Notices

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Manual Part Number
E3632-90010

Edition
Edition 9, March 2019

Printed in:
Printed in Malaysia

Published by:
Keysight Technologies
Bayan Lepas Free Industrial Zone,
11900 Penang, Malaysia

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Safety Information

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.

Keysight E3632A Service Guide
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.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>!</td>
<td>Caution, risk of danger (refer to this manual for specific Warning or Caution information)</td>
<td>Direct current (DC)</td>
</tr>
<tr>
<td>⚡</td>
<td>Protective conductor terminal</td>
<td>Alternating current (AC)</td>
</tr>
<tr>
<td>⚡</td>
<td>Earth (ground) terminal</td>
<td>Out position of a bi-stable push control</td>
</tr>
<tr>
<td>⚡</td>
<td>Terminal is at earth potential. Used for measurement and control circuits designed to be operated with one terminal at earth potential.</td>
<td>In position of a bi-stable push control</td>
</tr>
<tr>
<td>+</td>
<td>Positive binding post</td>
<td>Negative binding post</td>
</tr>
</tbody>
</table>
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.

- 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 a 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.
This power supply is a Safety Class I instrument, which means that it has a protective earth terminal. That terminal must be connected to earth ground through a power source with a 3-wire ground receptacle.

Before installation or operation, check the power supply and review this manual for safety markings and instructions. Safety information for specific procedures is located at the appropriate places in this manual.

- Do not use MAINS supply cords by inadequately RATED cord. Always use the MAINS supply cord provided by the manufacturer.
- Do not use the device if it appears damaged or defective. REMOVE POWER and do not use the device until safe operation is verified by service-trained personnel. If necessary, return the device to Keysight for service and repair to ensure that the safety features are maintained.
- 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. Return the device to Keysight for service and repair to ensure that the safety features are maintained.
- Do not operate the device with the cover removed or loosened.
Safety and EMC Requirements

This power supply is designed to comply with the following safety and Electromagnetic Compatibility (EMC) requirements:

- IEC61326-1:2005/EN61326-1:2006
- Canada: ICES/NMB-001: Issue 4, June 2006
- Australia/New Zealand: AS/NZS CISPR11:2004
- Canada: CAN/CSA-C22.2 No. 61010-1-04
- USA: ANSI/UL 61010-1:2004

Environmental Conditions

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

<table>
<thead>
<tr>
<th>Environmental condition</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature</td>
<td>Operating condition</td>
</tr>
<tr>
<td></td>
<td>– 0 °C to 40 °C</td>
</tr>
<tr>
<td></td>
<td>Storage condition</td>
</tr>
<tr>
<td></td>
<td>– –20 °C to 70 °C</td>
</tr>
<tr>
<td>Humidity</td>
<td>Up to 80% RH</td>
</tr>
<tr>
<td>Altitude</td>
<td>Up to 2000 m</td>
</tr>
<tr>
<td>Installation category</td>
<td>II (for indoor use)</td>
</tr>
<tr>
<td>Pollution degree</td>
<td>2</td>
</tr>
</tbody>
</table>
Regulatory Markings

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE</td>
<td>The CE marking is a legal compliance marking of the European Community. This CE marking shows that the product complies with all the relevant European Legal Directives.</td>
</tr>
<tr>
<td>CSA</td>
<td>The CSA mark is a registered trademark of the Canadian Standards Association.</td>
</tr>
<tr>
<td>RCM</td>
<td>The RCM mark is a registered trademark of the Australian Communications and Media Authority.</td>
</tr>
<tr>
<td>401</td>
<td>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.</td>
</tr>
<tr>
<td>ICES/NMB-001</td>
<td>ICES/NMB-001 indicates that this ISM device complies with the Canadian ICES-001. Cet appareil ISM est conforme à la norme NMB-001 du Canada.</td>
</tr>
<tr>
<td>K</td>
<td>This symbol is a South Korean Class A EMC Declaration. This is a Class A instrument suitable for professional use and in electromagnetic environment outside of the home.</td>
</tr>
<tr>
<td>WEEE</td>
<td>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.</td>
</tr>
</tbody>
</table>
Waste Electrical and Electronic Equipment (WEEE) Directive

This instrument complies with the WEEE Directive 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/powersupply
  (product-specific information and support, software and documentation updates)
- www.keysight.com/find/assist
  (worldwide contact information for repair and service)
# Table of Contents

Safety Symbols ......................................................... 3
Safety Considerations ............................................. 4
Safety and EMC Requirements ................................. 6
Environmental Conditions ........................................ 6
Regulatory Markings ............................................... 7
Waste Electrical and Electronic Equipment (WEEE) Directive .... 8
  Product category: ........................................... 8
Sales and Technical Support .................................. 8

1 Calibration Procedures
   Closed-Case Electronic Calibration ......................... 20
   Keysight Calibration Services ................................. 20
   Calibration Interval ......................................... 20
   Automating Calibration Procedures ......................... 21
   Recommended Test Equipment ............................ 22
   Test Considerations ........................................ 23
   Performance Verification Tests ......................... 24
     Self-test .............................................. 24
     Performance verification tests ..................... 24
   Measurement Techniques .................................. 25
     Setup for most tests .................................. 25
     Electronic load ...................................... 26
     Current-monitoring resistor ......................... 26
     Programming ........................................ 26
   Constant Voltage (CV) Verifications .................... 27
     Constant voltage test setup ......................... 27
     Voltage programming and readback accuracy ........ 27
     CV load regulation .................................. 28
     CV line regulation ................................... 29
     Normal mode voltage noise (CV ripple and noise) .... 29
Load transient response time ...........................................31
Constant Current (CC) Verifications .................................32
  Constant current test setup ........................................32
  Current programming and readback accuracy .................32
  CC load regulation ...............................................33
  CC line regulation ..............................................34
  Normal mode current noise (CC ripple and noise) .........35
Common Mode Current Noise .........................................36
Performance Test Record for E3632A ...............................37
  CV performance test record .....................................37
  CC performance test record ...................................38
Calibration Security Code .............................................39
  To unsecure the power supply for calibration ..........40
  To unsecure the power supply without the security code 41
Calibration Count ......................................................42
  Calibration Message .............................................42
General Calibration/Adjustment Procedure ......................43
  Voltage and OVP calibration ....................................44
  Current and OCP calibration ....................................46
Aborting a Calibration in Progress .................................49
Calibration Record for E3632A ..................................50
Error Messages .......................................................51
  System error messages ........................................51
  Self-test error messages ......................................52
  Calibration error messages ....................................53
Calibration Program ..................................................54

2 Service
  Operating Checklist ...............................................60
  Types of Service Available ....................................61
  Standard repair service (worldwide) .........................61
List of Figures

Figure 1-1  Performance verification test setup  .................25
Figure 1-2  Transient response time  .........................31
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List of Tables

Table 1-1  Recommended test equipment ..........................22
Table 1-2  CV performance test record ..........................37
Table 1-3  CC performance test record ..........................38
Table 1-4  Parameters for calibration ............................43
Table 1-5  Calibration record for E3632A ........................50
Table 1-6  System error messages .................................51
Table 1-7  Self-test error messages ...............................52
Table 1-8  Calibration error messages ............................53
Table 2-1  Bias supplies voltages .................................66
Table 2-2  Bias supplies voltages (serial MY53xx6xxx) ...........66
Table 2-3  Self-test error messages ...............................67
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1 Calibration Procedures

Closed-Case Electronic Calibration  20
Keysight Calibration Services  20
Calibration Interval  20
Automating Calibration Procedures  21
Recommended Test Equipment  22
Test Considerations  23
Performance Verification Tests  24
Measurement Techniques  25
Constant Voltage (CV) Verifications  27
Constant Current (CC) Verifications  32
Common Mode Current Noise  36
Performance Test Record for E3632A  37
Calibration Security Code  39
Calibration Count  42
General Calibration/Adjustment Procedure  43
Aborting a Calibration in Progress  49
Calibration Record for E3632A  50
Error Messages  51
Calibration Program  54

This chapter contains procedures to verify that the power supply is operating normally and is within published specifications.
Closed-Case Electronic Calibration

The power supply features closed-case electronic calibration since no internal mechanical adjustments are required for normal calibration. The power supply calculates correction factors based upon the input reference value you enter. The new correction factors are stored in non-volatile memory until the next calibration adjustment is performed. (Non-volatile memory does not change when power has been switched off or after a remote interface reset.)

Keysight Calibration Services

When your power supply is due for calibration, contact your local Keysight Service Center for a low-cost calibration. The Keysight E3632A power supply is supported on calibration processes which allow Keysight to provide this service at competitive prices.

Calibration Interval

The power supply should be calibrated on a regular interval determined by the accuracy requirements of your application. A 1-year interval is adequate for most applications. Keysight does not recommend extending calibration intervals beyond 1 year for any application. Keysight recommends that complete re-adjustment should always be performed at the calibration interval. This will increase your confidence that the Keysight E3632A will remain within specification for the next calibration interval. This criterion for re-adjustment provides the best long-term stability.
Automating Calibration Procedures

You can automate the complete verification procedures outlined in this chapter if you have access to programmable test equipment. You can program the instrument configurations specified for each test over the remote interface. You can then enter readback verification data into a test program and compare the results to the appropriate test limit values.

You can also enter calibration constants from the remote interface. Remote operation is similar to the local front-panel procedure. You can use a computer to perform the adjustment by first selecting the required setup. The calibration value is sent to the power supply and then the calibration is initiated over the remote interface. The power supply must be unsecured prior to initiating the calibration procedure. A Keysight BASIC program for calibration over the GPIB interface is listed at the end of this chapter.

