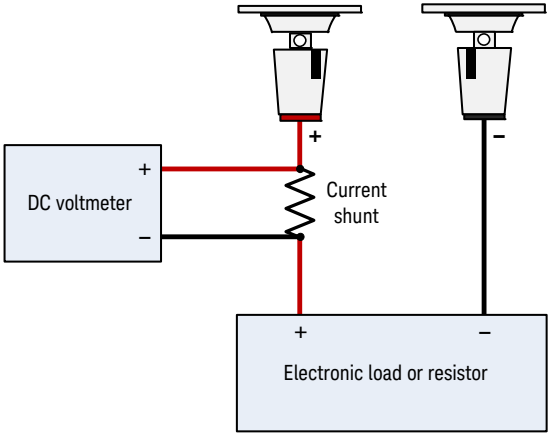

Figure 1-2 Test setup (B)

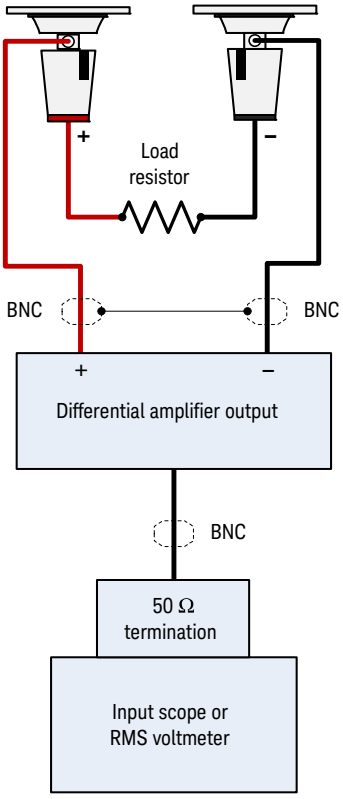

Figure 1-3 Test setup (C)

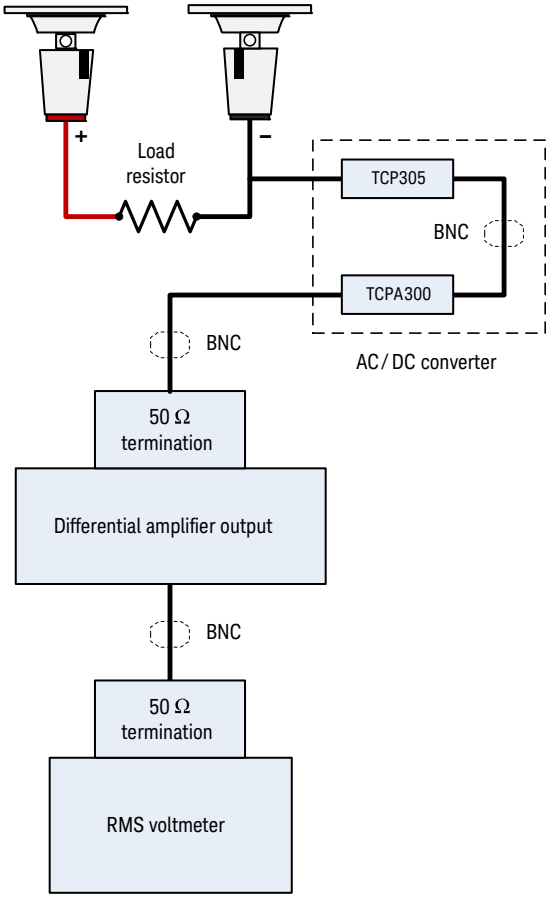

Figure 1-4 Test setup (D)

Current monitoring resistor

To eliminate output current measurement error caused by the voltage drops in the leads and connections, connect the current monitoring resistor (R_M) between the (–) output terminal and the load as a four-terminal device. Connect the current monitoring leads inside the load-lead connections directly at the monitoring points on the resistor element.

General measurement techniques

To achieve best results when measuring load regulation, peak to peak voltage, and transient response time of the power supply, measuring devices must be connected through the hole in the neck of the binding post at **(A)** while the load resistor is plugged into the front of the output terminals at **(B)**. A measurement made across the load includes the impedance of the leads to the load. The impedance of the load leads can easily be several orders of magnitude greater than the power supply impedance and thus invalidate the measurement. To avoid mutual coupling effects, each measuring device must be connected directly to the output terminals by separate pairs of leads.

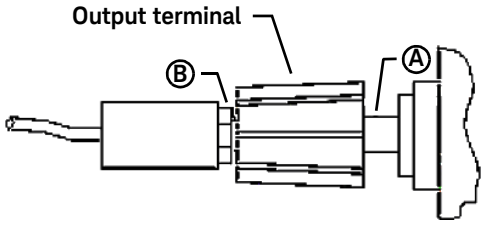

Figure 1-5 Binding post side view

Electronic load

Many of the test procedures require the use of a variable load resistor capable of dissipating the required power. Using a variable load resistor requires that switches should be used to connect, disconnect, and short the load resistor. An electronic load, if available, can be used in place of a variable load resistor and switches. The electronic load is considerably easier to use than load resistors. It eliminates the need for connecting resistors or rheostats in parallel to handle power, it is much more stable than a carbon-pile load, and it makes easy work of switching between load conditions as is required for the load regulation and load response tests. The substitution of the electronic load requires minor changes to the test procedures in this chapter.

