Programming Guide
Dynamic Measurement DC Source
Agilent Models 66312A, 66332A
System DC Power Supply
Agilent Models 6631B, 6632B, 6633B, 6634B
6611C, 6612C, 6613C, 6614C
Safety Guidelines

The beginning of the Operating Guide has a Safety Summary page. Be sure you are familiar with the information on this page before programming the dc source for operation from a controller.

Printing History

The edition and current revision of this manual are indicated below. Reprints of this guide containing minor corrections and updates may have the same printing date. Revised editions are identified by a new printing date. A revised edition incorporates all new or corrected material since the previous printing date. Changes to the manual occurring between revisions are covered by change sheets shipped with the guide.

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SENSe:CUR?6nt:RANGE
SENSe:CUR?6nt:DE?ector
SENSe:Functio?n
SENSe:SWep:OFFSet:POI?nts
SENSe:SWep:POI?nts
SENSe:SWep:TIN?erval
SENSe:WIN?ow

OUTPUT Commands

OUTPut
OUTPut:DFI
OUTPut:DFI:SOURce
OUTPut:PO?:STA?e
OUTPut:PRO?ec?on:CLEar
OUTPut:REL?ay
OUTPut:REL?ay:PO?arity
OUTPut:RI:MODE
[SOURce:]CUR?6nt
[SOURce:]CUR?6nt:TRIGger
[SOURce:]DIGita?l:DATA
[SOURce:]DIGita?l:Functio?n
[SOURce:]VOLTage:TRIGger
[SOURce:]VOLTage:PRO?ec?on

STATUS Commands

STATus:PRES?et
STATus:OPER?ation?
STATus:OPER?ation:COND?ition?
STATus:OPER?ation:ENABLE
STATus:QUESTIONable?
STATus:QUESTIONable:COND?ition?
STATus:QUESTIONable:ENABLE
STATus:QUESTIONable:NTR STA?us:QUESTIONable:PTR
*CLS
*ESE
*ESR?
*OPC
*PSC
*SRE
*STB?
*WAI

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General Information

About this Guide

This guide provides remote programming information for the following series of GPIB programmable dc power supplies:
- Agilent 66312A
- Agilent 66332A
- Agilent 6631B/6632B/6633B/6634B
- Agilent 6611C/6612C/6613C/6614C

You will find the following information in the rest of this guide:

Chapter 1  Introduction to this guide.
Chapter 2  Introduction to SCPI messages structure, syntax, and data formats. Examples of SCPI programs
Chapter 3  Introduction to Programming the dc source with SCPI commands.
Chapter 4  Dictionary of SCPI commands.
Appendix A  SCPI conformance information.
Appendix B  Use of the alternate Compatibility programming language.
Appendix C  Error messages

Documentation Summary

The following documents that are related to this Programming Guide have additional helpful information for using the dc source.

- User’s Guide for Agilent 66312A and Agilent 6611C/6612C/6613C/3314C. Includes specifications and supplemental characteristics, how to use the front panel, how to connect to the instrument, and calibration procedures.

- User’s Guide for Agilent 66332A and Agilent 6631B/6632B/6633B/6634B. Includes specifications and supplemental characteristics, how to use the front panel, how to connect to the instrument, and calibration procedures.
External References

GPIB References

The most important GPIB documents are your controller programming manuals - BASIC, GPIB Command Library for MS DOS, etc. Refer to these for all non-SCPI commands (for example: Local Lockout).

The following are two formal documents concerning the GPIB interface:

  - Defines the technical details of the GPIB interface. While much of the information is beyond the need of most programmers, it can serve to clarify terms used in this guide and in related documents.

  - Recommended as a reference only if you intend to do fairly sophisticated programming. Helpful for finding precise definitions of certain types of SCPI message formats, data types, or common commands.

The above two documents are available from the IEEE (Institute of Electrical and Electronics Engineers), 345 East 47th Street, New York, NY 10017, USA. The WEB address is www.ieee.org.

SCPI References

The following documents will assist you with programming in SCPI:

- **Standard Commands for Programmable Instruments Volume 1, Syntax and Style**
- **Standard Commands for Programmable Instruments Volume 2, Command References**
- **Standard Commands for Programmable Instruments Volume 3, Data Interchange Format**
- **Standard Commands for Programmable Instruments Volume 4, Instrument Classes**

To obtain a copy of the above documents, contact: Fred Bode, Executive Director, SCPI Consortium, 8380 Hercules Drive, Suite P3, La Mesa, CA 91942, USA
Introduction to Programming

VXIplug\&play Power Products Instrument Drivers

VXIplug\&play instrument drivers for Microsoft Windows 95 and Windows NT are now available on the Web at http://www.agilent.com/find/drivers. These instrument drivers provide a high-level programming interface to your Agilent Technologies instrument. VXIplug\&play instrument drivers are an alternative to programming your instrument with SCPI command strings. Because the instrument driver's function calls work together on top of the VISA I/O library, a single instrument driver can be used with multiple application environments.

Supported Applications

- Agilent VEE
- Microsoft Visual BASIC
- Microsoft Visual C/C++
- Borland C/C++
- National Instruments LabVIEW
- National Instruments LabWindows/CVI

System Requirements

The VXIplug\&play Power Products instrument driver complies with the following:

- Microsoft Windows 95
- Microsoft Windows NT 4.0
- HP VISA revision F.01.02
- National Instruments VISA 1.1

Downloading and Installing the Driver

NOTE: Before installing the VXIplug&play instrument driver, make sure that you have one of the supported applications installed and running on your computer.

2. Select the instrument for which you need the driver.
3. Click on the driver, either Windows 95 or Windows NT, and download the executable file to your pc.
4. Locate the file that you downloaded from the Web. From the Start menu select Run <path>:\agxxxx.exe - where <path> is the directory path where the file is located, and agxxxx is the instrument driver that you downloaded.
5. Follow the directions on the screen to install the software. The default installation selections will work in most cases. The readme.txt file contains product updates or corrections that are not documented in the on-line help. If you decide to install this file, use any text editor to open and read it.
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6. To use the VXIplug&play instrument driver, follow the directions in the VXIplug&play online help under "Introduction to Programming".

Accessing Online Help

A comprehensive online programming reference is provided with the driver. It describes how to get started using the instrument driver with Agilent VEE, LabVIEW, and LabWindows. It includes complete descriptions of all function calls as well as example programs in C/C++ and Visual BASIC.

- To access the online help when you have chosen the default Vxipnp start folder, click on the Start button and select Programs | Vxipnp | Agxxxx Help (32-bit).
  - where agxxxx is the instrument driver.

GPIB Capabilities of the DC Source

All dc source functions except for setting the GPIB address are programmable over the GPIB. The IEEE 488.2 capabilities of the dc source are listed in the Specifications Table of the User's Guide.

GPIB Address

The dc source operates from an GPIB address that is set from the front panel. To set the GPIB address, press the Address key on the front panel and enter the address using the Entry keys. The GPIB address is stored in non-volatile memory.

RS-232 Capabilities of the DC Source

The dc source provides an RS-232 programming interface, which is activated by commands located under the front panel Address key. All SCPI and COMPatibility commands are available through RS-232 programming. When the RS-232 interface is selected, the GPIB interface is disabled.

The EIA RS-232 Standard defines the interconnections between Data Terminal Equipment (DTE) and Data Communications Equipment (DCE). The dc source is designed to be a DTE. It can be connected to another DTE such as a PC COM port through a null modem cable.

NOTE: The RS-232 settings in your program must match the settings specified in the front panel Address menu. Press the front panel Address key if you need to change the settings.

RS-232 Data Format

The RS-232 data is a 10-bit word with one start bit and one stop bit. The number of start and stop bits is not programmable. However, the following parity options are selectable using the front panel Address key:

- **EVEN**: Seven data bits with even parity
- **ODD**: Seven data bits with odd parity
- **MARK**: Seven data bits with mark parity (parity is always true)
- **SPACE**: Seven data bits with space parity (parity is always false)
- **NONE**: Eight data bits without parity

Parity options are stored in non-volatile memory.
Baud Rate

The front panel Address key lets you select one of the following baud rates, which is stored in non-volatile memory:

300 600 1200 2400 4800 9600

RS-232 Flow Control

The RS-232 interface supports several flow control options that are selected using the front panel Address key. For each case, the dc source will send a maximum of five characters after holdoff is asserted by the controller. The dc source is capable of receiving as many as fifteen additional characters after it asserts holdoff.

XON-XOFF A software handshake that uses the ASCII control code DC3 (decimal code 19) to assert hold-off, and control code DC1 (decimal code 17) to release hold-off.

RTS-CTS The dc source asserts its Request to Send (RTS) line to signal hold-off when its input buffer is almost full, and it interprets its Clear to Send (CTS) line as a hold-off signal from the controller.

DTR-DSR The dc source asserts its Data Terminal Ready (DTR) line to signal hold-off when its input buffer is almost full, and it interprets its Data Set Ready (DSR) line as a hold-off signal from the controller.

NONE There is no flow control.

Flow control options are stored in non-volatile memory.

RS-232 Programming Example

The following program illustrates how to program the power supply using RS-232 to set the output voltage end current and to readback the model number and output voltage. The program was written to run on any controller using Microsoft QBasic.

```
' Program to write and read via RS232.
' Configure the power supply for 9600 baud, even parity and RS232
' Configure serial port for:
' 9600 baud
' 7 bit data
' 2 stop bits
' Ignore request to send
' Ignore carrier detect
' Even parity
' Send line feed
' Reserve 1000 character buffer for serial I/O
'DECLARE FUNCTION gets$ ()
CLS
LOCATE 1, 1
' Clear screen
' Position cursor at top left
' Configure Com Port
OPEN "com1:9600,e,7,2,rs,od,ps,1f" FOR RANDOM AS #1 LEN = 1000
PRINT #1, "OUTPUT ON" ' Turn on output then set voltage and current
PRINT #1, "VOLT 6" ' Set voltage to 6 volts
PRINT #1, "CURR .5" ' Set current to 0.5 amps
PRINT #1, "IDNT?" ' Query the power supply identification string
PRINT gets$ ' Go to gets$ Function and print data returned
PRINT #1, MEAS"VOLT?"; volt ' Query the power supply voltage
PRINT gets$ ' Convert gets$ string to a value
PRINT gets$ ' Print the value of the voltage
END ' End of main program
```
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FUNCTION gets$  
CS = ""  
WHILE CS <> CHR$(10)  
  CS = INPUT$(1, #1)  
  resp$ = resp$ + CS  
END WHILE  
END FUNCTION  
' Get a new line feed terminated string from device #1  
' Set CS to null  
' Set loop to stop at Line Feed  
' Read 1 bit into file #1  
' Concatenate bit with previous bits  
' End of WHILE loop  
' Assign response to gets$

RS-232 Troubleshooting

If you are having trouble communicating over the RS-232 interface, check the following:

- The computer and the dc source must be configured for the same baud rate, parity, number of data bits, and flow control options. Note that the dc source is configured for 1 start bit and 1 stop bit (these values are fixed).

- The correct interface cables or adaptors must be used, as described under RS-232 Connector. Note that even if the cable has the proper connectors for your system, the internal wiring may be incorrect.

- The interface cable must be connected to the correct serial port on your computer (COM1, COM2, etc.).

Introduction to SCPI

SCPI (Standard Commands for Programmable Instruments) is a programming language for controlling instrument functions over the GPIB. SCPI is layered on top of the hardware-portion of IEEE 488.2. The same SCPI commands and parameters control the same functions in different classes of instruments. For example, you would use the same DISPlay command to control the dc source display and the display of a SCPI-compatible multimeter.

Conventions Used in This Guide

- Angle brackets < > Items within angle brackets are parameter abbreviations. For example, <NR1> indicates a specific form of numerical data.

- Vertical bar | Vertical bars separate alternative parameters. For example, NORM | TEXT indicates that either "TEXT" or "NORM" can be used as a parameter.

- Square Brackets [ ] Items within square brackets are optional. The representation [SOURce:]. VOLTage means that SOURce: may be omitted.

- Braces {} Braces indicate parameters that may be repeated zero or more times. It is used especially for showing arrays. The notation <A>{<B>} shows that parameter "A" must be entered, while parameter "B" may be omitted or may be entered one or more times.

- Boldface font Boldface font is used to emphasize syntax in command definitions. TRIGger:COUNt:CURRent <NRF> shows command definition.

- Computer font Computer font is used to show program lines in text. TRIGger:COUNt:CURRent 10 shows a program line.
Types of SCPI Commands

SCPI has two types of commands, common and subsystem.

- Common commands generally are not related to specific operation but to controlling overall dc source functions, such as reset, status, and synchronization. All common commands consist of a three-letter mnemonic preceded by an asterisk: *RST  *IDN?  *SRE 

- Subsystem commands perform specific dc source functions. They are organized into an inverted tree structure with the "root" at the top. The following figure shows a portion of a subsystem command tree, from which you access the commands located along the various paths. You can see the complete tree in Table 4-1.

![Command Tree Diagram](image)

**Figure 2-1. Partial Command Tree**

Multiple Commands in a Message

Multiple SCPI commands can be combined and sent as a single message with one message terminator. There are two important considerations when sending several commands within a single message:

- Use a semicolon to separate commands within a message.
- There is an implied header path that affects how commands are interpreted by the dc source.

The header path can be thought of as a string that gets inserted before each command within a message. For the first command in a message, the header path is a null string. For each subsequent command the header path is defined as the characters that make up the headers of the previous command in the message up to and including the last colon separator. An example of a message with two commands is:

```
CURR:LEV 3;PROT:STAT OFF
```

which shows the use of the semicolon separating the two commands, and also illustrates the header path concept. Note that with the second command, the leading header "CURR" was omitted because after the "CURR:LEV 3" command, the header path was became defined as "CURR" and thus the instrument interpreted the second command as:

```
CURR:PROT:STAT OFF
```

In fact, it would have been syntactically incorrect to include the "CURR" explicitly in the second command, since the result after combining it with the header path would be:

```
CURR:CURR:PROT:STAT OFF
```

which is incorrect.
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Moving Among Subsystems

In order to combine commands from different subsystems, you need to be able to reset the header path to a null string within a message. You do this by beginning the command with a colon (:), which discards any previous header path. For example, you could clear the output protection and check the status of the Operation Condition register in one message by using a root specifier as follows:

```
OUTPUT:PROTECTION:CLEAR;:STATUS:OPERATION:CONDITION?
```

The following message shows how to combine commands from different subsystems as well as within the same subsystem:

```
VOLTage:LEVEL 20;PROTECTION 28; CURRent:LEVEL 3;PROTECTION:STATE ON
```

Note the use of the optional header LEVEL to maintain the correct path within the voltage and current subsystems, and the use of the root specifier to move between subsystems.

Including Common Commands

You can combine common commands with system commands in the same message. Treat the common command as a message unit by separating it with a semicolon (the message unit separator). Common commands do not affect the header path; you may insert them anywhere in the message.

```
VOLTage:TRIGGERed 17.5;:INITIALize:*TRG
OUTPUT OFF;:RCL 2;OUTPUT ON
```

Using Queries

Observe the following precautions with queries:

- Set up the proper number of variables for the returned data.
- Read back all the results of a query before sending another command to the dc source. Otherwise a Query Interrupted error will occur and the unretruned data will be lost.

Types of SCPI Messages

There are two types of SCPI messages, program and response.

- A program message consists of one or more properly formatted SCPI commands sent from the controller to the dc source. The message, which may be sent at any time, requests the dc source to perform some action.

- A response message consists of data in a specific SCPI format sent from the dc source to the controller. The dc source sends the message only when commanded by a program message called a "query."

The following figure illustrates SCPI message structure:
The Message Unit

The simplest SCPI command is a single message unit consisting of a command header (or keyword) followed by a message terminator. The message unit may include a parameter after the header. The parameter can be numeric or a string.

```
ABORT<NL>
VOLTage 20<NL>
```

Headers

Headers, also referred to as keywords, are instructions recognized by the dc source. Headers may be either in the long form or the short form. In the long form, the header is completely spelled out, such as VOLTAGE, STATUS, and DELAY. In the short form, the header has only the first three or four letters, such as VOLT, STAT, and DEL.

Query Indicator

Following a header with a question mark turns it into a query (VOLTage?, VOLTage:PROTection?). If a query contains a parameter, place the query indicator at the end of the last header (VOLTage:PROTection? MAX).

Message Unit Separator

When two or more message units are combined into a compound message, separate the units with a semicolon (STATus OPERation?, QUESTIONable?).

Root Specifier

When it precedes the first header of a message unit, the colon becomes the root specifier. It tells the command parser that this is the root or the top node of the command tree.

Message Terminator

A terminator informs SCPI that it has reached the end of a message. Three permitted messages terminators are:

- newline (<NL>), which is ASCII decimal 10 or hex 0A.
- end or identify (<END>)
- both of the above (<NL><END>).

In the examples of this guide, there is an assumed message terminator at the end of each message.
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NOTE: All RS-232 response data sent by the dc source is terminated by the ASCII character pair <carriage return><newline>. This differs from GPIB response data which is terminated by the single character <newline> with EOI asserted.

SCPI Data Formats

All data programmed to or returned from the dc source is ASCII. The data may be numerical or character string.

Numerical Data Formats

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Data Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;NR1&gt;</td>
<td>Digits with an implied decimal point assumed at the right of the least-significant digit. Examples: 273</td>
</tr>
<tr>
<td>&lt;NR2&gt;</td>
<td>Digits with an explicit decimal point. Example: .0273</td>
</tr>
<tr>
<td>&lt;NR3&gt;</td>
<td>Digits with an explicit decimal point and an exponent. Example: 2.73E+2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Data Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;NRF&gt;</td>
<td>Extended format that includes &lt;NR1&gt;, &lt;NR2&gt; and &lt;NR3&gt;. Examples: 273 273. 2.73E2</td>
</tr>
<tr>
<td>&lt;NRF+&gt;</td>
<td>Expanded decimal format that includes &lt;NRF&gt; and MIN MAX. Examples: 273 273. 2.73E2 MAX. MIN and MAX are the minimum and maximum limit values that are implicit in the range specification for the parameter.</td>
</tr>
<tr>
<td>&lt;Bool&gt;</td>
<td>Boolean Data. Example: 0</td>
</tr>
</tbody>
</table>

Suffixes and Multipliers

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<th>Suffix</th>
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<th>Unit with Multiplier</th>
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<tbody>
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<td>Current</td>
<td>A</td>
<td>ampere</td>
<td>MA (milliampere)</td>
</tr>
<tr>
<td>Amplitude</td>
<td>V</td>
<td>volt</td>
<td>MV (millivolt)</td>
</tr>
<tr>
<td>Time</td>
<td>S</td>
<td>second</td>
<td>MS (millisecond)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Common Multipliers</th>
</tr>
</thead>
<tbody>
<tr>
<td>1E3</td>
</tr>
<tr>
<td>1E-3</td>
</tr>
<tr>
<td>1E-6</td>
</tr>
</tbody>
</table>

Response Data Types

Character strings returned by query statements may take either of the the following forms, depending on the length of the returned string:

<CRD> Character Response Data. Permits the return of character strings.

<AARD> Arbitrary ASCII Response Data. Permits the return of undelimited 7-bit ASCII. This data type has an implied message terminator.

<SRD> String Response Data. Returns string parameters enclosed in double quotes.
**SCPI Command Completion**

SCPI commands sent to the dc source are processed either sequentially or in parallel. Sequential commands finish execution before a subsequent command begins. Parallel commands allow other commands to begin executing while the parallel command is still executing. Commands that affect trigger actions are among the parallel commands.

The *WAI, *OPC, and *OPC? common commands provide different ways of indicating when all transmitted commands, including any parallel ones, have completed their operations. The syntax and parameters for these commands are described in chapter 4. Some practical considerations for using these commands are as follows:

- **WAI**
  This prevents the dc source from processing subsequent commands until all pending operations are completed.

- **OPC?**
  This places a 1 in the Output Queue when all pending operations have completed. Because it requires your program to read the returned value before executing the next program statement, *OPC? can be used to cause the controller to wait for commands to complete before proceeding with its program.

- **OPC**
  This sets the OPC status bit when all pending operations have completed. Since your program can read this status bit on an interrupt basis, *OPC allows subsequent commands to be executed.

**NOTE:** The trigger subsystem must be in the Idle state in order for the status OPC bit to be true. Therefore, as far as triggers are concerned, OPC is false whenever the trigger subsystem is in the Initiated state.

**Using Device Clear**

You can send a device clear at any time abort a SCPI command that may be hanging up the GPIB interface. The status registers, the error queue, and all configuration states are left unchanged when a device clear message is received. Device clear performs the following actions:

- The input and output buffers of the dc source are cleared.
- The dc source is prepared to accept a new command string.

The following statement shows how to send a device clear over the GPIB interface using Agilent BASIC:

```
CLEAR 705
```

The following statement shows how to send a device clear over the GPIB interface using the GPIB command library for C or QuickBASIC:

```
IOCLEAR [705]
```

**NOTE:** For RS-232 operation, sending a Break will perform the same operation as the IEEE-488 device clear message.
Programming the DC Source

Introduction

This chapter contains examples on how to program your dc source. Simple examples show you how to program:

- output functions such as voltage and current
- internal and external triggers
- measurement functions
- the status and protection functions

NOTE: These examples in this chapter show which commands are used to perform a particular function, but do not show the commands being used in any particular programming environment. Refer to Appendix D for some examples of SCPI commands in a specific programming environment.

Programming the Output

Power-on Initialization

When the dc source is first turned on, it wakes up with the output state set OFF. In this state the output voltage is set to 0. The following commands are given implicitly at power-on:

*RST
*CLS
STATUS:PRESet
*SRE 0
*ESE 0

*RST is a convenient way to program all parameters to a known state. Refer to the *RST command in chapter 4 to see how each programmable parameter is set by *RST. Refer to the *PSC command in chapter 4 for more information on the power-on initialization of the *ESE and the *SRE registers.

Enabling the Output

To enable the output, use the command:

OUTPUT ON
3 - Programming the DC Source

Output Voltage

The output voltage is controlled with the VOLTage command. For example, to set the output voltage to 25 volts, use:

VOLTage 25

The dc source can be programmed to turn off its output if the output voltage exceeds a preset peak voltage limit. This protection feature is implemented with the VOLTage:PROTection command as explained in chapter 4.

Maximum Voltage

The maximum rms output voltage that can be programmed can be queried with:

VOLTage? MAX

Output Current

All models have a programmable current function. The command to program the current is:

CURRent <n>

where <n> is the current limit in amperes.

If the load attempts to draw more current than the programmed limit, the output voltage is reduced to keep the current within the limit.

Maximum Current

The maximum output current that can be programmed can be queried with:

CURRent? MAX

Overcurrent Protection

The dc source can also be programmed to turn off its output if the current limit is reached. As explained in chapter 4, this protection feature is implemented the following command:

CURRent:PROTection:STATe ON | OFF

NOTE: Use OUTP:PROT:DEL to prevent momentary current limit conditions caused by programmed output changes from tripping the overcurrent protection.
Triggering Output Changes

The dc source has two independent trigger systems. One is used for generating output changes, and the other is used for triggering measurements. This section describes the output trigger system. The measurement trigger system is described under "Triggering Measurements".

SCPI Triggering Nomenclature

In SCPI terms, trigger systems are called sequences. When more than one trigger system exists, they are differentiated by naming them SEQuence1 and SEQuence2. SEQuence1 is the transient trigger system and SEQuence2 is the measurement trigger system. The dc source uses aliases with more descriptive names for these sequences. These aliases can be used instead of the sequence forms.

<table>
<thead>
<tr>
<th>Sequence Form</th>
<th>Alias</th>
</tr>
</thead>
<tbody>
<tr>
<td>SEQuence1</td>
<td>TRANsient</td>
</tr>
<tr>
<td>SEQuence2</td>
<td>ACQuire</td>
</tr>
</tbody>
</table>

Output Trigger System Model

Figure 3-1 is a model of the output trigger system. The rectangular boxes represent states. The arrows show the transitions between states. These are labeled with the input or event that causes the transition to occur.

![Model of Output Triggers](image)

Figure 3-1. Model of Output Triggers

Setting the Voltage or Current Trigger Levels

To program output trigger levels, you must first specify a voltage or current trigger level that the output will go to once a trigger signal is received. Use the following commands to set the output trigger level:

\[
\text{VOLTage:TRIGgered <n> or CURRent:TRIGgered <n>} \]

**NOTE:** Until they are programmed, uninitialized trigger levels will assume their corresponding immediate levels. For example, if a dc source is powered up and VOLTage:LEVel is programmed to 6, then VOLTage:LEVel;TRIGger will also be 6 until you program it to another value. Once you program VOLTage:LEVel;TRIGger to a value, it will remain at that value regardless of how you subsequently reprogram VOLTage:LEVel.
3 - Programming the DC Source

**Initiating the Output Trigger System**

When the dc source is turned on, the trigger subsystem is in the idle state. In this state, the trigger subsystem ignores all triggers. Sending the following commands at any time returns the trigger system to the Idle state:

```
ABORt
*RST
*RCL
```

The INITiate commands move the trigger system from the Idle state to the Initiated state. This enables the dc source to receive triggers. To initiate for a single triggered action, use:

```
INITiate:SEQuence:IMMediate
INITiate:NAME TRAnsient
```

After a trigger is received and the action completes, the trigger system will return to the Idle state. Thus it will be necessary to initiate the system each time a triggered action is desired.

To keep a trigger system initiated for multiple actions without having to send an initiate command for each trigger, use:

```
INITiate:CONTInuous:SEQuence1 ON  or
INITiate:CONTInuous:NAME TRAnsient, ON
```

**Generating Triggers**

You can only program output triggers over the GPIB bus. Since BUS is the only trigger source for output triggers, the following command is provided for completeness only:

```
TRIGger:SOURce BUS
```

After you have specified the appropriate trigger source, you can generate triggers as follows:

<table>
<thead>
<tr>
<th>Single Triggers</th>
<th>Send one of the following commands over the GPIB:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>TRIGger:IMMediate</td>
</tr>
<tr>
<td></td>
<td>*TRG</td>
</tr>
<tr>
<td></td>
<td>a group execute trigger</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Continuous Triggers</th>
<th>Send the following command over the GPIB:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>INITiate:CONTInuous:SEQuence1 ON</td>
</tr>
</tbody>
</table>

When the trigger system enters the Output Change state upon receipt of a trigger (see figure 3-1), the triggered functions are set to their programmed trigger levels. When the triggered actions are completed, the trigger system returns to the Idle state.
Making Measurements

The dc source has the ability to make several types of voltage or current measurements. The measurement capabilities of the Agilent 66312A and Agilent 66332A models are particularly useful for loads that draw current in pulses.

NOTE: You cannot measure output voltage and current simultaneously.

All measurements are performed by digitizing the instantaneous output voltage or current for a defined number of samples and sample interval, storing the results in a buffer, and then calculating the measured result. Many parameters of the measurement are programmable. These include the number of samples, the time interval between samples, the bandwidth, and the method of triggering. Note that there is a tradeoff between these parameters and the speed, accuracy, and stability of the measurement in the presence of noise.

There are two ways to make measurements:

- Use the MEASure commands to immediately start acquiring new voltage or current data, and return measurement calculations from this data as soon as the buffer is full. This is the easiest way to make measurements, since it requires no explicit trigger programming.
- Use an acquisition trigger to acquire the data. Then use the FETCH commands to return calculations from the data that was retrieved by the acquisition trigger. This method gives you the flexibility to synchronize the data acquisition with a transition in the output voltage or current. FETCH commands do not trigger the acquisition of new measurement data, but they can be used to return many different calculations from the data that was retrieved by the acquisition trigger. Note that if you take a voltage measurement, you can fetch only voltage data.

Making triggered measurements with the acquisition trigger system is discussed under "Triggering Measurements".

NOTE: For each MEASure form of the query, there is a corresponding query that begins with the header FETCH. FETCH queries perform the same calculation as their MEASure counterparts, but do not cause new data to be acquired. Data acquired by an explicit trigger or a previously programmed MEASure command are used.

Voltage and Current Measurements

The SCPI language provides a number of MEASure and FETCH queries which return various measurement parameters of voltage and current waveforms.

DC Measurements

To measure the dc output voltage or current, use:

```
MEASure:VOLTage? or
MEASure:CURRENT?
```

Dc voltage and current is measured by acquiring a number of readings at the selected time interval, applying a Hanning window function to the readings, and averaging the readings. Windowing is a signal conditioning process that reduces the error in dc measurements made in the presence of periodic signals such as line ripple. At power-on and after a *RST command, the following parameters are set:

```
SENSe:SWEsp:TINterval 15.6E-6
SENSe:SWEsp:POINts 2048
```
3 - Programming the DC Source

This results in a data acquisition time of 32 milliseconds. Adding a command processing overhead of about 20 milliseconds results in a total measurement time of about 50 milliseconds per measurement sample.

Ripple rejection is a function of the number of cycles of the ripple frequency contained in the acquisition window. More cycles in the acquisition window results in better ripple rejection. If you increase the time interval for each measurement to 45 microseconds for example, this results in 5.53 cycles in the acquisition window at 60 Hz, for a ripple rejection of about 70 dB.

Note that the speed of the measurement can be increased by reducing the number of sample points. For example, the commands

```
SENSe:SWEep:TINTerval 15E-6
SENSe:SWEep:POInts 1024
```

speeds up the acquisition period to 16 milliseconds; however, the tradeoff is reduced measurement accuracy.

**RMS Measurements (Agilent 66312A, 66332A Only)**

To read the rms content of a voltage or current waveform, use:

```
MEASure:VOLTage:ACDC?  or
MEASure:CURRent:ACDC?
```

This returns the total rms measurement, including the dc portion.

Making rms measurements on ac waveforms for which a non-integral number of cycles of data has been acquired may result in measurement errors due to the last partial cycle of acquired data. The instrument reduces this error by using a Hanning window function when making the measurement.

**Minimum and Maximum Measurements (Agilent 66312A, 66332A Only)**

To measure the maximum or minimum voltage or current of a pulse or ac waveform, use:

```
MEASure:VOLTage:MAXimum?
MEASure:VOLTage:MINimum?
MEASure:CURRent:MAXimum?
MEASure:CURRent:MINimum?
```

**Current Ranges**

The dc source has two current measurement ranges. The command that controls the ranges is:

```
SENSe:CURRent:RANGE MIN | MAX
```

When the range is set to MIN, the maximum current that can be measured is 20 milliamperes.

**Returning Measurement Data From the Data Buffer (Agilent 66312A, 66332A Only)**

The MEASure and FETCH queries can also return all data values of the instantaneous voltage or current buffer. The commands are:

```
MEASure:ARRay:CURRent?
MEASure:ARRay:VOLTage?
```
Internally Triggered Measurements

You can use the data acquisition trigger system to synchronize the timing of the voltage and current data acquisition with a BUI or internal trigger source. Then use the FETCH commands to return different calculations from the data acquired by the measurement trigger.