For further details on programming the power supply, see chapters 3 and 4 in the Keysight E3632A User's Guide.
Recommended Test Equipment

The test equipment recommended for the performance verification and adjustment procedures is listed below. If the exact instrument is not available, use the accuracy requirements shown to select substitute calibration standards.

Table 1-1  Recommended test equipment

<table>
<thead>
<tr>
<th>Instrument</th>
<th>Requirements</th>
<th>Recommended model</th>
<th>Test function</th>
</tr>
</thead>
<tbody>
<tr>
<td>GPIB controller</td>
<td>Full GPIB capabilities</td>
<td>Keysight 82341C Interface card</td>
<td>Programming and readback accuracy.</td>
</tr>
<tr>
<td>Oscilloscope</td>
<td>100 MHz with 20 MHz bandwidth</td>
<td>Keysight 54602B</td>
<td>Display transient response and ripple and noise waveform.</td>
</tr>
<tr>
<td>RMS voltmeter</td>
<td>20 MHz</td>
<td></td>
<td>Measure rms ripple and noise.</td>
</tr>
<tr>
<td>Digital voltmeter</td>
<td>Resolution: 0.1 mV ACC: 0.01%</td>
<td>Keysight 34401A</td>
<td>Measure DC voltages.</td>
</tr>
<tr>
<td>Electronic load</td>
<td>Voltage Range: 50 Vdc</td>
<td>Keysight 6063B</td>
<td>Measure load and line regulations and transient response time.</td>
</tr>
<tr>
<td></td>
<td>Current Range: 10 A dc</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Open and short switches</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resistive loads ($R_l$)</td>
<td>2.1 Ω, 200 W</td>
<td></td>
<td>Measure ripple and noise.</td>
</tr>
<tr>
<td>Current monitoring resistor (shunt)</td>
<td>0.01 Ω, 0.01%</td>
<td></td>
<td>Constant current test setup.</td>
</tr>
</tbody>
</table>
Test Considerations

To ensure proper instrument operation, verify that you have selected the correct power-line voltage prior to attempting any test procedure in this chapter. Refer to the E3632A User’s Guide for more information.

For optimum performance verification, all test procedures should comply with the following recommendations.

- Assure that the calibration ambient temperature is stable and between 20 °C and 30 °C.
- Assure ambient relative humidity is less than 80%.
- Allow a 1-hour warm-up period before verification or calibration.
- Keep cables as short as possible, consistent with the impedance requirements.

**CAUTION**
The tests should be performed by qualified personnel. During performance verification tests, hazardous voltages may be present at the outputs of the power supply.
Performance Verification Tests

The performance verification tests use the power supply's specifications listed in the E3632A User’s Guide.

You can perform two different levels of performance verification tests:

- **Self-test**
  A series of internal verification tests that provides high confidence that the power supply is operational.

- **Performance verification tests**
  These tests can be used to verify the power supply specifications following repairs to specific circuits.

**Self-test**

A power-on self-test occurs automatically when you turn on the power supply. This limited test assures you that the power supply is operational.

The complete self-test is enabled by pressing the Recall key (actually any front panel keys except the Error key) and the power-line switch simultaneously and then continuing to press the Recall key for 5 seconds. The complete self-test will be finished in 2 more seconds.

You can also perform a self-test from the remote interface (see chapter 3 in the E3632A User's Guide).

- If the self-test is successful, PASS is displayed on the front panel.
- If the self-test fails, FAIL is displayed and the ERROR annunciator turns on. If repair is required, see Chapter 2, "Service" for further details.
- If self-test passes, you have a high confidence that the power supply is operational.

**Performance verification tests**

These tests can be used to verify the power supply specifications following repairs to specific circuits. The following sections explain all verification procedures in detail. All of the performance test specifications are shown in each test.
Measurement Techniques

Setup for most tests

Most tests are performed at the front terminals as shown in the following figure. Measure the DC voltage directly at the (+) and (–) terminals on the front panel.

![Performance verification test setup](image)

**Figure 1-1** Performance verification test setup
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 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 carbon-pile load, and it makes easy work of switching between load conditions as is required for the load regulation and load transient response tests. Substitution of the electronic load requires minor changes to the test procedures in this chapter.

Current-monitoring resistor

To eliminate output current measurement error caused by the voltage drops in the leads and connections, connect the current monitoring resistor 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 (see $R_M$ in Figure 1-1).

Programming

Most performance tests can be performed only from the front panel. However, a GPIB or RS-232 controller is required to perform the voltage and current programming accuracy and readback accuracy tests.

The test procedures are written assuming that you know how to program the power supply either from the front panel or from a GPIB or RS-232 controller. Complete instructions on front panel and remote programming are given in the E3632A User’s Guide.
Constant Voltage (CV) Verifications

Constant voltage test setup

If more than one meter or a meter and an oscilloscope are used, connect each to the (+) and (–) terminals by a separate pair of leads to avoid mutual coupling effects. Use a coaxial cable or shielded 2-wire cable to avoid noise pick-up on the test leads.

Voltage programming and readback accuracy

This test verifies that the voltage programming and the GPIB or RS-232 readback functions are within specifications. Note that the readback values over the remote interface should be identical to those displayed on the front panel.

NOTE You should program the power supply over the remote interface for this test to avoid round-off errors.

1. Turn off the power supply and connect a digital voltmeter between the (+) and (–) terminals of the output to be tested as shown in Figure 1-1.

2. Turn on the power supply. Select the 30 V/4 A range and enable the outputs by sending the commands:
   
   ```
   VOLT: RANG P30V
   OUTP ON
   ```

3. Program the output voltage to zero volt and current to full rated value (4.0 A) by sending the commands:
   
   ```
   VOLT 0
   CURR 4
   ```

4. Record the output voltage reading on the digital voltmeter (DVM). The reading should be within the limits of 0 V ±10 mV. Note that the CV, Adrs, Limit, and Rmt annunciators are on.

5. Readback the output voltage over the remote interface by sending the command:
   
   ```
   MEAS: VOLT?
   ```
6 Record the value displayed on the controller. This value should be within the limits of DVM ±5 mV.

7 Program the output voltage to full rated value (30.0 V) by sending the command.

```
VOLT 30.0
```

8 Record the output voltage reading on the digital voltmeter (DVM). The readings should be within the limits of 30 V ±25 mV.

9 Readback the output voltage over the remote interface by sending the command:

```
MEAS:VOLT?
```

10 Record the value displayed on the controller. This value should be within the limits of DVM ±20 mV.

CV load regulation

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

1 Turn off the power supply and connect a digital voltmeter between the (+) and (–) terminals of the output to be tested as shown in Figure 1-1.

2 Turn on the power supply. Select the 30 V/4 A range, enable the output, and set the display to the limit mode. When the display is in the limit mode, program the output current to the maximum programmable value and the voltage to the full rated value (30.0 V).

3 Operate the electronic load in constant current mode and set its current to 4.0 A. Check that the front panel CV annunciator remains lit. If not lit, adjust the load so that the output current drops slightly until the CV annunciator lights. Record the output voltage reading on the digital voltmeter.

4 Operate the electronic load in open mode (input off). Record the output voltage reading on the digital voltmeter immediately. The difference between the digital voltmeter readings in steps 3 and 4 is the CV load regulation. The difference of the readings during the immediate change should be within the limit of 5 mV.
CV line regulation

This test measures the immediate change in output voltage that results from a change in AC line voltage from the minimum value (10% below the nominal input voltage) to maximum value (10% above the nominal input voltage).

1. Turn off the power supply and connect a digital voltmeter between the (+) and (–) terminals of the output to be tested as shown in Figure 1-1.

2. Connect the AC power line through a variable voltage transformer.

3. Turn on the power supply. Select the 30 V/4 A range, enable the output, and set the display to the limit mode. When the display is in the limit mode, program the current to the maximum programmable value and the voltage to full rated value (30.0 V).

4. Operate the electronic load in constant current mode and set its current to 4.0 A. Check that the CV annunciator remains lit. If not lit, adjust the load so that the output current drops slightly until the CV annunciator lights.

5. Adjust the transformer to low line voltage limit (104 Vac for nominal 115 Vac, 90 Vac for nominal 100 Vac, or 207 Vac for nominal 230 Vac). Record the output reading on the digital voltmeter.

6. Adjust the autotransformer to high line voltage (127 Vac for nominal 115 Vac, 110 Vac for nominal 100 Vac, or 253 Vac for nominal 230 Vac). Record the voltage reading on the digital voltmeter immediately. The difference between the digital voltmeter readings in steps 5 and 6 is the CV line regulation. The difference of the readings during the immediate change should be within the limit of 5 mV.

Normal mode voltage noise (CV ripple and noise)

The normal mode voltage noise is in the form of ripple related to the line frequency plus some random noise. The normal mode voltage noise is specified as the rms or peak-to-peak output voltage in a frequency range from 20 Hz to 20 MHz.

1. Turn off the power supply and connect the output to be tested as shown in Figure 1-1 to an oscilloscope (AC coupled) between (+) and (–) terminals. Set the oscilloscope to AC mode and bandwidth limit to 20 MHz. Connect a resistive load (7.5 Ω) as shown in Figure 1-1.
2 Turn on the power supply. Select the 30 V/4 A range, enable the output, and set the display to the limit mode. When the display is in the limit mode, program the current to the full rated value (4.0 A) and the voltage to the full rated value (30.0 V).