Performance Verification Tests

Use the performance verification tests to verify the measurement performance of the instrument. The performance verification tests use the instrument's specifications listed in the *U8030A Series User's Guide* (available for download at www.keysight.com/find/U8030).

The performance verification tests are recommended as acceptance tests when you first receive the instrument. The acceptance test results should be compared against the one-year test limits. After acceptance, you should repeat the performance verification tests at every calibration interval.

If the power supply fails the performance verification tests, adjustment or repair is required.

NOTE **Ensure that you have read the "Test Considerations" on page 19 before running the performance verification tests.**

Constant voltage (CV) verification

Voltage programming and readback accuracy

This test is to verify that the voltage programming and readback accuracy are within the published specifications.

Procedure:

1. Power off the power supply, and connect a multimeter between the (+) and (–) terminals of the output to be tested. Remove the electronic load or resistor block as shown in Figure 1-1, to operate it as an open circuit.
2. Power on the power supply.
3. When the power supply is in the limit mode, program the output voltage to 0 V and the output current to the maximum programmable value.
4. Enable the output.
5. Wait a few seconds for the output of the power supply to settle. Ensure that the power supply is in the CV mode.

6 Record the voltage reading on the multimeter (V_{DMM}).

This value should be within the limit of

- 0 V ± 15 mV for Output 1 and Output 2, and
- 0 V ± 0.25 V for Output 3.

7 When the power supply is in the meter mode, record the voltage reading shown on the power supply.

This value should be within the limit of V_{DMM} ± 10 mV for Output 1 and Output 2.

8 Disable the output.

9 When the power supply is in limit mode, program the output voltage to its full rated value, i.e.,

- 30 V for U8031A,
- 60 V for U8032A, and
- 5 V for Output 3.

10 Enable the output.

11 Wait for a few seconds for the output of the power supply to settle. Ensure that the power supply is in the CV mode.

12 Record the voltage reading on the multimeter (V_{DMM}).

This value should be within the limit of

- 30 V ± 0.09 V for U8031A,
- 60 V ± 0.165 V for U8032A, and
- 5 V ± 0.25 V for Output 3.

13 When the power supply is in the meter mode, record the voltage reading shown on the power supply.

This value should be within the limit of

- V_{DMM} ± 0.09 V for U8031A, and
- V_{DMM} ± 0.165 V for U8032A.

CV load effect (load regulation)

This test measures the change in the output voltage resulting from a change in the output current from full load to no load or vice versa.

Procedure:

1. Power off the power supply, and connect a multimeter between the (+) and (–) terminals of the output as shown in Figure 1-1.
2. Power on the power supply.
3. When the power supply is in the limit mode, program the output voltage to its full rated value (i.e., 30 V for U8031A, 60 V for U8032A, and 5 V for Output 3) and the output current to the maximum programmable value.
4. Enable the output.
5. Operate the electronic load in the CC mode, and set its current to 6 A for U8031A, 3 A for U8032A, and 3 A for Output 3.

   Ensure that the power supply is in the CV mode. If not, adjust the electronic load so that the current drops slightly until the power supply is in the CV mode.
6. Record the reading on the multimeter.
7. Within a few seconds after step 6, operate the electronic load in open mode and record the reading on the multimeter.
8. Compare the reading obtained in step 5 and step 6 with the reading obtained in step 7. The difference should be within the limit of
   - 5 mV for U8031A,
   - 8 mV for U8032A, and
   - ≤ 5 mV for Output 3.

CV source effect (line regulation)

This test measures the change in the output voltage that results from a change in the AC line voltage from its minimum value to its maximum value.

Procedure:

1. Power off the power supply, and connect a multimeter between the (+) and (–) terminals of the output to be tested as shown in Figure 1-1.
2. Connect the AC power line through an AC voltage source. Adjust the AC voltage source to provide a nominal input voltage to the power supply.
3. Power on the power supply.
4. When the display is in the limit mode, program the output voltage to its full rated value (i.e., 30 V for U8031A and 60 V for U8032A, and 5 V for Output 3) and the output current to the maximum programmable value.
5. Enable the output.
6. Operate the electronic load in the CC mode, and set its current to
   - 6 A for U8031A,
   - 3 A for U8032A, and
   - 3 A for Output 3.