SCPI Triggering Nomenclature

As previously explained under "Triggering Output Changes", the dc source uses the following sequence name and alias for the measurement trigger system. This alias can be used instead of the sequence form.

<table>
<thead>
<tr>
<th>Sequence Form</th>
<th>Alias</th>
</tr>
</thead>
<tbody>
<tr>
<td>SEQuence2</td>
<td>ACQuire</td>
</tr>
</tbody>
</table>

Measurement Trigger System Model

Figure 3-2 is a model of the measurement trigger system. The rectangular boxes represent states. The arrows show the transitions between states. These are labeled with the input or event that causes the transition to occur.

![Model of Measurement Triggers](image)

Figure 3-2. Model of Measurement Triggers

Initiating the Measurement Trigger System (Agilent 66312A, 66332A Only)

When the dc source is turned on, the trigger system is in the idle state. In this state, the trigger system ignores all triggers. Sending the following commands at any time returns the trigger system to the Idle state:

- ABORT
- *RST
- *RCL

The INITiate commands move the trigger system from the Idle state to the Initiated state. This enables the dc source to receive triggers. To initiate for a measurement trigger, use:
3 - Programming the DC Source

INITiate:SEQuence2 or
INITiate:NAME ACQuire

After a trigger is received and the data acquisition completes, the trigger system will return to the idle state (unless multiple measurements are desired). Thus it will be necessary to initiate the system each time a triggered acquisition is desired.

NOTE: You cannot initiate measurement triggers continuously. Otherwise, the measurement data in the data buffer would continuously be overwritten by each triggered measurement.

Selecting the Measurement Trigger Source (Agilent 66312A, 66332A Only)

The trigger system is waiting for a trigger signal in the Initiated state. Before you generate a trigger, you must select a trigger source. The following measurement trigger sources can be selected:

BUS - selects GPIB bus triggers.
INTernal - selects the dc source’s output as the measurement trigger.

To select GPIB bus triggers (group execute trigger, device trigger, or *TRG command), use:

TRIGger:SEQuence2:SOURce BUS or
TRIGger:ACQuire:SOURce BUS

To select internal triggers (measurements triggered off the output signal) use:

TRIGger:SEQuence2:SOURce INTernal or
TRIGger:ACQuire:SOURce INTernal

Generating Measurement Triggers (Agilent 66312A, 66332A Only)

There is only one measurement converter in the dc source. Before you generate a measurement trigger, you must specify a measurement acquisition of either voltage or current. To specify a measurement acquisition use:

SENSe:FUNCTION "CURRENT" or
SENSe:FUNCTION "VOLTage"

Providing that you have specified the appropriate trigger source and a measurement acquisition, you can generate triggers as follows:

GPIB Triggers
Send one of the following commands over the GPIB:
TRIGger:IMMediate (not affected by the trigger source setting)
*TRG
a group execute trigger

Internal Triggers
To trigger off of the output signal, you must specify the output level that generates the trigger, the rising or falling edge of the slope, and a hysteresis to qualify trigger conditions. This is illustrated in figure 3-3.
Figure 3-3. Trigger Commands Used to Measure Output Pulses

To specify the output level that will generate triggers for both positive- and negative-going signals use:

TRIGger:SEQUence2:LEVEL:CURRENT <value> or
TRIGger:ACQuire:LEVEL:CURRENT <value>

To specify the slope on which triggering occurs use the following commands. You can specify a POSitive, a NEGative, or EITHER type of slope.

TRIGger:SEQUence2:SLOPe:CURRENT <slope> or
TRIGger:ACQuire:SLOPe:CURRENT <slope>

To specify a hysteresis band to qualify the positive- or negative-going signal use:

TRIGger:SEQUence2:HYSteresis:CURRENT <value> or
TRIGger:ACQuire:HYSteresis:CURRENT <value>

NOTE: When using internal triggers, do not INITiate the measurement until after you have specified the slope, level, and hysteresis.

When the acquisition finishes, any of the FETCH queries can be used to return the results. Once the measurement trigger is initiated, if a FETCH query is sent before the data acquisition is triggered or before it is finished, the response data will be delayed until the trigger occurs and the acquisition completes. This may tie up the controller if the trigger condition does not occur immediately.

One way to wait for results without tying up the controller is to use the SCPI command completion commands. For example, you can send the "OPC command after INITialize, then occasionally poll the OPC status bit in the standard event status register for status completion while doing other tasks. You can also set up an SRQ condition on the OPC status bit going true, and do other tasks until an SRQ interrupt occurs.
Measuring Output Pulses (Agilent 66312A, 66332A Only)

Current Detector

Check that the current detector is set to ACDC when measuring current pulses or other waveforms with a frequency content greater than a few kilohertz.

SENSe:CURRent:DETection ACDC

Only select DC as the measurement detector if you are making only DC current measurements and you require a measurement offset better than 2mA on the High current measurement range. Note that this selection gives inaccurate results on current waveforms that have ac content.

SENSe:CURRent:DETection DC

Pulse Measurement Queries

The dc source has several measurement queries that return key parameters of pulselwaveforms as shown in Figure 3-4.

![Figure 3-4. Measurement Commands Used to Return Pulse Data](image)

To return the maximum or minimum value of a pulse waveform use the following commands. Note that the data points of the measurement sample may not coincide with the actual maximum or minimum point on the waveform.

FETCH:VOLTage:MAXimum? or
FETCH:VOLTage:MINimum?
FETCH:CURRent:MAXimum? or
FETCH:CURRent:MINimum?

The average value of the high level or low level of a pulse can also be measured. To return the average value of the high level, use:

FETCH:CURRent:HIGH? or
FETCH:VOLTage:HIGH?

To return the average value of the low level, use:

FETCH:CURRent:LOW? or
FETCH:VOLTage:LOW?
Controlling Measurement Samples

Varying the Voltage or Current Sampling Rate

You can vary both the number of data points in a measurement sample, as well as the time between samples. This is illustrated in Figure 3-5.

![Figure 3-5. Sense Commands Used to Vary the Sampling Rate](image)

At *RST, the output voltage or current sampling rate is 15.6 microseconds. This means that it takes about 32 milliseconds to fill up 2048 data points in the data buffer. You can vary this data sampling rate with:

```
SENSe:SWEep:TINTerval <sample_period>
SENSe:SWEep:POINts <points>
```

For example, to set the time interval to 46.8 microseconds per sample with 1500 samples, use

```
SENSe:SWEep:TINTerval 46.8E-6; POINts 1500.
```

Multiple Measurements (Agilent 66312A, 66332A Only)

The instrument also has the ability to set up several acquisition triggers in succession and average the results from each acquisition in the returned measurement. To set up the trigger system for a number of sequential acquisitions use:

```
TRIGger:ACQuire:COUNT:CURRent <number> or
TRIGger:ACQuire:COUNT:VOLTage <number>
```

With this setup, the instrument performs each acquisition sequentially, storing the digitized readings in the internal measurement buffer. It is only necessary to initialize the measurement once at the start; after each completed acquisition the instrument will wait for the next valid trigger condition to start another. The results returned by MEASure or FETCH will be the average of the total data acquired.

**NOTE:**

The total number of data points cannot exceed 4096. This means that the product of the trigger count multiplied by the sweep points cannot exceed 4096; otherwise an error will occur.
Pre-event and Post-event Triggering (Agilent 66312A, 66332A Only)

When a measurement is initiated, the dc source continuously samples either the instantaneous output voltage or current. As shown in figure 3-6, you can move the block of data being read into the acquisition buffer with reference to the acquisition trigger. This permits pre-event or post-event data sampling.

![Figure 3-6. Pre-event and Post-event Triggering](image)

To offset the beginning of the acquisition buffer relative to the acquisition trigger, use:

```
SENSe:SWEep:OFFSet:POInts <offset>
```

The range for the offset is -4096 to 2,000,000,000 points. As shown in the figure, when the offset is negative, the values at the beginning of the data record represent samples taken prior to the trigger. When the value is 0, all of the values are taken after the trigger. Values greater than zero can be used to program a delay time from the receipt of the trigger until the data points that are entered into the buffer are valid. (Delay time = Offset X Sample period)

Pulse Measurement Example (Agilent 66312A, 66332A only)

The following program illustrates how to make a pulse measurement over the GPIB. The measurement function is set to ACDC, which gives the best results for current waveforms that have ac content. The measurement incorporates 100 readings taken at time intervals of 20 microseconds, for a total measurement time of 2 milliseconds. The trigger point for the pulse measurement occurs at 0.1 amperes on the positive slope of the current pulse. The measurement offset is programmed so that 20 measurement points prior to the trigger are also returned as part of the measurement sample.

Because measurement triggers are initiated by the current pulse, a FETCH command is used to return the measurement data. FETCH commands are also used to return the MAXimum, MINimum, HIGH, and LOW values of the measurement.

---

**NOTE:** MEASure commands cannot be used to return data in this example because they always acquire NEW measurement data each time they are used.

The program can be run on any controller operating under Agilent BASIC. To generate output pulses, an electronic load is programmed to generate 3-ampere pulses with a duty cycle of 100 microseconds at 1000 Hz. The power supply address is 705, and the load address is 706. If required, change these parameters in the appropriate statements.
When this program runs, it returns 100 measurement data points as well as the MIN, MAX, HIGH, and LOW data in the following format:

```
                      .030588   .031869   .0344369   .031655   .0320829   .0325109   .0333699   .0340089
        .0320825   .0314499   .0312277   .0314141   .0337949   .0327429   .0318699   .031655
        .0327249   .031013   .0325109   .0335669   3.09751   3.1814   3.14266   3.11667
        3.12187   3.13624   .977281   .0067496   .0045932   .0230171   .031033   .031655
        .0331529   .0350786   .0346546   .0327429   .0312277   .0327429   .0312277   .030799
        .0318699   .0329289   .0303171   .031655   .0318699   .0329389   .0318699   .0322869
        .0320829   .0325109   .0333669   .0340089   .0346546   .0327429   .0312277   .030799
        .0320829   .0307101   .0314499   .0312277   .0314141   .0337949   .0334499   .0333669
        .031441   .0337949   .0303171   .031655   .0318699   .0329389   .0318699   .0293011
        .031441   .0337949   .0327429   .0318699   .031655   .0320829   .0312277   .031655
        MAX CURRENT   3.18312
        MIN CURRENT   3.024912
        HIGH CURRENT   3.1371
        LOW CURRENT   0.0314677
```
Programming the Status Registers

You can use status register programming to determine the operating condition of the dc source at any time. For example, you may program the dc source to generate an interrupt (assert SRQ) when an event such as a current limit occurs. When the interrupt occurs, your program can then act on the event in the appropriate fashion.

Figure 3-7 shows the status register structure of the dc source. Table 3-1 defines the status bits. The Standard Event, Status Byte, and Service Request Enable registers and the Output Queue perform standard GPIB functions as defined in the IEEE 488.2 Standard Digital Interface for Programmable Instrumentation. The Operation Status and Questionable Status registers implement functions that are specific to the dc source.

Power-On Conditions

Refer to the **RST command description in chapter 4 for the power-on conditions of the status registers.

---

**Figure 3-7. DC Source Status Model**
### Table 3-1. Bit Configurations of Status Registers

<table>
<thead>
<tr>
<th>Bit</th>
<th>Signal</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>CAL</td>
<td>Operation Status Group</td>
</tr>
<tr>
<td>5</td>
<td>W(^G)</td>
<td>The dc source is computing new calibration constants</td>
</tr>
<tr>
<td>8</td>
<td>CV</td>
<td>The dc source is waiting for a trigger</td>
</tr>
<tr>
<td>10</td>
<td>CC+</td>
<td>The dc source is in constant current mode</td>
</tr>
<tr>
<td>11</td>
<td>CC−</td>
<td>The dc source is in negative constant current mode</td>
</tr>
<tr>
<td>0</td>
<td>OV</td>
<td>Questionable Status Group</td>
</tr>
<tr>
<td>1</td>
<td>OCP</td>
<td>The overcurrent protection has tripped</td>
</tr>
<tr>
<td>2</td>
<td>FS</td>
<td>The fuse is blown</td>
</tr>
<tr>
<td>4</td>
<td>OT</td>
<td>The overtemperature protection has tripped</td>
</tr>
<tr>
<td>9</td>
<td>RI</td>
<td>The remote inhibit state is active</td>
</tr>
<tr>
<td>10</td>
<td>Unreg</td>
<td>The output is unregulated</td>
</tr>
<tr>
<td>14</td>
<td>MeasOvld</td>
<td>Current measurement exceeded capability of low range</td>
</tr>
<tr>
<td>0</td>
<td>OPC</td>
<td>Standard Event Status Group</td>
</tr>
<tr>
<td>2</td>
<td>QYE</td>
<td>Operation complete</td>
</tr>
<tr>
<td>3</td>
<td>DDE</td>
<td>Query error</td>
</tr>
<tr>
<td>4</td>
<td>EXE</td>
<td>Device-dependent error</td>
</tr>
<tr>
<td>5</td>
<td>CME</td>
<td>Execution error</td>
</tr>
<tr>
<td>7</td>
<td>PON</td>
<td>Command error</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Power-on</td>
</tr>
<tr>
<td>3</td>
<td>QUES</td>
<td>Status Byte and Service Request Enable Registers</td>
</tr>
<tr>
<td>4</td>
<td>MAV</td>
<td>Questionable status summary bit</td>
</tr>
<tr>
<td>5</td>
<td>ESB</td>
<td>Message Available summary bit</td>
</tr>
<tr>
<td>6</td>
<td>MSS</td>
<td>Event Status Summary bit</td>
</tr>
<tr>
<td>7</td>
<td>ROS</td>
<td>Master Status Summary bit</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Request Service bit</td>
</tr>
<tr>
<td>7</td>
<td>OPER</td>
<td>Operation status summary bit</td>
</tr>
</tbody>
</table>

### Operation Status Group

The Operation Status registers record signals that occur during normal operation. As shown below, the group consists of a Condition, PTR/NTR, Event, and Enable register. The outputs of the Operation Status register group are logically-ORed into the OPER(ation) summary bit (7) of the Status Byte register.

<table>
<thead>
<tr>
<th>Register</th>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Condition</td>
<td>STAT:OPER:COND?</td>
<td>A register that holds real-time status of the circuits being monitored. It is a read-only register.</td>
</tr>
<tr>
<td>PTR Filter</td>
<td>STAT:OPER:PTR &lt;n&gt;</td>
<td>A positive transition filter that functions as described under STAT:OPER:NTR</td>
</tr>
<tr>
<td>NTR Filter</td>
<td>STAT:OPER:NTR &lt;n&gt;</td>
<td>A negative transition filter that functions as described under STAT:OPER:NTR</td>
</tr>
<tr>
<td>Event</td>
<td>STAT:OPER:EVEN?</td>
<td>A register that latches any condition that is passed through the PTR or NTR filters. It is a read-only register that is cleared when read.</td>
</tr>
<tr>
<td>Enable</td>
<td>STAT:OPER:ENAB &lt;n&gt;</td>
<td>A register that functions as a mask for enabling specific bits from the Event register. It is a read/write register.</td>
</tr>
</tbody>
</table>
Questionable Status Group

The Questionable Status registers record signals that indicate abnormal operation of the dc source. As shown in figure 3-7, the group consists of the same type of registers as the Status Operation group. The outputs of the Questionable Status group are logically-ORed into the QUESTionable summary bit (3) of the Status Byte register.

<table>
<thead>
<tr>
<th>Register</th>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Condition</td>
<td>STAT:QUES:COND?</td>
<td>A register that holds real-time status of the circuits being monitored. It is a read-only register.</td>
</tr>
<tr>
<td>PTR Filter</td>
<td>STAT:QUES:PTR &lt;n&gt;</td>
<td>A positive transition filter that functions as described under STAT:QUES:NTR</td>
</tr>
<tr>
<td>NTR Filter</td>
<td>STAT:QUES:NTR &lt;n&gt;</td>
<td>A negative transition filter that functions as described under STAT:QUES:NTR</td>
</tr>
<tr>
<td>Event</td>
<td>STAT:QUES:EVEN?</td>
<td>A register that latches any condition that is passed through the PTR or NTR filters. It is a read-only register that is cleared when read.</td>
</tr>
<tr>
<td>Enable</td>
<td>STAT:QUES:ENAB &lt;n&gt;</td>
<td>A register that functions as a mask for enabling specific bits from the Event register. It is a read/write register.</td>
</tr>
</tbody>
</table>

Standard Event Status Group

This group consists of an Event register and an Enable register that are programmed by Common commands. The Standard Event event register latches events relating to instrument communication status (see figure 3-7). It is a read-only register that is cleared when read. The Standard Event enable register functions similarly to the enable registers of the Operation and Questionable status groups.

<table>
<thead>
<tr>
<th>Command</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>*ESK</td>
<td>programs specific bits in the Standard Event enable register.</td>
</tr>
<tr>
<td>*PSC ON</td>
<td>clears the Standard Event enable register at power-on.</td>
</tr>
<tr>
<td>*ESR?</td>
<td>reads and clears the Standard Event event register.</td>
</tr>
</tbody>
</table>

The PON (Power On) Bit

The PON bit in the Standard Event event register is set whenever the dc source is turned on. The most common use for PON is to generate an SRQ at power-on following an unexpected loss of power. To do this, bit 7 of the Standard Event enable register must be set so that a power-on event registers in the ESB (Standard Event Summary Bit), bit 5 of the Service Request Enable register must be set to permit an SRQ to be generated, and *PSC OFF must be sent. The commands to accomplish these conditions are:

*PSC OFF *ESE 128 *SRE 32

Status Byte Register

This register summarizes the information from all other status groups as defined in the IEEE 488.2 Standard Digital Interface for Programmable Instrumentation. The bit configuration is shown in Table 3-1.

<table>
<thead>
<tr>
<th>Command</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>*STB?</td>
<td>reads the data in the register but does not clear it (returns MSS in bit 6)</td>
</tr>
<tr>
<td>serial poll</td>
<td>clears RQS inside the register and returns it in bit position 6 of the response.</td>
</tr>
</tbody>
</table>
The MSS Bit

This is a real-time (unlatched) summary of all Status Byte register bits that are enabled by the Service Request Enable register. MSS is set whenever the dc source has one or more reasons for requesting service. "STB?" reads the MSS in bit position 6 of the response but does not clear any of the bits in the Status Byte register.

The RQS Bit

The RQS bit is a latched version of the MSS bit. Whenever the dc source requests service, it sets the SRQ interrupt line true and latches RQS into bit 6 of the Status Byte register. When the controller does a serial poll, RQS is cleared inside the register and returned in bit position 6 of the response. The remaining bits of the Status Byte register are not disturbed.

The MAV Bit and Output Queue

The Output Queue is a first-in, first-out (FIFO) data register that stores dc source-to-controller messages until the controller reads them. Whenever the queue holds one or more bytes, it sets the MAV bit (4) of the Status Byte register.

Determining the Cause of a Service Interrupt

You can determine the reason for an SRQ by the following actions:

Step 1
Determine which summary bits are active. Use:
"STB?" or serial poll

Step 2
Read the corresponding Event register for each summary bit to determine which events caused the summary bit to be set. Use:
STATUS:QUESTIONable:EVENT?
STATUS:OPERation:EVENT?
ESR?
When an Event register is read, it is cleared. This also clears the corresponding summary bit.

Step 3
Remove the specific condition that caused the event. If this is not possible, the event may be disabled by programming the corresponding bit of the status group Enable register or NTR|PTR filter. A faster way to prevent the interrupt is to disable the service request by programming the appropriate bit of the Service Request Enable register.

Servicing Operation Status and Questionable Status Events

This example assumes you want a service request generated whenever the dc source switches to the CC (constant current) operating mode, or whenever the dc source's overvoltage, overcurrent, or overtemperature circuits have tripped. From figure 3-7, note the required path for a condition at bit 10 (CC) of the Operation Status register to set bit 6 (RQS) of the Status Byte register. Also note the required path for Questionable Status conditions at bits 0, 1, and 4 to generate a service request (RQS) at the Status Byte register. The required register programming is as follows:

Step 1
Program the Operation Status PTR register to allow a positive transition at bit 10 to be latched into the Operation Status Event register, and allow the latched event to be summed into the Operation summary bit. Use:
STATUS:OPERation:PTR 1024;ENABLE 1024

Step 2
Program the Questionable Status PTR register to allow a positive transition at bits 0, 1, or 4 to be latched into the Questionable Status Event register, and allow the latched
3 - Programming the DC Source

event to be summed into the Questionable summary bit. Use:
\[ \text{STATUS:QUESTionable:PTR 19;ENABle 19} \quad (1 + 2 + 16 = 19) \]

Step 3  Program the Service Request Enable register to allow both the Operation and the Questionable summary bits from the Status Byte register to generate RQS. Use:
\[ \text{*SRE 136} \quad (8 + 128 = 136) \]

Step 4  When you service the request, read the event registers to determine which Operation Status and Questionable Status Event register bits are set, and clear the registers for the next event. Use:
\[ \text{STATUS:OPERation:EVENt;QUESTionable:EVENt?} \]

Monitoring Both Phases of a Status Transition

You can monitor a status signal for both its positive and negative transitions. For example, to generate RQS when the dc source either enters the CC+ (constant current) condition or leaves that condition, program the Operational Status PTR/NTR filter as follows:

\[ \text{STATUS:OPERational:PTR 1024;NTR 1024} \]
\[ \text{STATUS:OPERational:ENABLE 1024;*SRE 128} \]

The PTR filter will cause the OPERational summary bit to set RQS when CC+ occurs. When the controller subsequently reads the event register with \text{STATUS:OPERational:EVENt?}, the register is cleared. When CC+ subsequently goes false, the NTR filter causes the OPERational summary bit to again set RQS.

Inhibit/Fault Indicator

The remote inhibit(INH) and discrete fault(FLT) indicators are implemented through the respective INH and FLT connections on the rear panel. Refer to Table 1-2 for the electrical parameters.

Remote Inhibit (RI)

Remote inhibit is an external, chassis-referenced logic signal routed through the rear panel INH connection, which allows an external device to signal a fault. To select an operating modes for the remote inhibit signal, use:
\[ \text{OUTPUT:RI:MODE LATCHing | LIVE | OFF} \]

Discrete Fault Indicator (DFI)

The discrete fault indicator is an open-collector logic signal connected to the rear panel FLT connection, that can be used to signal external devices when a fault condition is detected. To select the internal fault source that drives this signal, use:
\[ \text{OUTPUT:DFI:SOURce QUESTionable | OPERation | ESB | RQS | OFF} \]

To enable or disable the DFI output, use:
\[ \text{OUTPUT:DFI:STATe ON | OFF} \]
Using the Inhibit/Fault Port as a Digital I/O

You can configure the inhibit/fault port to provide a digital input/output to be used with custom digital interface circuits or relay circuits. As shipped from the factory, the port is shipped for inhibit/fault operation. You can change the configuration of the port to operate as a general purpose digital input/output port with the following command:

```
[SOURCE:]DIGItal:FUNCTION RIDFi | DIGio
```

The following table shows the pin assignments of the mating plug when used in RI/DFI mode as well as Digital I/O mode. Refer to Table 1-2 for the electrical characteristics of the port.

<table>
<thead>
<tr>
<th>Pin</th>
<th>FAULT/INHIBIT</th>
<th>DIGITAL I/O</th>
<th>Bit Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>FLT Output</td>
<td>OUT 0</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>FLT Output</td>
<td>OUT 1</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>INH Input</td>
<td>IN/OUT 2</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>INH Common</td>
<td>Common</td>
<td>not programmable</td>
</tr>
</tbody>
</table>

To program the digital I/O port use:

```
[SOURCE:]DIGItal:DATA <data>
```

where the data is an integer from 0 to 7 that sets pins 1 to 3 according to their binary weight. Refer to the DIGItal:DATA command for more information.

DFI Programming Example

The following program illustrates how to program the DFI port so that it goes low when an OCP condition turns off the output of the unit. To clear an overcurrent condition, the cause of the condition must first be removed and then an OUTput:PROTECTION:CLEar command must be sent. Note that the status event register will not clear the DFI port until the register is read.

```
10 :Rev A.00.00
20 ASSIGN @Ps TO 705
30 OUTPUT @Ps:"RST"
40 OUTPUT @Ps:"OUTP ON"
50 OUTPUT @Ps:"VOLT 10;CURR .1"
60 !
70 OUTPUT @Ld:"CURR:PROT:STAT ON"
80 OUTPUT @Ld:"OUTP:DFI:STAT ON"
90 OUTPUT @Ld:"OUTP:DFI:SOUR QUES"
100 OUTPUT @Ld:"STAT:QUES:SNAP 2;PTR 2" ! Unmask bit 2 (OCP) on positive transition
110 !
120 OUTPUT @Ld:"OUTP:PROT:CLE"
130 OUTPUT @Ld:"STAT:QUES:EVENT?" ! Clears the protection circuit
140 ENTER @Ld;EVENT ! Clears the Event register and DFI
150 !
```

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Language Dictionary

Introduction

This section gives the syntax and parameters for all the IEEE 488.2 SCPI commands and the Common commands used by the dc source. It is assumed that you are familiar with the material in “Chapter 2 - Remote Programming”. That chapter explains the terms, symbols, and syntactical structures used here and gives an introduction to programming. You should also be familiar with “Chapter 4 - Front Panel Operation” (in the Operating Guide) in order to understand how the dc source functions.

The programming examples are simple applications of SCPI commands. Because the SCPI syntax remains the same for all programming languages, the examples given for each command are generic.

Syntax Forms  Syntax definitions use the long form, but only short form headers (or “keywords”) appear in the examples. Use the long form to help make your program self-documenting.

Parameters  Most commands require a parameter and all queries will return a parameter. The range for a parameter may vary according to the model of dc source. When this is the case, refer to the Specifications table in the Operating Guide.

Models  If a command only applies to specific models, those models are listed in the <Model> Only entry. If there is no <Model> Only entry, the command applies to all models.

Related Commands  Where appropriate, related commands or queries are included. These are listed because they are either directly related by function, or because reading about them will clarify or enhance your understanding of the original command or query.

Order of Presentation  The dictionary is organized according to the following functions: calibration, measurement, output, status, system, and trigger. Both the subsystem commands and the common commands that follow are arranged in alphabetical order under each function.

Subsystem Commands

Subsystem commands are specific to functions. They can be a single command or a group of commands. The groups are comprised of commands that extend one or more levels below the root.