3 Check that the front panel CV annunciator remains lit. If not lit, adjust the load down slightly.

4 Note that the waveform on the oscilloscope does not exceed the peak-to-peak limit of 2 mV.

5 Disconnect the oscilloscope and connect an AC RMS voltmeter in its place. The rms voltage reading does not exceed the rms limit of 0.35 mV.
Load transient response time

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

1  Turn 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 constant current mode.

2  Turn on the power supply. Select the 30 V/4 A range, enable the outputs, and set the display to the limit mode. When the display is in the limit mode, program the current to the full rated value (4.0 A) and the voltage to the full rated value (30.0 V).

3  Set the electronic load to transient operation mode between one half of the output's full scale value and the output's full rated value at a 1 kHz rate with 50% duty cycle.

4  Set the the oscilloscope for AC coupling, internal sync, and lock on either the positive or negative load transient.

5  Adjust the the oscilloscope to display transients as shown in Figure 1-2. Note that the pulse width (t2–t1) of the transients at 15 mV from the base line is no more than 50 msec for the output.

![Figure 1-2: Transient response time](image)
Constant Current (CC) Verifications

Constant current test setup

Follow the general setup instructions in the Measurement Techniques and the specific instructions given in the following paragraphs.

Current programming and readback accuracy

This test verifies that the current programming and the GPIB or RS-232 readback functions are within specifications. Note that the readback values over the remote interface should be identical to those displayed on the front panel. The accuracy of the current monitoring resistor must be 0.01% or better.

NOTE

You should program the power supply over the remote interface for this test to avoid round-off errors.

1. Turn off the power supply and connect a 0.01 Ω current monitoring resistor (R_M) across the output to be tested and a digital voltmeter (DVM) across the current monitoring resistor (R_M).

2. Turn on the power supply. Select the 15 V/7 A range and enable the output by sending the commands:
   - VOLT:RANG P15V
   - OUTP ON

3. Program the output voltage to full rated voltage (15.0 V) and output current to zero amp by sending the commands:
   - VOLT 15
   - CURR 0

4. Divide the voltage drop (DVM reading) across the current monitoring resistor (R_M) by its resistance to convert to amps and record this value (I_0). This value should be within the limits of 0 A ±10 mA. Also, note that the CC, Adrs, Limit, and Rmt annunciators are on.

5. Readback the output current over the remote interface by sending the command:
**MEAS:CURR?**

6 Record the value displayed on the controller. This value should be within the limit of $I_0 \pm 5$ mA.

7 Program the output current to the full rated value (7.0 A) by sending the commands:

```
CURR 7.0
```

8 Divide the voltage drop (DVM reading) across the current monitoring resistor (RM) by its resistance to convert to amps and record this value ($I_0$). This value should be within the limit of 7 A ±24 mA.

9 Readback the output current over the remote interface by sending the command:

```
MEAS:CURR?
```

10 Record the value displayed on the controller. This value should be within the limit $I_0 \pm 15.5$ mA.

**CC load regulation**

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

1 Turn off the power supply and connect the output to be tested as shown in Figure 1-1 with the digital voltmeter connected across the 0.01 Ω current monitoring resistor ($R_M$).

2 Turn on the power supply. Select the 15 V/7 A range, enable the output, and set the display to the limit mode. When the display is in the limit mode, program the output voltage to the maximum programmable value and the output current to the full rated value (7.0 A).

3 Operate the electronic load in constant voltage mode and set its voltage to 15.0 V. Check that the CC annunciator is on. If it is not, adjust the load so that the output voltage drops slightly. Record the current reading by dividing the voltage reading on the digital voltmeter by the resistance of the current monitoring resistor.

4 Operate the electronic load in short (input short) mode. Record the current reading immediately by dividing the voltage reading on the digital voltmeter by the resistance of the current monitoring resistor. The difference between the current readings in step 3 and 4 is the load regulation current. The
1 Calibration Procedures

difference of the readings during the immediate change should be within the limit of 0.95 mA.

CC line regulation

This test measures the immediate change in output current that results from a change in AC line voltage from the minimum value (10% below the nominal input voltage) to the maximum value (10% above nominal voltage).

1 Turn off the power supply and connect the output to be tested as shown in Figure 1-1 with the digital voltmeter connected across the current monitoring resistor \((R_M)\).

2 Connect the AC power line through a variable voltage transformer.

3 Turn on the power supply. Select the 15 V/7 A range, enable the output, and set the display to the limit mode. When the display is in the limit mode, program the output voltage to the maximum programmable value and the output current to the full rated value (7.0 A).

4 Operate the electronic load in constant voltage mode and set its voltage to 15.0 V. Check that the CC annunciator remains lit. If not lit, adjust the load so that the output voltage drops slightly until the CC annunciator lights.

5 Adjust the transformer to low line voltage limit (104 Vac for nominal 115 Vac, 90 Vac for nominal 100 Vac, or 207 Vac for nominal 230 Vac). Record the output current reading by dividing the voltage reading on the digital voltmeter by the resistance of the current monitoring resistor.

6 Adjust the transformer to 10% above the nominal line voltage (127 Vac for a 115 Vac nominal input, 110 Vac for a 100 Vac nominal input or 253 Vac for a 230 Vac nominal input). Record the current reading again immediately by dividing the voltage reading on the digital voltmeter by the resistance of the current monitoring resistor. The difference between the current readings in step 5 and 6 is the load regulation current. The difference of the readings during the immediate change should be within the limit of 0.95 mA.
Normal mode current noise (CC ripple and noise)

The normal mode current noise is specified as the rms output current in a frequency range 20 Hz to 20 MHz with the power supply in constant current operation.

1. Turn off the power supply and connect the output to be tested as shown in Figure 1-1 with a load resistor (2.1 Ω) across output terminals to be tested. Connect a RMS voltmeter across the load resistor. Use only a resistive load for this test.

2. Turn on the power supply. Select the 15 V/7 A range, enable the output, and set the display to the limit mode. When the display is in the limit mode, program the current to full rated value (7.0 A) and the voltage to the full rated value (15.0 V).

3. The output current should be at the full-rated rating with the CC annunciator on. If not lit, adjust the load so that the output voltage drops slightly until the CC annunciator lights.

4. Divide the reading on the RMS voltmeter by the load resistance to obtain rms current. The readings should be within the limit of 2 mA.
Common Mode Current Noise

The common mode current is that AC current component which exists between the output or output lines and chassis ground. Common mode noise can be a problem for very sensitive circuitry that is referenced to earth ground. When a circuit is referenced to earth ground, a low level line-related AC current will flow from the output terminals to earth ground. Any impedance to earth ground will create a voltage drop equal to the output current flow multiplied by the impedance.

1. Turn off the power supply and connect a 100 KΩ resistor (R_S) and a 2200 pF capacitor in parallel between the (–) terminal and chassis ground.

2. Connect a digital voltmeter (DVM) across R_S.

3. Turn on the power supply. Select the 15 V/7 A range, enable the output, and set the display to the limit mode. When the display is in the limit mode, program the output to the full rated value (15.0 V and 7.0 A).

4. Record the voltage across R_S and convert it to current by dividing by the resistance (DVM reading/100 KΩ). Note that the current is less than 1.5 μA.
Performance Test Record for E3632A

Table 1-2 CV performance test record

<table>
<thead>
<tr>
<th>Test description</th>
<th>Actual result</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Upper limit</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lower limit</td>
</tr>
<tr>
<td>CV programming accuracy @ 0 volts (DVM reading)</td>
<td>+0.0100 V</td>
<td>–0.0100 V</td>
</tr>
<tr>
<td>CV readback accuracy @ 0 volts</td>
<td>DVM + 0.0050 V</td>
<td>DVM – 0.0050 V</td>
</tr>
<tr>
<td>CV programming accuracy @ full scale (DVM reading)</td>
<td>+30.025 V</td>
<td>29.9750 V</td>
</tr>
<tr>
<td>CV readback accuracy @ full scale</td>
<td>DVM + 0.0200 V</td>
<td>DVM – 0.0200 V</td>
</tr>
<tr>
<td>CV load regulation</td>
<td>Maximum change: &lt;5 mV</td>
<td></td>
</tr>
<tr>
<td>CV line regulation</td>
<td>Maximum change: &lt;5 mV</td>
<td></td>
</tr>
<tr>
<td>CV ripple/noise</td>
<td>&lt;2 mVp-p, 0.35 mVrms</td>
<td></td>
</tr>
<tr>
<td>Load transient response time</td>
<td>&lt;50 μsec</td>
<td></td>
</tr>
</tbody>
</table>
## CC performance test record

**Table 1-3**  
**CC performance test record**

<table>
<thead>
<tr>
<th>Test description</th>
<th>Actual result</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Upper limit</td>
<td>Lower limit</td>
</tr>
<tr>
<td>CC programming accuracy @ 0 A (I₀)</td>
<td>+0.0100 A</td>
<td>-0.0100 A</td>
</tr>
<tr>
<td>CC readback accuracy @ 0 A</td>
<td>I₀ + 0.0050 A</td>
<td>I₀ - 0.0050 A</td>
</tr>
<tr>
<td>CC programming accuracy @ full scale (I₀)</td>
<td>7.0240 A</td>
<td>6.9760 A</td>
</tr>
<tr>
<td>CC readback accuracy @ full scale</td>
<td>I₀ + 0.0155 A</td>
<td>I₀ - 0.0155 A</td>
</tr>
<tr>
<td>CC load regulation</td>
<td>Maximum change: &lt;0.95 mA</td>
<td></td>
</tr>
<tr>
<td>CC line regulation</td>
<td>Maximum change: &lt;0.95 mA</td>
<td></td>
</tr>
<tr>
<td>CC ripple/noise</td>
<td>&lt;2 mA</td>
<td></td>
</tr>
<tr>
<td>Common mode current noise</td>
<td>&lt;1.5 μArms</td>
<td></td>
</tr>
</tbody>
</table>
Calibration Security Code

This feature allows you to enter a security code (electronic key) to prevent accidental or unauthorized calibrations of the power supply. When you first receive your power supply, it is secured. Before you can calibrate the power supply, you must unsecure it by entering the correct security code. A procedure to unsecure the power supply is given on the following page.