   Ensure that the power supply is in the CV mode. If not, adjust the electronic load so that the output current drops slightly until the power supply is in the CV mode.
7. Adjust the AC voltage source to its low line voltage limit. Record the output reading on the multimeter.
8. Within a few seconds after step 7, adjust the AC voltage source to its high line voltage limit, and record the voltage reading on the multimeter.
9. The difference between the multimeter readings in step 7 and step 8 should be within the limit of
   - 5 mV for U8031A,
   - 8 mV for U8032A, and
   - ≤ 5 mV for Output 3.

Line voltage, Vac	Low line voltage limit, Vac	High line voltage limit, Vac
100	90	110
115	104	127
230	207	253

CV noise

CV noise is specified as the RMS or peak-to-peak output voltage in the frequency range from 20 Hz to 20 MHz.

Procedure:

1. Power off the power supply, and connect the output to be tested as shown in Figure 1-3 to a differential amplifier and load resistor (5 Ω for U8031A, 20 Ω for U8032A, and 1.67 Ω for Output 3).
2. Power on the power supply.
3. When the display is in the limit mode, program the output voltage to its full rated value (i.e., 30 V for U8031A, 60 V for U8032A, and 5 V for Output 3) and output current to the maximum programmable value.
4. Enable the output of the power supply.
5. Ensure that the power supply is in the CV mode. If not, adjust the resistive load so that the output current drops slightly until the power supply is in the CV mode.
6. Configure the differential amplifier as follows.
   - Enable the AC mode (positive and negative) to remove the DC component
   - Enable the differential mode
   - Set the gain to ×10
   - Set the attenuation to 1
   - Set the low-pass filter to 20 MHz bandwidth limit to filter out input signals that contain higher frequencies
   - Enable the zero precision voltage generator
   - Set the input impedance to 50 Ω

7 Configure the scope as follows.

- Set the time range to 50 ms (20 Hz)
- Acquire every single sample at the maximum sampling rate and retain only the minimum and maximum values in a “sampling region” (50 ms time range)
- Enable the 20 MHz cut-off frequency for better high frequency cut-off
- Enable AC coupling
- Enable auto-triggering

8 Allow the scope run for a few seconds to generate enough measurement points.

9 Obtain the maximum peak-to-peak voltage measurement as indicated in the scope. Divide this value by 10 to get the CV peak-to-peak noise measurement. The result should not exceed

- 10 mV_{pp} for U8031A and U8032A, and
- 50 mV_{pp} for Output 3.

10 Configure the RMS voltmeter as follows.

- Set the high-pass filter to 10 Hz
- Enable AC coupling

11 Disconnect the oscilloscope, and connect an RMS voltmeter in its place. Do not disconnect the 50 Ω termination. Divide the reading of the RMS voltmeter by 10. The result should not exceed the RMS limits of

- 1 mV_{RMS} for U8031A and U8032A, and
- 2 mV_{RMS} for Output 3.

Load transient response time

This test measures the time for the output voltage to recover to within 15 mV of the nominal output voltage following a load change from full load to half load or vice versa.

Procedure:

1. Power off the power supply, and connect the output to be tested as shown in Figure 1-1 with an oscilloscope. Operate the electronic load in the CC mode.
2. Power on the power supply.
3. When the display is in the limit mode, program the output voltage to full rated value (i.e., 30 V for U8031A and 60 V for U8032A) and the output current to the maximum programmable value.
4. Enable the output.
5. Set the electronic load to the transient operation mode between one half of the output's full rated value and the output's full rated value at a 1 kHz rate with 50% duty cycle.
6. Set the oscilloscope coupling, internal sync, and lock on to either the positive or negative load transient.
7. Adjust the oscilloscope to display transients as shown in Figure 1-6. Note that the pulse width ($t_2 - t_1$) of the transients at 15 mV from the base line is no more than 50 μs for the output.

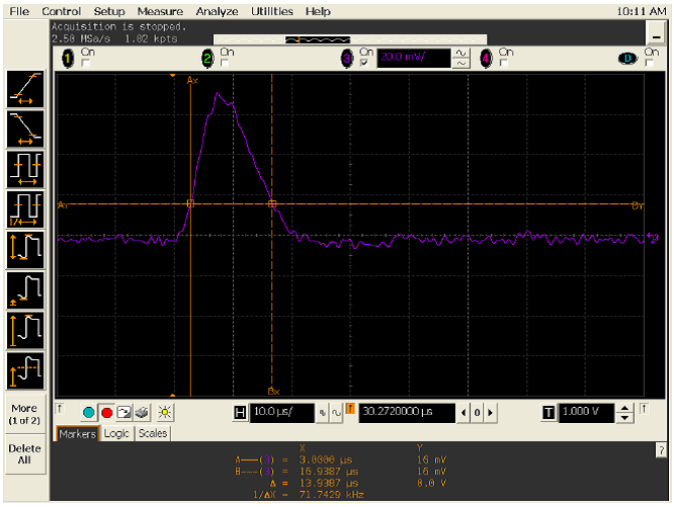

Figure 1-6 Graph of load transient response

Constant current (CC) verification

Current programming and readback accuracy

This test is to verify that the current programming and readback accuracy are within published specifications. The accuracy of the current monitoring resistor must be 0.1% or better.