The subsystem command groups are grouped according to function: Calibration, Measurement, Output, Status, System, and Trigger. Commands under each function are grouped alphabetically. Commands followed by a question mark (?) take only the query form. When commands take both the command and query form, this is noted in the syntax descriptions. Table 4-1 lists all of the subsystem commands in alphabetical order.
### Table 4-1. Subsystem Commands Syntax

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABORT</td>
<td>Resets the trigger system to the Idle state</td>
</tr>
<tr>
<td>CALibrate</td>
<td>Calibrate positive output current and high current measurement range</td>
</tr>
<tr>
<td>CURRent</td>
<td>Calibrate negative output current</td>
</tr>
<tr>
<td>[:SOURce]</td>
<td>Calibrate low current measurement range</td>
</tr>
<tr>
<td>[:DC] [:POSitive]</td>
<td>Calibrate ac current measurement circuits</td>
</tr>
<tr>
<td>[:NEGative]</td>
<td>Input a calibration measurement</td>
</tr>
<tr>
<td>[:DATA &lt;n&gt;</td>
<td>Advance to next calibration step (P1</td>
</tr>
<tr>
<td>[:LEVEL &lt;level&gt;</td>
<td>Set calibration password</td>
</tr>
<tr>
<td>[:PASSword &lt;n&gt;</td>
<td>Save new calibration constants in non-volatile memory</td>
</tr>
<tr>
<td>[:SAVE] [:STATE &lt;bool&gt; [,n&gt;]</td>
<td>Enable or disable calibration mode</td>
</tr>
<tr>
<td>[:VOLTage [:DC]</td>
<td>Calibrate output voltage and voltage readback</td>
</tr>
<tr>
<td>[:PROTec]</td>
<td>Begin voltage protection calibration sequence</td>
</tr>
<tr>
<td>DISPLAY</td>
<td>Enable/disable front panel display</td>
</tr>
<tr>
<td>[:WINDow] [:STATe] &lt;bool&gt;</td>
<td>Set display mode (NORM</td>
</tr>
<tr>
<td>[:MODE &lt;mode&gt;</td>
<td>Sets the text that is displayed</td>
</tr>
<tr>
<td>[:TEXT [:DATA] &lt;string&gt;</td>
<td>Initiate a specific numbered sequence (1</td>
</tr>
<tr>
<td>[:IMMEDIATE]</td>
<td>Initiate a specific named sequence (TRAN</td>
</tr>
<tr>
<td>CONTinuous</td>
<td>Set continuous initialization</td>
</tr>
<tr>
<td>SEQUENCE1, &lt;bool&gt;</td>
<td>Set continuous initialization</td>
</tr>
<tr>
<td>NAME TRANSient, &lt;bool&gt;</td>
<td>Returns the digitized instantaneous current</td>
</tr>
<tr>
<td>MEASure</td>
<td>Returns the digitized instantaneous voltage</td>
</tr>
<tr>
<td>FETCH</td>
<td>Returns dc current</td>
</tr>
<tr>
<td>ARRay</td>
<td>Returns the total rms current (ac+dc)</td>
</tr>
<tr>
<td>CURRent [:DC]?</td>
<td>Returns the HIGH level of a current pulse</td>
</tr>
<tr>
<td>[:SCAlar] CURRent [:DC]?</td>
<td>Returns the LOW level of a current pulse</td>
</tr>
<tr>
<td>[:VOLTage [:DC]?</td>
<td>Returns maximum current</td>
</tr>
<tr>
<td>[:ACDC?</td>
<td>Returns minimum current</td>
</tr>
<tr>
<td>[:HIGH?</td>
<td>Returns voltage</td>
</tr>
<tr>
<td>[:LOW?</td>
<td>Returns the total rms voltage (ac+dc)</td>
</tr>
<tr>
<td>[:NAX?</td>
<td>Returns the HIGH level of a voltage pulse</td>
</tr>
<tr>
<td>[:MIN?</td>
<td>Returns the LOW level of a voltage pulse</td>
</tr>
<tr>
<td>[:VOLTage [:DC]?</td>
<td>Returns maximum voltage</td>
</tr>
<tr>
<td>[:ACDC?</td>
<td>Returns minimum voltage</td>
</tr>
<tr>
<td>[:HIGH?</td>
<td>Returns the LOW level of a voltage pulse</td>
</tr>
<tr>
<td>[:LOW?</td>
<td>Returns minimum voltage</td>
</tr>
<tr>
<td>[:NAX?</td>
<td>Returns the HIGH level of a voltage pulse</td>
</tr>
<tr>
<td>[:MIN?</td>
<td>Returns the LOW level of a voltage pulse</td>
</tr>
</tbody>
</table>
### Table 4-1. Subsystem Commands Syntax (continued)

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>:OUTPut [:STATe] &lt;bool&gt; [:NORelay]</td>
<td>Enables/disables the dc source output</td>
</tr>
<tr>
<td>:DFI [:STATe] &lt;bool&gt;</td>
<td>Enable/disable DFI output</td>
</tr>
<tr>
<td>:SOURce &lt;source&gt;</td>
<td>Selects event source (QUES</td>
</tr>
<tr>
<td>:PON [:STATe] &lt;state&gt;</td>
<td>Set power-on state (*RST</td>
</tr>
<tr>
<td>:PROTECTION [:STATe]</td>
<td>Reset latched protection</td>
</tr>
<tr>
<td>:CLEAR</td>
<td>Delay after programming/before protection</td>
</tr>
<tr>
<td>:RELay [:STATe] &lt;bool&gt;</td>
<td>Opens/closes the external relay contacts</td>
</tr>
<tr>
<td>:POLarity &lt;polarity&gt;</td>
<td>Sets the external relay polarity (NORM</td>
</tr>
<tr>
<td>:RI [:MODE] &lt;mode&gt;</td>
<td>Sets remote inhibit input (LATC</td>
</tr>
<tr>
<td>:SENSe [:CURRent [:DC] [:RANGE] &lt;UPPPer&gt; &lt;n&gt;</td>
<td>Selects the high current measurement range</td>
</tr>
<tr>
<td></td>
<td>[:DETector &lt;detector&gt;]</td>
</tr>
<tr>
<td></td>
<td>[:FUNCtion &lt;function&gt;]</td>
</tr>
<tr>
<td></td>
<td>[:SWEep</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>[:SOURce:]</td>
<td></td>
</tr>
<tr>
<td>[:CURRent [:LEVEL] [:IMMediate]:[AMPLitude] &lt;n&gt;</td>
<td>Sets the output current level</td>
</tr>
<tr>
<td></td>
<td>[:TRIGgered [:AMPLitude] &lt;n&gt;]</td>
</tr>
<tr>
<td></td>
<td>[:PROTection [:STATe] &lt;bool&gt;]</td>
</tr>
<tr>
<td>[:DIGItal</td>
<td>[:DATA [:VALUE] &lt;n&gt;]</td>
</tr>
<tr>
<td></td>
<td>[:FUNCtion &lt;function&gt;]</td>
</tr>
<tr>
<td>[:VOLTage [:LEVEL] [:IMMediate]:[AMPLitude] &lt;n&gt;</td>
<td>Sets the dc voltage level</td>
</tr>
<tr>
<td></td>
<td>[:TRIGgered [:AMPLitude] &lt;n&gt;]</td>
</tr>
<tr>
<td></td>
<td>[:ALC [:BANDwidth?</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Table 4-1. Subsystem Commands Syntax (continued)

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>STATus</strong></td>
<td>Presets all enable and transition registers to power-on</td>
</tr>
<tr>
<td>:PRESet</td>
<td></td>
</tr>
<tr>
<td>:OPERation</td>
<td>Returns the value of the event register</td>
</tr>
<tr>
<td>[:EVENT]?</td>
<td>Returns the value of the condition register</td>
</tr>
<tr>
<td>:CONDition?</td>
<td>Enables specific bits in the Event register</td>
</tr>
<tr>
<td>:ENABLE &lt;n&gt;</td>
<td>Sets the Negative transition filter</td>
</tr>
<tr>
<td>:NTRTransion&lt;n&gt;</td>
<td>Sets the Positive transition filter</td>
</tr>
<tr>
<td>:PTRTransition&lt;n&gt;</td>
<td>Returns the value of the event register</td>
</tr>
<tr>
<td>:QUESTionable</td>
<td>Returns the value of the condition register</td>
</tr>
<tr>
<td>[:EVENT]?</td>
<td>Enables specific bits in the Event register</td>
</tr>
<tr>
<td>:CONDition?</td>
<td>Sets the Negative transition filter</td>
</tr>
<tr>
<td>:ENABLE &lt;n&gt;</td>
<td>Sets the Positive transition filter</td>
</tr>
<tr>
<td>:NTRTransion&lt;n&gt;</td>
<td>Returns the error number and error string</td>
</tr>
<tr>
<td>:PTRTransition&lt;n&gt;</td>
<td>Sets the programming language (SCPI</td>
</tr>
<tr>
<td>SYSTem</td>
<td>Returns the SCPI version number</td>
</tr>
<tr>
<td>:ERRor?</td>
<td>Go to local mode (for RS-232 operation)</td>
</tr>
<tr>
<td>:LANGuage &lt;language&gt;</td>
<td>Go to remote mode (for RS-232 operation)</td>
</tr>
<tr>
<td>:VERSION?</td>
<td>Go to remote with local lockout (for RS-232 operation)</td>
</tr>
<tr>
<td>:LOCal</td>
<td>:REMote</td>
</tr>
<tr>
<td>:RWLock</td>
<td>TRIGger</td>
</tr>
<tr>
<td>:SEQuence2</td>
<td>:ACQuire</td>
</tr>
<tr>
<td>[:IMMEDIATE]</td>
<td></td>
</tr>
<tr>
<td>:COUNt</td>
<td>Sets the number of sweeps per current measurement</td>
</tr>
<tr>
<td>:CURRent &lt;n&gt;</td>
<td>Sets the number of sweeps per voltage measurement</td>
</tr>
<tr>
<td>:VOLTage &lt;n&gt;</td>
<td>QUALifies the trigger when measuring current</td>
</tr>
<tr>
<td>:HYSTATeresis</td>
<td>QUALifies the trigger when measuring voltage</td>
</tr>
<tr>
<td>:CURRent &lt;n&gt;</td>
<td>Sets the trigger level for measuring current</td>
</tr>
<tr>
<td>:VOLTage &lt;n&gt;</td>
<td>Sets the trigger level for measuring voltage</td>
</tr>
<tr>
<td>:LEVEL</td>
<td></td>
</tr>
<tr>
<td>:SLOPe</td>
<td>Sets the triggered current slope (POS</td>
</tr>
<tr>
<td>:CURRent &lt;slope&gt;</td>
<td>Sets the triggered voltage slope (POS</td>
</tr>
<tr>
<td>:VOLTage &lt;slope&gt;</td>
<td>Sets the trigger source (BUS</td>
</tr>
<tr>
<td>:SOURce &lt;source&gt;</td>
<td>[:SEQuence1</td>
</tr>
<tr>
<td>[:IMMEDIATE]</td>
<td></td>
</tr>
<tr>
<td>:SOURce &lt;source&gt;</td>
<td>Sets the trigger source (BUS)</td>
</tr>
<tr>
<td>:SEQuence1</td>
<td></td>
</tr>
<tr>
<td>:DEFIne TRANSient</td>
<td>Sets or queries the SEQ1 name</td>
</tr>
<tr>
<td>:SEQuence2</td>
<td></td>
</tr>
<tr>
<td>:DEFIne ACQUire</td>
<td>Sets or queries the SEQ2 name</td>
</tr>
</tbody>
</table>
Common Commands

Common commands begin with an * and consist of three letters (command) or three letters and a ? (query). They are defined by the IEEE 488.2 standard to perform common interface functions. Common commands and queries are categorized under System, Status, or Trigger functions and are listed at the end of each group. The dc source responds to the following commands:

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>*CLS</td>
<td>Clear status</td>
</tr>
<tr>
<td>*ESE &lt;n&gt;</td>
<td>Standard event status enable</td>
</tr>
<tr>
<td>*ESE?</td>
<td>Return standard event status enable</td>
</tr>
<tr>
<td>*ESR?</td>
<td>Return event status register</td>
</tr>
<tr>
<td>*IDN?</td>
<td>Return instrument identification</td>
</tr>
<tr>
<td>*OPC</td>
<td>Enable &quot;operation complete&quot; bit in ESR</td>
</tr>
<tr>
<td>*OPC?</td>
<td>Return a &quot;1&quot; when operation complete</td>
</tr>
<tr>
<td>*OPT?</td>
<td>Return option number</td>
</tr>
<tr>
<td>*PSC &lt;bool&gt;</td>
<td>Power-on status clear state set/reset</td>
</tr>
<tr>
<td>*PSC?</td>
<td>Return power-on status clear state</td>
</tr>
<tr>
<td>*RCL &lt;n&gt;</td>
<td>Recall instrument state</td>
</tr>
<tr>
<td>*RST</td>
<td>Reset</td>
</tr>
<tr>
<td>*SAV &lt;n&gt;</td>
<td>Save instrument state</td>
</tr>
<tr>
<td>*SRE &lt;n&gt;</td>
<td>Set service request enable register</td>
</tr>
<tr>
<td>*SRE?</td>
<td>Return service request enable register</td>
</tr>
<tr>
<td>*STB?</td>
<td>Return status byte</td>
</tr>
<tr>
<td>*TRG</td>
<td>Trigger</td>
</tr>
<tr>
<td>*TST?</td>
<td>Perform selftest, then return result</td>
</tr>
<tr>
<td>*WAI</td>
<td>Hold off bus until all device commands done</td>
</tr>
</tbody>
</table>

Programming Parameters

The following table lists the output programming parameters for each model.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>[SOUR:][CURR][:LEV][:IMM] MAX and [SOUR:][CURR][:LEV]:TRIG MAX *RST Current Value</td>
<td>2.0475 5.1188 10.237 5.1188 2.0475 1.0238</td>
</tr>
<tr>
<td>[SOUR:][VOLT][:LEV][:IMM]MAX and [SOUR:][VOLT][:LEV]:TRIG MAX *RST Voltage Value</td>
<td>20.475 20.475 8.190 20.475 51.188 102.38</td>
</tr>
<tr>
<td>[SOUR:][VOLT][:PRCT][:LEV] MAX *RST OVP Value</td>
<td>22 22 12 22 55 110</td>
</tr>
<tr>
<td>OUTP:PROT:DEL MAX *RST Protection Delay Value</td>
<td>2,147,483.647 seconds for all models</td>
</tr>
<tr>
<td>SENS:CURR:RANG</td>
<td>Low range = 0 – 20 mA for all models</td>
</tr>
<tr>
<td>*RST Current Range</td>
<td>High Range = 20 mA – MAX for all models</td>
</tr>
</tbody>
</table>
Calibration Commands

Calibration commands let you:
- Enable and disable the calibration mode
- Change the calibration password
- Calibrate the current and voltage programming and measurement, and store new calibration constants in nonvolatile memory.

NOTE: If calibration mode has not been enabled with CALibrate:STATe, programming the calibration commands will generate an error.

CALibrate:CURRent

This command initiates the calibration of the positive dc output current as well as the high-range current measurement circuit.

Command Syntax CALibrate:CURRent[;SOURce][;DC][;POSitive]
Parameters None
Examples CAL:CURR:CAL, CURR:SOUR:DC:POS
Related Commands CAL:CURR:NEG

CALibrate:CURRent:NEGative

This command initiates the calibration of the negative dc output current.

Command Syntax CALibrate:CURRent[;SOURce][;DC]:NEGative
Parameters None
Related Commands CAL:CURR

CALibrate:CURRent:MEASure:LOWRange

This command initiates the calibration of the low-range current measurement circuit.

Command Syntax CALibrate:CURRent:MEASure[;DC]:LOWRange
Parameters None
Examples CAL:CURR:MEAS
Related Commands CAL:CURR

CALibrate:CURRent:MEASure:AC

Agilent 66312A, 66332A Only

This command initiates the calibration of the high bandwidth (ac) measurement circuit.

Command Syntax CALibrate:CURRent:MEASure:AC
Parameters None
Examples CAL:CURR:MEAS:AC
CALibrate:DATA

This command enters a calibration value that you obtain by reading an external meter. You must first select a calibration level (with CALibrate:LEVel) for the value being entered.

Command Syntax: CALibrate:DATA<NRf>
Parameters: <external reading>
Unit: A (amperes)
Examples: CAL:DATA 3222.3 MA    CAL:DATA 5.000
Related Commands: CAL:STAT    CAL:LEV

CALibrate:LEVel

This command selects the next point in the calibration sequence.

P1:  the first calibration point
P2:  the second calibration point

Command Syntax: CALibrate:LEVel <point>
Parameters: P1 | P2
Examples: CAL:LEV P2

CALibrate:PASSword

This command lets you change the calibration password. A new password is automatically stored in nonvolatile memory and does not have to be stored with CALibrate:SAVE.

If the password is set to 0, password protection is removed and the ability to enter the calibration mode is unrestricted.

Command Syntax: CALibrate:PASScode<NRf>
Parameters: <model number> (default)
Examples: CAL:PASS 6812    CAL:PASS 6.1994
Related Commands: CAL:SAV

CALibrate:SAVE

This command saves any new calibration constants after a calibration procedure has been completed in nonvolatile memory. If CALibrate:STATe OFF is programmed without a CALibrate:SAVE, the previous calibration constants are restored.

Command Syntax: CALibrate:SAVE
Parameters: None
Examples: CAL:SAVE
Related Commands: CAL:PASS    CAL:STAT
CALibrate:STATe

This command enables and disables calibration mode. The calibration mode must be enabled before the will accept any other calibration commands.

The first parameter specifies the enabled or disabled state. The second parameter is the password. It is required if the calibration mode is being enabled and the existing password is not 0. If the password is not entered or is incorrect, an error is generated and the calibration mode remains disabled. The query statement returns only the state, not the password.

NOTE: Whenever the calibration state is changed from enabled to disabled, any new calibration constants are lost unless they have been stored with CALibrate:SAVE.

<table>
<thead>
<tr>
<th>Command Syntax</th>
<th>CALibrate:STATe&lt;bool&gt;[,&lt;NR1&gt;]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameters</td>
<td>0</td>
</tr>
<tr>
<td>*RST Value</td>
<td>OFF</td>
</tr>
<tr>
<td>Examples</td>
<td>CAL:STAT 1,6812 CAL:STAT OFF</td>
</tr>
<tr>
<td>Query Syntax</td>
<td>CALibrate:STATe?</td>
</tr>
<tr>
<td>Returned Parameters</td>
<td>&lt;NR1&gt;</td>
</tr>
<tr>
<td>Related Commands</td>
<td>CAL:PASS CAL:SAVE *RST</td>
</tr>
</tbody>
</table>

CALibrate:VOLTage

This command initiates the calibration of the output voltage and the voltage readback circuit.

<table>
<thead>
<tr>
<th>Command Syntax</th>
<th>CALibrate:VOLTage[:DC]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameters</td>
<td>None</td>
</tr>
<tr>
<td>Examples</td>
<td>CAL:VOLT CAL:VOLT:DC</td>
</tr>
</tbody>
</table>

CALibrate:VOLTage:PROTection

This command can calibrates the overvoltage protection (OV) circuit. The dc source automatically performs the calibration. CALibrate:VOLTage:PROTection is a sequential command that takes several seconds to complete.

<table>
<thead>
<tr>
<th>Command Syntax</th>
<th>CALibrate:VOLTage:PROTection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameters</td>
<td>None</td>
</tr>
<tr>
<td>Examples</td>
<td>CAL:VOLT:PROT</td>
</tr>
</tbody>
</table>
Measurement Commands

Measurement commands consist of measure and sense commands.

**Measure commands** measure the output voltage or current. Measurements are performed by digitizing the instantaneous output voltage or current for a defined number of samples and sample interval, storing the results in a buffer, and calculating the measured result. Two types of measurement commands are available: MEASure and FETCH. MEASure triggers the acquisition of new data before returning the reading; FETCH returns a reading computed from previously acquired data. If you take a voltage measurement, you can fetch only voltage data.

- Use MEASure when the measurement does not need to be synchronized with any other event.
- Use FETCH when it is important that the measurement be synchronized with either a trigger or with a particular part of the output waveform.

**Sense commands** control the current measurement range, the bandwidth detector of the , and the data acquisition sequence.

**MEASure:ARRRay:CURRent?**
**FETCH:ARRRay:CURRent?**

**Agilent 66312A, 66332A Only**

These queries return an array containing the instantaneous output current in amperes. The output voltage or output current are digitized whenever a measure command is given or whenever an acquire trigger occurs. The time interval is set by SENSE:SWEep:TINTerval. The position of the trigger relative to the beginning of the data buffer is determined by SENSE:SWEep:OFFSet. The number of points returned is set by SENSE:SWEep:POINts.

**Query Syntax**  
MEASure:ARRRay:CURRent[:DC]?  
FETCH:ARRRay:CURRent[:DC]?

**Parameters**  
None

**Examples**  
MEAS:ARR:CURR?  
FETCH:ARR:CURR?

**Returned Parameters**  
<NR3>

**Related Commands**  
SENS:SWE:TINT  
SENS:SWE:OFFS  
SENS:SWE:POIN

**MEASure:ARRRay:VOLTage?**
**FETCH:ARRRay:VOLTage?**

**Agilent 66312A, 66332A Only**

These queries return an array containing the instantaneous output voltage in volts. The output voltage or output current are digitized whenever a measure command is given or whenever an acquire trigger occurs. The time interval is set by SENSE:SWEep:TINTerval. The position of the trigger relative to the beginning of the data buffer is determined by SENSE:SWEep:OFFSet. The number of points returned is set by SENSE:SWEep:POINts.

**Query Syntax**  
MEASure:ARRRay:VOLTage[:DC]?

**Parameters**  
None

**Examples**  
MEAS:ARR:VOLT?

**Returned Parameters**  
<NR3>

**Related Commands**  
SENS:SWE:TINT  
SENS:SWE:OFFS  
SENS:SWE:POIN
4 - Language Dictionary

MEASure:CURRent?
FETCh:CURRent?

FETCh:CURRent? applies to Agilent 66312A, 66332A Only

These queries return the dc output current.

<table>
<thead>
<tr>
<th>Query Syntax</th>
<th>Parameters</th>
<th>Examples</th>
<th>Returned Parameters</th>
<th>Related Commands</th>
</tr>
</thead>
<tbody>
<tr>
<td>MEASure:[SCALar]:CURRent:DC?</td>
<td>None</td>
<td>None</td>
<td>MEAS:CURR?</td>
<td>MEAS:CURR:DC?</td>
</tr>
<tr>
<td>FETCh:[SCALar]:CURRent:DC?</td>
<td></td>
<td></td>
<td>&lt;NR3&gt;</td>
<td></td>
</tr>
<tr>
<td>MEAS:VOLT?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

MEASure:CURRent:ACDC?
FETCh:CURRent:ACDC?

Agilent 66312A, 66332A Only

These queries return the ac+dc rms output current.

<table>
<thead>
<tr>
<th>Query Syntax</th>
<th>Parameters</th>
<th>Examples</th>
<th>Returned Parameters</th>
<th>Related Commands</th>
</tr>
</thead>
<tbody>
<tr>
<td>MEASure:[SCALar]:CURRent:ACDC?</td>
<td>None</td>
<td>None</td>
<td>MEAS:CURR:ACDC?</td>
<td>FETC:CURR:ACDC?</td>
</tr>
<tr>
<td>FETCh:[SCALar]:CURRent:ACDC?</td>
<td></td>
<td></td>
<td>&lt;NR3&gt;</td>
<td></td>
</tr>
<tr>
<td>MEAS:VOLT:ACDC?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

MEASure:CURRent:HIGH?
FETCh:CURRent:HIGH?

Agilent 66312A, 66332A Only

These queries return the High level current of a current pulse waveform. The instrument first measures the minimum and maximum data points of the pulse waveform. It then generates a histogram of the pulse waveform using 1024 bins between the maximum and minimum data points. The bin containing the most data points above the 50% point is the high bin. The average of all the data points in the high bin is returned as the High level. If no high bin contains more than 1.25% of the total number of acquired points, then the maximum value is returned by these queries.

<table>
<thead>
<tr>
<th>Query Syntax</th>
<th>Parameters</th>
<th>Examples</th>
<th>Returned Parameters</th>
<th>Related Commands</th>
</tr>
</thead>
<tbody>
<tr>
<td>MEASure:[SCALar]:CURRent:HIGH?</td>
<td>None</td>
<td>None</td>
<td>MEAS:CURR:HIGH?</td>
<td>FETC:CURR:HIGH?</td>
</tr>
<tr>
<td>FETCh:[SCALar]:CURRent:HIGH?</td>
<td></td>
<td></td>
<td>&lt;NR3&gt;</td>
<td></td>
</tr>
<tr>
<td>MEAS:CURR:LOW?</td>
<td></td>
<td></td>
<td>CALC:REF:HIGH</td>
<td></td>
</tr>
</tbody>
</table>
MEASure:CURRent:LOW?
FETCH:CURRent:LOW?
Agilent 66312A, 66332A Only

These queries return the Low level current of a current pulse waveform. The instrument first measures the minimum and maximum data points of the pulse waveform. It then generates a histogram of the pulse waveform using 1024 bins between the maximum and minimum data points. The bin containing the most data points below the 50% point is the low bin. The average of all the data points in the low bin is returned as the Low level. If no low bin contains more than 1.25% of the total number of acquired points, then the minimum value is returned by these queries.

**Query Syntax**
MEASure[:SCAlar]:CURRent:LOW?
FETCH[:SCAlar]:CURRent:LOW?

**Parameters**
None

**Examples**
MEAS:CURR:LOW?
FETCH:CURR:LOW?

**Returned Parameters**
<NR3>

**Related Commands**
MEAS:CURR:HIGH?
CALC:REF:LOW

MEASure:CURRent:MAXimum?
FETCH:CURRent:MAXimum?
Agilent 66312A, 66332A Only

These queries return the maximum output current reading from the measurement sample.

**Query Syntax**
MEASure[:SCAlar]:CURRent:MAXimum?
FETCH[:SCAlar]:CURRent:MAXimum?

**Parameters**
None

**Examples**
MEAS:CURR:MAX?
FETCH:CURR:MAX?

**Returned Parameters**
<NR3>

**Related Commands**
MEAS:CURR:MIN?

MEASure:CURRent:MINimum?
FETCH:CURRent:MINimum?
Agilent 66312A, 66332A Only

These queries return the minimum output current reading from the measurement sample.

**Query Syntax**
MEASure[:SCAlar]:CURRent:MINimum?
FETCH[:SCAlar]:CURRent:MINimum?

**Parameters**
None

**Examples**
MEAS:CURR:MIN?
FETCH:CURR:MIN?

**Returned Parameters**
<NR3>

**Related Commands**
MEAS:CURR:MAX?
MEASure:VOLTage?
FETCh:VOLTage?

FETCh:VOLTage? applies to Agilent 66312A, 66332A Only

These queries return the dc output voltage.

| Query Syntax       | MEASure[:SCALar]:VOLTage[:DC]?
|--------------------| MEASure[:SCALar]:VOLTage[:DC]?
| Parameters         | None
| Examples           | MEAS:VOLT?     FETC:VOLT:DC?
| Returned Parameters | <NR3>
| Related Commands   | MEAS:CURR?

MEASure:VOLTage:ACDC?
FETCh:VOLTage:ACDC?

Agilent 66312A, 66332A Only

These queries return the ac+dc rms output voltage.

| Query Syntax       | MEASure[:SCALar]:VOLTage:ACDC?
|--------------------| FETCh[:SCALar]:VOLTage:ACDC?
| Parameters         | None
| Returned Parameters | <NR3>
| Related Commands   | MEAS:CURR:ACDC?

MEASure:VOLTage:HIGH?
FETCh:VOLTage:HIGH?

Agilent 66312A, 66332A Only

These queries return the High level voltage of a voltage pulse waveform. The instrument first measures the minimum and maximum data points of the pulse waveform. It then generates a histogram of the pulse waveform using 1024 bins between the maximum and minimum data points. The bin containing the most data points above the 50% point is the high bin. The average of all the data points in the high bin is returned as the High level. If no high bin contains more than 1.25% of the total number of acquired points, then the maximum value is returned by these queries.

| Query Syntax       | MEASure[:SCALar]:VOLTage:HIGH?
|--------------------| FETCh[:SCALar]:VOLTage:HIGH?
| Parameters         | None
| Examples           | MEAS:VOLT:HIGH?     FETC:VOLT:HIGH?
| Returned Parameters | <NR3>
| Related Commands   | MEAS:VOLT:LOW?     CALC:REF:HIGH
MEASure:VOLTage:LOW?
FETCh:VOLTage:LOW?

Agilent 66312A, 66332A Only

These queries return the Low level voltage of a voltage pulse waveform. The instrument first measures the minimum and maximum data points of the pulse waveform. It then generates a histogram of the pulse waveform using 1024 bins between the maximum and minimum data points. The bin containing the most data points below the 50% point is the low bin. The average of all the data points in the low bin is returned as the Low level. If no low bin contains more than 1.25% of the total number of acquired points, then the minimum value is returned by these queries.

Query Syntax  MEASure[SCALar]:VOLTage:LOW?
                FETCh:[SCALar]:VOLTage:LOW?
Parameters     None
Examples       MEAS:VOLT:LOW?    FETC:VOLT:LOW?
Returned Parameters  <NR3>
Related Commands  MEAS:VOLT:HIGH?  CALC:REF:LOW

MEASure:VOLTage:MAXimum?
FETCh:VOLTage:MAXimum?

Agilent 66312A, 66332A Only

These queries return the maximum output voltage reading from the measurement sample.

Query Syntax  MEASure[SCALar]:VOLTage:MAXimum?
                FETCh:[SCALar]:VOLTage:MAXimum?
Parameters     None
Examples       MEAS:VOLT:MAX?    FETC:VOLT:MAX?
Returned Parameters  <NR3>
Related Commands  MEAS:VOLT:MIN?

MEASure:VOLTage:MINimum?
FETCh:VOLTage:MINimum?

Agilent 66312A, 66332A Only

These queries return the minimum output voltage reading from the measurement sample.

Query Syntax  MEASure[SCALar]:VOLTage:MINimum?
                FETCh:[SCALar]:VOLTage:MINimum?
Parameters     None
Examples       MEAS:VOLT:MIN?    FETC:VOLT:MIN?
Returned Parameters  <NR3>
Related Commands  MEAS:VOLT:MAX?
**SENSe:CURRent:RANGe**

This command selects the dc current measurement range. All models have two current measurement ranges:

**High Range:** 0 through MAX (see Table 4-3)
**Low Range:** 0 through 0.02 A (all models)

The High range covers the full current measurement capability of the instrument. The Low range measures currents up to a maximum of 20 mA. This increases the low current measurement sensitivity for greater accuracy and resolution. The value that you program with SENSE:CURRent:RANGe must be the maximum current that you expect to measure. The instrument will select the range that gives the best resolution. The crossover value is 20 mA. When queried, the returned value is the maximum current that can be measured on the range that is presently set.

<table>
<thead>
<tr>
<th>Command Syntax</th>
<th>SENSE:CURRent[:DC]:RANGe[:UPPPer]&lt;NRf+&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameters</td>
<td>0 through MAX (see table 4-3)</td>
</tr>
<tr>
<td>Unit</td>
<td>A (amperes)</td>
</tr>
<tr>
<td>*RST Value</td>
<td>MAX (high range)</td>
</tr>
<tr>
<td>Examples</td>
<td>SENS:CURR:RANG 4 . 0</td>
</tr>
<tr>
<td>Query Syntax</td>
<td>SENSE:CURRent:RANGe?</td>
</tr>
<tr>
<td>Returned Parameters</td>
<td>&lt;NR3&gt;</td>
</tr>
</tbody>
</table>

**SENSe:CURRent:DETector**

*Agilent 66312A, 66332A Only*

This command lets you select the type of detector used for output current measurements. Two choices for detecting current measurements are available:

**ACDC** This is the preferred choice for all dynamic current measurements. When ACDC is selected, the measured output current includes the current that flows in the instrument’s output capacitor. It is especially important to use ACDC detection when measuring pulse or other waveforms with frequency contents greater than several kilohertz.

**DC** Select DC only if you are making dc current measurements and you require a dc measurement offset accuracy better than 2mA on the High current measurement range. When DC is selected, the component of output current that is supplied by the instrument’s output filter is not sensed. Note that this selection gives inaccurate results on current waveforms with frequency contents greater than several kilohertz.

**NOTE:** This command only applies to the High current measurement range.

<table>
<thead>
<tr>
<th>Command Syntax</th>
<th>SENE:CURRent:DETector&lt;detector&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameters</td>
<td>ACDC or DC</td>
</tr>
<tr>
<td>*RST Value</td>
<td>ACDC</td>
</tr>
<tr>
<td>Examples</td>
<td>SENS:CURR:DETe ACDC</td>
</tr>
<tr>
<td>Query Syntax</td>
<td>SENSE:CURRent:DETect?</td>
</tr>
<tr>
<td>Returned Parameters</td>
<td>&lt;CRD&gt;</td>
</tr>
</tbody>
</table>
**SENSe:FUNCTION**

Agilent 66312A, 66332A Only

This command configures the measurement sensor to measure either voltage or current when an acquire trigger is used. The query returns the function setting, either VOLT or CURR.

**Command Syntax**  
SENSe:FUNCTION <function>

**Parameters**  
"VOLTage" | "CURRent"

**Examples**  
SENSe:FUNCTION "VOLT"

**Query Syntax**  
SENSe:FUNCTION?

**Returned Parameters**  
<SRD>

**SENSe:SWEep:OFFSet:POINts**

Agilent 66312A, 66332A Only

This command defines the offset in a data sweep when an acquire trigger is used. Negative values represent data samples taken prior to the trigger.

**Command Syntax**  
SENSe:SWEep:OFFSet:POINts <NRI+>

**Parameters**  
-4095 through 2,000,000,000

**RST Value**  
0

**Examples**  
SENSe:SWEep:OFFSet:POINts -2047

**Query Syntax**  
SENSe:SWEep:OFFSet:POINts?

**Returned Parameters**  
<NRI3>

**Related Commands**  
SENS:SWEP:TINT  SENSe:SWEP:POIN MEAS:ARR

**SENSe:SWEep:POINts**

This command defines the number of points in a data sweep.

**Command Syntax**  
SENSe:SWEep:POINts <NRI+>

**Parameters**  
0 through 4096

**RST Value**  
2048

**Examples**  
SENSe:SWEep:POINts 1024

**Query Syntax**  
SENSe:SWEep:POINts?

**Returned Parameters**  
<NRI3>

**Related Commands**  
SENS:SWEP:TINT  SENSe:SWEP:OFFS MEAS:ARR

**SENSe:SWEep:TINTerval**

This command defines the time period between samples.