- The security code is set to HP003632 when the power supply is shipped from the factory. The security code is stored in non-volatile memory, and it does not change when power has been off or after a remote interface reset.

- To secure the power supply from the remote interface, the security code may contain up to 12 alphanumeric characters as shown below. The first character must be a letter, but the remaining characters can be letters or numbers. You do not have to use all 12 characters but the first character must always be a letter.

  A _ _ _ _ _ _ _ _ _ _ _ (12 characters)

- To secure the power supply from the remote interface so that it can be unsecured from the front panel, use the eight-character format shown below. The first two characters must be "H P" and the remaining characters must be numbers. Only the last six characters are recognized from the front panel, but all eight characters are required. To unsecure the power supply from the front panel, omit the "H P" and enter the remaining numbers as shown on the following pages.

  H P _ _ _ _ _ _ (8 characters)

- If you forget your security code, you can disable the security feature by adding a jumper inside the power supply, and then entering a new code. Refer to To unsecure the power supply without the security code.
To unsecure the power supply for calibration

The power supply can use a calibration security code to prevent unauthorized or accidental calibration. This procedure shows you how to unsecure the power supply for calibration from the front panel.

1. Turn on the front-panel calibration mode.

   **SECURED**

   Turn on the calibration mode by pressing the Calibrate key while simultaneously turning on the power supply then continue to hold the Calibrate key for about 5 seconds until a beep is heard.

   If the power supply is secured, you will see the above message from the front panel for approximately one second. The CAL MODE message is then displayed on the front panel.

2. Move to the security code by pressing the Secure key.

   **000000 CODE**

3. Enter the security code using the knob and resolution selection keys.

   **003632 CODE**

   The security code is set to “HP003632” when the power supply is shipped from the factory. The security code is stored in non-volatile memory and does not change when the power has been off or after a remote interface reset.

   To enter the security code from the front panel, enter only the last six digits. To enter the security code from the remote interface, you may enter up to 12 characters.

   Use the resolution selection keys to move left or right between digits. Use the knob to change the digits. Notice that the security code may be different if the security code has been changed from the default setting.

4. Unsecure the power supply.

   **UNSECURED**

   The power supply is unsecured when you press the Secure key. You will see the above message from the front panel for one second. The CAL MODE message is displayed on the front panel after above message.

5. Turn off the calibration mode.

   Turn off the power supply to exit the calibration mode.
To unsecure the power supply without the security code

To unsecure the power supply without the correct security code (when you forget the security code), follow the steps below. Refer to “Electrostatic Discharge (ESD) Precautions” on page 62 before beginning this procedure.

1. Disconnect the power cord and all load connections from front terminals.
2. Remove the instrument cover.
3. Connect the power cord and turn on the calibration mode by pressing the Calibrate key while simultaneously turning on the power supply, and then continue to hold the Calibrate key for about 5 seconds until a beep is heard. Be careful not to touch the power line connections.
4. Apply a short between the two exposed metal pads on JP5\[1\] (located near U13). Refer to “Component locator diagram for the main board assembly — top” on page 71.
5. While maintaining the short, press **Secure** to move to the security code and enter any unsecure code in the calibration mode. The power supply is now unsecured.
6. Remove the short at JP5\[2\]. (An error occurs if not removed.)
7. Turn off and reassemble the power supply. Now you can enter a new security code. Be sure you take note of the new security code.

---


Calibration Count

The calibration count feature provides an independent "serialization" of your calibrations. You can determine the number of times that your power supply has been calibrated. By monitoring the calibration count, you can determine whether an unauthorized calibration has been performed. Since the value increments by one for each calibration parameter (see Table 1-4 on the next page), a complete calibration increases the value by 5 counts.

The calibration count is stored in non-volatile memory and does not change when power has been off or after a remote interface reset. Your power supply was calibrated before it left the factory. When you receive the power supply, read the calibration count to determine its value.

The calibration count increments up to a maximum of 32,767 after which it wraps around to 0. No way is provided to program or reset the calibration count.

Calibration Message

You can use the calibration message feature to record calibration information about your power supply. For example, you can store such information as the last calibration date, the next calibration due date, the power supply’s serial number, or even the name and phone number of the person to contact for a new calibration.

You can record and read information in the calibration message from the remote interface only.

The calibration message may contain up to 40 characters.

The calibration message is stored in non-volatile memory and does not change when power has been off or after a remote interface reset.
General Calibration/Adjustment Procedure

The calibration procedures from the front panel are described in this section. For voltage calibration, disconnect all loads from the power supply and connect a DVM across the output terminals. For current calibration, disconnect all loads from the power supply, connect an appropriate current monitoring resistor (0.01 Ω) across the output terminals, and connect a DVM across the terminals of the monitoring resistor.

NOTE
The power supply should be calibrated after 1-hour warm-up with no load connected.

The following table shows calibration parameters and points which should be used to calibrate the output voltage and current.

**Table 1-4  Parameters for calibration**

<table>
<thead>
<tr>
<th>Calibration parameter</th>
<th>Voltage/current</th>
<th>Calibration point mnemonic</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAL SETUP 1</td>
<td>Voltage</td>
<td>V LO</td>
</tr>
<tr>
<td></td>
<td></td>
<td>V MI</td>
</tr>
<tr>
<td></td>
<td></td>
<td>V HI</td>
</tr>
<tr>
<td>CAL SETUP 2</td>
<td>OVP</td>
<td>None</td>
</tr>
<tr>
<td>CAL SETUP 3</td>
<td>Current</td>
<td>I LO</td>
</tr>
<tr>
<td></td>
<td></td>
<td>I MI</td>
</tr>
<tr>
<td></td>
<td></td>
<td>I HI</td>
</tr>
<tr>
<td>CAL SETUP 4</td>
<td>OCP</td>
<td>None</td>
</tr>
</tbody>
</table>

NOTE
- You can terminate any CAL SETUP without changing its calibration constants by turning off power.
- Perform the voltage calibration prior to the OVP calibration and the current calibration prior to the OCP calibration.
To calibrate the output voltages and currents of the power supply from the front panel, proceed as follows:

1. Unsecure the power supply.
   To calibrate the voltage and current, you must unsecure the power supply according to “To unsecure the power supply for calibration” on page 40.

2. Disconnect all loads from the power supply and connect a DVM across output terminals.

3. Turn on the calibration mode.
   
   **CAL MODE**

   Turn on the calibration mode by pressing the Calibrate key while simultaneously turning on the power supply, and then continue to hold the Calibrate key for about 5 seconds until a beep is heard. Make sure that the power supply is in CV mode. If the power supply is not in CV mode, an error occurs.

Voltage and OVP calibration

4. Move down a level to the voltage calibration mode.
   
   **CAL SETUP 1**

   The display shows the above message to indicate that the power supply is ready for the voltage calibration.

5. Calibrate DAC and select the low voltage calibration point.
   
   **30 LEFT**

   The START BITCAL message is displayed for about 3 seconds to indicate that the power supply is ready for DAC calibration. Then it counts down numbers from 30 to 0.

   **V LO 0.5000 V**

   Then, the display shows the low voltage calibration point.

6. Read the DVM and change the low voltage value on the display to match the measured voltage.
   For example, if the DVM reading is 0.4500 V, adjust the voltage to 0.4500 V using the knob and resolution selection keys.
**Calibration Procedures 1**

**V LO 0.4500 V**

**Calibrate**

7 Pressing the Calibrate key saves the change and selects the middle voltage calibration point.

**V MI 15.000 V**

If the entered number is within an acceptable range, an ENTERED message appears for one second. If the entered number is not correct, a MIN VALUE or MAX VALUE message appears for one second and the display shows the low voltage calibration point again. The display now shows the middle voltage calibration point.

8 Read the DVM and change the middle voltage value on the display to match the measured voltage.

For example, if the DVM reads 14.995 V, adjust the voltage to 14.995 V using the knob and arrow keys.

**V MI 14.995 V**

**Calibrate**

9 Pressing the Calibrate key saves the change and selects the high voltage calibration point.

**V HI 29.500 V**

If the entered number is within an acceptable range, a ENTERED message appears for one second. If the entered number is not correct, a MIN VALUE or MAX VALUE message appears for one second and the display shows the middle voltage calibration point again. The display now shows the high voltage calibration point.

10 Read the DVM and change the high voltage value on the display to match the measured voltage.

For example, if the DVM reads 28.995 V, adjust the voltage to 28.995 V using the knob and arrow keys.

**V HI 28.995 V**

**Calibrate**

11 Pressing the Calibrate key saves the new voltage calibration constants, and goes to the OVP calibration mode.

**CAL SETUP 2**

A CALIBRATING message appears for one second to indicate that the voltage calibration is progressing and new voltage calibration constants of “SETUP 1” are stored. Then, the display shows above message to indicate that the power supply is ready for the OVP calibration.
Calibration Procedures

If the calibration fails, a DAC CAL FAIL or ADC CAL FAIL message appears for one second and the display shows the CAL SETUP 1 for voltage calibration again.

Current and OCP calibration

**NOTE**  Connect an appropriate shunt (0.01 Ω) across the output terminals, and connect a digital voltmeter across the shunt resistor for the current calibration.

12 Pressing the Calibrate key saves the new calibration constants for OVP circuit and goes to the current calibration mode.