Procedure:

1. Power off the power supply, and connect a 0.01 Ω current shunt monitoring resistor (R_M) across the output to be tested as shown in Figure 1-2 and a multimeter across the current monitoring resistor (R_M).
2. Power on the power supply.
3. When the power supply is in the limit mode, program the output voltage to the maximum programmable value and the current to 0 A.
4. Enable the output.
5. Wait for a few seconds for the output of the power supply to settle. Ensure that the power supply is in the CC mode.

6 Divide the voltage drop (DMM reading) across the current monitoring resistor (R_M) by its resistance to convert it to ampere and record this value (I_O). This value should be within the limit of 0 A ± 15 mA.

7 When the power supply is in the meter mode, record the current reading shown on the power supply. This value should be within the limit of I_O ± 10 mA.

8 Disable the output.

9 When the power supply is in the limit mode, program the output current to its full rated value, i.e., 6 A for U8031A and 3 A for U8032A.

10 Enable the output.

11 Wait for a few seconds for the output of the power supply to settle. Ensure that the power supply is in CC mode.

12 Divide the voltage drop (DMM reading) across the current monitoring resistor (R_M) by its resistance to convert it to ampere and record this value (I_O). This value should be within the limit of:

- 6 A ± 33 mA for U8031A, and
- 3 A ± 24 mA for U8032A.

13 When the power supply is in the meter mode, record the current reading shown on the power supply. This value should be within the limit of:

- I_O ± 25 mA for U8031A, and
- I_O ± 17.5 mA for U8032A.

CC load effect (load regulation)

This test measures the immediate change in the output current resulting from a change in the load from the full rated output voltage to a short circuit.

Procedure:

1. Power off the power supply, and connect the output to be tested as shown in Figure 1-2 with the multimeter connected across the 0.01 Ω current monitoring resistor (R_M).
2. Power on the power supply.
3. When the power supply is in the limit mode, program the output voltage to its maximum programmable value and the output current to full rated value, i.e., 6 A for U8031A and 3 A for U8032A.
4. Enable the output.
5. Operate the electronic load in the CV mode, and set its voltage to 30 V for U8031A and 60 V for U8032A. Ensure that the power supply is in the CC mode. If not, adjust the electronic load so that the voltage drops slightly until the power supply is in the CC mode.
6. Allow the instrument to stabilize for 7 minutes before you record the current reading by dividing the voltage reading on the multimeter by the resistance of the current monitoring resistor.
7. Within a few seconds after step 6, operate the electronic load in the short mode, and allow the instrument to stabilize for 7 minutes before you record the current reading by dividing the voltage reading on the multimeter by the resistance of the current monitoring resistor.
8. Compare the reading obtained in step 6 and step 7. The difference should be within the limit of:
   - 3.2 mA for U8031A, and
   - 2.6 mA for U8032A.

CC source effect (line regulation)

This test measures the change in the output current that results from a change in the AC line voltage from the minimum value to the maximum value.

Procedure:

1. Power off the power supply, and connect the output to be tested as shown in step 1-2 with the multimeter connected across the current monitoring resistor (R_M).
2. Connect the AC power line through an AC voltage source. Adjust the AC voltage source to provide nominal input voltage to the power supply.
3. Power on the power supply.
4. When the display is in the limit mode, program the output voltage to the maximum programmable value and the output current to its full rated value, i.e., 6 A for U8031A and 3 A for U8032A.
5. Enable the output.
6. Operate the electronic load in the CV mode and set its voltage to 30 V for U8031A and 60 V for U8032A. Ensure that the power supply is in the CC mode. If not, adjust the electronic load so that the output voltage drops slightly until the power supply is in the CC mode.
7. Adjust the AC voltage source to the low line voltage limit. Allow the instrument to stabilize for 7 minutes before you record the output current reading by dividing the voltage reading on the multimeter by the resistance of the current monitoring resistor.
8. Within a few seconds after step 7, adjust the AC voltage source to the high line voltage limit and record the output current reading by dividing the voltage reading on the multimeter by the resistance of the current monitoring resistor.
9. Compare the reading obtained in step 7 and step 8. The difference should be within the limit of:
   - 3.2 mA for U8031A, and
   - 2.6 mA for U8032A.

Line voltage, Vac	Low line voltage limit, Vac	High line voltage limit, Vac
100	90	110
115	104	127
230	207	253

CC noise

CC noise is specified as the RMS output current in a frequency range 20 Hz to 20 MHz with the power supply in the CC operation.