**Command Syntax**  
SENSe:SWEep:TINTerval <NRI+>

**Parameters**  
15.6 microseconds through 31200 seconds

**RST Value**  
15.6 microseconds

**Examples**  
SENS:SWEP:TINT 31.2E-6

**Query Syntax**  
SENSe:SWEep:TINTerval?

**Returned Parameters**  
<NRI3>

**Related Commands**  
SENS:SWEP:POIN  SENSe:SWEP:OFFS MEAS:ARR
SENSe:WINDow

This command sets the window function that is used in output measurement calculations. The following functions can be selected:

**HANNing**
A signal conditioning window that reduces errors in dc and rms measurement calculations in the presence of periodic signals such as line ripple. It also reduces jitter when measuring successive pulse waveforms. The Hanning window multiplies each point in the measurement sample by the function cos^2.
Do not use the Hanning window when measuring single-shot pulse waveforms.

**RECTangular**
A window that returns measurement calculations without any signal conditioning. This window may be used for pulse measurements where the exact period of the pulse waveform is known and the measurement interval can be set accordingly using the SENS:WEEp:TINTerval command.

---

**NOTE:** Neither window function alters the instantaneous voltage or current data returned in the measurement array.

---

**Command Syntax**
SENSe:WINDow[:TYPE] <type>

**Parameters**
HANNing | RECTangular

**‘RST Value**
HANNing

**Examples**
SENSe:WIND RECT

**Query Syntax**
SENSe:WINDow[:TYPE]?

**Returned Parameters**
<CRD>
Output Commands

Output commands consist of output and source commands.

**Output commands** control the output and digital port functions. They also control the output relay on units with Relay Option 760.

**Source commands** program the actual voltage, current, and digital port output.

**OUTPut**

This command enables or disables the dc source output. The state of a disabled output is a condition of zero output voltage and a model-dependent minimum source current (see *RST). Unless the NORelay command is programmed, the OUTput command also controls the output relay on Agilent models 66332A, 6631B, 6632B, 6633B, and 6634B with Relay Option 760. If the NORelay command is sent, the output relay state does NOT change.

<table>
<thead>
<tr>
<th>Command Syntax</th>
<th>OUTPut[:STATE]&lt;bool&gt; [NORelay]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameters</td>
<td>0</td>
</tr>
<tr>
<td>*RST Value</td>
<td>0</td>
</tr>
<tr>
<td>Examples</td>
<td>OUTP 1</td>
</tr>
</tbody>
</table>
| Query Syntax   | OUTPut[:STATE]?
| Returned Parameters | <NR1>0 or 1 |
| Related Commands | *RST | *RCL | *SAV |

**OUTPut:DFI**

This command enables or disables the discrete fault indicator (DFI) output from the dc source.

<table>
<thead>
<tr>
<th>Command Syntax</th>
<th>OUTPut:DFI[:STATE]&lt;bool&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameters</td>
<td>0</td>
</tr>
<tr>
<td>*RST Value</td>
<td>OFF</td>
</tr>
<tr>
<td>Examples</td>
<td>OUTP:DFI 1</td>
</tr>
</tbody>
</table>
| Query Syntax   | OUTPut:DFI[:STATE]?
| Returned Parameters | 0 | 1 |
| Related Commands | OUTP:DFI:SOUR |

**OUTPut:DFI:SCURce**

This command selects the source for discrete fault indicator (DFI) events. The choices are:

- QUESTionable: selects the Questionable event summary bit (bit 3 of the Status Byte Register)
- OPERation: selects the Operation Event summary bit (bit 7 of the Status Byte Register)
- ESB: selects the Standard Event summary bit (bit 5 of the Status Byte Register)
- RQS: selects the Request Service bit (bit 6 of the Status Byte Register)
- OFF: selects no DFI source

<table>
<thead>
<tr>
<th>Command Syntax</th>
<th>OUTPut:DFI:SOUR&lt;source&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameters</td>
<td>QUES</td>
</tr>
<tr>
<td>*RST Value</td>
<td>OFF</td>
</tr>
<tr>
<td>Examples</td>
<td>OUTP:DFI:SOUR OPER</td>
</tr>
<tr>
<td>Query Syntax</td>
<td>OUTPut:DFI:SOUR?</td>
</tr>
<tr>
<td>Returned Parameters</td>
<td>&lt;CRD&gt;</td>
</tr>
<tr>
<td>Related Commands</td>
<td>OUTP:DFI</td>
</tr>
</tbody>
</table>
**OUTPut:PON:STATe**

This command selects the power-on state of the dc source. This information is saved in non-volatile memory. The following states can be selected:

- **RST**: Sets the power-on state to *RST. Refer to the *RST command as described in this chapter for more information.
- **RCL0**: Sets the power-on state to *RCL 0. Refer to the *RCL command as described in this chapter for more information.

<table>
<thead>
<tr>
<th>Command Syntax</th>
<th>OUTPut:PON:STATe &lt;state&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameters</td>
<td>RST</td>
</tr>
<tr>
<td>Examples</td>
<td>OUTPut:PON:STAT RST</td>
</tr>
<tr>
<td>Query Syntax</td>
<td>OUTPut:PON:STATe?</td>
</tr>
<tr>
<td>Returned Parameters</td>
<td>&lt;CRD&gt;</td>
</tr>
<tr>
<td>Related Commands</td>
<td>*RST *RCL</td>
</tr>
</tbody>
</table>

**OUTPut:PROTection:CLEar**

This command clears the latch that disables the output when an OverVoltage, OverCurrent, OverTemperature, Remote Inhibit, or Fuse Status condition is detected. All conditions that generate the fault must be removed before the latch can be cleared. The output is then restored to the state it was in before the fault condition occurred.

<table>
<thead>
<tr>
<th>Command Syntax</th>
<th>OUTPut:PROTection:CLEar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameters</td>
<td>None</td>
</tr>
<tr>
<td>Examples</td>
<td>OUTPut:PROT:CLE</td>
</tr>
<tr>
<td>Related Commands</td>
<td>OUTPut:PROT:DEL *RCL *SAV</td>
</tr>
</tbody>
</table>

**OUTPut:PROTection:DELay**

This command sets the time between the programming of an output change that produces a constant current condition (CC) and the recording of that condition by the Operation Status Condition register. The delay prevents the momentary changes in status that can occur during reprogramming from being registered as events by the status subsystem. Since the constant current condition is used to trigger overcurrent protection (OCP), this command also delays OCP. Overvoltage protection is not affected by this command.

<table>
<thead>
<tr>
<th>Command Syntax</th>
<th>OUTPut:PROTection:DELay &lt;NR3+&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameters</td>
<td>0 to 2,147,483,647</td>
</tr>
<tr>
<td>Unit</td>
<td>seconds</td>
</tr>
<tr>
<td>*RST Value</td>
<td>0.08 (Normal)</td>
</tr>
<tr>
<td>Examples</td>
<td>OUTPut:PROTection:DELAY 75E-1</td>
</tr>
<tr>
<td>Query Syntax</td>
<td>OUTPut:PROTection:DElay?</td>
</tr>
<tr>
<td>Returned Parameters</td>
<td>&lt;NR3&gt;</td>
</tr>
<tr>
<td>Related Commands</td>
<td>OUTPut:PROT:CLE *RCL *SAV</td>
</tr>
</tbody>
</table>
OUTPut:RELay


This command is only valid for units with Relay Option 760, otherwise an error will occur. Programming ON closes the output relay contacts; programming OFF opens them. The relay is controlled independently of the output state. If the dc source is supplying power to a load, that power will appear at the relay contacts during switching.

Command Syntax: OUTPut:RELay[:STATe]<bool>
Parameters:
  0 | 1 | OFF ON
  *RST Value: 0
Examples:
  OUTP:REL 1  OUTP:REL OFF
Query Syntax: OUTPut:RELay?
Returned Parameters:
  0 | 1
Related Commands: OUTP *RCL *SAV

OUTPut:RELay:POLarity


This command is only valid for units with Relay Option 760, otherwise an error will occur. Programming NORMAL causes the output relay polarity to be the same as the dc source output. Programming REVerse causes the relay output polarity to be opposite to that of the dc source output. If OUTPut = ON when either command is sent, the output voltage is set to 0 during the time that the relays are changing polarity.

Command Syntax: OUTPut:RELay:POLarity<CRD>
Parameters:
  NORMAL | REVerse
  *RST Value: NORMAL
Examples:
  OUTP:REL:POL NORM
Query Syntax: OUTPut:RELay:POLarity?
Returned Parameters:
  NORM | REV
Related Commands: OUTP *RCL *SAV

OUTPut:RI:MODE

This command selects the mode of operation of the Remote Inhibit protection. The Ri mode is stored in non-volatile memory. The following modes can be selected:

LATChing causes a TTL low signal on the INH input to disable the output. The only way to clear the latch is by sending an OUTPut:PROTection:CLEAR command while the INH input is false.
LIVE allows the INH input to disable the output in a non-latching manner. In other words, the output follows the state of the INH input. When INH is low true, the output is disabled. When INH is high the output is not affected.
OFF the INH input is disabled.

Command Syntax: OUTPut:RI:MODE <mode>
Parameters:
  LATChing | LIVE | OFF
Examples:
  OUTP:RI:MODE LIVE
Query Syntax: OUTPut:RI:MODE?
Returned Parameters: <CRD>
Related Commands: OUTP:PROT:CLE
4 - Language Dictionary

[SOURce:]CURRent

This command sets the immediate current level of the dc source. The immediate level is the current programmed for the output terminals.

Command Syntax  [SOURce]:CURRent[:LEVel][:IMMediate][:AMPLitude]<NR3->
Parameters see Table 4-3
Default Suffix A (amperes)
*RST Value 10% of MAX
Examples CURR 200 MA
Query Syntax [SOURce]:CURRent[:LEVel][:IMMediate][:AMPLitude]?
Returned Parameters <NR3>
Related Commands CURR:TRIG

[SOURce:]CURRent:TRIGger

This command sets the pending triggered current level of the dc source. The pending triggered level is a stored current value that is transferred to the output terminals when a trigger occurs. In order for a trigger to occur, the trigger subsystem must be initiated (see the INITiate command in the trigger subsystem).

Command Syntax  [SOURce]:CURRent[:LEVel]:TRIGgered[:AMPLitude]<NR3->
Parameters see Table 4-3
Default Suffix A (amperes)
*RST Value 10% of MAX
Examples CURR:TRIG 1
Query Syntax [SOURce]:CURRent[:LEVel]:TRIGgered[:AMPLitude]?
Returned Parameters <NR3>
Related Commands CURR

[SOURce:]CURRent:PROTection:STATe

This command enables or disables the overcurrent protection (OCP) function. If the dc source overcurrent protection function is enabled and the dc source goes into constant current operation, then the output is disabled and the Questionable Condition status register OC bit is set (see chapter 3 under Programming the Status Registers). Note that the [SOURce:]CURRent command sets the current limit, which determines when the dc source goes into constant current operation. An overcurrent condition can be cleared with the OUTPut:PROTection:CLEAR command after the cause of the condition is removed.

NOTE: Use OUTP:PROT:DEL to prevent momentary current limit conditions caused by programmed output changes from tripping the overcurrent protection.

Command Syntax  [SOURce]:CURRent:PROTection:STATe <bool>
Parameters 0 | 1 | OFF | ON
*RST Value OFF
Examples CURR:PROT:STAT 0
Query Syntax Syntax [SOURce]:CURRent:PROTection:STATe?
Returned Parameters <NR1>0 or 1
Related Commands OUTP:PROT:CLEAR *RST
[SOURCE::DIGital::DATA]

This command sets and reads the dc source digital control port when that port is configured for Digital I/O operation. The port has three signal pins and a digital ground pin. Pins 1 and 2 are output pins controlled by bits 0 and 1. Pin 3 is controlled by bit 2, and can be programmed to serve either as an input or an output. It normally serves as an output. Bit 2 must be programmed high to use pin 3 as an input. Pin 4 is the digital ground. The query returns the last programmed value in bits 0 and 1 and the value read at pin 3 in bit 2.

<table>
<thead>
<tr>
<th>Program Value</th>
<th>Bit Configuration</th>
<th>Pin Setting</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2 1 0</td>
<td>4 3 2 1</td>
</tr>
<tr>
<td>0</td>
<td>0 0 0</td>
<td>GND Output Lo Lo</td>
</tr>
<tr>
<td>1</td>
<td>0 0 1</td>
<td>GND Output Lo Hi</td>
</tr>
<tr>
<td>2</td>
<td>0 1 0</td>
<td>GND Output Hi Lo</td>
</tr>
<tr>
<td>3</td>
<td>0 1 1</td>
<td>GND Output Hi Hi</td>
</tr>
<tr>
<td>4</td>
<td>1 0 0</td>
<td>GND Input Lo Lo</td>
</tr>
<tr>
<td>5</td>
<td>1 0 1</td>
<td>GND Input Lo Hi</td>
</tr>
<tr>
<td>6</td>
<td>1 1 0</td>
<td>GND Input Hi Lo</td>
</tr>
<tr>
<td>7</td>
<td>1 1 1</td>
<td>GND Input Hi Hi</td>
</tr>
</tbody>
</table>

Command Syntax: [SOURCE::DIGital::DATA::VALUE] <NR1>
Parameters: 0 to 7
*RST Value: 0
Examples: DIG::DATA 7
Query Syntax: [SOURCE::DIGital::DATA?]
Returned Parameters: <NR1>
Related Commands: DIG::FUNC

[SOURCE::DIGital::FUNCTION]

This command configures the dc source digital control port. The configuration setting is saved in non-volatile memory.

RIDFi Configures the port for Remote Inhibit/Discrete Fault Interrupt operation
DIGio Configures the port for Digital input/output operation (see DIG::DATA)

Command Syntax: [SOURCE::DIGital::FUNCTION <CRD>]
Parameters: RIDFi | DIGio
Examples: DIG::FUNC DIG
Query Syntax: [SOURCE::DIGital::FUNCTION?]
Returned Parameters: <CRD>
Related Commands: DIG::DATA

[SOURCE::VOLTage]

This command sets the output voltage level of the dc source.

Command Syntax: [SOURCE::VOLTage::LEVEL[:IMMediate][:AMPLitude]<NRf+>
Parameters: see Table 4-3
Default Suffix: V (volts)
*RST Value: 0
Examples: VOLT 2 VOLTAGE::LEVEL 200 MV
Query Syntax: [SOURCE::VOLTage::LEVEL[:IMMediate][:AMPLitude]?]
Returned Parameters: <NR3>
Related Commands: VOLT::TRIG

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4 - Language Dictionary

[SOURce:]VOLTage:ALC:Bandwidth?
[SOURce:]VOLTage:ALC:BWIDth?

Agilent 66332A, 6631B, 6632B, 6633B and 6634B Only

These queries return the setting of the output mode switch. The output mode switch is used to connect or disconnect the output capacitor located inside the unit. The returned value is 15,000 if the switch is set to Normal and 60,000 if the switch is set to Fast.

Query Syntax: [SOURce:]VOLTage:ALC:Bandwidth?

Examples: VOLT:ALC:BAND?

Return Parameters: <NR3>

[SOURce:]VOLTage:TRIGger

This command sets the pending triggered voltage level of the dc source. The pending trigger level is a stored voltage value that is transferred to the output terminals when a trigger occurs. In order for a trigger to occur, the trigger subsystem must be initiated (see the INITiate command in the trigger subsystem).

Command Syntax: [SOURce:]VOLTage[:LEVEL]:TRIGGERed[:AMPLitude]<NRf+>

Parameters: see Table 4-3

Default Suffix: V (volts)

*RST Value: 0

Examples: VOLT:TRIG 20

Query Syntax: [SOURce:]VOLTage[:LEVEL]:TRIGGERed[:AMPLitude]?

Returned Parameters: <NR3>

Related Commands: VOLT *RST

[SOURce:]VOLTage:PROTection

This command sets the overvoltage protection (OVP) level of the dc source. If the output voltage exceeds the OVP level, then the dc source output is disabled and the Questionable Condition status register OV bit is set (see chapter 3 under Programming the Status Registers). An overvoltage condition can be cleared with the OUTP:PROT:CLE command after the condition that caused the OVP trip is removed. The OVP always trips with zero delay and is unaffected by the OUTP:PROT:DEL command.

Command Syntax: [SOURce:]VOLTage:PROTection[:LEVEL]<NRf+>

Parameters: see Table 4-3

Default Suffix: V (volts)

*RST Value: MAX

Examples: VOLT:PROT 21.5

Query Syntax: [SOURce:]VOLTage:PROTection[:LEVEL]?

Returned Parameters: <NR3>

Related Commands: OUTP:PROT:CLE OUTP:PROT:DEL
Status Commands

Status commands program the dc source status registers. The dc source has three groups of status registers: Operation, Questionable, and Standard Event. The Standard Event group is programmed with Common commands as described later in this section. The Operation and Questionable status groups each consist of the Condition, Enable, and Event registers and the NTR and PTR filters. Chapter 3 under "Programming the Status Registers" explains how to read specific register bits and use the information they return.

Common commands also perform status functions. The following common commands are discussed in this section: *CLS *ESE *SR? *OPC *PSC *SRE *STB *WAI.

STATus:PRESet

This command sets all defined bits in the Status Subsystem PTR registers and clears all bits in the subsystem NTR and Enable registers.

<table>
<thead>
<tr>
<th>Command Syntax</th>
<th>Parameters</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>STATus:PRESet</td>
<td>None</td>
<td>STAT:PRES STATUS:PRESET</td>
</tr>
</tbody>
</table>

Table 4-4. Bit Configuration of Operation Status Registers

<table>
<thead>
<tr>
<th>Bit Position</th>
<th>15-12</th>
<th>11</th>
<th>10</th>
<th>9</th>
<th>8</th>
<th>7-6</th>
<th>5</th>
<th>4-1</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bit Name</td>
<td>not used</td>
<td>CC-</td>
<td>CC+</td>
<td>not used</td>
<td>CV</td>
<td>not used</td>
<td>WTG</td>
<td>not used</td>
<td>CAL</td>
</tr>
<tr>
<td>Bit Weight</td>
<td>2048</td>
<td>1024</td>
<td>256</td>
<td>32</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

CAL = The dc source is computing new calibration constants.
WTG = The dc source is waiting for a trigger.
CV = The dc source is operating in constant voltage mode.
CC+ = The dc source is operating in constant current mode.
CC = The dc source is operating in negative constant current mode.

STATus:OPERation?

This query returns the value of the Operation Event register. The Event register is a read-only register which holds (latches) all events that are passed by the Operation NTR and/or PTR filter. Reading the Operation Event register clears it.

<table>
<thead>
<tr>
<th>Query Syntax</th>
<th>Parameters</th>
<th>Returned Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>STATus:OPERation?:EVEN?</td>
<td>None</td>
<td>&lt;NR1&gt;(Register Value)</td>
</tr>
</tbody>
</table>

STATus:OPERation:CONDition?

This query returns the value of the Operation Condition register. That is a read-only register which holds the real-time (unlatched) operational status of the dc source.

<table>
<thead>
<tr>
<th>Query Syntax</th>
<th>Parameters</th>
<th>Returned Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>STATus:OPERation:CONDition?</td>
<td>None</td>
<td>&lt;NR1&gt; (register value)</td>
</tr>
</tbody>
</table>
4 - Language Dictionary

**STATUs:OPERation:ENABle**

This command and its query set and read the value of the Operational Enable register. This register is a mask for enabling specific bits from the Operation Event register to set the operation summary bit (OPER) of the Status Byte register. This bit (bit 7) is the logical OR of all the Operational Event register bits that are enabled by the Status Operation Enable register.

<table>
<thead>
<tr>
<th>Command Syntax</th>
<th>STATus:OPERation:ENABle&lt;NRf&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameters</td>
<td>0 to 32727</td>
</tr>
<tr>
<td>Preset Value</td>
<td>0</td>
</tr>
<tr>
<td>Examples</td>
<td>STAT:OPER:ENAB 1312</td>
</tr>
<tr>
<td></td>
<td>STAT:OPER:ENAB 1</td>
</tr>
<tr>
<td></td>
<td>STAT:OPER:ENAB?</td>
</tr>
<tr>
<td>Query Syntax</td>
<td>STATus:OPERation:ENABle?</td>
</tr>
<tr>
<td>Returned Parameters</td>
<td>&lt;NR1&gt; (register value)</td>
</tr>
<tr>
<td>Related Commands</td>
<td>STAT:OPER:ENAB</td>
</tr>
</tbody>
</table>

**STATus:OPERation:NTR**

**STATus:OPERation:PTR**

These commands set or read the value of the Operation NTR (Negative-Transition) and PTR (Positive-Transition) registers. These registers serve as polarity filters between the Operation Enable and Operation Event registers to cause the following actions:

- When a bit in the Operation NTR register is set to 1, then a 1-to-0 transition of the corresponding bit in the Operation Condition register causes that bit in the Operation Event register to be set.
- When a bit of the Operation PTR register is set to 1, then a 0-to-1 transition of the corresponding bit in the Operation Condition register causes that bit in the Operation Event register to be set.
- If the same bits in both NTR and PTR registers are set to 1, then any transition of that bit at the Operation Condition register sets the corresponding bit in the Operation Event register.
- If the same bits in both NTR and PTR registers are set to 0, then no transition of that bit at the Operation Condition register can set the corresponding bit in the Operation Event register.

<table>
<thead>
<tr>
<th>Command Syntax</th>
<th>STATus:OPERation:NTRtransition&lt;NRf&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>STATus:OPERation:PRTransition&lt;NRf&gt;</td>
</tr>
<tr>
<td>Parameters</td>
<td>0 to 32727</td>
</tr>
<tr>
<td>Preset Value</td>
<td>NTR register = 0; PTR register = 32727</td>
</tr>
<tr>
<td>Examples</td>
<td>STAT:OPER:NTR 32</td>
</tr>
<tr>
<td></td>
<td>STAT:OPER:PTR 1312</td>
</tr>
<tr>
<td>Query Syntax</td>
<td>STAT:OPER:NTR?</td>
</tr>
<tr>
<td>Returned Parameters</td>
<td>&lt;NR1&gt; (register value)</td>
</tr>
<tr>
<td>Related Commands</td>
<td>STAT:OPER:ENAB</td>
</tr>
</tbody>
</table>
Table 4.5. Bit Configuration of Questionable Status Registers

<table>
<thead>
<tr>
<th>Bit Position</th>
<th>15</th>
<th>14</th>
<th>13-11</th>
<th>10</th>
<th>8-5</th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bit Name</td>
<td>not used</td>
<td>Meas Ovld</td>
<td>not used</td>
<td>Unreg</td>
<td>RI</td>
<td>not used</td>
<td>OT</td>
<td>not used</td>
<td>FS</td>
<td>OCP</td>
</tr>
<tr>
<td>Bit Weight</td>
<td>16364</td>
<td>1024</td>
<td>512</td>
<td>16</td>
<td>4</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

OV = overvoltage protection has tripped
OCP = overcurrent protection has tripped
FS = the fuse is blown
OT = overtemperature protection has tripped
RI = remote inhibit is active
Unreg = output is unregulated
Meas Ovld = measurement overload

**STATus:QUESTionable?**

This query returns the value of the Questionable Event register. The Event register is a read-only register which holds (latches) all events that are passed by the Questionable NTR and/or PTR filter. Reading the Questionable Event register clears it.

Query Syntax: STATus:QUESTionable[:EVEN]? Parameters: None

Examples: STAT:QUES? STAT:QUESTIONABLE:EVENT?

Returned Parameters: <NR1> (register value)


**STATus:QUESTionable:CONDition?**

This query returns the value of the Questionable Condition register. That is a read-only register which holds the real-time (unlatched) questionable status of the dc source.

Query Syntax: STATus:QUESTionable:CONDition?

Parameters: None


Returned Parameters: <NR1> (register value)

**STATus:QUESTionable:ENABLE**

This command and its query set and read the value of the Questionable Enable register. This register is a mask for enabling specific bits from the Questionable Event register to set the questionable summary bit (QUES) of the Status Byte register. This bit (bit 3) is the logical OR of all the Questionable Event register bits that are enabled by the Questionable Status Enable register.

Command Syntax: STATus:QUESTionable:ENABLE<nRf>

Parameters: 0 to 32767

Preset Value: 0


Query Syntax: STATus:QUESTionable:ENABLE?

Returned Parameters: <NR1> (register value)

Related Commands: STAT:QUES?
4 - Language Dictionary

**STATUs:QUEStionable:NTR**
**STATUs:QUEStionable:PTR**

These commands allow you to set or read the value of the Questionable NTR (Negative-Transition) and PTR (Positive-Transition) registers. These registers serve as polarity filters between the Questionable Enable and Questionable Event registers to cause the following actions:

- When a bit of the Questionable NTR register is set to 1, then a 1-to-0 transition of the corresponding bit of the Questionable Condition register causes that bit in the Questionable Event register to be set.
- When a bit of the Questionable PTR register is set to 1, then a 0-to-1 transition of the corresponding bit in the Questionable Condition register causes that bit in the Questionable Event register to be set.
- If the same bits in both NTR and PTR registers are set to 1, then any transition of that bit at the Questionable Condition register sets the corresponding bit in the Questionable Event register.
- If the same bits in both NTR and PTR registers are set to 0, then no transition of that bit at the Questionable Condition register can set the corresponding bit in the Questionable Event register.

| Command Syntax       | STATus:QUEStionable:NTR{transition<NRf>}
|----------------------|---------------------------------------------------
| Parameters           | 0 to 32727                                         
| Preset Value         | NTR register = 0; PTR register = 32727             
| Examples             | STAT:QUES:NTR 16  STATUS:QUEStionable:PTR 512      
| Query Syntax         | STAT:QUES:NTR?STAT:QUES:PTR?                        
| Returned Parameters  | <NR1>(Register value)                              
| Related Commands     | STAT:QUES:ENAB                                      

**CLS**

This command causes the following actions (see chapter 3 under Programming the Status Registers, for the descriptions of all registers):

- Clears the following registers:
  - Standard Event Status
  - Operation Status Event
  - Questionable Status Event
  - Status Byte
- Clears the Error Queue
- If **CLS** immediately follows a program message terminator (<NL>), then the output queue and the MAV bit are also cleared.

| Command Syntax | *CLS  
|----------------|---------------------------------------------------
| Parameters     | None                                              

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**ESE**

This command programs the Standard Event Status Enable register bits. The programming determines which events of the Standard Event Status register (see *ESR?) are allowed to set the ESB (Event Summary Bit) of the Status Byte register. A "1" in the bit position enables the corresponding event. All of the enabled events of the Standard Event Status Enable Register are logically ORed to cause the Event Summary Bit (ESB) of the Status Byte Register to be set. The query reads the Standard Event. The query reads the Standard Event Status Enable register.

<table>
<thead>
<tr>
<th>Bit Position</th>
<th>7</th>
<th>6</th>
<th>5</th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bit Name</td>
<td>PON</td>
<td>0</td>
<td>CME</td>
<td>EXE</td>
<td>DDE</td>
<td>QUE</td>
<td>0</td>
<td>OPC</td>
</tr>
<tr>
<td>Bit Weight</td>
<td>128</td>
<td>64</td>
<td>32</td>
<td>16</td>
<td>8</td>
<td>4</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

PON = Power-on has occurred
CME = Command error
EXE = Execution error
DDE = Device-dependent error
QUE = Query error
OPC = Operation complete

**Command Syntax**  
*ESE <NRF?
**Parameters**  
0 to 255
**Power-On Value**  
(See *PSC)
**Examples**  
*ESE 129
**Query Syntax**  
*ESE?
**Returned Parameters**  
<NR1>(Register value)
**Related Commands**  
*ESR?  *PSC  *STB?

---

**CAUTION:** If *PSC is programmed to 0, the *ESE command causes a write cycle to nonvolatile memory. Nonvolatile memory has a finite maximum number of write cycles. Programs that repeatedly cause write cycles to nonvolatile memory can eventually exceed the maximum number of write cycles and cause the memory to fail.

---

**ESR?**

This query reads the Standard Event Status Event register. Reading the register clears it. The bit configuration is the same as the Standard Event Status Enable register (see *ESE).

**Query Syntax**  
*ESR?
**Parameters**  
None
**Returned Parameters**  
<NR1>(Register binary value)
**Related Commands**  
*CLS  *ESE  *ESR?  *OPC

---

**OPC**

This command causes the instrument to set the OPC bit (bit 0) of the Standard Event Status register when the has completed all pending operations. (See *ESE for the bit configuration of the Standard Event Status register.) Pending operations are complete when:

- all commands sent before *OPC have been executed. This includes overlapped commands. Most commands are sequential and are completed before the next command is executed. Overlapped commands are executed in parallel with other commands. Commands that affect output voltage, current or state, relays, and trigger actions are overlapped with subsequent commands sent to the dc source. The *OPC command provides notification that all overlapped commands have been completed.
- all triggered actions are completed
4 - Language Dictionary

* OPC does not prevent processing of subsequent commands, but bit 0 will not be set until all pending operations are completed.

*OPC? causes the instrument to place an ASCII "1" in the Output Queue when all pending operations are completed. Unlike *OPC, *OPC? prevents processing of all subsequent commands. It is intended to be used at the end of a command line so that the application program can then monitor the bus for data until it receives the "1" from the dc source Output Queue.

| Command Syntax | *OPC
| Parameters      | None
| Query Syntax    | *OPC?
| Returned Parameters | <NR1>, 1
| Related Commands | *OPC, *TRIG, *WAI

*PSC

This command controls the automatic clearing at power-on of the Service Request Enable and the Standard Event Status Enable registers.

*PSC ON | 1 causes these registers to be cleared at power-on. This prevents a PON event from generating SRQ at power-on.

*PSC OFF | 0 causes the contents of the Standard Event Enable and Service Request Enable registers to be saved in nonvolatile memory and recalled at power-on. This allows a PON event to generate SRQ at power-on.

The query returns the current state of *PSC.

| Command Syntax | *PSC <Bool>
| Parameters      | 0 | 1 | OFF | ON
| Example         | *PSC 0 | *PSC 1
| Query Syntax    | *PSC?
| Returned Parameters | <NR1>, 0
| Related Commands | *ESE, *SRE

CAUTION: *PSC causes a write cycle to nonvolatile memory. Nonvolatile memory has a finite maximum number of write cycles. Programs that repeatedly cause write cycles to nonvolatile memory can eventually exceed the maximum number of write cycles and cause the memory to fail.

*SRE

This command sets the condition of the Service Request Enable Register. This register determines which bits from the Status Byte Register (see *STB for its bit configuration) are allowed to set the Master Status Summary (MSS) bit and the Request for Service (RQS) summary bit. A 1 in any Service Request Enable Register bit position enables the corresponding Status Byte Register bit and all such enabled bits then are logically ORed to cause Bit 6 of the Status Byte Register to be set.

When the controller conducts a serial poll in response to SRQ, the RQS bit is cleared, but the MSS bit is not. When *SRE is cleared (by programming it with 0), the dc source cannot generate an SRQ to the controller.