**CAL SETUP 3**

A CALIBRATING message appears for about several seconds to indicate that the OVP calibration is progressing and new calibration constants of “SETUP 2” are stored. Then, the display shows the above message to indicate that the power supply is ready for the current calibration.

If the calibration fails, a OVP CAL FAIL message appears for one second and the display shows the CAL SETUP 2 for OVP calibration again.

13 Select the low current calibration point.

**I LO 0.2000 A**

The display shows the low current calibration point.

14 Read the DVM and change the low current value on the display to match the computed current (DVM reading divided by shunt resistance).

For example, if the computed value is 0.199 A, adjust the current to 0.199 A using the knob and arrow keys.

**I LO +0.1990 A**

**NOTE**  Notice that you should wait for the DVM reading to stabilize for accurate calibration.

15 Pressing the Calibrate key saves the change and selects the middle current calibration point.
I MI 3.5000 A

If the entered number is within an acceptable range, an ENTERED message appears for one second. If the entered number is not correct, a MIN VALUE or MAX VALUE message appears for one second and the display shows the low current calibration point again. The display now shows the middle current calibration point.

16 Read the DVM and change the middle current value on the display to match the computed current (DVM reading divided by shunt resistance).

For example, if the computed value is 3.499 A, adjust the current to 3.499 A using the knob and arrow keys.

I MI 3.4990 A

NOTE
Notice that you should wait for the DVM reading to stabilize for accurate calibration.

17 Pressing the Calibrate key saves the change and selects the high current calibration point.

I HI 6.9000 A

If the entered number is within an acceptable range, an ENTERED message appears for one second. If the entered number is not correct, a MIN VALUE or MAX VALUE message appears for one second and the display shows the middle current calibration point again. The display now shows the high current calibration point.

18 Read the DVM and change the high current value on the display to match the computed current (DVM reading divided by shunt resistance).

For example, if the computed value is 6.899 A, adjust the current to 6.899 A using the knob and arrow keys.

I HI 6.8990 A

NOTE
Notice that you should wait for the DVM reading to stabilize for accurate calibration.
19 Pressing the Calibrate key saves the new calibration constants for the output current and goes to the OCP calibration mode.

**CAL SETUP 4**

A CALIBRATING message appears for one second to indicate that the current calibration is progressing and new calibration constants of “SETUP 3” are stored. Then, the display shows the above message to indicate that the power supply is ready for the OCP calibration.

If the calibration fails, a DAC CAL FAIL or ADC CAL FAIL message appears for one second and the display shows the CAL SETUP 3 for current calibration again.

20 Pressing the Calibrate key saves the new OCP calibration constants and return to the calibration mode.

**CAL MODE**

A CALIBRATING message appears for several seconds to indicate that the OCP calibration is progressing and new OCP calibration constants of “SETUP 4” are stored. Then the display will return to the calibration mode.

21 Turn off the power supply to exit the calibration mode.
Aborting a Calibration in Progress

Sometimes it may be necessary to abort a calibration after the procedure has already been initiated. You can abort a calibration at any time by turning the power supply off from the front panel. When performing a calibration from the remote interface, you can abort a calibration by issuing a remote interface device clear message or by pressing the front-panel Local key.
Calibration Procedures

Calibration Record for E3632A

Table 1-5  Calibration record for E3632A

<table>
<thead>
<tr>
<th>Step</th>
<th>Calibration Description</th>
<th>Measurement Mode (DVM)</th>
<th>Supply Being Adjusted</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Unsecure the power supply (see “To unsecure the power supply for calibration” on page 40).</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Turn on CAL MODE (simultaneously press the Calibrate and Power keys) until it beeps.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Move down menu to CAL SETUP 1 (press the Calibrate key).</td>
<td></td>
<td>Voltage Calibration</td>
</tr>
<tr>
<td>4</td>
<td>Calibrate the DAC and select the low point for voltage calibration; “START BITCAL appears for 3 seconds and the display counts down numbers from 30 to 0. Then, “V LO 0.5000 V” appears on the display (press the Calibrate key and wait about 30 seconds, and change the display to match the DVM reading).</td>
<td>V</td>
<td>DAC and low voltage point calibration</td>
</tr>
<tr>
<td>5</td>
<td>“V MI 15.000 V” appears on the display (press the Calibrate key and change the display to match the DVM reading).</td>
<td>V</td>
<td>Middle voltage point calibration</td>
</tr>
<tr>
<td>6</td>
<td>“V HI 29.500 V” appears on the display (press the Calibrate key and change the display to match the DVM reading).</td>
<td>V</td>
<td>High voltage point calibration</td>
</tr>
<tr>
<td>7</td>
<td>“CAL SETUP” now appears on the display (press the Calibrate key).</td>
<td>V</td>
<td>OVP calibration</td>
</tr>
<tr>
<td>8</td>
<td>“CAL SETUP 3” now appears on the display (press the Calibrate key and connect 0.01 Ω resistor across the output terminals).</td>
<td></td>
<td>Current calibration</td>
</tr>
<tr>
<td>9</td>
<td>“I LO 0.2000 A” appears on the display (press the Calibrate key; then change the display to match the computed current through 0.01 Ω resistor).</td>
<td>A</td>
<td>Low current point calibration</td>
</tr>
<tr>
<td>10</td>
<td>“I MI 3.5000 A” appears on the display (press the Calibrate key; then change the display to match the computed current through 0.01 Ω resistor).</td>
<td>A</td>
<td>Middle current point calibration</td>
</tr>
<tr>
<td>11</td>
<td>“I HI 6.9000 A” appears on the display (press the Calibrate key and change the display to match the computed current through 0.01 Ω resistor).</td>
<td>A</td>
<td>High current point calibration</td>
</tr>
<tr>
<td>12</td>
<td>“CAL SETUP 4” now appears on the display (press the Calibrate key).</td>
<td>A</td>
<td>OCP calibration</td>
</tr>
<tr>
<td>13</td>
<td>Press the Calibrate key, and then press the Power switch.</td>
<td></td>
<td>Exit CAL MODE</td>
</tr>
</tbody>
</table>
Error Messages

The following tables are abbreviated lists of error messages for the E3632A. The errors listed are the most likely errors to be encountered during calibration and adjustment. A more complete list of error messages and descriptions is contained in “Chapter 4” of the E3632A User’s Guide.

System error messages

<table>
<thead>
<tr>
<th>Error</th>
<th>Error Message</th>
</tr>
</thead>
<tbody>
<tr>
<td>-330</td>
<td>Self-test failed</td>
</tr>
<tr>
<td>-350</td>
<td>Queue overflow</td>
</tr>
<tr>
<td>501</td>
<td>Isolator UART framing error</td>
</tr>
<tr>
<td>502</td>
<td>Isolator UART overrun error</td>
</tr>
<tr>
<td>503[a]</td>
<td>SPI data error</td>
</tr>
<tr>
<td>511</td>
<td>RS-232 framing error</td>
</tr>
<tr>
<td>512</td>
<td>RS-232 overrun error</td>
</tr>
<tr>
<td>513</td>
<td>RS-232 parity error</td>
</tr>
<tr>
<td>514</td>
<td>Command allowed only with RS-232</td>
</tr>
<tr>
<td>521</td>
<td>Input buffer overflow</td>
</tr>
<tr>
<td>522</td>
<td>Output buffer overflow</td>
</tr>
<tr>
<td>550</td>
<td>Command not allowed in local</td>
</tr>
</tbody>
</table>

[a] This error message is only applicable for serial MY53xx6xxx.
Self-test error messages

<table>
<thead>
<tr>
<th>Error Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>601</td>
<td>Front panel does not respond</td>
</tr>
<tr>
<td>602</td>
<td>RAM read/write failed</td>
</tr>
<tr>
<td>603</td>
<td>A/D sync stuck</td>
</tr>
<tr>
<td>604</td>
<td>A/D slope convergence failed</td>
</tr>
<tr>
<td>605</td>
<td>Cannot calibrate rundown gain</td>
</tr>
<tr>
<td>606</td>
<td>Rundown gain out of range</td>
</tr>
<tr>
<td>607</td>
<td>Rundown too noisy</td>
</tr>
<tr>
<td>608</td>
<td>Serial configuration readback failed</td>
</tr>
<tr>
<td>609[a]</td>
<td>System ADC test failed</td>
</tr>
<tr>
<td>624</td>
<td>Unable to sense line frequency</td>
</tr>
<tr>
<td>625</td>
<td>I/O processor does not respond</td>
</tr>
<tr>
<td>626</td>
<td>I/O processor failed self-test</td>
</tr>
<tr>
<td>630</td>
<td>Fan test failed</td>
</tr>
<tr>
<td>631</td>
<td>System DAC test failed</td>
</tr>
<tr>
<td>632</td>
<td>Hardware test failed</td>
</tr>
</tbody>
</table>

[a] This error message is only applicable for serial MY53xx6xxx.
# Calibration error messages