Procedure:

1. Power off the power supply, and connect the output to be tested as shown in Figure 1-4 to an AC/DC converter and load resistor (5 Ω for U8031A, 20 Ω for U8032A).
2. Power on the power supply.
3. When the display is in the limit mode, program the output voltage to the maximum programmable value and the output current to its full rated value, i.e., 6 A for U8031A and 3 A for U8032A.
4. Enable the output.
5. Ensure that the power supply is in the CC mode. If not, adjust the resistive load so that the output voltage drops slightly until the power supply is in the CC mode.
6. Configure the differential amplifier as follows.
   - Enable the AC mode (positive and negative) to remove the DC component
   - Enable the differential mode
   - Set the gain to ×10
   - Set the attenuation to 1
   - Set the low-pass filter to 20 MHz bandwidth limit to filter out input signals that contain higher frequencies
   - Enable the zero precision voltage generator
   - Set input impedance to 50 Ω

7 Configure the RMS voltmeter as follows.
   - Set high-pass filter to 10 Hz
   - AC coupling

8 Divide the reading of the RMS voltmeter by 10, and then multiply the result by 5 to get the RMS noise measurement. The result should not exceed the RMS limits of 1 mA_{RMS}.

Performance Test Record for U8031A

Table 1-2 U8031A CV performance test record

Test description	Actual result	Specifications	
		Upper limit	Lower limit
CV programming accuracy @ 0 volts (DVM reading)			
Output 1		+0.015 V	–0.015 V
Output 2		+0.015 V	–0.015 V
Output 3		+0.25 V	–0.25 V
CV readback accuracy @ 0 volts			
Output 1		DVM + 0.010 V	DVM – 0.010 V
Output 2		DVM + 0.010 V	DVM – 0.010 V
CV programming accuracy @ full scale (DVM reading)			
Output 1		30.090 V	29.910 V
Output 2		30.090 V	29.910 V
Output 3		5.25 V	4.75 V
CV readback accuracy @ full scale			
Output 1		DVM + 0.085 V	DVM – 0.085 V
Output 2		DVM + 0.085 V	DVM – 0.085 V
CV load regulation		Maximum change:	
Output 1		<5 mV	
Output 2		<5 mV	
Output 3		≤5 mV	

Table 1-2 U8031A CV performance test record (continued)

Test description	Actual result	Specifications	
		Upper limit	Lower limit
CV line regulation			
Output 1		<5 mV	
Output 2		<5 mV	
Output 3		≤5 mV	
CV ripple/noise			
Output 1		≤10 mV_{PP}, ≤1 mV_{RMS}	
Output 2		≤10 mV_{PP}, ≤1 mV_{RMS}	
Output 3		≤50 mV_{PP}, <2 mV_{RMS}	
Load transient response time			
Output 1		<50 µs	
Output 2			

Table 1-3 U8031A CC performance test record

Test description	Actual result	Specifications	
		Upper limit	Lower limit
CC programming accuracy @ 0 volts (I_0)			
Output 1		+0.015 A	–0.015 A
Output 2		+0.015 A	–0.015 A
CC readback accuracy @ 0 volts			
Output 1		I_0 + 0.010 A	I_0 – 0.010 A
Output 2		I_0 + 0.010 A	I_0 – 0.010 A

Table 1-3 U8031A CC performance test record (continued)

Test description	Actual result	Specifications	
		Upper limit	Lower limit
CC programming accuracy @ full scale (I_0)			
Output 1		6.033 A	5.967 A
Output 2		6.033 A	5.967 A
CC readback accuracy @ full scale			
Output 1		I_0 + 0.0250 A	I_0 – 0.0250 A
Output 2		I_0 + 0.0250 A	I_0 – 0.0250 A
CC load regulation		Maximum change:	
Output 1		<3.2 mA	
Output 2		<3.2 mA	
CC line regulation		Maximum change:	
Output 1		<3.2 mA	
Output 2		<3.2 mA	
CC ripple/noise			
Output 1		≤1 mA_{RMS}	
Output 2		≤1 mA_{RMS}	

Performance Test Record for U8032A

Table 1-4 U8032A CV performance test record

Test description	Actual result	Specifications	
		Upper limit	Lower limit
CV programming accuracy @ 0 volts (DVM reading[a])			
Output 1		+0.015 V	–0.015 V
Output 2		+0.015 V	–0.015 V
Output 3		+0.25 V	–0.25 V
CV readback accuracy @ 0 volts			
Output 1		DVM + 0.010 V	DVM – 0.010 V
Output 2		DVM + 0.010 V	DVM – 0.010 V
CV programming accuracy @ full scale (DVM reading)			
Output 1		60.165 V	59.835 V
Output 2		60.165 V	59.835 V
Output 3		5.25 V	4.75 V
CV readback accuracy @ full scale			
Output 1		DVM + 0.165 V	DVM – 0.165 V
Output 2		DVM + 0.165 V	DVM – 0.165 V
CV load regulation		Maximum change:	
Output 1		<8 mV	
Output 2		<8 mV	
Output 3		≤5 mV	