The query returns the current state of *SRE.
Command Syntax *SRE <NR1>
Parameters 0 to 255
Power-on Value see *PSC
Example *SRE 20
Query Syntax *SRE?
Returned Parameters <NR1> (register binary value)
Related Commands *ESE *ESR *PSC

CAUTION: If *FSC is programmed to 0, the *SRE command causes a write cycle to nonvolatile memory. Nonvolatile memory has a finite maximum number of write cycles. Programs that repeatedly cause write cycles to nonvolatile memory can eventually exceed the maximum number of write cycles and cause the memory to fail.

*STB?

This query reads the Status Byte register, which contains the status summary bits and the Output Queue MAV bit. Reading the Status Byte register does not clear it. The input summary bits are cleared when the appropriate event registers are read. The MAV bit is cleared at power-on, by *CLS or when there is no more response data available.

A serial poll also returns the value of the Status Byte register, except that bit 6 returns Request for Service (RQS) instead of Master Status Summary (MSS). A serial poll clears RQS, but not MSS. When MSS is set, it indicates that the has one or more reasons for requesting service.

<table>
<thead>
<tr>
<th>Bit Position</th>
<th>7</th>
<th>6</th>
<th>5</th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bit Name</td>
<td>OPER</td>
<td>MSS (RQS)</td>
<td>ESB</td>
<td>MAV</td>
<td>QUES</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Bit Weight</td>
<td>128</td>
<td>64</td>
<td>32</td>
<td>16</td>
<td>8</td>
<td>4</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>ESB = Event status byte summary</td>
<td>OPER = Operation status summary</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MAV = Message available</td>
<td>QUES = Questionable status summary</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MSS = Master status summary</td>
<td>RQS = Request for service</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Query Syntax *STB?
Returned Parameters <NR1> (Register binary value)

*WAI

This command instructs the dc source not to process any further commands until all pending operations are completed. "Pending operations" are as defined under the *OPC command. *WAI can be aborted only by sending the dc source an GPIB DCL (Device Clear) command.

Command Syntax WAI?
Parameters None
Related Commands *OPC *OPC?
System Commands

System commands consist of system, display, and common commands.

**System commands** commands control system functions that are not directly related to output control or measurement functions.

**Display commands** control the front panel display of the .

**Common commands** also perform system functions. The following common commands are discussed in this section: *IDN?, OPT?, *RCL, *RST, *SAV, *TST?.

**DISPLAY**

This command turns the front panel display on or off. When off, the front panel display is blank. The display annunciators are not affected by this command.

<table>
<thead>
<tr>
<th>Command Syntax</th>
<th>DISPLAY[:WINDow][:STATE] &lt;bool&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameters</td>
<td>0</td>
</tr>
<tr>
<td>*RST Value</td>
<td>ON</td>
</tr>
<tr>
<td>Examples</td>
<td>DISP ON DISPLAY:STATE ON</td>
</tr>
<tr>
<td>Query Syntax</td>
<td>DISPLAY[:WINDow][:STATE]?</td>
</tr>
<tr>
<td>Returned Parameters</td>
<td>&lt;NR1&gt; 0 or 1</td>
</tr>
<tr>
<td>Related Commands</td>
<td>DISP:MODE DISP:TEXT *RST</td>
</tr>
</tbody>
</table>

**DISPLAY:MODE**

Switches the display between its normal instrument functions and a mode in which it displays text sent by the user. Text messages are defined with the DISPLAY:TEXT command.

| Command Syntax   | DISPLAY[:WINDow]:MODE NORMAL|TEXT |
|------------------|----------------------------|
| Parameters       | <CRD>NORMAL | TEXT |
| *RST Value       | NORM |
| Examples         | DISP:MODE NORM DISPLAY:MODE TEXT |
| Query Syntax     | DISPLAY[:WINDow]:MODE? |
| Returned Parameters | <CRD> NORMAL or TEXT |
| Related Commands | DISP DISP:TEXT *RST |

**DISPLAY:TEXT**

This command sends character strings to the display when the display mode is set to TEXT. The character string is case-sensitive and must be enclosed in either single (') or double (") quotes. The display is capable of showing up to 14 characters. Strings exceeding 14 characters will be truncated.

<table>
<thead>
<tr>
<th>Command Syntax</th>
<th>DISPLAY[:WINDow]:TEXT [:DATA] &lt;display_string&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameters</td>
<td>&lt;display string&gt;</td>
</tr>
<tr>
<td>*RST Value</td>
<td>null string</td>
</tr>
<tr>
<td>Examples</td>
<td>DISP:TEXT &quot;DEFAULT_MODE&quot;</td>
</tr>
<tr>
<td>Query Syntax</td>
<td>DISPLAY[:WINDow]:TEXT?</td>
</tr>
<tr>
<td>Returned Parameters</td>
<td>&lt;STR&gt;(Last programmed text string)</td>
</tr>
<tr>
<td>Related Commands</td>
<td>DISP DISP:MODE</td>
</tr>
</tbody>
</table>
SYSTem:ERROR?

This query returns the next error number followed by its corresponding error message string from the remote programming error queue. The queue is a FIFO (first-in, first-out) buffer that stores errors as they occur. As it is read, each error is removed from the queue. When all errors have been read, the query returns 0, NO ERROR. If more errors are accumulated than the queue can hold, the last error in the queue will be -350, TOO MANY ERRORS (see Appendix C for other error codes).

You can use the front panel Error key to read errors from the queue. Errors generated at the front panel are not put into the queue but appear immediately on the display.

<table>
<thead>
<tr>
<th>Query Syntax</th>
<th>SYSTem:ERROR?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameters</td>
<td>(None)</td>
</tr>
<tr>
<td>Returned Parameters</td>
<td>&lt;NR1&gt;, &lt;SRD&gt;</td>
</tr>
<tr>
<td>Examples</td>
<td>SYST:ERR?</td>
</tr>
<tr>
<td></td>
<td>SYSTEM:ERROR?</td>
</tr>
</tbody>
</table>

SYSTem:LANGUAGE

This command switches the instrument between its SCPI command language and its compatibility language. The compatibility language is provided for emulation of older dc source systems and is described in Appendix B. Sending the command causes:

- The selected language to become active and to be stored in nonvolatile memory.
- The to reset to its power-on state.

If the dc source is shut off, it will resume operation in the last-selected language when power is restored. Note that this command and query can be used regardless of the language that is presently selected.

<table>
<thead>
<tr>
<th>Command Syntax</th>
<th>SYSTem:LANGUAGE&lt;string&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameters</td>
<td>SCPI</td>
</tr>
<tr>
<td>Power-on Value</td>
<td>last selected language</td>
</tr>
<tr>
<td>Example</td>
<td>SYST:LANG SCPI SYSTEM:LANGUAGE COMPATIBILITY</td>
</tr>
<tr>
<td>Query Syntax</td>
<td>SYSTem:LANGUAGE?</td>
</tr>
<tr>
<td>Returned Parameters</td>
<td>&lt;CRD&gt;</td>
</tr>
</tbody>
</table>

SYSTem:VERSION?

This query returns the SCPI version number to which the complies. The returned value is of the form YYYY.V, where YYYY represents the year and V is the revision number for that year.

<table>
<thead>
<tr>
<th>Query Syntax</th>
<th>SYSTem:VERSION?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameters</td>
<td>(none)</td>
</tr>
<tr>
<td>Returned Parameters</td>
<td>&lt;NR2&gt;</td>
</tr>
<tr>
<td>Examples</td>
<td>SYST:VERS?</td>
</tr>
<tr>
<td></td>
<td>SYSTEM:VERSION?</td>
</tr>
</tbody>
</table>
4 - Language Dictionary

**SYSTem:LOCal**

For RS-232 Operation Only

This command places the dc source in local mode during RS-232 operation. The front panel keys are functional.

<table>
<thead>
<tr>
<th>Command Syntax</th>
<th>SYSTem:LOCal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameters</td>
<td>None</td>
</tr>
<tr>
<td>Example</td>
<td>SYST:LOC</td>
</tr>
<tr>
<td>Related Commands</td>
<td>SYST:REM   SYST:RWL</td>
</tr>
</tbody>
</table>

**SYSTem:REMote**

For RS-232 Operation Only

This command places the dc source in remote mode during RS-232 operation. This disables all front panel keys except the Local key. Pressing the Local key while in the remote state returns the front panel to the local state.

<table>
<thead>
<tr>
<th>Command Syntax</th>
<th>SYSTem:REMote</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameters</td>
<td>None</td>
</tr>
<tr>
<td>Example</td>
<td>SYST:REM</td>
</tr>
<tr>
<td>Related Commands</td>
<td>SYST:LOC   SYST:RWL</td>
</tr>
</tbody>
</table>

**SYSTem:RWLock**

For RS-232 Operation Only

This command places the dc source in remote mode during RS-232 operation. All front panel keys including the Local key are disabled. Use SYSTem:LOCal to return the front panel to the local state.

<table>
<thead>
<tr>
<th>Command Syntax</th>
<th>SYSTem:RWLock</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameters</td>
<td>None</td>
</tr>
<tr>
<td>Example</td>
<td>SYST:RWL</td>
</tr>
<tr>
<td>Related Commands</td>
<td>SYST:REM   SYST:LOC</td>
</tr>
</tbody>
</table>

**"IDN?"**

This query requests the dc source to identify itself. It returns a string composed of four fields separated by commas.

<table>
<thead>
<tr>
<th>Query Syntax</th>
<th>&quot;IDN?&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Returned Parameters</td>
<td>&lt;AARD&gt;</td>
</tr>
<tr>
<td>Field</td>
<td>Agilent Technologies xxxxA nnnnA-nnnn &lt;A&gt;.xx.xx</td>
</tr>
<tr>
<td>Information</td>
<td>Manufacturer model number followed by a letter suffix 10-character serial number or 0 Revision levels of firmware</td>
</tr>
</tbody>
</table>

Example: AGILENT,66312A,0,A.00.01
*OPT?

This query requests the dc source to identify any options that are installed. Options are identified by number A. 0 indicates no options are installed.

Query Syntax  *OPT?
Returned Parameters <AARD>

*RCL

WARNING: Recalling a previously stored state may place hazardous voltages at the dc source output.

This command restores the dc source to a state that was previously stored in memory with the *SAV command to the specified location. All states are recalled with the following exceptions:

- the trigger system is set to the Idle state by an implied ABORt command (this cancels any uncompleted trigger actions)
- the calibration function is disabled by setting CAL:STATe to OFF

NOTE: The device state stored in location 0 is automatically recalled at power turn-on when the OUTPut:POW:STATe is set to RCL0.

Command Syntax  *RCL <NR>
Parameters  0 | 1 | 2 | 3
Example  *RCL 3
Related Commands  *PSC  *RST  *SAV

*RST

This command resets the to a factory-defined state as defined in the following table. *RST also forces an ABORt command.

Command Syntax  *RST
Parameters  None
Related Commands  *PSC  *SAV
Table 4-8. *RST Settings

| CAL:STAT | OFF | SOUR:CURR | 10% of MAX* |
| DIG:DATA | 0   | SOUR:CURR:TRIG | 10% of MAX* |
| DISP:STAT | ON | SOUR:CURR:PROT:STAT | OFF |
| DISP:MODE | NORM | SOUR:LIST:COUNT | 0 |
| DISP:TEXT | | SOUR:VOLT | 0 |
| INIT:CONT | OFF | SOUR:VOLT:TRIG | 0 |
| OUTP | OFF | SOUR:VOLT:PROT | MAX* |
| OUTP:DFI | OFF | TRIG:ACQ:COUNT:CURR | 1 |
| OUTP:DFI:SOUR | OFF | TRIG:ACQ:COUNT:VOLT | 1 |
| OUTP:PROT:DEL | .08 Norm; .008 Fast | TRIG:ACQ:HYST:CURR | 0 |
| OUTP:REL | OFF | TRIG:ACQ:HYST:VOLT | 0 |
| OUTP:REL:POL | NORM | TRIG:ACQ:LEV:CURR | MAX* |
| SENS:CURR:RANG | MAX | TRIG:ACQ:LEV:VOLT | MAX* |
| SENS:CURR:DET | ACDC | TRIG:ACQ:SLOP:CURR | PCS |
| SENS:FUNC | VOLT | TRIG:ACQ:SLOP:VOLT | PCS |
| SENS:SWE:OFFS:POS:N | 0 | TRIG:ACQ:SOUR | INTERNAL |
| SENS:SWE:POIN | 2048 | TRIG:TRAN:SOUR | BUS |
| SENS:SWE:TINT | 15.6 μs | |

* Maximum values are model-dependent. Refer to Table 4-3.

*SAV

This command stores the present state of the dc source to the specified location in non-volatile memory. Up to 4 states can be stored. If a particular state is desired at power-on, it should be stored in location 0. It will then be automatically recalled at power turn-on if OUTPut:PO:STAT’s is set to RCL0. *RCL retrieves instrument states.

Command Syntax *SAV <NR1>
Parameters 0 1 2 3
Example *SAV 3
Related Commands *RCL  *RST

CAUTION: *SAV causes a write cycle to nonvolatile memory. Nonvolatile memory has a finite maximum number of write cycles. Programs that repeatedly cause write cycles to nonvolatile memory can eventually exceed the maximum number of write cycles and cause the memory to fail.

*TST?

This query causes the instrument to do a self-test and report any errors. 0 indicates that the dc source passed self-test. 1 indicates that one or more tests failed. Selftest errors are written to the error queue (see Appendix C).

Query Syntax TST?
Returned Parameters <NR1>
### Trigger Commands

Trigger commands consist of trigger and initiate commands.

**Trigger commands** control the remote triggering of the dc source. Trigger commands (and Initiate commands) are referenced either by name or by number. The correspondence between names and numbers is:

<table>
<thead>
<tr>
<th>Sequence Number</th>
<th>Sequence Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (the default)</td>
<td>TRANsient</td>
<td>Output transient trigger sequence</td>
</tr>
<tr>
<td>2</td>
<td>ACQuire</td>
<td>Measurement acquire trigger sequence</td>
</tr>
</tbody>
</table>

**Initiate commands** initialize the trigger system.

### ABORT

This command cancels any trigger actions presently in process. Pending trigger levels are reset to their corresponding immediate values. ABORt also resets the WTG bit in the Operation Condition Status register (see chapter 3 under Programming the Status Registers). If INITiate:CONTinuous ON has been programmed, the trigger subsystem initiates itself immediately after ABORt, thereby setting WTG. ABORt is executed at power turn on and upon execution of *RCL or RST.*

<table>
<thead>
<tr>
<th>Command Syntax</th>
<th>Parameters</th>
<th>Examples</th>
<th>Related Commands</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABORt</td>
<td>None</td>
<td>ABOR</td>
<td>INIT *RST *TRG TRIG</td>
</tr>
</tbody>
</table>

### INITiate:SEQuence

**INITiate:NAME**

INIT:SEQ2 or INIT:NAME ACQ applies to Agilent 66312A, 66332A Only

**INITiate commands** control the initiation of both output and measurement triggers. When a trigger is enabled, an event on a selected trigger source causes the specified triggering action to occur. If the trigger subsystem is not enabled, all trigger commands are ignored.

<table>
<thead>
<tr>
<th>Command Syntax</th>
<th>Parameters</th>
<th>Examples</th>
<th>Related Commands</th>
</tr>
</thead>
<tbody>
<tr>
<td>INITiate[:IMMediate]:SEQuence{ 1</td>
<td>2 }</td>
<td>For INIT:NAME TRANsient</td>
<td>INIT:SEQ2 INIT:NAME TRAN</td>
</tr>
<tr>
<td>INITiate[:IMMediate]:NAME&lt;name&gt;</td>
<td>INIT:NAME</td>
<td>INIT:CONT TRIG TRIG:SEQ:DEF TRIG</td>
<td></td>
</tr>
</tbody>
</table>

### INITiate:CONTinuous:SEQuence1

**INITiate:CONTinuous:NAME**

These commands control the output transient trigger system.

1 or ON: continuously initiates the output trigger system..

0 or OFF: turns off continuous triggering. In this state, the output trigger system must be initiated for each trigger using INITiate:SEQuence.

<table>
<thead>
<tr>
<th>Command Syntax</th>
<th>Parameters</th>
<th>Examples</th>
<th>Related Commands</th>
</tr>
</thead>
<tbody>
<tr>
<td>INITiate:CONTinuous:SEQuence1&lt;bool&gt;</td>
<td>0</td>
<td>INIT:CONT:SEQ ON INIT:CONT:NAME TRAN</td>
<td>ABOR INIT TRIG TRIG:SEQ:DEF TRIG</td>
</tr>
<tr>
<td>INITiate:CONTinuous:NAME TRANsient,&lt;bool&gt;</td>
<td>1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
TRIGger

When the transient trigger subsystem is initiated, this command generates a trigger signal. The trigger will then:

1. Initiate a pending level change as specified by CURRent:TRIGger or VOLTage:TRIGger.
2. Clear the WTG bit in the Status Operation Condition register after both transient and acquire trigger sequences have completed. (WTG is the logical-or of both transient and acquire sequences.)
3. If INITiate:CONTInuous ON has been programmed, the trigger subsystem is immediately re-enabled for subsequent triggers. As soon as it is cleared, the WTG bit is again set to 1.

Command Syntax  TRIGger[:SEQUence1][:IMMediate]
                 TRIGger[:TRANsient][:IMMediate]
Parameters       None
Examples         TRIG TRIG:IMM
Related Commands ABOR CURR:TRIG INIT 'TRG VOLT:TRIG

TRIGger:SOURce

This command is included for completeness. It selects the trigger source for transient triggers. Since BUS is the only trigger source for transient triggers, this command does not need to be used.

BUS
     GPIB device, *TRG, or <GET> (Group Execute Trigger)

Command Syntax  TRIGger[:SEQUence1]:SOURce<source>
                 TRIGger[:TRANsient]:SOURce<source>
Parameters      BUS
 *RST Value      BUS
Examples        TRIG:SOUR BUS
Query Syntax    TRIGger[:SEQUence1]:SOURce?
                 TRIGger[:TRANsient]:SOURce?
Returned Parameters <CRD>

TRIGger:SEQuence2
TRIGger:ACQuire

Agilent 66312A, 66332A Only

When the trigger subsystem is initiated, these commands generate a measurement trigger signal. The measurement trigger causes the dc source to measure the output voltage and current and store the results in a buffer.

Command Syntax  TRIGger:SEQuence2[:IMMediate]
                 TRIGger:ACQuire[:IMMediate]
Parameters      None
Examples        TRIG:SEQ2 TRIG:ACQ
Related Commands TRIG:SOUR TRIG:SEQ2:DEF TRIG:SEQ2:COUN
**TRIGger:SEQUence2:COUNT:CURRent**
**TRIGger:ACQuire:COUNT:CURRent**

*Agilent 66312A, 66332A Only*

This command sets up a successive number of triggers for measuring current data. With this command, the trigger system needs to be initialized only once at the start of the acquisition period. After each completed measurement, the instrument waits for the next valid trigger condition to start another measurement. This continues until the count has completed.

**Command Syntax**
- TRIGger:SEQUence2:COUNT:CURRent<NRf+>
- TRIGger:ACQuire:COUNT:CURRent<NRf+>

**Parameters**
- 1 to 100

**RST Value**
- 1

**Examples**
- TRIG:SEQ2:COUN:CURR 5
- TRIG:ACQ:COUN:CURR 1

**Query Syntax**
- TRIGger:SEQUence2:COUNT:CURRent?
- TRIGger:ACQuire:COUNT:CURRent?

**Returned Parameters**
- <NR3>

**Related Commands**
- TRIG:SEQ2
- TRIG:ACQ

---

**TRIGger:SEQUence2:COUNT:VOLTage**
**TRIGger:ACQuire:COUNT:VOLTage**

*Agilent 66312A, 66332A Only*

This command sets up a successive number of triggers for measuring voltage data. With this command, the trigger system needs to be initialized only once at the start of the acquisition period. After each completed measurement, the instrument waits for the next valid trigger condition to start another measurement. This continues until the count has completed.

**Command Syntax**
- TRIGger:SEQUence2:COUNT:VOLTage<NRf+>
- TRIGger:ACQuire:COUNT:VOLTage<NRf+>

**Parameters**
- 1 to 100

**RST Value**
- 1

**Examples**
- TRIG:SEQ2:COUN:VOLT 5
- TRIG:ACQ:COUN:VOLT 1

**Query Syntax**
- TRIGger:SEQUence2:COUNT:VOLTage?
- TRIGger:ACQuire:COUNT:VOLTage?

**Returned Parameters**
- <NR3>

**Related Commands**
- TRIG:SEQ2
- TRIG:ACQ
TRIGger:SEQUence2:HYSTeresis:CURRent
TRIGger:ACQuire:HYSTeresis:CURRent

Agilent 66312A, 66332A Only

This command defines a band around the trigger level through which the signal must pass before an internal measurement can occur. The band limit above and below the trigger level is one half of the hysteresis value added to or subtracted from the trigger level.

For a positive trigger to occur, the excursion of an output waveform in the positive direction must start below the lower hysteresis band limit and pass through the upper hysteresis band limit. For a negative trigger to occur, the excursion of an output waveform in the negative direction must start above the upper hysteresis band limit and pass through the lower hysteresis band limit.

Command Syntax
TRIGger:SEQUence2:HYSTeresis:CURRent<NRF+>
TRIGger:ACQuire:HYSTeresis:CURRent<NRF+>

Parameters
0 to MAX (see table 4-3)

Unit
A (amperes)

*RST Value
0

Examples
TRIG:SEQ:HYST:CURR 0.5 TRIG:ACQ:HYST:CURR 0.5

Query Syntax
TRIGger:SEQUence2:HYSTeresis:CURRent?
TRIGger:ACQuire:HYSTeresis:CURRent?

Returned Parameters
<NRF3>

Related Commands

TRIGger:SEQUence2:HYSTeresis:VOLTage
TRIGger:ACQuire:HYSTeresis:VOLTage

Agilent 66312A, 66332A Only

This command defines a band around the trigger level through which the signal must pass before an internal measurement can occur. The band limit above and below the trigger level is one half of the hysteresis value added to or subtracted from the trigger level.

For a positive trigger to occur, the excursion of an output waveform in the positive direction must start below the lower hysteresis band limit and pass through the upper hysteresis band limit. For a negative trigger to occur, the excursion of an output waveform in the negative direction must start above the upper hysteresis band limit and pass through the lower hysteresis band limit.

Command Syntax
TRIGger:SEQUence2:HYSTeresis:VOLTage<NRF+>
TRIGger:ACQuire:HYSTeresis:VOLTage<NRF+>

Parameters
0 to MAX (see table 4-3)

Unit
V (volts)

*RST Value
0

Examples

Query Syntax
TRIGger:SEQUence2:HYSTeresis:VOLTage?
TRIGger:ACQuire:HYSTeresis:VOLTage?

Returned Parameters
<NRF3>

Related Commands
TRIGger:SEQUence2:LEVel:CURRent
TRIGger:ACQuire:LEVel:CURRent

Agilent 66312A, 66332A Only

This command sets the trigger level for internally triggered current measurements. A positive current trigger occurs when the current level changes from a value less than the lower hysteresis band limit to a value greater than the upper hysteresis band limit. Similarly, a negative current trigger occurs when the current level changes from a value greater than the upper hysteresis band limit to a value less than the lower hysteresis band limit.

| Command Syntax | TRIGger:SEQUence2:LEVel:CURRent<NRf+>
|                | TRIGger:ACQuire:LEVel:CURRent<NRf+>
| Parameters     | 0 to MAX (see table 4-3)
| Unit           | A (amperes)
| "RST Value"    | 0
| Examples       | TRIG:SEQ2:LEV:CURR 5  TRIG:ACQ:LEV:CURR MAX
|                | TRIG:ACQ:LEV 2
| Query Syntax   | TRIGger:SEQUence2:LEVel:CURRent?
|                | TRIGger:ACQuire:LEVel:CURRent?
| Returned Parameters | <NR3>
| Related Commands | TRIG:SEQ2:LEV:VOLT  TRIG:SEQ2:HYST:CURR

TRIGger:SEQUence2:LEVel:VOLTage
TRIGger:ACQuire:LEVel:VOLTage

Agilent 66312A, 66332A Only

This command sets the trigger level for internally triggered voltage measurements. A positive voltage trigger occurs when the voltage level changes from a value less than the lower hysteresis band limit to a value greater than the upper hysteresis band limit. Similarly, a negative voltage trigger occurs when the voltage level changes from a value greater than the upper hysteresis band limit to a value less than the lower hysteresis band limit.

| Command Syntax | TRIGger:SEQUence2:LEVel:VOLTage<NRf+>
|                | TRIGger:ACQuire:LEVel:VOLTage<NRf+>
| Parameters     | 0 to MAX (see table 4-3)
| Unit           | V (volts)
| "RST Value"    | 0
| Examples       | TRIG:SEQ2:LEV:VOLT 5  TRIG:ACQ:LEV:VOLT MAX
|                | TRIG:ACQ:LEV 2
| Query Syntax   | TRIGger:SEQUence2:LEVel:VOLTage?
|                | TRIGger:ACQuire:LEVel:VOLTage?
| Returned Parameters | <NR3>
| Related Commands | TRIG:SEQ2:LEV:CURR  TRIG:SEQ2:HYST:VOLT
TRIGger:SEQUence2:SLOPe:CURRent
TRIGger:ACQuire:SLOPe:CURRent

Agilent 66312A, 66332A Only

This command sets the slope of an internally triggered current measurement.

POSitive triggering occurs on the rising edge.
NEGative triggering occurs on the falling edge.
EITHER triggering occurs on either edge.

**Command Syntax**

```
TRIGger:SEQUence2:SLOPe:CURRent<slope>
TRIGger:ACQuire:SLOPe:CURRent<slope>
```

**Parameters**

```
EITHER|POSitive|NEGative
```

**RST Value**

```
EITHER
```

**Examples**

```
TRIG:SEQ2:SLOP:CURR POS
TRIG:ACQ:SLOP:CURR EITH
```

**Query Syntax**

```
TRIGger:SEQUence2:SLOPe:CURRent?
TRIGger:ACQuire:SLOPe:CURRent?
```

**Returned Parameters**

```
<CRD>
```

**Related Commands**

```
TRIG:SEQ2:SLOP:VOLT
```

TRIGger:SEQUence2:SLOPe:VOLTage
TRIGger:ACQuire:SLOPe:VOLTage

Agilent 66312A, 66332A Only

This command sets the slope of an internally triggered voltage measurement.

POSitive triggering occurs on the rising edge.
NEGative triggering occurs on the falling edge.
EITHER triggering occurs on either edge.

**Command Syntax**

```
TRIGger:SEQUence2:SLOPe:VOLTage<slope>
TRIGger:ACQuire:SLOPe:VOLTage<slope>
```

**Parameters**

```
EITHER|POSitive|NEGative
```

**RST Value**

```
EITHER
```

**Examples**

```
TRIG:SEQ2:SLOP:VOLT POS
TRIG:ACQ:SLOP:VOLT EITH
```

**Query Syntax**

```
TRIGger:SEQUence2:SLOPe:VOLTage?
TRIGger:ACQuire:SLOPe:VOLTage?
```

**Returned Parameters**

```
<CRD>
```

**Related Commands**

```
TRIG:SEQ2:SLOP:CURR
```
TRIGger:SEQUence2:SOURce
TRIGger:ACQuire:SOURce

Agilent 66312A, 66332A Only

These commands select the trigger source for measurement triggers as follows:

BUS CPRI device, *TRG, or <GET> (Group Execute Trigger)

INTernal trigger is generated internally when the measured waveform crosses the trigger level with the selected slope.

Command Syntax TRIGger:SEQUence2:SOURce<source>
TRIGger:ACQuire:SOURce<source>

Parameters BUS | INTernal

*RST Value INTernal

Examples TRIG:ACQ:SOUR BUS

Query Syntax TRIGger:SEQUence2:SOURce?
TRIGger:ACQuire:SOURce?

Returned Parameters <CRD>

TRIGger:SEQUence1:DEFine
TRIGger:SEQUence2:DEFine

TRIGger:SEQUence2:DEFine applies to Agilent 66312A, 66332A Only

These commands define the names that are aliased to trigger sequences 1 and 2. The command accepts only ACQuire for sequence 2 and TRANsient for sequence 1 as predefined names. The query allows the user to query the instrument names aliased to sequences 1 and 2.

Command Syntax TRIGger:SEQUence1:DEFine TRANsient
TRIGger:SEQUence2:DEFine ACQuire

Parameters TRANsient, ACQuire

Examples SEQ1:DEF ACQ  SEQ2:DEF TRAN

Query Syntax TRIGger:SEQUence1:DEFine?
TRIGger:SEQUence2:DEFine?

Returned Parameters <CRD>

Related Commands TRIG:SEQ2:ACQ  TRIG:SEQ1:TRAN

*TRG

This common command generates a trigger when the trigger subsystem has BUS selected as its source. The command has the same affect as the Group Execute Trigger (<GET>) command.

In RS-232 mode, this command emulates some of the functionality of the IEEE-488 Group Execute Trigger command.