## Table 1-8 Calibration error messages

<table>
<thead>
<tr>
<th>Error</th>
<th>Error message</th>
</tr>
</thead>
<tbody>
<tr>
<td>701</td>
<td>Cal security disabled by jumper</td>
</tr>
<tr>
<td>702</td>
<td>Cal secured</td>
</tr>
<tr>
<td>703</td>
<td>Invalid secure code</td>
</tr>
<tr>
<td>704</td>
<td>Secure code too long</td>
</tr>
<tr>
<td>705</td>
<td>Cal aborted</td>
</tr>
<tr>
<td>708</td>
<td>Cal output disabled</td>
</tr>
<tr>
<td>712</td>
<td>Bad DAC cal data</td>
</tr>
<tr>
<td>713</td>
<td>Bad readback cal data</td>
</tr>
<tr>
<td>714</td>
<td>Bad OVP cal data</td>
</tr>
<tr>
<td>715</td>
<td>Bad OCP cal data</td>
</tr>
<tr>
<td>716</td>
<td>Bad OVP DNL error correction data</td>
</tr>
<tr>
<td>717</td>
<td>Cal OVP or OCP status enabled</td>
</tr>
<tr>
<td>740</td>
<td>Cal checksum failed, secure state</td>
</tr>
<tr>
<td>741</td>
<td>Cal checksum failed, string data</td>
</tr>
<tr>
<td>742</td>
<td>Cal checksum failed, store/recall data in location 0</td>
</tr>
<tr>
<td>743</td>
<td>Cal checksum failed, store/recall data in location 1</td>
</tr>
<tr>
<td>744</td>
<td>Cal checksum failed, store/recall data in location 2</td>
</tr>
<tr>
<td>745</td>
<td>Cal checksum failed, store/recall data in location 3</td>
</tr>
<tr>
<td>746</td>
<td>Cal checksum failed, DAC cal constants</td>
</tr>
<tr>
<td>747</td>
<td>Cal checksum failed, readback cal constants</td>
</tr>
<tr>
<td>748</td>
<td>Cal checksum failed, GPIB address</td>
</tr>
<tr>
<td>749</td>
<td>Cal checksum failed, internal data</td>
</tr>
<tr>
<td>750</td>
<td>Cal checksum failed, DAC DNL error correction data</td>
</tr>
</tbody>
</table>
Calibration Program

This section contains a Keysight BASIC program for calibration over the GPIB interface. This program makes software adjustments to the E3632A power supply using a current shunt and a digital multimeter which is connected to the controller. In this program a 0.01 ohm current shunt is used. Be sure to change the value of the variable "Current_shunt" to the value of the current shunt used and the GPIB address for the power supply and the digital voltmeter.

```basic
10 ! This program was written on a PC with Keysight Basic for Windows.
20 ! It will make software adjustments to the E3632A Power Supply
30 ! on the GPIB bus using a Keysight 34401A Digital Multimeter and a
40 ! current shunt. In the program a 0.01 ohm current shunt is
50 ! used to measure current. Be sure to change the value of
60 ! the variable 'Current_shunt' to the value of the current
70 ! shunt used.
80 !
90 ! CLEAR SCREEN
100 DIM Cal_msg$[40],Error$[40],Sec_code$[10]
110 REAL Dmm_rdg,Current_shunt
120 Current_shunt=.01             ! Current Shunt value in Ohms
130 Sec_code$="HP003632"           ! Assign the security code
140 ASSIGN @Dmm TO 722             ! Assign address 22 to the Dmm
150 ASSIGN @Pwrsupply TO 705       ! Assign address 5 to the Power Supply
160 CLEAR 7                        ! Clear GPIB, Dmm and Power Supply
170 OUTPUT @Pwrsupply;"*CLS"       ! Clear Power Supply errors
180 OUTPUT @Dmm;"*RST"             ! Reset Dmm
190 OUTPUT @Pwrsupply;"*RST"       ! Reset Power Supply
200 OUTPUT @Pwrsupply;"CAL:STR?"   ! Read the calibration message
210 ENTER @Pwrsupply;Cal_msg$
220 PRINT TABXY(5,2),"Calibration message of Power Supply is: ";Cal_msg$
230 !
240 ! Set the Calibration security to off, and check to be sure
250 ! it is off. If not successful, print message to screen and end.
260 !
270 !
280 OUTPUT @Pwrsupply;"VOLT:PROT:STAT OFF"
290 OUTPUT @Pwrsupply;"CURR:PROT:STAT OFF"
300 OUTPUT @Pwrsupply;"CAL:SEC:STAT OFF, ";Sec_code$
310 OUTPUT @Pwrsupply;"CAL:SEC:STAT?"
320 ENTER @Pwrsupply;A
330 IF A=1 THEN
340 PRINT TABXY(5,5),"****** Unable to Unsecure the Power supply ******"
350 GOTO 2290
360 END IF
370 !
380 ! Perform the DAC error correction, voltage calibration and OVP
390 ! calibration.
400 ! Alert the operator to hook up the connection before calibrating.
410 ! Alert operator to connect lead
420 PRINT
430 TABXY(10,10),"***********************************************************************"
```
Calibration Procedures

430 PRINT TABXY(10, 11), "Prepare for E3632A DAC DNL error correction and"
440 PRINT TABXY(10, 12), "Voltage/OVP calibration. Connect the output to the"
450 PRINT TABXY(10, 13), "Observe Polarity!"
460 PRINT TABXY(10, 14), "Press 'C' to Continue, 'I' to go to CURRENT"
470 PRINT TABXY(10, 16), "X' to eXit, then press 'Enter'"
480 Ch$ = "C"
490 INPUT Ch$
500 IF Ch$ = "X" OR Ch$ = "x" THEN GOTO 2250
510 IF Ch$ = "I" OR Ch$ = "i" THEN
520 CLEAR SCREEN
530 GOTO 1460
540 CLEAR SCREEN
550 PRINT TABXY(10, 17), "BEGIN DAC ERROR CORRECTION"
560 WAIT 4
570 CLEAR SCREEN
580 OUTPUT @Pwrsupply; "OUTP ON"               ! Turn on Power Supply output
590 OUTPUT @Pwrsupply; "CAL:DAC:ERROR"         ! Perform DAC DNL error correction
600 WAIT 29                                   ! Allow DAC error correction to finish
610 OUTPUT @Pwrsupply; "OUTPUT OFF"            ! Turn off Power Supply output
620 OUTPUT @Pwrsupply; "SYST:ERR?"             ! Check to see if there is an error. If there is an error,
630 ENTER @Pwrsupply; Error$                   ! display the error and exit the program.
640 CLEAR SCREEN                               ! Check to see if there is an error. If there is an error,
650 IF Error$ = "+0,""No error"" THEN            ! display the error and exit the program.
660 PRINT "DAC DNL Error Correction completed for Power Supply ",
670 ELSE                                       ! display the error and exit the program.
680 PRINT "ERROR:”;Error$;"DAC DNL Error not corrected ",
690 BEEP
700 GOTO 2250
710 CLEAR SCREEN
720 IF Error$ = "+0,""No error"" THEN
730 PRINT "DAC DNL Error Correction completed for Power Supply ",
740 ELSE
750 PRINT "ERROR:”;Error$;"DAC DNL Error not corrected ",
760 BEEP
770 GOTO 2250
780 CLEAR SCREEN
790 IF Error$ = "+0,""No error"" THEN
800 PRINT "DAC DNL Error Correction completed for Power Supply ",
810 ELSE
820 PRINT "ERROR:”;Error$;"DAC DNL Error not corrected ",
830 BEEP
840 GOTO 2250
850 CLEAR SCREEN
860 OUTPUT @Pwrsupply; "CAL:VOLT:LEV MIN"      ! send stored value to Power
870 OUTPUT @Pwrsupply; "CAL:VOLT:LEV MID"      ! send stored value to Power
880 OUTPUT @Pwrsupply; "CAL:VOLT:LEV MAX"      ! send stored value to Power
890 WAIT 2                                     ! allow output to settle
900 OUTPUT @Dmm; "MEAS:VOLT:DC?"               ! measure output with Dmm and
910 OUTPUT @Dmm; "MEAS:VOLT:DC?"               ! measure output with Dmm and
920 ENTER @Dmm; Dmm_rdg                        ! store in variable Dmm_rdg
930 PRINT Dmm_rdg                               ! store in variable Dmm_rdg
940 PRINT Dmm_rdg                               ! store in variable Dmm_rdg
950 OUTPUT @Pwrsupply; "CAL:VOLT:DATA ", Dmm_rdg ! send stored value to Power
Supply
960 WAIT 2                                     ! allow output to settle
Calibration Procedures