Table 1-4 U8032A CV performance test record (continued)

Test description	Actual result	Specifications	
		Upper limit	Lower limit
CV line regulation			
Output 1		<8 mV	
Output 2		<8 mV	
Output 3		≤5 mV	
CV ripple/noise			
Output 1		≤10 $mV_{PP,}$ ≤1 mV_{RMS}	
Output 2		≤10 $mV_{PP,}$ ≤1 mV_{RMS}	
Output 3		≤50 $mV_{PP,}$ <2 mV_{RMS}	
Load transient response time			
Output 1		<50 µs	
Output 2			

[a] **DVM**: Digital Volt Meter

Table 1-5 U8032A CC performance test record

Test description	Actual result	Specifications	
		Upper limit	Lower limit
CC programming accuracy @ 0 volts (I_0)			
Output 1		+0.015 A	–0.015 A
Output 2		+0.015 A	–0.015 A
CC readback accuracy @ 0 volts			
Output 1		I_0 + 0.010 A	I_0 – 0.010 A
Output 2		I_0 + 0.010 A	I_0 – 0.010 A

Table 1-5 U8032A CC performance test record (continued)

Test description	Actual result	Specifications	
		Upper limit	Lower limit
CC programming accuracy @ full scale (I_0)			
Output 1		3.024 A	2.976 A
Output 2		3.024 A	2.976 A
CC readback accuracy @ full scale			
Output 1		I_0 + 0.0175 A	I_0 – 0.0175 A
Output 2		I_0 + 0.0175 A	I_0 – 0.0175 A
CC load regulation		Maximum change:	
Output 1		<2.6 mA	
Output 2		<2.6 mA	
CC line regulation		Maximum change:	
Output 1		<2.6 mA	
Output 2		<2.6 mA	
CC ripple/noise			
Output 1		≤1 mA_{RMS}	
Output 2		≤1 mA_{RMS}	

Using the Front Panel for Adjustments

This section describes the procedures to perform voltage and current adjustments (calibrations) from the front panel of the power supply.

Calibration procedure

NOTE Review the Test Considerations before beginning the calibration procedure.

1 Press and hold the **[Memory]** button when powering on the power supply to begin the calibration procedure.

2 The calibration procedure starts with the voltage calibration for Output 1.

NOTE Disconnect all loads from the power supply, and connect a digital volt meter (DVM) across the output terminals of Output 1.

Voltage calibration for Output 1

1 The display shows the calibration setup screen.
   - All the outputs are disabled. The **OFF** annunciator turns on.
   - The **OUT1** annunciator turns on.
   - The **CV** annunciator for Output 1 turns on.
   - The display shows **SET UP** on line 1 and **CAL** on line 2. The **CAL** annunciator blinks.

2 Press the **[Memory]** button.
   - Output 1 is enabled. The **OFF** annunciator turns off.
   - Ensure that the output is in the CV mode, otherwise the **CC** annunciator for Output 1 will blink and the calibration will not proceed.

3 **Voltage calibration low point:**
   - The **M1** annunciator turns on.
   - Use the knob to enter the reading obtained from the DVM.
   - Press the **[Memory]** button to save the value.
   - The calibration proceeds to the next calibration point.

4 **Voltage calibration high point:**
   - The **M2** annunciator turns on.
   - Use the knob to enter the reading obtained from the DVM.
   - Press the **[Memory]** button to save the value.

5 The voltage calibration for Output 1 is completed.
   - Output 1 is disabled.
   - The display shows **DONE** for a brief period of time.
   - The calibration procedure proceeds to the current calibration for Output 1.

NOTE Connect an appropriate 0.01 Ω shunt resistor across the output terminals of Output 1, and connect a DVM across the shunt resistor.

Current calibration for Output 1

1 The display shows the calibration setup screen.
   - All the outputs are disabled. The **OFF** annunciator turns on.
   - The **OUT1** annunciator turns on.
   - The **CC** annunciator for Output 1 turns on.
   - The display shows **SET UP** on line 1 and **CAL** on line 2. The **CAL** annunciator blinks.

2 Press the **[Memory]** button.
   - Output 1 is enabled. The **OFF** annunciator turns off.
   - Ensure that the output is in the CC mode, otherwise the **CV** annunciator for Output 1 will blink and the calibration will not proceed.

3 **Current calibration low point:**
   - The **M1** annunciator turns on.
   - Use the knob to enter the calculated value (the DVM reading divided by the shunt resistance).
   - Press the **[Memory]** button to save the value.
   - The calibration proceeds to the next calibration point.

4 **Current calibration high point:**
   - The **M2** annunciator turns on.
   - Use the knob to enter the calculated value (the DVM reading divided by the shunt resistance).
   - Press the **[Memory]** button to save the value.