Command Syntax *TRG

Parameters None

Related Commands ABOR  INIT  TRIG[:IMM]  <GET>
SCPI Conformance Information

SCPI Version


SCPI Confirmed Commands

ACOR
CAL:DATA
CAL:STAT
DISP:WIND[:STAT]
DISP:WIND[:TEXT][DATA]
INIT[:IMM]:SEQ|NAME
INIT:CONT:SEQ|NAME
MEAS[:FETC]:ARR[:CURR]:[DC]?
MEAS[:FETC]:ARR[:VOLT]:[DC]?
MEAS[:FETC]:CALC[:CURR]:[DC]?
MEAS[:FETC]:CALC[:CURR]:[HIGH]?
MEAS[:FETC]:CALC[:CURR]:[LOW]?
MEAS[:FETC]:CALC[:CURR]:[MAX]?
MEAS[:FETC]:CALC[:CURR]:[MIN]?
MEAS[:FETC]:CALC[:VOLT]:[DC]?
MEAS[:FETC]:CALC[:VOLT]:[HIGH]?
MEAS[:FETC]:CALC[:VOLT]:[LOW]?
MEAS[:FETC]:CALC[:VOLT]:[MAX]?
MEAS[:FETC]:CALC[:VOLT]:[MIN]?
OUTP[:STAT]
OUTP:PROT[:CLE]
OUTP:PROT[:DEL]
[SOUR]:CURR[:LEV][IMM][:AMPL]
[SOUR]:CURR[:LEV][TRIG][:AMPL]
[SOUR]:CURR:PROT[:STAT]
[SOUR]:VOLT[:LEV][IMM][:AMPL]
[SOUR]:VOLT[:LEV][TRIG][:AMPL]
[SOUR]:VOLT:PROT
SENS:CURR[:DC]:RANG[:UPP]
SENS:FUNC
SENS:SWE:OFFS:POIN
SENS:SWE:POIN
SENS:SWE:INT
STAT:OPER[:EVEN]?
STAT:OPER[:COND]?
STAT:OPER:ENAB
STAT:OPER:NTR
STAT:OPER:PTR
STAT:PREN
STAT:QUEST[:EVEN]?
STAT:QUEST[:COND]?
STAT:QUEST:ENAB
STAT:QUEST:NTR
STAT:QUEST:PTR
SYST:ERR?
SYST:LANG
SYST:VERS?
TRIG[:SEQ] [:TRAN][:IMM]
TRIG[:SEQ] [:TRAN][SOUR]
TRIG[:SEQ2] [ACQ][IMM]
TRIG[:SEQ2] [ACQ][SOUR]
TRIG[:SEQ]:DEF
*CBO
*CLS
*ESE**ESE?*ESR?
*IDN?
*OPC*OPC?*OPT?
*PSC*PSC?
*RCL*RST
*SAY*SAY*STB?
*TRG*TST?
*WAI

Non-SCPI Commands

CALC:CURR[:SOUR][DC]:POS
CALC:CURR[:SOUR][DC]:NEG
CALC:MEAS[:DC]:LOWR
CALC:MEAS:AC
CALC:LEV
CALC:PASS
CALC:SAVE
CALC:VOLT[DC]
CALC:VOLT:PROT
DISP:WIND[:MODE]
MEAS[:FETC]:CALC[:CURR]:ACDC?
MEAS[:FETC]:CALC[:VOLT]:ACDC?
OUTP:DFI[:STAT]
OUTP:DFI:SOUR
OUTP:POI:STAT
OUTP:REL[:STAT]
OUTP:REL:POL
OUTP:RI:MODE
SENS:CURR:DET
[SOUR]:DIG:DATA[:VAL]
[SOUR]:DIG:FUNC
TRIG:SEQ2 [ACQ][COUN[:CURR][:VOLT
TRIG:SEQ2 [ACQ][HYST[:CURR][:VOLT
TRIG:SEQ2 [ACQ][LEV[:CURR][:VOLT
TRIG:SEQ2 [ACQ][SLOP[:CURR][:VOLT

81
Compatibility Language

Introduction

The Agilent power supplies covered by this manual are programmatically compatible with the HP/Agilent 6632A, 6633A, and 6634A dc power supplies. This means that by using COMPatibility language mode you can program these newer dc sources over the GPIB using COMPatibility commands.

To switch from SCP/ commands to COMPatibility commands (and vice versa), use the SYST:LANG command, as documented in chapter 4. The language setting is saved in non-volatile memory.

Table B-2 summarizes the COMPatibility commands that program the supplies. You may need to refer to the HP/Agilent Series 6632, 6633A, and 6634A Operating Guide (p/n 5957-6360) for complete information on the COMPatibility commands.

The rest of this appendix discusses the COMPatibility language status system, and the COMPatibility language error codes.

Note: For complete information on the Compatibility programming language, order the HP/Agilent 6632A/6633A/6634A Operating manual, p/n 5957-6360.

<table>
<thead>
<tr>
<th>Command</th>
<th>Setting</th>
<th>Command</th>
<th>Setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC</td>
<td>1 (ON)</td>
<td>POL</td>
<td>1 (normal)</td>
</tr>
<tr>
<td>DLY</td>
<td>8 ms (fast)</td>
<td>PON</td>
<td>last stored value</td>
</tr>
<tr>
<td></td>
<td>80 ms (normal)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DSP</td>
<td>1 (ON)</td>
<td>RELAY</td>
<td>1 (close)</td>
</tr>
<tr>
<td>ISET</td>
<td>0.04 A (6631B)</td>
<td>RLYPON</td>
<td>1 (close)</td>
</tr>
<tr>
<td></td>
<td>0.02 A (6632B)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.008 A (6633B)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.004 A (6634B)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>OCP</td>
<td>OFF</td>
<td>SRQ</td>
<td>0</td>
</tr>
<tr>
<td>OUT</td>
<td>1 (ON)</td>
<td>UNMASK</td>
<td>0</td>
</tr>
<tr>
<td>OVSET</td>
<td>MAX</td>
<td>VSET</td>
<td>0 V</td>
</tr>
</tbody>
</table>
## Table B-2. COMPatibility Commands

<table>
<thead>
<tr>
<th>Compatibility Command</th>
<th>Description</th>
<th>Similar SCPI Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTS?</td>
<td>This command reads the contents of the accumulated status register, which stores any bit condition entered in the status register since the accumulated status register was last read, regardless of whether the condition still exists. Data Representation: ZZZZD</td>
<td>STAT:OPER? STAT:QUES? 'ESE?</td>
</tr>
<tr>
<td>CLR</td>
<td>This command initializes the dc source to the power-on state. It also resets the PON bit in the serial poll register. The command performs the same function as the Device Clear (DCL) interface message.</td>
<td>'RST</td>
</tr>
<tr>
<td>DC 0</td>
<td>1</td>
<td>Only applies to units with Relay Option 760. This command enables or disables the output without affecting the state of the output relays. Initial condition: DC 1</td>
</tr>
<tr>
<td>DLY &lt;n&gt;</td>
<td>This command programs the delay time between the programming of an output change that produces a CV, CC, or an UNREG condition, and the recording of that condition by the status registers. This can be used to prevent false triggering of the OverCurrent Protection feature (OCP). Initial delay: 0.08s (Normal): 0.008s (Fast).</td>
<td>OUTP:PROT:DEL</td>
</tr>
<tr>
<td>DSP 0</td>
<td>1</td>
<td>This command enables or disables the dc source's front panel display. Initial condition: DSP 1</td>
</tr>
<tr>
<td>ERR?</td>
<td>This command determines the type of programming error detected by the dc source. A remote programming error sets the ERR bit in the status register, which can be enabled by UNMASK to request service.</td>
<td>SYST:ERR?</td>
</tr>
<tr>
<td>FAULT?</td>
<td>This command reads which bits have been set in the fault register. A bit is set in the fault register when the corresponding bit in the status register changes from inactive to active AND the corresponding bit in the mask register has been enabled. The fault register is reset only after it has been read. The decimal equivalent of the total bit weight of all enabled bits is returned. Data Representation: ZZZZD</td>
<td>STAT:OPER? STAT:QUES? 'ESE</td>
</tr>
<tr>
<td>ID?</td>
<td>This command causes the dc source to report its model number and any options that affect the dc source's output. Data Representation: Agilent663XA</td>
<td>'IDN?</td>
</tr>
<tr>
<td>IOUT?</td>
<td>This command measures and returns the actual output current. Data Representation: SD.DDDD</td>
<td>MEAS:CURR?</td>
</tr>
<tr>
<td>ISET &lt;n&gt;</td>
<td>This command programs the output current. See Table 4-3 for the programming range of this command. Initial condition: see Table B-1</td>
<td>CURR</td>
</tr>
<tr>
<td>OCP 0</td>
<td>1</td>
<td>This command enables or disables the dc source's overcurrent protection. If this function is enabled and the dc source goes into CC mode, the output of the dc source is disabled. Initial condition: OCP 0</td>
</tr>
<tr>
<td>OUT 0</td>
<td>1</td>
<td>This command enables or disables the dc source's output. The dc source will be able to implement commands even while the output is disabled. Initial condition: OUT 1</td>
</tr>
<tr>
<td>Compatibility Command</td>
<td>Description</td>
<td>Similar SCPI Command</td>
</tr>
<tr>
<td>------------------------</td>
<td>-------------</td>
<td>---------------------</td>
</tr>
<tr>
<td>OVSET &lt;n&gt;</td>
<td>This command programs the overvoltage protection. See Table 4-3 for the programming range of this command. Initial condition: MAX</td>
<td>VOLT:PROT</td>
</tr>
<tr>
<td>POL 0</td>
<td>1</td>
<td>Only applies to units with Option 760. This command sets the polarity of the output relays to either normal (1) or inverted (0). Initial condition: POL 1</td>
</tr>
<tr>
<td>PON 0</td>
<td>1</td>
<td>This command enables (1) or disables (0) SRQ at power-on. Initial condition: last programmed value</td>
</tr>
<tr>
<td>RELAY 0</td>
<td>1</td>
<td>Only applies to units with Relay Option 760. This command opens (0) or closes (1) the output relays without affecting the programmed output state of the unit. Initial condition: RELAY 1</td>
</tr>
<tr>
<td>RLYPON 0</td>
<td>1</td>
<td>Only applies to units with Relay Option 760. This command opens (0) or closes (1) the output relays at power-on without affecting the programmed output state of the unit. Initial condition: FLYPON 1</td>
</tr>
<tr>
<td>ROM?</td>
<td>This command returns the ROM version of the dc source. Data Representation: AAA AAA</td>
<td>*IDN?</td>
</tr>
<tr>
<td>RST</td>
<td>This command resets the dc source if the output is disabled by the output protection circuits.</td>
<td>OUTP:PROT:CLE</td>
</tr>
<tr>
<td>SENS:CURR :RANG &lt;n&gt;</td>
<td>This command sets the current measurement range of the dc source. See Table 4-3 for the programming range of this command. Initial condition: MAX</td>
<td>SENS:CURR:RANG</td>
</tr>
<tr>
<td>SENS:SWE :POIN &lt;n&gt;</td>
<td>This command defines the number of data points in a measurement sweep. Initial condition: 32</td>
<td>SENS:SWE:POIN</td>
</tr>
<tr>
<td>SENS:SWE :TINT &lt;n&gt;</td>
<td>This command defines the time period between measurement samples. Initial condition: 15.6 μs.</td>
<td>SENS:SWE:TINT</td>
</tr>
<tr>
<td>SRQ 0</td>
<td>1</td>
<td>These commands enable or disable the dc source's ability to request service from the controller for fault conditions. UNMASK defines which conditions are defined as faults. Initial condition: SRQ 0</td>
</tr>
<tr>
<td>STS?</td>
<td>This command reads the contents of the status register, which maintains the present status of the dc source. Data Representation: ZZZZD</td>
<td>STAT:OPER.COND? STAT:QUES.COND? *ESE?</td>
</tr>
<tr>
<td>SYST:LANG</td>
<td>This command causes the alternate language to become active and to be stored in nonvolatile memory. In this case, the commands are equivalent. After being shut off, the dc source will resume in the last-selected language when power is restored. The parameter must be either COMP or SCPI.</td>
<td>SYST:LANG</td>
</tr>
<tr>
<td>TEST?</td>
<td>This command causes the dc source to run selftest and report any detected failures. Data Representation: ZZZZD</td>
<td>*TST?</td>
</tr>
</tbody>
</table>
### Table B-2. COMPatibility Commands (continued)

<table>
<thead>
<tr>
<th>Compatibility Command</th>
<th>Description</th>
<th>Similar SCPI Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>UNMASK xxx</td>
<td>These commands determine the conditions that will set bits in the fault register, allowing the operator to define the conditions that will be reported as fault. Fault conditions can be enabled by sending the decimal equivalent of the total bit weight of all conditions to be enabled.</td>
<td>STAT:OPER:ENAB</td>
</tr>
<tr>
<td></td>
<td></td>
<td>STAT:QUES:ENAB *ESE</td>
</tr>
<tr>
<td>VOUT?</td>
<td>This command measures and returns the actual output voltage. Data Representation: ZZDD,DD; (ZD,DDD for 6634B only)</td>
<td>MEAS:VOLT?</td>
</tr>
<tr>
<td>VSET &lt;n&gt;</td>
<td>This command programs the output voltage. See Table 4-3 for the programming range of this command. Initial condition: 0 V</td>
<td>VOLT</td>
</tr>
</tbody>
</table>

A = Alpha
D = Digit
S = Sign (blank for positive and – for negative)
Z = Digit with leading zeros output as spaces

### Table B-3. COMPatibility Errors

<table>
<thead>
<tr>
<th>Error</th>
<th>Number</th>
<th>Error String [Description/Explanation/Examples]</th>
</tr>
</thead>
<tbody>
<tr>
<td>ERR 0</td>
<td></td>
<td>No error.</td>
</tr>
<tr>
<td>ERR 1</td>
<td>EEPROM</td>
<td>EEPROM save failed [Data write to non-volatile memory failed]</td>
</tr>
<tr>
<td>ERR 2</td>
<td></td>
<td>Second PON after power-on [More than one PON command received after power-on. Only one is allowed.]</td>
</tr>
<tr>
<td>ERR 4</td>
<td>RLYPON</td>
<td>RLYPON sent with no relay option present [A RLYPON command was sent with no relay option present.]</td>
</tr>
<tr>
<td>ERR 5</td>
<td></td>
<td>No relay option present [A relay option command was sent with no relay option present.]</td>
</tr>
<tr>
<td>ERR 8</td>
<td></td>
<td>Addressed to talk and nothing to say [The unit was addressed to talk without first receiving a query.]</td>
</tr>
<tr>
<td>ERR 10</td>
<td></td>
<td>Header expected [A non-alpha character was received when a header was expected.]</td>
</tr>
<tr>
<td>ERR 11</td>
<td>Unrecognized</td>
<td>Unrecognized header [The string of alpha characters received was not a valid command.]</td>
</tr>
<tr>
<td>ERR 20</td>
<td></td>
<td>Number expected [A non-numeric character was received when a number was expected.]</td>
</tr>
<tr>
<td>ERR 21</td>
<td>Number</td>
<td>Number Syntax [The numeric character received did not represent a proper number.]</td>
</tr>
<tr>
<td>ERR 22</td>
<td></td>
<td>Number out of internal range [The number received was too large or small to be represented in internal format.]</td>
</tr>
<tr>
<td>ERR 30</td>
<td></td>
<td>Comma [A comma was not received where one was expected.]</td>
</tr>
<tr>
<td>ERR 31</td>
<td></td>
<td>Terminator expected [A valid terminator was not received where one was expected.]</td>
</tr>
<tr>
<td>ERR 41</td>
<td>Parameter</td>
<td>Parameter Out [The number received exceeded the limits for its associated command.]</td>
</tr>
<tr>
<td>ERR 42</td>
<td></td>
<td>Voltage Programming Error [The programmed value exceeded the valid voltage limits.]</td>
</tr>
<tr>
<td>ERR 43</td>
<td></td>
<td>Current Programming Error [The programmed value exceeded the valid current limits.]</td>
</tr>
<tr>
<td>ERR 44</td>
<td></td>
<td>Overvoltage Programming Error [The programmed value exceeded the valid overvoltage limits.]</td>
</tr>
<tr>
<td>ERR 45</td>
<td></td>
<td>Delay Programming Error [The programmed value exceeded the valid delay limits.]</td>
</tr>
<tr>
<td>ERR 46</td>
<td></td>
<td>Mask Programming Error [The programmed value exceeded the fault mask limits.]</td>
</tr>
<tr>
<td>ERR 51</td>
<td>EEPROM</td>
<td>EEPROM Checksum [EEPROM failed, or a new uncalibrated EEPROM was installed.]</td>
</tr>
</tbody>
</table>
Figure B-1. COMpatibility Status Model

Table B-4. Bit Assignment of Status, Astatus, Fault, & Mask Registers

<table>
<thead>
<tr>
<th>Bit Position</th>
<th>11</th>
<th>10</th>
<th>9</th>
<th>8</th>
<th>7</th>
<th>6</th>
<th>5</th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bit Name</td>
<td>NORM</td>
<td>FAST</td>
<td>-CC</td>
<td>INH</td>
<td>ERR</td>
<td>OC</td>
<td>not used</td>
<td>OT</td>
<td>OV</td>
<td>UNR</td>
<td>+CC</td>
<td>CV</td>
</tr>
<tr>
<td>Bit Weight</td>
<td>2048</td>
<td>1024</td>
<td>512</td>
<td>256</td>
<td>128</td>
<td>64</td>
<td>32</td>
<td>16</td>
<td>8</td>
<td>4</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

CV = The unit is operating in constant voltage mode.
CC+ = The unit is operating in constant current mode.
UNR = The output of the unit is unregulated.
OV = The overvoltage protection circuit has tripped.
OT = The over-temperature protection circuit has tripped.
OC = The overcurrent protection circuit has tripped.
ERR = A programming error has occurred. Use ERR? to clear.
OC = The unit is operating in negative constant current mode.
INH = The external remote inhibit signal has turned the output off.
FAST = The output is in Fast operating mode. (Agilent 66332A, 6631B, 6632B, 6633B, 6634B only)
NORM = The output is in Normal operating mode. (Agilent 66332A, 6631B, 6632B, 6633B, 6634B only)

Table B-5. Bit Configuration of Serial Poll Register

<table>
<thead>
<tr>
<th>Bit Position</th>
<th>7</th>
<th>6</th>
<th>5</th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bit Name</td>
<td>not used</td>
<td>RQS</td>
<td>ERR</td>
<td>RDY</td>
<td>not used</td>
<td>not used</td>
<td>PON</td>
<td>FAU</td>
</tr>
<tr>
<td>Bit Weight</td>
<td>64</td>
<td>32</td>
<td>16</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

RQS = The dc source has generated a service request. Use a serial poll to clear.
ERR = Same as EFR bit in Status register. Use ERR? to clear.
RDY = This bit cleared when unit busy processing commands. Set when processing complete.
PON = A Power-on has occurred. Use CLR to clear.
FAU = A bit has been set in the Fault register. Use FAULT? to clear.
Error Messages

Error Number List

This appendix gives the error numbers and descriptions that are returned by the dc source. Error numbers are returned in two ways:

- Error numbers are displayed on the front panel
- Error numbers and messages are read back with the SYStem:ERRor? query. SYStem:ERRor? returns the error number into a variable and returns two parameters: an NR1 and a string.

The following table lists the errors that are associated with SCPI syntax errors and interface problems. It also lists the device dependent errors. Information inside the brackets is not part of the standard error message, but is included for clarification.

When errors occur, the Standard Event Status register records them as follows:

<table>
<thead>
<tr>
<th>Bit Set</th>
<th>Error Code</th>
<th>Error Type</th>
<th>Bit Set</th>
<th>Error Code</th>
<th>Error Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>-100 thru -199</td>
<td>Command</td>
<td>3</td>
<td>-300 thru -399 or 1 thru 32767</td>
<td>Device-dependent</td>
</tr>
<tr>
<td>4</td>
<td>200 thru -299</td>
<td>Execution</td>
<td>2</td>
<td>-400 thru -499</td>
<td>Query</td>
</tr>
</tbody>
</table>

### Table C-1. Error Numbers

<table>
<thead>
<tr>
<th>Error Number</th>
<th>Error String [Description/Explanation/Examples]</th>
</tr>
</thead>
<tbody>
<tr>
<td>-100</td>
<td>Command error [generic]</td>
</tr>
<tr>
<td>-101</td>
<td>Invalid character</td>
</tr>
<tr>
<td>-102</td>
<td>Syntax error [unrecognized command or data type]</td>
</tr>
<tr>
<td>-103</td>
<td>Invalid separator</td>
</tr>
<tr>
<td>-104</td>
<td>Data type error [e.g., “numeric or string expected, got block data”]</td>
</tr>
<tr>
<td>-105</td>
<td>GET not allowed</td>
</tr>
<tr>
<td>-108</td>
<td>Parameter not allowed [too many parameters]</td>
</tr>
<tr>
<td>-109</td>
<td>Missing parameter [too few parameters]</td>
</tr>
<tr>
<td>-112</td>
<td>Program mnemonic too long [maximum 12 characters]</td>
</tr>
<tr>
<td>-113</td>
<td>Undefined header [operation not allowed for this device]</td>
</tr>
<tr>
<td>-121</td>
<td>Invalid character in number [includes “9” in octal data, etc.]</td>
</tr>
<tr>
<td>-123</td>
<td>Numeric overflow [exponent too large; exponent magnitude &gt;32 k]</td>
</tr>
<tr>
<td>-124</td>
<td>Too many digits [number too long; more than 255 digits received]</td>
</tr>
<tr>
<td>-128</td>
<td>Numeric data not allowed</td>
</tr>
<tr>
<td>-131</td>
<td>Invalid suffix [unrecognized units, or units not appropriate]</td>
</tr>
<tr>
<td>-138</td>
<td>Suffix not allowed</td>
</tr>
</tbody>
</table>
## Table C-1. Error Numbers (continued)

<table>
<thead>
<tr>
<th>Error Number</th>
<th>Error String [Description/Explanation/Examples]</th>
</tr>
</thead>
<tbody>
<tr>
<td>-141</td>
<td>Invalid character data [bad character, or unrecognized]</td>
</tr>
<tr>
<td>-144</td>
<td>Character data too long</td>
</tr>
<tr>
<td>-148</td>
<td>Character data not allowed</td>
</tr>
<tr>
<td>-150</td>
<td>String data error</td>
</tr>
<tr>
<td>-151</td>
<td>Invalid string data [e.g., END received before close quote]</td>
</tr>
<tr>
<td>-158</td>
<td>String data not allowed</td>
</tr>
<tr>
<td>-160</td>
<td>Block data error</td>
</tr>
<tr>
<td>-161</td>
<td>Invalid block data [e.g., END received before length satisfied]</td>
</tr>
<tr>
<td>-168</td>
<td>Block data not allowed</td>
</tr>
<tr>
<td>-170</td>
<td>Expression error</td>
</tr>
<tr>
<td>-171</td>
<td>Invalid expression</td>
</tr>
<tr>
<td>-178</td>
<td>Expression data not allowed</td>
</tr>
<tr>
<td>-200</td>
<td>Execution error [generic]</td>
</tr>
<tr>
<td>-222</td>
<td>Data out of range [e.g., too large for this device]</td>
</tr>
<tr>
<td>-223</td>
<td>Too much data [out of memory; block, string, or expression too long]</td>
</tr>
<tr>
<td>-224</td>
<td>Illegal parameter value [device-specific]</td>
</tr>
<tr>
<td>-225</td>
<td>Out of memory</td>
</tr>
<tr>
<td>-270</td>
<td>Macro error</td>
</tr>
<tr>
<td>-272</td>
<td>Macro execution error</td>
</tr>
<tr>
<td>-273</td>
<td>Illegal macro label</td>
</tr>
<tr>
<td>-276</td>
<td>Macro recursion error</td>
</tr>
<tr>
<td>-277</td>
<td>Macro redefinition not allowed</td>
</tr>
<tr>
<td>-310</td>
<td>System error</td>
</tr>
<tr>
<td>-350</td>
<td>Too many errors [errors beyond 9 lost due to queue overflow]</td>
</tr>
<tr>
<td>-400</td>
<td>Query error [generic]</td>
</tr>
<tr>
<td>-410</td>
<td>Query INTERRUPTED [query followed by DAB or GET before response complete]</td>
</tr>
<tr>
<td>-420</td>
<td>Query UNTERMINATED [addressed to talk, incomplete programming message received]</td>
</tr>
<tr>
<td>-430</td>
<td>Query DEADLOCKED [too many queries in command string]</td>
</tr>
<tr>
<td>-440</td>
<td>Query UNTERMINATED [after indefinite response]</td>
</tr>
<tr>
<td>0</td>
<td>No error</td>
</tr>
<tr>
<td>1</td>
<td>Non-volatile RAM RDO section checksum failed</td>
</tr>
<tr>
<td>2</td>
<td>Non-volatile RAM CONFIG section checksum failed</td>
</tr>
<tr>
<td>3</td>
<td>Non-volatile RAM CAL section checksum failed</td>
</tr>
<tr>
<td>4</td>
<td>Non-volatile RAM STATE section checksum failed</td>
</tr>
<tr>
<td>5</td>
<td>Non-volatile RST section checksum failed</td>
</tr>
<tr>
<td>10</td>
<td>RAM selftest</td>
</tr>
<tr>
<td>11</td>
<td>VDAC/IDAC selftest 1</td>
</tr>
<tr>
<td>12</td>
<td>VDAC/IDAC selftest 2</td>
</tr>
<tr>
<td>13</td>
<td>VDAC/IDAC selftest 3</td>
</tr>
<tr>
<td>14</td>
<td>VDAC/IDAC selftest 4</td>
</tr>
<tr>
<td>15</td>
<td>OVDAC selftest</td>
</tr>
<tr>
<td>80</td>
<td>Digital I/O selftest error</td>
</tr>
<tr>
<td>Error Number</td>
<td>Error String [Description/Explanation/Examples]</td>
</tr>
<tr>
<td>--------------</td>
<td>-----------------------------------------------</td>
</tr>
<tr>
<td>213</td>
<td>Ingrid receiver buffer overrun</td>
</tr>
<tr>
<td>216</td>
<td>RS-232 receiver framing error</td>
</tr>
<tr>
<td>217</td>
<td>RS-232 receiver parity error</td>
</tr>
<tr>
<td>218</td>
<td>RS-232 receiver overrun error</td>
</tr>
<tr>
<td>220</td>
<td>Front panel uart overrun</td>
</tr>
<tr>
<td>221</td>
<td>Front panel uart framing</td>
</tr>
<tr>
<td>222</td>
<td>Front panel uart parity</td>
</tr>
<tr>
<td>223</td>
<td>Front panel buffer overrun</td>
</tr>
<tr>
<td>224</td>
<td>Front panel timeout</td>
</tr>
<tr>
<td>401</td>
<td>CAL switch prevents calibration</td>
</tr>
<tr>
<td>402</td>
<td>CAL password is incorrect</td>
</tr>
<tr>
<td>403</td>
<td>CAL not enabled</td>
</tr>
<tr>
<td>404</td>
<td>Computed readback cal constants are incorrect</td>
</tr>
<tr>
<td>405</td>
<td>Computed programming cal constants are incorrect</td>
</tr>
<tr>
<td>406</td>
<td>Incorrect sequence of calibration commands</td>
</tr>
<tr>
<td>407</td>
<td>CV or CC status is incorrect for this command</td>
</tr>
<tr>
<td>408</td>
<td>Output mode switch must be in NORMAL position</td>
</tr>
<tr>
<td>601</td>
<td>Too many sweep points</td>
</tr>
<tr>
<td>602</td>
<td>Command only applies to RS-232 interface</td>
</tr>
<tr>
<td>603</td>
<td>CURRent or VOLTage fetch incompatible with last acquisition</td>
</tr>
<tr>
<td>604</td>
<td>Measurement overrange</td>
</tr>
</tbody>
</table>
Example Programs

Introduction

The example programs in this section are intended to show how some of the same dc source functions can be programmed to each of the following GPIB interfaces:

1. HP Vectra FC controller with Agilent 82335A GPIB Interface Command Library
2. IBM PC controller with National Instruments GPIB-PCII Interface/Handler
3. Agilent controller with BASIC Language System

Assigning the GPIB Address in Programs

The dc source address cannot be set remotely. It must be set using the front panel Address key. Once the address is set, you can assign it inside programs. The following examples assume that the GPIB select code is 7, and the dc source is assigned to the variable PS.

1070 PS=706           !Agilent 82335A Interface
1070 ASSIGN @PS TO 706 !BASIC Interface

For systems using the National Instruments DOS driver, the address is specified in the software configuration program (IBCONFIG.EXE) and assigned a symbolic name. The address then is referenced only by this name within the application program (see the National Instruments GPIB documentation).

Types of DOS Drivers

The Agilent 82335A and National Instruments GPIB are two popular DOS drivers. Each is briefly described here. See the software documentation supplied with the driver for more details.

Agilent 82335A Driver

For GW-BASIC programming, the GPIB library is implemented as a series of subroutine calls. To access these subroutines, your application program must include the header file SETUP.BAS, which is part of the DOS driver software.

SETUP.BAS starts at program line 5 and can run up to line 999. Your application programs must begin at line 1000. SETUP.BAS has built-in error-checking routines that provide a method to check for GPIB errors during program execution. You can use the error-trapping code in these routines or write your own code using the same variables as used by SETUP.BAS.

National Instruments GPIB Driver

Your program must include the National Instruments header file DECL.BAS. This contains the initialization code for the interface. Prior to running any applications programs, you must set up the interface with the configuration program (IBCONF.EXE).
D - Example Programs

Your application program will not include the dc source's symbolic name and GPIB address.
These must be specified during configuration (when you run IBCONF.EXE). Note that the primary
address range is from 0 to 30 but any secondary address must be specified in the address range
of 96 to 126. The dc source expects a message termination on EOI or line feed, so set EOI with
last byte of Write. It is also recommended that you set Disable Auto Serial Polling.

All function calls return the status word IBSTA%, which contains a bit (ERR) that is set if the call
results in an error. When ERR is set, an appropriate code is placed in variable IBERR%. Be sure
to check IBSTA% after every function call. If it is not equal to zero, branch to an error handler that
reads IBERR% to extract the specific error.

Error Handling

If there is no error-handling code in your program, undetected errors can cause unpredictable
results. This includes “hanging up” the controller and forcing you to reset the system. Both of the
above DOS drivers have routines for detecting program execution errors. Error detection should
be used after every call to a subroutine.

BASIC Controllers

The BASIC Programming Language provides access to GPIB functions at the operating system
level. This makes it unnecessary to have the header files required in front of DOS applications
programs. Also, you do not have to be concerned about controller “hangups” as long as your
program includes a timeout statement. Because the dc source can be programmed to generate
SRQ on errors, your program can use an SRQ service routine for decoding detected errors. The
detectable errors are listed in Appendix C.