970  OUTPUT @Dmm;"MEAS:VOLT:DC?" ! measure output with Dmm and
980  ENTER @Dmm;Dmm_rdg          ! store in variable Dmm_rdg
990  OUTPUT @Pwrsupply;"CAL:VOLT:DATA ";Dmm_rdg  ! send stored value to Power
1000 OUTPUT @Pwrsupply;"OUTP OFF"
1010 OUTPUT @Pwrsupply;"SYST:ERR?"
1020 ENTER @Pwrsupply;Error$
1030 !
1040 ! Check to see if there is an error. If there is an error,
1050 ! display the error and exit the program.
1060 !
1070 !
1080 CLEAR SCREEN
1090 IF Error$="+0,""No error"" THEN
1100 PRINT "Voltage calibration completed for Power Supply 
1110 ELSE
1120 PRINT "ERROR:”;Error$;"Voltage not Calibrated"
1130 BEEP
1140 GOTO 2250
1150 END IF
1160 PRINT TABXY(10,5),"VOLTAGE CALIBRATION COMPLETE"
1170 PRINT TABXY(10,7),"BEGIN OVP CALIBRATION"
1180 WAIT 4
1190 CLEAR SCREEN
1200 OUTPUT @Pwrsupply;"OUTP ON" ! Turn on Power Supply output
1210 OUTPUT @Pwrsupply;"CAL:VOLT:PROT" ! Perform OVP circuit calibration
1220 WAIT 9 ! Allow OVP calibration to finish
1230 OUTPUT @Pwrsupply;"OUTP OFF" ! Turn off Power Supply output
1240 OUTPUT @Pwrsupply;"SYST:ERR?"
1250 ENTER @Pwrsupply;Error$
1260 !
1270 ! Check to see if there is an error. If there is an error,
1280 ! display the error and exit the program.
1290 !
1300 CLEAR SCREEN
1310 IF Error$="+0,""No error"" THEN
1320 PRINT "OVP calibration completed for Power Supply 
1330 ELSE
1340 PRINT "ERROR:”;Error$;"OVP not Calibrated"
1350 BEEP
1360 GOTO 2250
1370 END IF
1380 CLEAR SCREEN
1390 PRINT TABXY(10,5),"DAC ERROR CORRECTION AND VOLTAGE/OVP CALIBRATION
1400 COMPLETE"
1410 !
1420 ! Perform the Current calibration and OCP calibration. Alert the operator
to
1430 ! hook up the connection before calibrating.
1440 !
1450 ! Alert operator to connect lead
1460 PRINT
1470 PRINT TABXY(10,10),"*********************************************************"
1480 PRINT TABXY(10,11),"Connect a CURRENT SHUNT to the Dmm input for
1490 PRINT TABXY(10,12),"measuring current. Connect the output to the shunt. Observe
1490 PRINT
TABXY(10,13),"*********************************************************
1500 PRINT TABXY(10,15),"Press 'C' to Continue, or 'X' to eXit, then 'Enter':"
1510 Ch$="C"
1520 INPUT Ch$
1530 IF Ch$="X" OR Ch$="x" THEN GOTO 2250
1540 OUTPUT @Pwrsupply;"OUTP ON"               ! Turn on Power Supply output
1550 CLEAR SCREEN
1560 PRINT TABXY(10,7),"BEGIN CURRENT/OCP CALIBRATION"
1570 WAIT 4
1580 CLEAR SCREEN
1590 OUTPUT @Pwrsupply;"CAL:CURR:LEVel MIN"  ! set output to minimum cal value
1600 WAIT 2                                    ! allow output to settle
1610 OUTPUT @Dmm;"MEAS:VOLT:DC? "               ! measure output with Dmm and
1620 ENTER @Dmm;Dmm_rdg                        ! store in variable Dmm_rdg
1630 Dmm_rdg=Dmm_rdg/Current_shunt             ! scale reading to amps
1640 PRINT Dmm_rdg
1650 OUTPUT @Pwrsupply;"CAL:CURR:DATA ";Dmm_rdg  ! send stored value to Power Supply
1660 OUTPUT @Pwrsupply;"CAL:CURR:LEVel MID"     ! set output to middle cal value
1670 WAIT 2                                    ! allow output to settle
1680 OUTPUT @Dmm;"MEAS:VOLT:DC? "               ! measure output with Dmm and
1690 ENTER @Dmm;Dmm_rdg                        ! store in variable Dmm_rdg
1700 Dmm_rdg=Dmm_rdg/Current_shunt             ! scale reading to amps
1710 PRINT Dmm_rdg
1720 OUTPUT @Pwrsupply;"CAL:CURR:DATA ";Dmm_rdg  ! send stored value to Power Supply
1730 OUTPUT @Pwrsupply;"CAL:CURR:LEVel MAX"     ! set output to maximum cal value
1740 WAIT 2                                    ! allow output to settle
1750 OUTPUT @Dmm;"MEAS:VOLT:DC? "               ! measure output with Dmm and
1760 ENTER @Dmm;Dmm_rdg                        ! store in variable Dmm_rdg
1770 Dmm_rdg=Dmm_rdg/Current_shunt             ! scale reading to amps
1780 PRINT Dmm_rdg
1790 OUTPUT @Pwrsupply;"CAL:CURR:DATA ";Dmm_rdg  ! send stored value to Power Supply
1800 OUTPUT @Pwrsupply;"OUTP OFF"               ! Turn off Power Supply output
1810 OUTPUT @Pwrsupply;"SYST:ERR?"
1820 ENTER @Pwrsupply;Error$
1830 IF Error$="+0,""No error"" THEN
1840 ! Check to see if there is an error. If there is an error,
1850 ! display the error and exit the program.
1860 !
1870 CLEAR SCREEN
1880 IF Error$="+0,""No error"" THEN
1890 PRINT "Current calibration completed for Power Supply ";Error$
1900 ELSE
1910 PRINT "ERROR: ";Error$;"Current not Calibrated"
1920 BEEP
1930 GOTO 2250
1940 END IF
1950 CLEAR SCREEN
1960 PRINT TABXY(10,5),"CURRENT CALIBRATION COMPLETE"
1970 PRINT TABXY(10,7),"BEGIN OCP CALIBRATION"
1980 WAIT 4
1990 CLEAR SCREEN
2000 OUTPUT @Pwrsupply;"OUTP ON"                ! Turn on Power Supply output
2010 OUTPUT @Pwrsupply;"CAL:CURR:PROT"           ! Perform OCP calibration
Calibration Procedures

```
2020  WAIT 9 ! Allow OCP calibration to finish
2030  OUTPUT @Pwrsupply;"OUTP OFF" ! Turn off Power Supply output
2040  OUTPUT @Pwrsupply;"SYST:ERR?"
2050  ENTER @Pwrsupply;Error$
2060  !
2070  ! Check to see if there is an error. If there is an error,
2080  ! display the error and exit the program.
2090  !
2100  CLEAR SCREEN
2110  IF Error$="0","No error"" THEN
2120    PRINT "OCP calibration completed for Power Supply "
2130  ELSE
2140    PRINT "ERROR:";Error$;"OCP not Calibrated"
2150    BEEP
2160    GOTO 2250
2170  END IF
2180  CLEAR SCREEN
2190  PRINT TABXY(10,5),"CURRENT/OCP CALIBRATION COMPLETE"
2200  !
2210  ! Create a time stamp and output to power supply
2220  !
2230  Cal_msg$="Last Calibrated \"&DATE$(TIMEDATE)\" \"&TIME$(TIMEDATE)"
2240  OUTPUT @Pwrsupply;"CAL:STR \"";Cal_msg$;"\""
2250  OUTPUT @Pwrsupply;"CAL:SEC:STAT ON,";Sec_code$
2260  OUTPUT @Pwrsupply;"VOLT:PROT:STAT ON"
2270  OUTPUT @Pwrsupply;"CURR:PROT:STAT ON"
2280  DISP "Calibration terminated."
2290  END
```
2 Service

Operating Checklist 60
Types of Service Available 61
Repacking for Shipment 61
Electrostatic Discharge (ESD) Precautions 62
Surface Mount Repair 62
To Replace the Power-Line Fuse 63
To Disconnect the Output Using an External Relay 63
Troubleshooting Hints 65
Self-Test Procedures 67
Component Locator Diagram 71

This chapter contains procedures for returning a failed power supply to Keysight for service or repair.
Operating Checklist

Before returning your power supply to Keysight for service or repair check the following items:

Is the power supply inoperative?
- Verify that the AC power cord is connected to the power supply.
- Verify that the front-panel power switch is depressed.
- Verify that the power-line fuse is installed:
  - Use the 4 AT, 250 V fuse for 100 Vac or 115 Vac operation.
  - Use the 2.5 AT, 250 V fuse for 230 Vac operation.
- Verify the power-line voltage setting.
- Refer to the E3632A User’s Guide.

Does the power supply fail self-test?
- Verify that the correct power-line voltage is selected.
- Refer to the E3632A User’s Guide.
- Remove all load connections to the power supply.
- Ensure that all terminal connections are removed while the self-test is performed.
Types of Service Available

If your power supply fails within three years of original purchase, Keysight will repair or replace it free of charge. If your unit fails after your three year’s warranty expires, Keysight will repair or replace it at a very competitive price. Keysight will make the decision locally whether to repair or replace your unit.

Standard repair service (worldwide)

Contact your nearest Keysight Service Center. They will arrange to have your power supply repaired or replaced.

Repacking for Shipment

For the Express Exchange Service described on the previous page, return your failed Keysight E3632A to the designated Keysight Service Center using the shipping carton of the exchange unit. A shipping label will be supplied. Keysight will notify you when your failed unit has been received.

If the instrument is to be shipped to Keysight for service or repair, be sure to:

- Attach a tag to the power supply identifying the owner and indicating the required service or repair. Include the instrument model number and full serial number.
- Place the power supply in its original container with appropriate packaging material.
- Secure the container with strong tape or metal bands.

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

NOTE

Keysight recommends that you always insure shipments.
Electrostatic Discharge (ESD) Precautions

Almost all electrical components can be damaged by electrostatic discharge (ESD) during handling. Component damage can occur at electrostatic discharge voltages as low as 50 V.

The following guidelines will help prevent ESD damage when serving the power supply or any electronic device.

- Disassemble instruments only in a static-free work area.
- Use a conductive work area to dissipate static charge.
- Use a conductive wrist strap to dissipate static charge accumulation.
- Minimize handling.
- Keep replacement parts in original static-free packaging.
- Remove all plastic, styrofoam, vinyl, paper, and other static-generating materials from the immediate work area.
- Use only anti-static solder suckers.

Surface Mount Repair

Surface mount components should only be removed using soldering irons or desoldering stations expressly designed for surface mount components.

**NOTE**

Use of conventional solder removal equipment will almost always result in permanent damage to the printed circuit board and will void your Keysight factory warranty.
To Replace the Power-Line Fuse

The power-line fuse is located within the power supply’s fuse-holder assembly on the rear panel (refer to the E3632A User’s Guide). For 100 Vac or 115 Vac operation, you must use a 4 AT slow-blow fuse (Keysight part number 2110-0996). For 230 Vac operation, you must use a 2.5 AT slow-blow fuse (Keysight part number 2110-0999).