5 The current calibration for Output 1 is completed.
   - Output 1 is disabled.
   - The display shows **DONE** for a brief period of time.
   - The calibration procedure proceeds to the voltage calibration for Output 2.

NOTE Disconnect all loads from the unit, and connect a DVM across the output terminals of Output 2.

Voltage calibration for Output 2

1 The display shows the calibration setup screen.
   - All the outputs are disabled. The **OFF** annunciator turns on.
   - The **OUT2** annunciator turns on.
   - The **CV** annunciator for Output 2 turns on.
   - The display shows **SET UP** on line 1 and **CAL** on line 2. The **CAL** annunciator blinks.

2 Press the **[Memory]** button.
   - Output 2 is enabled. The **OFF** annunciator turns off.
   - Ensure that the output is in the CV mode, otherwise the **CC** annunciator for Output 2 will blink and the calibration will not proceed.

3 **Voltage calibration low point:**
   - The **M1** annunciator turns on.
   - Use the knob to enter the reading obtained from the DVM.
   - Press the **[Memory]** button to save the value.
   - The calibration proceeds to the next calibration point.

4 **Voltage calibration high point:**
   - The **M2** annunciator turns on.
   - Use the knob to enter the reading obtained from the DVM.
   - Press the **[Memory]** button to save the value.

5 The voltage calibration for Output 2 is completed.
   - Output 2 is disabled.
   - The display shows **DONE** for a brief period of time.
   - The calibration procedure proceeds to the current calibration for Output 2.

NOTE Connect an appropriate 0.01 Ω shunt resistor across the output terminals of Output 2, and connect a DVM across the shunt resistor.

Current calibration for Output 2

1 The display shows the calibration setup screen.
   - All the outputs are disabled. The **OFF** annunciator turns on.
   - The **OUT2** annunciator turns on.
   - The **CC** annunciator for Output 2 turns on.
   - The display shows **SET UP** on line 1 and **CAL** on line 2. The **CAL** annunciator blinks.

2 Press the **[Memory]** button.
   - Output 2 is enabled. The **OFF** annunciator turns off.
   - Ensure that the output is in the CC mode, otherwise the **CV** annunciator for Output 2 will blink and the calibration will not proceed.

3 **Current calibration low point:**
   - The **M1** annunciator turns on.
   - Use the knob to enter the calculated value (the DVM reading divided by the shunt resistance).
   - Press the **[Memory]** button to save the value.
   - The calibration proceeds to the next calibration point.

4 **Current calibration high point:**
   - The **M2** annunciator turns on.
   - Use the knob to enter the calculated value (the DVM reading divided by the shunt resistance).
   - Press the **[Memory]** button to save the value.

5 The current calibration for Output 2 is completed.
   - Output 2 is disabled.
   - The display shows **DONE** for a brief period of time.
   - The entire calibration procedure is now completed.
   - The display shows **DONE CAL**.

6 Verify the calibrations using the "Performance Verification Tests" on page 24.

Restarting the calibration procedure

After the calibration procedure is completed, it can be restarted by pressing the **[Memory]** button.

The calibration procedure will restart with the voltage calibration for Output 1.

Toggling between channels and calibration modes

To select the output channel for calibration, press the **[1]** or **[2]** button.

When the output channel is changed, the calibration will always start with the voltage calibration mode.

During the calibration, pressing the **[Voltage/Current]** button will toggle between the voltage calibration mode and current calibration mode.

Exiting the calibration mode

1. Remove all the shunt resistors and connectors from the instrument.
2. Power off and on again. The instrument will return to normal operation.

List of Error Codes

The following errors indicate failures that may occur while operating the power supply.

System errors

Table 1-6 List of system error codes

Error code	Description
001	Failed firmware test
002	Failed RAM test
003	Flash read/write error

Power channel errors

Table 1-7 List of power channel error codes

Error code	Description
104	EEPROM write error
105	Analog board firmware update error
106	Analog board firmware checksum error
107	EEPROM read error
108	Failed to calibrate voltage DAC
109	Failed to calibrate voltage ADC
110	Failed to calibrate OVP
111	Failed to calibrate current DAC
112	Failed to calibrate current ADC
113	Failed to calibrate OCP
119	Analog board unknown error

Table 1-7 List of power channel error codes (continued)

Error code	Description
120	Over temperature
130	Failed EEPROM test
131	Failed voltage +15 V
132	Failed voltage +5 V
133	Failed voltage +2.5 V_{REF}
134	Failed voltage +1 V_{REF}
135	Failed ADC test
136	Failed DAC test
140	Failed communication with analog board
141	Unsupported analog board

2 Service and Maintenance

This chapter will help you troubleshoot a failing instrument. It also describes how to obtain repair services and lists the replaceable assemblies.

Troubleshooting

WARNING To avoid electrical shock, do not perform any service unless you are qualified to do so.

This section provides a brief check list of the common failures. Before troubleshooting or repairing the power supply, make sure that the failure is in the instrument rather than any external connections. Also make sure that the instrument is accurately calibrated.