Example 1. HP Vectra PC Controller Using Agilent 82335 Interface

```plaintext
5 ' ---------------------- Merge SETUP.BAS here ----------------------
1000 MAX ELEMENTS=2 : ACTUAL ELEMENTS=0 : MAX LENGTH=80 : ACT LENGTH=0
1005 DIM OUTPUTS (2) : CODES$=SPACE$(40)
1010 ISC=7 : PS=706
1015 '
1020 ' Set up the DC Source Interface for DOS driver
1025 CALL IDORESET [ISC] ' Reset the interface
1030 IF PCIB.ERR <> NOERR THEN ERROR PCIB.BASERR
1035 TIMEOUT=3
1040 CALL IDOTIMEOUT (ISC, TIMEOUT) ' Set timeout to 3 seconds
1045 IF PCIB.ERR <> NOERR THEN ERROR PCIB.BASERR
1050 CALL ICTRLBAR [ISC] ' Clear the interface
1055 IF PCIB.ERR <> NOERR THEN ERROR PCIB.BASERR
1060 CALL IDOREMOTE (ISC) ' Set dc source to remote mode
1065 IF PCIB.ERR <> NOERR THEN ERROR PCIB.BASERR
1070 '
1075 ' Program dc source to CV mode with following voltage and current
1080 CODES$ = "VOLTAGE MAX\CURRENT MAX" : GOSUB 2000
```
Example Programs - D

1085 'Query dc source outputs CURRENT?" :GOSUB 2000 :GOSUB 3000
1090 VOUT = OUTPUTS(1)
1095 IOUT = OUTPUTS(2)
1100 PRINT "The output levels are " VOUT Volts and "IOUT" Amps"
1105 'Program triggered current level to value insufficient to maintain
1110 'supply within its CV operating characteristic
1115 CODES$ = "CURR:TRIG MIN" :GOSUB 2000
1120 'Set operation status mask to detect mode change from CV to CC
1125 CODES$ = "STAT:OPER:ENAB 1024;PTR 1024" :GOSUB 2000
1130 'Enable Status Byte OPER summary bit
1135 CODES$ = "SRE 128" :GOSUB 2000
1140 'Arm trigger circuit and send trigger to dc source
1145 CODES$ = "INITIATE:SEQUENCE:TRIGGER" :GOSUB 2000
1150 'Wait for supply to respond to trigger
1155 FOR I = 1 TO 100 :NEXT I
1160 'Poll for interrupt caused by change to CC mode and print to
1165 CALL IOGPOK (PS, RESPONSE)
1170 IF (RESPONSE AND 128) <> 128 THEN GOTO 1240 'No OPER event to
1175 CODES$ = "STATUS:OPER:EVEN?" :GOSUB 2000 'Query status oper
1180 'register
1185 CALL IOENTER (PS, EVENT)
1190 IF PCIB. ERR <> NOERR THEN ERROR PCIB.BASERR
1195 IF (EVENT AND 1024) = 1024 THEN PRINT "Supply switched to CC
1200 'Clear the status circuit
1205 CODES$ = "CLS" :GOSUB 2000
1210 FOR I = 1 TO 100 :NEXT I 'Wait for supply to
1215 'Disable output and save present state in location 2
1220 CODES$ = "OUTPUT OFF;"SAV 2" :GOSUB 2000
1225 END
1230 'Send command to dc source
1235 CALL IOOUTPUTS (PS, CODES$, LENGTH)
1240 'Send command to interface
1245 IF PCIB. ERR <> NOERR THEN ERROR PCIB.BASERR 'SETUP.BAS error
1250 trap
1255 RETURN
1260 'Get data from dc source
1265 CALL IOENTERA (PS, OUTPUTS(1), MAX. ELEMENTS, ACTUAL. ELEMENTS)
1270 IF PCIB. ERR <> NOERR THEN ERROR PCIB.BASERR
1275 RETURN
Example 2. IBM Controller Using National Interface

990 ' ------------------------- Merge DECL.BAS here -------------------------
1000 ' DC Source Variable = PS% ; Stand-Alone Address = 706
1005 CODESS=SPACE$(50);MODES=SPACE$(5);OEVENTS=SPACE$(20)
1010 DS=SPACE$(66);OUTPUTS=SPACE$(40);BDNAME$="PS%"
1015 DIM OUTP$(2)
1020 ' Set up dc source interface for DOS driver
1030 CALL IBFIND(BDNAME$,PS%)
1035 IF PS%>
1040 CALL IBCLR(PS%)
1045 ' Program dc source to CV mode with following voltage and current
1050 CODESS = "VOLTAGE MAX;CURRENT MAX" :GOSUB 2000
1060 ' Query dc source outputs and print to screen
1070 CODESS = "MEASURE:VOLTAGE?;CURRENT?" :GOSUB 2000 ;GOSUB 3000
1075 OUT = OUTPUT(1)
1080 OOUT = OUTPUT(2)
1085 PRINT"The programmed levels are "VOUT" Volts and "IOUT" Amps"
1090 '
1095 ' Program triggered current level to value insufficient to maintain
1100 ' supply within its CV operating characteristic
1105 CODESS = "CURRE:TRIG MIN" :GOSUB 2000
1110 ' Set operation status mask to detect mode change from CV to CC
1120 CODESS = "STAT:OPER:ENAB 1024;PTR 1024" :GOSUB 2000
1125 '
1130 ' Enable Status Byte OPER summary bit
1135 CODESS = "*SRE 128" :GOSUB 2000
1140 ' Arm trigger circuit and send trigger to dc source
1150 CODESS = "INITIATE:SEQUENCE:TRIGGER" :GOSUB 2000
1160 ' Wait for supply to respond to trigger
1165 FOR = 1 TO 100 :NEXT I
1170 ' Poll for interrupt caused by change to CC mode and print to screen
1175 SPOL%=0
1180 CALL IBSR$(PS%,SPOL$)
1190 IF (SPOL% AND 128) = 128 THEN POLL = 1 ' Set interrupt flag on
1195 OPER bit
1200 IF POLL <> 1 THEN GOTO 1230 ' No interrupt to
1205 ' Query status oper
1210 ' Read back event bit
1215 OEVENT=VAL(OEVENT$)
1220 IF (OEVENT AND 1024) = 1024 THEN PRINT "Supply switched to CC mode."
' Clear status circuit
CODES$ = "CLS" :GOSUB 2000
FOR I=1 TO 50 :NEXT I
' Wait for supply to clear
' Disable output and save present state to location 2
CODES$ = "OUTPUT OFF;SAV 2" :GOSUB 2000
END
' Send command to dc source
CALL IBWR (PS%, CODES$)
IF ISTAT% = 0 THEN RETURN
' Disable output and save present state to location 2
CODES$ = "OUTPUT OFF;SAV 2" :GOSUB 2000
END
' Send command to dc source
CALL IBRD (PS%, OUTPUT$)
IF IBSTAT% = 0 THEN RETURN
' Error detection routine
PRINT "SPIB error. ISTAT% = HEX$(IBSTAT%)
PRINT "IBERR% = "; IBERR%" in line ";BRL
STOP
' Get data from dc source
CALL IBRD (PS%, OUTPUT$)
IF IBSTAT% = 0 THEN RETURN
I=1
X=1
C=INSTR (I, OUTPUT$, ";")
D$=MID$(OUTPUT$, I, C-1)
OUTPUT (X) = VAL (D$)
I=C+1
C=INSTR (I, OUTPUT$, ";")
X=X+1
WEND
D$=RIGHT$(OUTPUT$, LEN(OUTPUT$)-(I-1))
OUTPUT (X) = VAL (D$)
OUTPUT$ = SPACES$ (40)
' Clear string
RETURN
D - Example Programs

Example 3. Controller Using BASIC

1000 !Do source at stand-alone address = 706
1010 OPTION BASE 1
1020 DIM Response$[80]
1030 ASSIGN @Ps TO 706
1040 CLEAR SCREEN
1050 !
1060 PRINT "Disconnect any load from output terminals and press
1070 CONTINUE..."
1080 PAUSE
1090 !
1100 !Program dc source with following voltage level and current limit
1110 OUTPUT @Ps;"VOLT MAX"
1120 OUTPUT @Ps;"CURR MAX"
1130 OUTPUT @Ps;"OUTP ON"
1140 !
1150 OUTPUT @Ps;"MEAS:VOLT?,CURR?"!Query output levels
1160 ENTER @Ps;Vout,Iout
1170 PRINT "The output levels are ";Vout;" Volts and ";Iout;" Amps"
1180 !
1190 !Program current triggered level to a value insufficient to maintain
1200 !supply within its CV operating characteristic
1210 OUTPUT @Ps;"CURR:TRIG MIN"
1220 !
1230 !Set operation status mask to detect mode change from CV to CC
1240 OUTPUT @Ps;"STAT:OPER:ENAB 1024;PTR 1024"
1250 !
1260 !Enable Status Byte OPER summary bit
1270 OUTPUT @Ps;"SRE 128"
1280 !
1290 !Arm trigger circuit and send trigger to dc source
1300 OUTPUT @Ps;"INIT:NAME TRAN"
1310 OUTPUT @Ps;"TRIGGER"
1320 !Poll for interrupt caused by change to CC mode and print to screen
1330 PRINT "Connect 1K ohm load and hit CONTINUE...
1340 PAUSE
1350 Response=POLL($Ps)
1360 IF NOT BIT(Response,7) THEN !No OPER event to report
1370 PRINT "Supply not in CC mode!!!"
1380 GOTO 1320
1390 END IF
1400 OUTPUT @Ps;"STAT:OPER:EVEN?"!Query status operation register
1410 ENTER @Ps;Event!Read back event bit
1420 IF BIT(0,Event,10) THEN PRINT "Supply switched to CC mode."
1430 !
1440 !Clear status
1450 OUTPUT @Ps;"CLS"
1460 !
1470 !Disable output and save present state in location 2
1480 OUTPUT @Ps;"OUTPUT OFF;SAY 2"
1490 PRINT "Program terminated."
1500 END
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Manual Updates

The following updates have been made to this manual since the December 1998 printing indicated on the Printing History page.

11/9/99

Information about installing VXIplug&play Power Products Instrument Drivers has been included in the beginning of chapter 2.

1/4/00

All references to HP have been changed to Agilent.

All references to HP-I8 have been changed to GPIB.
USER'S GUIDE
Dynamic Measurement DC Source
Agilent Model 66312A
System DC Power Supply
Agilent 6611C, 6612C, 6613C and 6614C

For instruments with Serial Numbers:
Agilent 66312A: US36310891 and up
Agilent 6611C: US37450101 and up
Agilent 6612C: US37460101 and up
Agilent 6613C: US37460101 and up
Agilent 6614C: US37460101 and up

Agilent Technologies
Innovating the HP Way

Agilent Part No. 5962-8194
Microfiche No. 5962-8195
Printed in USA: January 2000
Warranty Information

CERTIFICATION

Agilent Technologies certifies that this product met its published specifications at time of shipment from the factory. Agilent Technologies further certifies that its calibration measurements are traceable to the United States National Bureau of Standards, to the extent allowed by the Bureau’s calibration facility, and to the calibration facilities of other International Standards Organization members.

WARRANTY

This Agilent Technologies hardware product is warranted against defects in material and workmanship for a period of three years from date of delivery. Agilent software and firmware products, which are designated by Agilent for use with a hardware product and when properly installed on that hardware product, are warranted not to fail to execute their programming instructions due to defects in material and workmanship for a period of 90 days from date of delivery. During the warranty period Agilent Technologies will, at its option, either repair or replace products which prove to be defective. Agilent does not warrant that the operation for the software, firmware, or hardware shall be uninterrupted or error free.

For warranty service, with the exception of warranty options, this product must be returned to a service facility designated by Agilent. Customer shall prepay shipping charges by (and shall pay all duty and taxes) for products returned to Agilent for warranty service. Except for products returned to Customer from another country, Agilent shall pay for return of products to Customer.

Warranty services outside the country of initial purchase are included in Agilent’s product price, only if Customer pays Agilent international prices (defined as destination local currency price, or U.S. or Geneva Export price).

If Agilent is unable, within a reasonable time to repair or replace any product to condition as warranted, the Customer shall be entitled to a refund of the purchase price upon return of the product to Agilent.

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The foregoing warranty shall not apply to defects resulting from improper or inadequate maintenance by the Customer, Customer-supplied software or interfacing, unauthorized modification or misuse, operation outside of the environmental specifications for the product, or improper site preparation and maintenance. NO OTHER WARRANTY IS EXPRESSED OR IMPLIED. AGILENT SPECIFICALLY DISCLAIMS THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

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THE REMEDIES PROVIDED HEREIN ARE THE CUSTOMER'S SOLE AND EXCLUSIVE REMEDIES. AGILENT SHALL NOT BE LIABLE FOR ANY DIRECT, INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, WHETHER BASED ON CONTRACT, TORT, OR ANY OTHER LEGAL THEORY.

ASSISTANCE

The above statements apply only to the standard product warranty. Warranty options, extended support contacts, product maintenance agreements and customer assistance agreements are also available. Contact your nearest Agilent Technologies Sales and Service office for further information on Agilent’s full line of Support Programs.
Safety Summary

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

GENERAL

This product is a Safety Class I instrument (provided with a protective earth terminal). The protective features of this product may be impaired if it is used in a manner not specified in the operation instructions.

Any LEDs used in this product are Class I LEDs as per IEC 825-1.

ENVIRONMENTAL CONDITIONS

This instrument is intended for indoor use in an installation category II, pollution degree 2 environment. It is designed to operate at a maximum relative humidity of 95% and at altitudes of up to 2000 meters. Refer to the specifications tables for the ac mains voltage requirements and ambient operating temperature range.

BEFORE APPLYING POWER

Verify that the product is set to match the available line voltage, the correct fuse is installed, and all safety precautions are taken. Note the instrument's external markings described under "Safety Symbols".

GROUND THE INSTRUMENT

To minimize shock hazard, the instrument chassis and cover must be connected to an electrical ground. The instrument must be connected to the ac power mains through a grounded power cable, with the ground wire firmly connected to an electrical ground (safety ground) at the power outlet. Any interruption of the protective (grounding) conductor or disconnection of the protective earth terminal will cause a potential shock hazard that could result in personal injury.

ATTENTION: Un circuit de terre continu est essentiel en vue du fonctionnement sécuritaire de l'appareil. Ne jamais mettre l'appareil en marche lorsque le conducteur de mise ... la terre est d,branch.

FUSES

Only fuses with the required rated current, voltage, and specified type (normal blow, time delay, etc.) should be used. Do not use repaired fuses or short-circuited fuseholders. To do so could cause a shock or fire hazard.

DO NOT OPERATE IN AN EXPLOSIVE ATMOSPHERE

Do not operate the instrument in the presence of flammable gases or fumes.

DO NOT REMOVE THE INSTRUMENT COVER

Operating personnel must not remove instrument covers. Component replacement and internal adjustments must be made only by qualified service personnel.

Instruments that appear damaged or defective should be made inoperative and secured against unintended operation until they can be repaired by qualified service personnel.
<table>
<thead>
<tr>
<th>Safety Symbols</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>D D D D D D</td>
<td>Direct current</td>
</tr>
<tr>
<td>~ ~ ~ ~ ~ ~</td>
<td>Alternating current</td>
</tr>
<tr>
<td>⬇️ ⬆️ ⬇️ ⬆️</td>
<td>Both direct and alternating current</td>
</tr>
<tr>
<td>🌐 🌐 🌐 🌐</td>
<td>Three-phase alternating current</td>
</tr>
<tr>
<td>⚡ ⚡ ⚡ ⚡</td>
<td>Earth (ground) terminal</td>
</tr>
<tr>
<td>⚡ ⚡ ⚡ ⚡</td>
<td>Protective earth (ground) terminal</td>
</tr>
<tr>
<td>✡️ ✡️ ✡️ ✡️</td>
<td>Frame or chassis terminal</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>
</tr>
<tr>
<td>🔐 🔐 🔐 🔐</td>
<td>Terminal for Neutral conductor on permanently installed equipment</td>
</tr>
<tr>
<td>🔐 🔐 🔐 🔐</td>
<td>Terminal for Line conductor on permanently installed equipment</td>
</tr>
<tr>
<td>🔐 🔐 🔐 🔐</td>
<td>On (supply)</td>
</tr>
<tr>
<td>🔐 🔐 🔐 🔐</td>
<td>Off (supply)</td>
</tr>
<tr>
<td>🔐 🔐 🔐 🔐</td>
<td>Standby (supply). Units with this symbol are not completely disconnected from ac mains when this switch is off. To completely disconnect the unit from ac mains, either disconnect the power cord or have a qualified electrician install an external switch.</td>
</tr>
<tr>
<td>🔐 🔐 🔐 🔐</td>
<td>In position of a bi-stable push control</td>
</tr>
<tr>
<td>🔐 🔐 🔐 🔐</td>
<td>Out position of a bi-stable push control</td>
</tr>
<tr>
<td>🔴 🔴 🔴 🔴</td>
<td>Caution, risk of electric shock</td>
</tr>
<tr>
<td>🔴 🔴 🔴 🔴</td>
<td>Caution, hot surface</td>
</tr>
<tr>
<td>🔴 🔴 🔴 🔴</td>
<td>Caution (refer to accompanying documents)</td>
</tr>
</tbody>
</table>

**WARNING**
The WARNING sign denotes a hazard. It calls attention to a procedure, practice, or the like, which, if not correctly performed or adhered to, could result in personal injury. Do not proceed beyond a WARNING sign until the indicated conditions are fully understood and met.

**Caution**
The CAUTION sign denotes a hazard. It calls attention to an operating procedure, or the like, which, if not correctly performed or adhered to, could result in damage to or destruction of part or all of the product. Do not proceed beyond a CAUTION sign until the indicated conditions are fully understood and met.
DECLARATION OF CONFORMITY
according to ISO/IEC Guide 22 and EN 45014

Manufacturer's Name: Agilent Technologies

Manufacturer's Address: 140 Green Pond Road
Rockaway, New Jersey 07866
U.S.A.

declares that the Product

Product Name: a) Dynamic Measurement DC Source
              b) System DC Power Supply

Model Number: a) Agilent 66312A, 66312B
             b) Agilent 6612B, 6611C, 6612C, 6613C, 6614C

conforms to the following Product Specifications:


EMC:    CISPR 11:1990 / EN 55011:1991 - Group 1 Class B
        IEC 801-2:1991 / EN 50082-1:1992 - 4 kV CD, 8 kV AD
        IEC 801-3:1984 / EN 50082-1:1992 - 3 V / m
        IEC 801-4:1988 / EN 50082-1:1992 - 0.5 kV Signal Lines
              1 kV Power Lines

Supplementary Information:

The product herewith complies with the requirements of the Low Voltage Directive

Bruce Krueger / Quality Manager

European Contact: Your local Agilent Technologies Sales and Service Office or Agilent Technologies GmbH, Department TRE, Herrenberger Strasse 130, D-71034 Boeblingen (FAX:+49-7031-14-3143)
Acoustic Noise Information

Herstellerbescheinigung


* Schalldruckpegel $L_p < 70 \text{ dB(A)}$
* Am Arbeitsplatz
* Normaler Betrieb
* Nach EN 27779 (Typprüfung).

Manufacturer's Declaration

This statement is provided to comply with the requirements of the German Sound Emission Directive, from 18 January 1991.

* Sound Pressure $L_p < 70 \text{ dB(A)}$
* At Operator Position
* Normal Operation
* According to EN 27779 (Type Test).

Printing History

The edition and current revision of this manual are indicated below. Reprints of this manual containing minor corrections and updates may have the same printing date. Revised editions are identified by a new printing date. A revised edition incorporates all new or corrected material since the previous printing date.

Changes to the manual occurring between revisions are covered by change sheets shipped with the manual. In some cases, the manual change applies only to specific instruments. Instructions provided on the change sheet will indicate if a particular change applies only to certain instruments.

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Quick Reference

Agilent 66312A Dynamic Measurement DC Source and
Agilent 6611C/6612C/6613C/6614C System DC Power Supply

The Agilent 66312A is a 40 Watt, high performance dc power supply that provides dynamic measurement and analysis of voltage and current waveforms. It is designed to simplify the testing of digital cellular and mobile phones. For example, data acquired using its dynamic measurement capability can be used in determining the battery operating time of digital wireless communications products.

The Agilent 6611C, 6612C, 6613C and 6614C are 40 and 50 Watt, high performance dc power supplies with output current measurement capability in the microampere range. They are well suited for testing portable battery-powered products.

Additionally, the combination of bench-top and system features in these dc sources provide versatile solutions for your design and test requirements.

Convenient bench-top features
♦ Up to 50 Watts output power
♦ Easy to use knob for voltage and current settings
♦ Highly visible vacuum-fluorescent front panel display
♦ Excellent load and line regulation; low ripple and noise
♦ Measurement capability down to microampere levels
♦ Current sinking up to 30% of the rated current
♦ Instrument state storage
♦ Portable case

Flexible system features
♦ GPIB (IEEE-488) and RS-232 interfaces are standard
♦ SCPI (Standard Commands for Programmable Instruments) compatibility
♦ Triggered acquisition of digitized output current and voltage waveforms (Agilent 66312A only)
♦ I/O setup easily done from the front panel
The Front Panel - At a Glance

1. 14-character display shows output measurements and programmed values.
2. Annunciators indicate operating modes and status conditions.
3. Rotary control sets voltage, current, and menu parameters. Use ← and → to set the resolution; then adjust the value with the knob.

### The Front Panel

5. Turns the dc source on and off.
6. System keys:
   - return to Local mode
   - set the GPIB address
   - set the RS-232 interface
   - display SCPI error codes
   - save and recall instrument states.
7. Function keys:
   - enable/disable output
   - select metering functions
   - program voltage and current
   - set and clear protection functions
   - ↓ and ↑ scroll through the front panel menu commands.
8. Entry keys:
   - enter values
   - increment or decrement values
   - ← and → select front panel menu parameters.
   - ← and → select a digit in the numeric entry field.
Front Panel Number Entry

Enter numbers from the front panel using one of the following methods:

Use the arrow keys and knob to change voltage or current settings

NOTE The output must be ON to see the displayed values change in Meter mode.

Use the Function keys and knob to change the displayed settings

Use the arrow keys to edit individual digits in the displayed setting

- \( \uparrow \) Increments the flashing digit
- \( \downarrow \) Decrements the flashing digit
- \( \rightarrow \) Moves the flashing digit to the right
- \( \leftarrow \) Moves the flashing digit to the left
- Enter Enters the value when editing is complete

Use the Function keys and Entry keys to enter a new value

NOTE If you make a mistake, use the Backspace key to delete the number, or press the Meter key to return to meter mode.
Front Panel Annunciators

CV  CC  Unr  Dis  OCP  Prot  Cal  Shift  Rmt  Addr  Err  SRQ

| CV | The output is operating in constant voltage mode. |
| CC | The output is operating in constant current mode.  |
| Unr | The output is unregulated. |
| Dis | The output is OFF. Press the Output On/Off key to turn the output on. |
| OCP | The over-current protection state is ON. Press the OCP key to turn over-current protection off. |
| Prot | Indicates that the output has been disabled by one of the protection features. Press the Prot Clear key to clear the protection condition. |
| Cal | Calibration mode is ON. Scroll to the Cal Off command and press the Enter key to exit the calibration mode. |
| Shift | The Shift key has been pressed. |
| Rmt | The selected Remote programming interface (either GPIB or RS-232) is active. Press the Local key to return the unit to front panel control. |
| Addr | The interface is addressed to talk or listen. |
| Err | There is an error in the SCPI error queue. Press the Error key to view the error code. |
| SRQ | The interface is requesting service. |

Immediate Action Keys

<table>
<thead>
<tr>
<th>Output</th>
<th>A toggle switch that turns the output of the dc source on or off.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local</td>
<td>Activates front panel control when the unit is in remote mode (unless a Lockout command is in effect).</td>
</tr>
<tr>
<td>Shift</td>
<td>Resets the protection circuit and allows the unit to return to its last programmed state.</td>
</tr>
<tr>
<td>Shift OCP</td>
<td>A toggle switch that enables or disables overcurrent protection.</td>
</tr>
</tbody>
</table>
# Front Panel Menus - At a Glance

<table>
<thead>
<tr>
<th>Address</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ADDRESS 7</strong></td>
<td>Sets the GPIB Address</td>
</tr>
<tr>
<td><strong>INTF GPIB</strong></td>
<td>Selects an interface (GPIB or RS232)</td>
</tr>
<tr>
<td><strong>BAUDRATE 300</strong></td>
<td>Selects baud rate (300, 600, 1200, 2400, 4800, 9600)</td>
</tr>
<tr>
<td><strong>PARITY NONE</strong></td>
<td>Selects message parity (NONE, EVEN, ODD, MARK, SPACE)</td>
</tr>
<tr>
<td><strong>FLOW NONE</strong></td>
<td>Selects flow control (XON-XOFF, RTS-CTS, DTR-DSR, NONE)</td>
</tr>
<tr>
<td><strong>LANG SCPI</strong></td>
<td>Selects language (SCPI or COMP)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Recall</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>RCL 0</strong></td>
<td>Recalls instrument state</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Shift</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SAVE 0</strong></td>
<td>Saves present instrument state</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Shift</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ERROR 0</strong></td>
<td>Displays errors in SCPI error queue</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Meter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>12.000V 0.204A</td>
<td>Measures output voltage and current</td>
</tr>
<tr>
<td>12.500V MAX</td>
<td>Measures peak output voltage 1</td>
</tr>
<tr>
<td>1.000V MIN</td>
<td>Measures minimum output voltage 1</td>
</tr>
<tr>
<td>12.330V HIGH</td>
<td>Measures the high level of a voltage pulse waveform 1</td>
</tr>
<tr>
<td>0.080V LOW</td>
<td>Measures the low level of a voltage pulse waveform 1</td>
</tr>
<tr>
<td>12.000V RMS</td>
<td>Measures rms voltage 1</td>
</tr>
<tr>
<td>0.350A MAX</td>
<td>Measures peak output current 1</td>
</tr>
<tr>
<td>0.050A MIN</td>
<td>Measures minimum output current 1</td>
</tr>
<tr>
<td>0.400A HIGH</td>
<td>Measures the high level of a current pulse waveform 1</td>
</tr>
<tr>
<td>0.012A LOW</td>
<td>Measures the low level of a current pulse waveform 1</td>
</tr>
<tr>
<td>0.210A RMS</td>
<td>Measures rms current 1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Voltage</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>VCLT 20.000</td>
<td>Sets the output voltage</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Current</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CURR 2.000</td>
<td>Sets the output current</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Protect</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>OC -- -- --</td>
<td>Protection status (example shows overcurrent tripped)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Output</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>RST</strong></td>
<td>Places the dc source in the factory-default state</td>
</tr>
<tr>
<td><strong>ON:STATE RST</strong></td>
<td>Select the power-on state command (RST or RCL0)</td>
</tr>
<tr>
<td><strong>PROT:DLY 0.08</strong></td>
<td>Sets the output protection delay in seconds</td>
</tr>
<tr>
<td><strong>RI:LATCHING</strong></td>
<td>Sets the remote inhibit mode (LATCHING, LIVE, or OFF)</td>
</tr>
<tr>
<td><strong>DF:OFF</strong></td>
<td>Sets the discrete fault indicator state (ON or OFF)</td>
</tr>
<tr>
<td><strong>DF:SOUR OFF</strong></td>
<td>Selects the DF source (QUES, OPER, ESB, RMS, or OFF)</td>
</tr>
<tr>
<td><strong>PORT RIDFI</strong></td>
<td>Sets the output port functions (RIDFI or DIGIO)</td>
</tr>
<tr>
<td><strong>DIGIO 7</strong></td>
<td>Sets and reads the I/O port value (0 through 7)</td>
</tr>
<tr>
<td><strong>RELAY ON</strong></td>
<td>Sets the output relay state (ON or OFF) 2</td>
</tr>
<tr>
<td><strong>RELAY NORM</strong></td>
<td>Sets the output relay polarity (NORM or REV) 2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Shift</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>OV</strong></td>
<td>VOLT:PROT 22</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Shift</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CURR:RANG HIGH</strong></td>
<td>Sets current range (HIGH, LOW, or AUTO)</td>
</tr>
<tr>
<td><strong>CURR:DET ACDC</strong></td>
<td>Sets current measurement detector (ACDC or DC) 1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Shift</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CAL</strong></td>
<td>CAL ON</td>
</tr>
</tbody>
</table>

Use **∇** and **∇∇** to select menu parameters. Use **Meter** to exit any menu and return to metering mode.

1Not available on Agilent 6611C – 6614C or in Compatibility mode.
2Not available on Agilent 66312A.
SCPI Programming Commands - At a Glance

NOTE: Most [optional] commands have been omitted for clarity. Refer to the Programming Guide for a complete description of all programming commands.

ABORT
CALibrate
.:CURRent [:POSSive]
.:MEASURE :LOWRange
.:AC
.:DATA :
.:LEVEL P1 | P2 | P3 | P4
.:PASSWORD :
.:SAVE
.:STATE <bool> [ <nothing> ]
.:VOLTage :PROTection

DISPLAY
.<bool>
.:MODE NORMAL | TEXT
.:TEXT <display_string>

INITiate
.:SEQUence[1][2]
.:NAME TRANSient | ACQuire
.:CONTinuous :SEQUence[1]. <bool>
.:NAME TRANSient, <bool>

MEASure | FETCH
.:ARRray :CURRent?
.:VOLTage?
.:CURRent[1][DC]
.:ACDC?
.:HIGH?
.:LOW?
.:MAX?
.:MIN?
.:VOLTage[1][DC]
.:ACDC?
.:HIGH?
.:LOW?
.:MAX?
.:MIN?

OUTPUT
.<bool>
.:OPl <bool>
.:SOURce QUES | OPER | ESB | ROS | OFF
.:POW | RST | RCLR
.:PROTection :CLR
.:DELay <int>
.:RELay <STATE> [ <bool> ]
.:POLarity NORM | REV
.:RIM :MODE LATCHing | LIVE | OFF

SENSE
.:CURRent :RANGE <nothing>
.:DETermin ACDC | DC
.:FUNCTION "VOLT" | "CURR"
.:SWEep :OFFSet :POINTS <nothing>
.: POINTS <nothing>
.:TIMe <nothing>

[SOURCE:] CURRent <nothing>
.:TRIGgered <nothing>
.:PROTection :STATe <bool>

DIGial :DATA <nothing>
.:FUNCTION RIDF | DIG

VOLTage <nothing>
.:TRIGgered <nothing>
.:PROTection <nothing>

STATUS
.:PRESet
.:OPERation [ :EVENT ]?
.:CONDition?
.:ENABLE <nothing>
.:NTRan <nothing>
.:PTran <nothing>

SYSTEM
.:ERror <nothing>
.:LANGuage SCPI | COMPatibility
.:VERSIon
.:LOCal
.:REMote
.:RWElock

TRIGger
.:SEQUence 2 [ :ACQuire [ :IMMediate ] ]
.:COUNT .CURRent <nothing>
.:VOLTage <nothing>
.:HYSTeresis:CURRent <nothing>
.:VOLTage <nothing>
.:LEVEL .CURRent <nothing>
.:VOLTage <nothing>
.:SLOPe .CURRent | POS | NEG | EITH
.:VOLTage POS | NEG | EITH
.:SOURCe BUS | INTernal
.:SEQUence 1 :TRANsient[:IMMediate]
.:SOURCe BUS
.:SEQUence 1 :DEFine TRANSient
.:SEQUence 2 :DEFine ACQuire

1 Not available on Agilent 6611C - 6614C.
2 Fetch commands not available on Agilent 6611C - 6614C.
3 Not available on Agilent 66312A.
The Rear Panel - At a Glance

1. GPIB (IEEE-488) interface connector
2. RS-232 interface connector
3. INH/FLT (remote INHibit / internal FauLT) connector. Connector plug is removable.
4. Output and Remote sense connector. Connector plug is removable.
5. Remote or Local sense switch
6. Fuse holder
7. Power cord connector (IEC 320)

Use the front panel Address menu to
- Select the GPIB or RS-232 interface (see chapter 4 in User’s Guide)
- Select the GPIB bus address (see chapter 4 in User’s Guide)
- Configure the RS-232 interface (see chapter 4 in User’s Guide)
General Information

Document Orientation

This manual describes the operation of the Agilent Model 66312A Dynamic Measurement DC Source and the Agilent Model 6611C, 6612C 6613C and 6614C System DC Power Supplies. Unless otherwise noted, all units will be referred to by the description "dc source" throughout this manual. The following documents and software are shipped with your dc source:

- a User’s Guide (this document), contains installation, checkout, and front panel information
- a Programming Guide, contains detailed GPIB programming information

The following Getting Started Map will help you find the information you need to complete the specific task that you want to accomplish. Refer to the table of contents or index of each guide for a complete list of the information contained within.