To Disconnect the Output Using an External Relay

When the output of the E3632A is turned off, it is implemented by setting the output to 0 V and 0.02 A. This gives a zero output voltage without actually disconnecting the output. To disconnect the output, an external relay must be connected between the output and the load. A TTL signal of either low true or high true is provided to control an external relay. This signal can only be controlled with the remote command OUTPut:RELay {OFF|ON}. The TTL output is available on the RS-232 connector pin 1 and pin 9.

When the OUTPut:RELay state is ON, the TTL output of pin 1 is high (4.5 V) and pin 9 is low (0.5 V). The levels are reversed when the OUTPut:RELay state is OFF.

**NOTE**

- TTL output of pin 1 or pin 9 of the RS-232 connector is available only after installing two jumpers inside the power supply. See below for more information.
- Do not use the RS-232 interface if you have configured the power supply to output relay control signals. Internal components on the RS-232 circuitry may be damaged.
Installation procedure for an external relay

The assembly drawings are located in "Component Locator Diagram" on page 71.

1. Remove the front and rear bumpers and take off the cover.


3. Reassemble the power supply.

[1] For serial MY53xx6xxx, install JP751 and JP752 located adjacent to the connector CN751 (refer to "Component locator diagram for the main board assembly – top (serial MY53xx6xxx)" on page 73 on page 63)
Troubleshooting Hints

This section provides a brief check list of 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 power supply's circuits allow troubleshooting and repair with basic equipment such as a digital multimeter and a 100 MHz oscilloscope.

**CAUTION**

This instrument contains CMOS integrated circuits which are susceptible to failure due to electrostatic discharge. Refer to the “Electrostatic Discharge (ESD) Precautions” on page 62 for further handling precautions.

Unit is inoperative

- Verify that the AC power cord is connected to the power supply.
- Verify that the front-panel power switch is depressed.
- Verify that the power-line fuse is installed:
  - Use the 4 AT, 250 V fuse for 100 Vac or 115 Vac operation.
  - Use the 2.5 AT, 250 V fuse for 230 Vac operation.
- Verify the power-line voltage setting.
- Refer to the E3632A User’s Guide

Unit reports errors 740 to 750

These errors may be produced if you accidentally turn off power the unit during a calibration or while changing a non-volatile state of the instrument. Recalibration or resetting the state should clear the error. If the error persists, a hardware failure may have occurred.

Unit fails self-test

Verify that the correct power-line voltage setting is selected. Also, ensure that all terminal connections are removed while the self-test is performed. Failure of the
DAC U21\(^1\) on the top board will cause many self-test failures.

Bias supplies problems

Check that the input to the voltage regulators of the bias supplies is at least 1 V greater than their output. Circuit failures can cause heavy loads of the bias supplies which may pull down the regulator output voltages.

Check the voltages of bias supplies as tabulated below.

**Table 2-1**

<table>
<thead>
<tr>
<th>Bias supply</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Check at</th>
</tr>
</thead>
<tbody>
<tr>
<td>+5 V Floating</td>
<td>+4.75 V</td>
<td>+5.25 V</td>
<td>U11 pin 2</td>
</tr>
<tr>
<td>–5.1 V Floating</td>
<td>–4.75 V</td>
<td>–5.25 V</td>
<td>Anode of CR5</td>
</tr>
<tr>
<td>+15 V Floating</td>
<td>+14.25 V</td>
<td>+15.75 V</td>
<td>Anode of CR9</td>
</tr>
</tbody>
</table>

**Table 2-2**

<table>
<thead>
<tr>
<th>Bias supply</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Check at</th>
</tr>
</thead>
<tbody>
<tr>
<td>+3.3 V Floating</td>
<td>+3.135 V</td>
<td>+3.465 V</td>
<td>U23 pin 3</td>
</tr>
<tr>
<td>+15 V Floating</td>
<td>+14.25 V</td>
<td>+15.75 V</td>
<td>Anode of CR7</td>
</tr>
</tbody>
</table>

Some circuits produce their own local bias supplies from the main bias supplies. Be sure to check that these local bias supplies are active. In particular, the ADC (analog-to-digital converter), AC input, and front panel sections have local bias supplies. Always check that the power supplies are free of AC oscillations using an oscilloscope. Failure of bias supplies will cause many self-test failures.

\(^{1}\) For serial MY53xx6xxx, failure of the DAC U36 on the top board will cause many self-test failures.
Self-Test Procedures

Power-on self-test

Each time the power supply is powered on, a set of self-tests are performed. These tests check that the minimum set of logic and measurement hardware are functioning properly. The power-on self-test performs checks, which covers from 601 through 604 and 624 through 634. For serial MY53xx6xxx, the power-on self-test utilizes the complete self-test, which covers from error codes 601 through 632.

Complete self-test

Hold any front panel key except the Error key for more than 5 seconds while turning on the power to perform a complete self-test. The power supply beeps when the test starts. The tests are performed in the order shown below.

<table>
<thead>
<tr>
<th>Table 2-3</th>
<th>Self-test error messages</th>
</tr>
</thead>
<tbody>
<tr>
<td>601</td>
<td>Front panel does not respond</td>
</tr>
<tr>
<td></td>
<td>The main controller U17 (U10 for serial MY53xx6xxx) attempts to establish serial communications with the front panel controller U7 (U602 for serial MY53xx6xxx) on the front panel board. During this test, the U7 (U602 for serial MY53xx6xxx) turns on all display segments. Communication must function in both directions for this test to pass. If this error is detected during power-on self-test, the power supply will beep twice. This error is only readable from the remote interface.</td>
</tr>
<tr>
<td>602</td>
<td>RAM read/write failed</td>
</tr>
<tr>
<td></td>
<td>This test writes and reads a 55h and AAh checker board pattern to each address of RAM U14. Any incorrect readback will cause a test failure. This error is only readable from the remote interface.</td>
</tr>
<tr>
<td>603</td>
<td>A/D sync stuck</td>
</tr>
<tr>
<td></td>
<td>The main controller issues an A/D sync pulse to U17 and U18 to latch the value in the ADC slope counters. A failure is detected when a sync interrupt is not recognized and subsequent time-out occurs.</td>
</tr>
<tr>
<td>604</td>
<td>A/D slope convergence failed</td>
</tr>
<tr>
<td></td>
<td>The input amplifier is configured to the measure zero (MZ) state in the 10 V range. This test checks whether the ADC integrator produces nominally the same number of positive and negative slope decisions (±10%) during a 20 ms interval.</td>
</tr>
<tr>
<td>Test Code</td>
<td>Description</td>
</tr>
<tr>
<td>-----------</td>
<td>-------------</td>
</tr>
<tr>
<td>605</td>
<td>Cannot calibrate rundown gain. This test checks the nominal gain between integrating ADC and the U17 on-chip ADC. This error is reported if the procedure cannot run to completion due to a hardware failure.</td>
</tr>
<tr>
<td>606</td>
<td>Rundown gain out of range. This test checks the nominal gain between the integrating ADC and the U17 on-chip ADC. The nominal gain is checked to ±10% tolerance.</td>
</tr>
<tr>
<td>607</td>
<td>Rundown too noisy. This test checks the gain repeatability between the integrating ADC and the U17 on-chip ADC. The gain test (606) is performed eight times. Gain noise must be less that ±64 LSB's of the U17 on-chip ADC.</td>
</tr>
<tr>
<td>608</td>
<td>Serial configuration readback failed. This test re-sends the last 3 byte serial configuration data to all the serial path (SERDAT, SERBCK, SERCLK). The data is then clocked back into U18 and compared against the original 3 bytes sent. A failure occurs if the data do not match. This tests checks the serial data path through U22.</td>
</tr>
<tr>
<td>609[a]</td>
<td>This test checks if the ADC hardware is functional. The main controller U10 establishes communication with the ADC and checks if there are any error bits set for the ADC's status reporting.</td>
</tr>
<tr>
<td>624</td>
<td>Unable to sense line frequency. This test checks that the LSENCE logic input U17 is toggling. If no logic input detected, the power supply will assume a 50 Hz line operation for all future measurements.</td>
</tr>
<tr>
<td>625</td>
<td>I/O processor does not respond. This test checks that communications can be established between U17 (U10 for serial MY53xx6xxx) and U4 (U752 for serial MY53xx6xxx) through the isolated (U6 and U7) (U751 for serial MY53xx6xxx) serial data link. Failure to establish communication in either direction will generate an error. If this condition is detected at power-on self-test, the power supply will beep and the error annunciator will be on.</td>
</tr>
<tr>
<td>626</td>
<td>I/O processor failed self-test. This test causes the earth referenced processor U4 (U752 for serial MY53xx6xxx) to execute an internal, ram test. Failure will generate an error.</td>
</tr>
<tr>
<td>630</td>
<td>Fan test failed. This test checks if the fan current is flowing. If the current is not detected at power-on self-test, the power supply will beep and the error annunciator will be on. Fan test fail could likely induce overtemperature condition in the power supply.</td>
</tr>
</tbody>
</table>
631 System DAC test failed
This test checks if the DAC hardware is functional. The main controller U17 (U10 for serial MY53xxx) sends a reference voltage data to DAC and converts the DAC output to digital data to see if the digital data is within a valid range.

632 Hardware test failed
This test checks the status of voltage and current error amplifiers for the power circuit of output1. If both amplifiers are not operational, the power supply will beep and the error annunciator will be lit on.

[a] This error message is only applicable for serial MY53xxx.  
Component Locator Diagram

Component locator diagram for the main board assembly – top
Component locator diagram for the front panel — top
Component locator diagram for the main board assembly – top (serial MY53xx6xxx)
Component locator diagram for the front panel – top (serial MY53xx6xxx)