The table below will assist you in identifying some basic malfunctions.

Table 2-1 Operating checklist

Malfunction	Identification
Unit is inoperative	– Verify that the AC power cord is connected to the power supply. – Verify that the front panel power switch is at the **ON** position. – Verify the power- line voltage setting. – Verify that the power- line fuse is installed.[a]

[a] See Table 2-3 on page 56 for more information on the power-line fuse part number and description.

Line Voltage Conversion

WARNING SHOCK HAZARD

Operating personnel must not remove power supply covers. Component replacement and internal adjustment must be made only by qualified service personnel.

Line voltage conversion is accomplished by adjusting one component: the line voltage selection switch. To convert the supply from one line voltage option to another, proceed as follows.

1 Turn off the power supply, and disconnect the power cord.

1 Select the desired line voltage with the line voltage selection switch

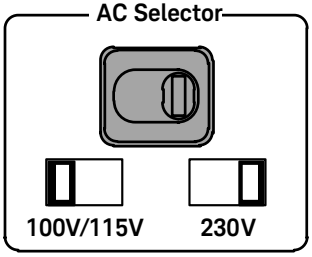

Figure 2-1 Orientation of voltage selector for different voltage selection

Table 2-2 Line voltage fuse rating indicator for U8031A/U8032A

	Fuse	~ Line
Rating: 47-63 Hz 600 VA	**1.0 AT**	**100 V** ▭
		115 V ▭
		230 V ▭

NOTE The authorized personnel will mark the fuse rating indicator printed on the rear panel each time the fuse is changed.

Self-Test Procedure

Power-on self-test

Each time the power supply is powered on, a set of self-tests is performed. These tests check that the minimum set of logic and measurement hardware are functioning properly.

If the unit fails the power-on self-test

Verify that the correct power-line voltage setting is selected. Also, ensure that all terminal connections are removed while the power-on self-test is performed. Please refer to "List of Error Codes" on page 49 for the list of error codes.

Returning the Instrument for Service

Before shipping your instrument for repair or replacement, Keysight recommends that you acquire the shipping instructions from the Keysight Technologies Service Center. A clear understanding of the shipping instructions is necessary to secure your product for shipment.

1. Attach a tag to the instrument with the following information:
   - Name and address of the owner
   - Instrument model number
   - Instrument serial number
   - Description of the service required or failure indications
2. Remove all accessories from the instrument. Do not include accessories unless they are associated with the failure symptoms.
3. Place the instrument in its original container with appropriate packaging material for shipping.

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

NOTE Keysight suggests that you always insure your shipments.

Replaceable Parts

This section contains information for ordering replacement parts for your instrument. You can find the instrument support part list in the *Keysight's Test & Measurement Parts Catalog* at http://www.keysight.com/find/parts

Table 2-3 include a brief description of each part with the applicable Keysight part number.

Table 2-3 Replaceable parts for U8031A/U8032A

Part number	Description
2110-1504	FUSE 1 A 250 V TIME-DELAY 0.0757-OHM 20 × 5.2 × 5.2-MM
U8031-48001	Rubber Keypad
E3632-40003	Knob
5190-3459	Fuse holder
0371-3806	AC switch Key Cap
U8031-30001	LCD Module
U8031-66504	Display PCA
U8031-68501	DC Fan Assembly
5041-9172	Trim Side
E3631-61201	STRAP Handle Assembly

To order replaceable parts

You can order replaceable parts from Keysight using the Keysight part number. Note that not all parts listed are available as field-replaceable parts.

To order replaceable parts from Keysight, do the following:

1. Contact your nearest Keysight Sales Office or Service Center.
2. Identify the parts by the Keysight part number shown in the support parts list.
3. Provide the instrument model number and serial number.

Types of Service Available

If your instrument fails during the warranty period, Keysight Technologies will repair or replace it under the terms of your warranty.

Extended service contracts

Many Keysight products are available with optional service contracts that extend the covered period after the standard warranty expires. If you have such a service contract and your instrument fails during the covered period, Keysight Technologies will repair or replace it in accordance with the contract.

Obtaining Repair Service (Worldwide)

To obtain service for your instrument (in-warranty or under service contract), contact your nearest Keysight Technologies Service Center. They will arrange to have your unit repaired or replaced, and can provide warranty information where applicable.

To obtain warranty, service, or technical support information you can contact Keysight Technologies at one of the following telephone numbers:

- In the United States: (800) 829-4444
- In Europe: 31 20 547 2111
- In Japan: 0120-421-345

Or use our web link for information on contacting Keysight worldwide: www.keysight.com/find/assist

Or contact your Keysight Technologies Representative.

Before shipping your instrument, ask the Keysight Technologies Service Center to provide shipping instructions, including what components to ship. Keysight recommends that you retain the original shipping carton for use in such shipments.

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