<table>
<thead>
<tr>
<th>Getting Started Map</th>
<th>Where to find information</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Installing the unit</strong></td>
<td>User’s Guide</td>
</tr>
<tr>
<td>Line voltage connections</td>
<td></td>
</tr>
<tr>
<td>Computer connections</td>
<td></td>
</tr>
<tr>
<td>Load connections</td>
<td></td>
</tr>
<tr>
<td><strong>Checking out the unit</strong></td>
<td>User’s Guide</td>
</tr>
<tr>
<td>Verifying proper operation</td>
<td></td>
</tr>
<tr>
<td>Using the front panel</td>
<td></td>
</tr>
<tr>
<td>Calibrating the unit</td>
<td></td>
</tr>
<tr>
<td><strong>Using the front panel</strong></td>
<td>User’s Guide</td>
</tr>
<tr>
<td>Front panel keys</td>
<td></td>
</tr>
<tr>
<td>Front panel examples</td>
<td></td>
</tr>
<tr>
<td><strong>Using the programming interface</strong></td>
<td>User’s Guide</td>
</tr>
<tr>
<td>GPIB interface</td>
<td></td>
</tr>
<tr>
<td>RS-232 interface</td>
<td></td>
</tr>
<tr>
<td><strong>Programming the unit using SCPI (and Compatibility) commands</strong></td>
<td>Programming Guide</td>
</tr>
<tr>
<td>SCPI commands</td>
<td></td>
</tr>
<tr>
<td>SCPI programming examples</td>
<td></td>
</tr>
<tr>
<td>Compatibility language</td>
<td></td>
</tr>
<tr>
<td><strong>Installing the VXIplug&amp;play instrument driver</strong></td>
<td>Programming Guide</td>
</tr>
</tbody>
</table>

**NOTE:** The driver must be installed on your pc to access the on-line information. Drivers are available on the web at www.agilent.com/find/drivers.
Safety Considerations

This dc source is a Safety Class I instrument, which means it has a protective earth terminal. That terminal must be connected to earth ground through a power source equipped with a ground receptacle. Refer to the Safety Summary page at the beginning of this guide for general safety information. Before installation or operation, check the dc source and review this guide for safety warnings and instructions. Safety warnings for specific procedures are located at appropriate places in the guide.

Options and Accessories

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>87–106 Vac, 47–63 Hz</td>
</tr>
<tr>
<td>220</td>
<td>191–233 Vac, 47–63 Hz</td>
</tr>
<tr>
<td>230</td>
<td>207–253 Vac, 47–63 Hz</td>
</tr>
<tr>
<td>760</td>
<td>Isolation and polarity reversal relays (not available on Agilent 66312A)</td>
</tr>
<tr>
<td>ICM^1</td>
<td>Rack mount kit for one unit (p/n 5062-3972)</td>
</tr>
<tr>
<td>AXS^1</td>
<td>Rack mount kit for 2 side-by-side units. Consists of: Lock-link kit (p/n 5061-9694) and Flange kit (p/n 5062-3974)</td>
</tr>
<tr>
<td>AXU</td>
<td>Rack mount and slide kit for 2 side-by-side units of different depth. Consists of: Support shelf (p/n 5062-3996) and Slide kit (p/n 1494-0015)</td>
</tr>
<tr>
<td>AXV</td>
<td>Rack mount, slide kit, and support shelf for mounting one unit. Consists of: Fill panel (p/n 5062-4022), Support shelf (p/n 5062-3996), and Slide kit (p/n 1494-0015)</td>
</tr>
<tr>
<td>0BN</td>
<td>Service manual with extra operating manuals</td>
</tr>
</tbody>
</table>

1Support rails are required when rack mounting units. Use E3663A support rails for Agilent rack cabinets, and E3664A for non-Agilent rack cabinets.

<table>
<thead>
<tr>
<th>Item</th>
<th>Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>GPIB cables</td>
<td>10833A</td>
</tr>
<tr>
<td>1.0 meter (3.3 ft)</td>
<td>10833B</td>
</tr>
<tr>
<td>2.0 meters (6.6 ft)</td>
<td>10833C</td>
</tr>
<tr>
<td>4.0 meters (13.2 ft)</td>
<td>10833D</td>
</tr>
<tr>
<td>0.5 meters (1.6 ft)</td>
<td></td>
</tr>
<tr>
<td>RS-232 cable</td>
<td>34398A</td>
</tr>
<tr>
<td>(9-pin F to 9-pin F, 2.5 meter, null modem/printer cable with one 9-pin F to 25-pin F adapter)</td>
<td></td>
</tr>
<tr>
<td>RS-232 adapter kit (contains 4 adapters)</td>
<td>34399A</td>
</tr>
<tr>
<td>9-pin M to 25-pin M for pc or printer</td>
<td></td>
</tr>
<tr>
<td>9-pin M to 25-pin M for pc or printer</td>
<td></td>
</tr>
<tr>
<td>9-pin M to 25-pin M for modem</td>
<td></td>
</tr>
<tr>
<td>9-pin M to 9-pin M for modem</td>
<td></td>
</tr>
</tbody>
</table>

18
Description

Both the Agilent 66312A Dynamic Measurement DC Source and the Agilent 6611C, 6612C, 6613C and 6614C System DC Power Supplies combine two instruments in one unit. They include a dc source, which produces dc output with programmable voltage and current amplitude, and a highly accurate voltage and current meter, with the capability to measure very low-level currents. Additionally, the Agilent 66312A Dynamic Measurement DC Source has the ability to measure and characterize output voltage and current of pulse or ac waveforms.

Capabilities

- Output Voltage and Current control with 12-bit programming resolution
- Extensive measurement capability:
  - dc voltage and current.
  - rms and peak voltage and current (Agilent 66312A only).
  - 16-bit measurement resolution (low range accurate down to 2 microamperes).
  - Triggered acquisition of digitized current and voltage waveforms (Agilent 66312A only).
- Front panel control with 14-character vacuum fluorescent display, keypad, and rotary control for voltage and current settings.
- Built-in GPIB and RS-232 interface programming with SCPI command language.
- Non-volatile state storage and recall with SCPI command language.
- Over-voltage, over-current, over-temperature, and RI/DFI protection features.
- Extensive self-test, status reporting, and software calibration.

Front Panel Controls

The front panel has both rotary (RPG) and keypad controls for setting the output voltage and current. The panel display provides digital readouts of a number of output measurements. Annunciators display the operating status of the dc source. System keys let you perform system functions such as setting the GPIB address and recalling operating states. Front panel Function keys access the dc source function menus. Front panel Entry keys let you select and enter parameter values. Refer to chapter 5 for a complete description of the front panel controls.

Remote Programming

**NOTE:** When shipped, all units are set to the SCPI programming language. The language setting is saved in non-volatile memory.

To change the programming language from SCPI to Compatibility language, press the front panel **Address** key, use ▼ to scroll to the LANG command, press ◄ to select SCPI, then press **Enter**. Refer to the Programming Guide supplied with your dc source for further information about remote programming.

The dc source may be remotely programmed via the GPIB bus and/or from an RS-232 serial port. GPIB programming is with SCPI commands (Standard Commands for Programmable Instruments), which make the dc source programs compatible with those of other GPIB instruments. Compatibility commands are also included to make the dc source compatible with the Agilent 6632A, 6633A, and 6634A Series dc power supplies (refer to appendix D in the Programming Guide). Dc source status registers allow remote monitoring of a wide variety of dc source operating conditions.
Output Characteristic

The dc source’s output characteristic is shown in the following figure. The output of the dc source may be adjusted to any value within the boundaries shown.

![Output Characteristic Diagram]

**Figure 2-1. Dc Source Output Characteristic**

The dc source can operate in either constant voltage (CV) or constant current (CC) over the rated output voltage and current. Although the dc source can operate in either mode, it is designed as a constant voltage source. This means that the unit turns on in constant voltage mode with the output voltage rising to its Vset value. There is no command for constant current operation. The only way to turn the unit on in constant current mode is by placing a short across the output and then enabling or turning the output on.

Note that the dc source cannot be programmed to operate in a specific mode. After initial turn-on, the operating mode of the unit will be determined by the voltage setting, the current setting, and the load resistance. In figure 2-1, operating point 1 is defined by the load line traversing the positive operating quadrant in the constant voltage region. Operating point 2 is defined by the load line traversing the positive operating quadrant in the constant current region.

Figure 2-1 also shows a single range – two quadrant capability. This means that the dc source is capable of sourcing as well as sinking current over the output voltage range from zero volts to the rated maximum. The negative current sinking capability of the dc source is not programmable, and is fixed at a maximum of approximately 60% of Imax.

**NOTE:** If you attempt to operate the dc source beyond its output ratings, the output of the unit will become unregulated. This is indicated by the UNR annunciator on the front panel. The output may also become unregulated if the ac input voltage drops below the minimum rating specified in Appendix A.

Appendix A documents the dc source’s specifications and supplemental characteristics.
Installation

Inspection

Damage

When you receive your dc source, inspect it for any obvious damage that may have occurred during shipment. If there is damage, notify the shipping carrier and the nearest Agilent Sales and Support Office immediately. The list of Agilent Sales and Support Offices is at the back of this guide. Warranty information is printed in the front of this guide.

Packaging Material

Until you have checked out the dc source, save the shipping carton and packing materials in case the unit has to be returned. If you return the dc source for service, attach a tag identifying the model number and the owner. Also include a brief description of the problem.

Items Supplied

The following user-replaceable items are included with your dc source. Some of these items are installed in the unit.

<table>
<thead>
<tr>
<th>Item</th>
<th>Part Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power Cord</td>
<td>contact nearest Agilent Sales and Support Office</td>
<td>A power cord appropriate for your location.</td>
</tr>
<tr>
<td>Digital connector</td>
<td>1252-1488</td>
<td>A 4-terminal digital plug that connects to the back of the unit.</td>
</tr>
<tr>
<td>Output connector</td>
<td>0360-2604</td>
<td>A 5-terminal plug that connects to the back of the unit.</td>
</tr>
<tr>
<td>Line Fuse</td>
<td>2110-0633</td>
<td>2.5 AT (time delay) for 100/120 Vac operation</td>
</tr>
<tr>
<td></td>
<td>2110-0788</td>
<td>1.25 AT (time delay) for 220/230 Vac operation</td>
</tr>
<tr>
<td>Feet</td>
<td>5041-8801</td>
<td>feet for bench mounting</td>
</tr>
<tr>
<td>Programming Guide</td>
<td>5962-8198</td>
<td>Contains detailed GPIB programming information.</td>
</tr>
</tbody>
</table>

Cleaning

Use a dry cloth or one slightly dampened with water to clean the external case parts. Do not attempt to clean internally.

**WARNING:** To prevent electric shock, unplug the unit before cleaning.
Location

Figure 3-1 gives the dimensions of your dc source. The dc source must be installed in a location that allows sufficient space at the sides and back for adequate air circulation (see Bench Operation).

NOTE: This dc source generates magnetic fields that may affect the operation of other instruments. If your instrument is susceptible to operating magnetic fields, do not locate it in the immediate vicinity of the dc source. Typically, at three inches from the dc source, the electromagnetic field is less than 5 gauss. Many CRT’s, such as those used in computer displays, are susceptible to magnetic fields much lower than 5 gauss. Check susceptibility before mounting any display near the dc source.

Bench Operation

A fan cools the dc source by drawing air in through the sides and exhausting it out the back. Minimum clearances for bench operation are 1 inch (25 mm) along the sides. Do not block the fan exhaust at the rear of the unit.

Rack Mounting

The dc source can be mounted in a standard 19-inch rack panel or cabinet. Table 2-1 documents the Agilent part numbers for the various rack mounting options that are available for the dc source. Installation instructions are included with each rack mount option.

NOTE: Support rails or an instrument shelf is required when rack mounting units.

Figure 3-1. Outline Diagram
Input Connections

Connect the Power Cord

1. Unscrew the line fuse cap from the rear panel and verify that the fuse rating matches what is specified on the FUSES label on the rear panel. Reinstall the fuse. (See table 3-1 for fuse part numbers.)

2. Connect the power cord to the IEC 320 connector on the rear of the unit. If the wrong power cord was shipped with your unit, contact your nearest Agilent Sales and Support Office (refer to the list at the back of this guide) to obtain the correct cord.

Output Connections

The output connector has a termination for the + and − output, the + and − sense terminals, and an earth ground terminal. The 5-pin connector is removable and accepts wires sizes from AWG 22 to AWG 12. Disconnect the mating plug from the unit by pulling it straight back.

**Front panel binding posts** are available to connect load wires for bench operation. The front panel binding posts are paralleled with the rear panel + and − connections. **Before using the front panel binding posts, make sure that the sense switch on the back of the unit is set to Local.**

**NOTE:** Front panel binding posts are provided for convenience. Only the rear panel terminals are optimized for noise, regulation, and transient response as documented in Appendix A.

Wire Considerations

To minimize the possibility of instability on the output,

* keep load leads as short as possible
* bundle or twist the leads tightly together to minimize inductance

Current Ratings

**Fire Hazard** To satisfy safety requirements, load wires must be large enough not to overheat when carrying the maximum short-circuit current of the dc source. If there is more than one load, then any pair of load wires must be capable of safely carrying the full-rated current of the dc source.

The following table lists the characteristics of AWG (American Wire Gage) copper wire.

<table>
<thead>
<tr>
<th>Table 3-2. Ampacity and Resistance of Stranded Copper Conductors</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>AWG No.</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>-------------</td>
</tr>
<tr>
<td>20</td>
</tr>
<tr>
<td>18</td>
</tr>
<tr>
<td>16</td>
</tr>
<tr>
<td>14</td>
</tr>
<tr>
<td>12</td>
</tr>
</tbody>
</table>
3 - Installation

**Voltage Drops**

The load wires must also be large enough to avoid excessive voltage drops due to the impedance of the wires. In general, if the wires are heavy enough to carry the maximum short circuit current without overheating, excessive voltage drops will not be a problem. The voltage drops across the load wires should be limited to less than two volts. Refer to Table 3-2 to calculate the voltage drop for some commonly used AWG copper wire.

**Multiple Load Connections**

When the unit is in local sensing mode and you are connecting multiple loads to the output, connect each load to the output terminals using separate load leads. This minimizes mutual coupling effects and takes full advantage of the dc source's low output impedance. Each pair of wires should be as short as possible and twisted or bundled to reduce lead inductance and noise pickup.

If cabling considerations require the use of distribution terminals that are located remotely from the dc source, connect the dc source's output terminals to the remote distribution terminals by a pair of twisted or bundled wires. Connect each load to the distribution terminals separately. Remote voltage sensing is recommended under these circumstances. Sense either at the remote distribution terminals, or if one load is more sensitive than the others, sense directly at the critical load.

![Figure 3-2. Multiple Load Connections](image)
Remote Sense Connections

Under normal operation, the dc source senses the output voltage at the output terminals on the back of the unit. External sense terminals are available on the back of the unit that allow the output voltages to be sensed at the load, compensating for impedance losses in the load wiring. You cannot remote sense at the front panel binding posts.

The output connector accepts wires sizes from AWG 22 to AWG 12. Disconnect the mating plug to make your wiring connections. When the sense wire connections are complete, set the Remote/Local switch on the back of the unit to Remote (switch is out).

Sense Leads

The sense leads are part of the dc source’s feedback path and must be kept at a low resistance (less than several ohms) to maintain optimal performance. Connect the sense leads carefully so that they do not become open-circuited. If the sense leads are left unconnected or become open during operation, the dc source will regulate at the output terminals, resulting in a 3% to 5% increase in output over the programmed value. Shorting the sense leads trips the OVP circuit.

NOTE: It is good engineering practice to twist and shield all signal wires to and from the sense connectors. Connect the shield at the dc source end only. Do not use the shield as one of the sensing conductors.

Figure 3-3. Remote Sense Connections
3 - Installation

The overvoltage protection circuit senses voltage near the output terminals, not at the load. Therefore the signal sensed by the OVP circuit can be significantly higher than the actual voltage at the load. When using remote sensing, you must program the OVP trip voltage high enough to compensate for the voltage drop between the output terminals and the load. Also, if the sum of the programmed voltage and the load-lead drop exceeds the dc source’s maximum voltage rating, this may also trip the OVP protection circuit.

Stability

When the unit is configured for remote sensing, it is possible for the impedance of the load wires and the capacitance of the lead to form a filter, which becomes part of the unit’s feedback loop. This can degrade the unit’s stability and result in poor transient response performance. In extreme cases it may also cause oscillations. The wiring guidelines previously discussed under “Wire Considerations” will eliminate most stability problems associated with load lead inductance. If additional measures are required:
- keep the load capacitance as small as possible
- use larger diameter load wires to reduce resistance

OVP Considerations

The dc source’s OVP circuit contains a crowbar SCR, which effectively shorts the output of the dc source whenever the OVP trips. If an external voltage source such as a battery is connected across the output and the OVP is inadvertently triggered, the SCR will continuously sink a large current from the battery, possibly damaging the dc source.

To avoid this, program the OVP setting to its maximum value to prevent it from inadvertently tripping. Additionally, an internal fuse is connected in series with the SCR. When this fuse is triggered, the SCR will open to prevent large currents from damaging the SCRs. If this internal fuse has opened, the FS status annunciator will be set. Refer to the Service Manual for instructions about replacing this fuse.

In addition, the OVP circuit’s SCR crowbar has been designed to discharge capacitances up to a specific limit. This limit is:

- Agilent 6611C: 127,000 µF.
- Agilent 6612C and 6612A: 50,000 µF.
- Agilent 6613C: 20,000 µF.
- Agilent 6614C: 10,000 µF.

If your load capacitance approaches this limit, it is recommended that you do not intentionally trip the OVP and discharge the capacitance through the SCR as part of your normal testing procedure, as this may lead to long-term failure of some components.

INH/FLT Connections

This rear panel connector, has a fault output port and an inhibit input port. The fault (FLT) output, also referred to as the DII (discrete fault indicator) signal in the front panel and SCPI commands, is an open collector circuit that pulls the positive output low with respect to the negative (chassis-referenced) common. The high impedance inhibit (INH) input, also referred to as the RI (remote inhibit) signal in the front panel and SCPI commands, is used to shut down the power supply output whenever the INH + is pulled low with respect to the INH (chassis-referenced) common.

The connector accepts wires sizes from AWG 22 to AWG 12. Disconnect the mating plug to make your wire connections.
NOTE: It is good engineering practice to twist and shield all signal wires to and from the digital connectors. If shielded wire is used, connect only one end of the shield to chassis ground to prevent ground loops.

Figure 3-4 shows how you can connect the FLT/INH circuits of the dc source.

**In example A,** the INH input connects to a switch that shorts the Inhibit pin (+) to common whenever it is necessary to disable output of the unit. This activates the remote inhibit (RI) circuit, which turns off the dc output. The front panel Prot annunciator comes on and the RI bit is set in the Questionable Status Event register. To re-enable the unit, first open the connection between pins INH + and common and then clear the protection circuit. This can be done either from the front panel or over the GPIB/RS-232.

**In example B,** the FLT output of one unit is connected to the INH input of another unit. A fault condition in one of the units will disable all of them without intervention either by the controller or external circuitry. The controller can be made aware of the fault via a service request (SRQ) generated by the Questionable Status summary bit. Note that the FLT output can also be used to drive an external relay circuit or signal other devices whenever a user-definable fault occurs.

---

*Figure 3-4. FLT/INH Examples*
3 - Installation

Digital I/O Connections

As shown in Table 3-3 and Figure 3-5, the FLT/INH connector can also be configured as a digital I/O port. Information on programming the digital I/O port is found in chapter 5 and under [SOURce:]DIGital:DATA and [SOURce:]DIGital:FUNCtion commands in the Programming Guide. The electrical characteristics of the digital connector are described in appendix A.

<table>
<thead>
<tr>
<th>PIN</th>
<th>FAULT/INHIBIT</th>
<th>DIGITAL I/O</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>FLT Output</td>
<td>Output 0</td>
</tr>
<tr>
<td>2</td>
<td>FLT Common</td>
<td>Output 1</td>
</tr>
<tr>
<td>3</td>
<td>INH Input</td>
<td>Input/Output 2</td>
</tr>
<tr>
<td>4</td>
<td>INH Common</td>
<td>Common</td>
</tr>
</tbody>
</table>

Table 3-3. FLT/INH DIGital I/O Connector

**Figure 3-5. Digital I/O Examples**

**Controller Connections**

The dc source connects to a controller either through an GPIB or an RS-232 connector.

**GPIB Interface**

Each dc source has its own GPIB bus address, which can be set using the front panel **Address** key as described in chapter 5. GPIB address data is stored in non-volatile memory. The dc source is shipped with its GPIB address set to 5.

Dc sources may be connected to the GPIB interface in series configuration, star configuration, or a combination of the two, provided the following rules are observed:
The total number of devices including the controller is no more than 15.

The total length of all cables used is no more than 2 meters times the number of devices connected together, up to a maximum of 20 meters. (Refer to table 2-2 for a list of GPIB cables available from Agilent Technologies.)

Do not stack more than three connector blocks together on any GPIB connector.

Make sure all connectors are fully seated and the lock screws are firmly finger-tightened.

RS-232 Interface

The dc source has an RS-232 programming interface, which is activated by commands located in the front panel **Address** menu. All SCPI and COMPatibility commands are available through RS-232 programming. When the RS-232 interface is selected, the GPIB interface is disabled.

The RS-232 connector is a DB-9, male connector. Adapters are available to connect the dc source to any computer or terminal with a properly configured DB-25 connector (see Table 2-2).

![Figure 3-6. RS-232 Connector](image)

<table>
<thead>
<tr>
<th>Pin</th>
<th>Input/Output</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>-</td>
<td>no connection</td>
</tr>
<tr>
<td>2</td>
<td>Input</td>
<td>Receive Data (RxD)</td>
</tr>
<tr>
<td>3</td>
<td>Output</td>
<td>Transmit Data (TxD)</td>
</tr>
<tr>
<td>4</td>
<td>Output</td>
<td>Data Terminal Ready (DTR)</td>
</tr>
<tr>
<td>5</td>
<td>Common</td>
<td>Signal ground</td>
</tr>
<tr>
<td>6</td>
<td>Input</td>
<td>Data Set Ready (DSR)</td>
</tr>
<tr>
<td>7</td>
<td>Output</td>
<td>Request to Send (RQS)</td>
</tr>
<tr>
<td>8</td>
<td>Input</td>
<td>Clear to Send (CTS)</td>
</tr>
<tr>
<td>9</td>
<td>-</td>
<td>no connection</td>
</tr>
</tbody>
</table>
Turn-On Checkout

Introduction

Successful tests in this chapter provide a high degree of confidence that the dc source is operating properly. For verification tests, see appendix B. Complete performance tests are given in the Service Guide.

NOTE: This chapter provides a preliminary introduction to the dc source front panel. See chapter 5 for more details.

Using the Keypad

(shift) Some of the front panel keys perform two functions, one labeled in black and the other in blue. You access the blue function by first pressing the blue shift key. Release the key after you press it. The Shift annunciator will be on, indicating that you have access to any key’s shifted function.

Enter Number

These keys let you scroll up and down through the choices in the presently selected function menu. All menu lists are circular; you can return to the starting position by continuously pressing either key.

and These keys let you select the previous or the next parameter for a specific command. If the command has a numeric range, these keys increment or decrement the existing value. In meter mode, these keys can be used to adjust the magnitude of the output voltage or current. Only the flashing digit is changed by these keys. Use the and keys to move the flashing digit.

and These Entry keys move the flashing digit in a numeric entry field to the right or left. This lets you increment or decrement a specific digit in the entry field using the and keys or the rotary control knob.

Back space

The backspace key is an erase key. If you make a mistake entering a digit and have not yet pressed Enter, you can delete the digit by pressing Backspace. Delete more digits by repeatedly pressing this key.

Enter

Executes the entered value or parameter of the presently accessed command. Until you press this key, the parameters you enter with the other keys are displayed but not entered into the dc source. After pressing Enter, the dc source returns to Meter mode.
Checkout Procedure

The tests in this section checks for output voltage and current on the dc source.

NOTE: To perform the checkout procedure, you will need a wire for shorting the output terminals together.

The following procedure assumes that the unit turns on in the factory-default state. If you need more information about the factory default state, refer to the *RST command in chapter 4 of the Programming Guide. Note that the values shown in the Display column may not exactly match the values that appear on the front panel of your unit.

If you have not already done so, connect the power cord to the unit and plug it in.

<table>
<thead>
<tr>
<th>Model</th>
<th>Voltage</th>
<th>OV Prot</th>
<th>Current</th>
<th>Note:</th>
</tr>
</thead>
<tbody>
<tr>
<td>6611C</td>
<td>8</td>
<td>12</td>
<td>5</td>
<td>The checkout procedure is written for models 6612C and 66312A.</td>
</tr>
<tr>
<td>6612C/66312A</td>
<td>20</td>
<td>22</td>
<td>2</td>
<td>If you have another model, enter the correct values from the table.</td>
</tr>
<tr>
<td>6613C</td>
<td>50</td>
<td>55</td>
<td>1</td>
<td>where the procedure calls for an &lt;input&gt;.</td>
</tr>
<tr>
<td>6614C</td>
<td>100</td>
<td>110</td>
<td>0.5</td>
<td></td>
</tr>
</tbody>
</table>

### Table 4-1. Checkout Programming Values

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Display</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Turn the unit on. The dc source undergoes a self-test when you first turn it on.</td>
<td>*******ADDRESS 5 0.002V .0006A</td>
<td>During selftest, all display segments are briefly lit, followed by the GPIB Address. The display then goes into meter mode with the Dis annunciator on, and all others off. In Meter mode the *******V digits indicate the output voltage and the *******A digits indicate the output current. The flashing digit on the display indicates the digit that will be affected if changes are made to the displayed values using the rotary control or the ↑ and ↓ keys. You will only see the changes if the output is ON.</td>
</tr>
</tbody>
</table>

NOTE: Press the Meter key to exit a menu at any time and return to meter mode. If the Err annunciator on the display is on, press the Shift key followed by the Error key to see the error number. See table 4-2 at the end of this chapter.

2. Check that the dc source fan is on
   
   You should be able to hear the fan and feel the air coming from the back of the unit.

3. Press Voltage, Enter Number, <2, 0>, Enter
   
   VOLT 0.000
   
   VOLT <20>

   Programs the output to 20 volts. After the value is entered, the display returns to Meter mode. Because the output has not been enabled, the meter still indicates approximately 0 volts.

4. Press Output On/Off
   
   <20.003>V
   
   0.0006A

   Turns the output on. The Dis annunciator should be off and CV should be on.

5. Press Shift, OV
   
   VOLT:PROT
   
   <22.00>

   Display shows the overvoltage protection trip voltage for your unit.
<table>
<thead>
<tr>
<th>Procedure</th>
<th>Display</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>6. Press <strong>Enter Number, 8, Enter</strong></td>
<td>VOLT: PROT 8</td>
<td>Programs the OVP to 8 volts, which is less than the previously set output voltage.</td>
</tr>
<tr>
<td></td>
<td><strong>0.449V  0.145A</strong></td>
<td>Because the OVP voltage entered was less than the output voltage, the OVP circuit tripped. The output dropped to zero, CV turned off, and Prot turned on.</td>
</tr>
<tr>
<td>7. Press <strong>Shift, OV, Enter Number, &lt;2, 2&gt;, Enter</strong></td>
<td>VOLT: PROT &lt;22&gt;</td>
<td>Programs the OVP to a value greater than the output voltage setting of the unit. This prevents the OV circuit from tripping again when the protection condition is cleared.</td>
</tr>
<tr>
<td>8. Press <strong>Shift, Prot Clear</strong></td>
<td>&lt;20.003&gt;V 0.0034A</td>
<td>Clears the protection condition, thus restoring the output of the unit. Prot turns off and CV turns on.</td>
</tr>
<tr>
<td>9. Press <strong>Output on/off</strong></td>
<td></td>
<td>Turn the output off.</td>
</tr>
<tr>
<td>10. Connect a jumper wire across the + and - output terminals.</td>
<td></td>
<td>Shorts the output of the unit.</td>
</tr>
<tr>
<td>11. Press <strong>Output on/off</strong></td>
<td><strong>0.0005V &lt;0.2005&gt;A</strong></td>
<td>The CC annunciator is on, indicating that the unit is in constant current mode. The unit is sourcing output current at 10% of the maximum rating (the default output current limit setting).</td>
</tr>
<tr>
<td>12. Press <strong>Current, Enter Number, &lt;2&gt;, Enter.</strong></td>
<td><strong>0.0452V &lt;1.998&gt;A</strong></td>
<td>Programs the output current to &lt;2&gt; amperes.</td>
</tr>
<tr>
<td>13. Press <strong>Shift, OCP</strong></td>
<td><strong>0.0005V 0.0003A</strong></td>
<td>You enabled the overcurrent protection circuit. The circuit then tripped because the unit was operating in constant current mode. The CC annunciator turns off and the OCP and Prot annunciators come on.</td>
</tr>
<tr>
<td>14. Press <strong>Shift, OCP</strong></td>
<td><strong>0.0005V 0.0003A</strong></td>
<td>You have disabled the overcurrent protection circuit. The OCP annunciator turns off.</td>
</tr>
<tr>
<td>15. Press <strong>Shift, Prot Clear</strong></td>
<td><strong>0.0452V &lt;1.998&gt;A</strong></td>
<td>Restores the output. The Prot annunciator turns off. CC is on.</td>
</tr>
<tr>
<td>16. Turn the unit off and remove the shorting wire from the output terminals.</td>
<td></td>
<td>The next time the unit turns on it will be restored to the *RST or factory default state.</td>
</tr>
</tbody>
</table>
In Case of Trouble

Error Messages

DC source failure may occur during power-on selftest or during operation. In either case, the display may show an error message that indicates the reason for the failure.

Selftest Errors

Pressing the Shift, Error keys will show the error number. Selftest error messages appear as: ERROR <n> where "n" is a number listed in the following table. If this occurs, turn the power off and then back on to see if the error persists. If the error message persists, the DC source requires service.

<table>
<thead>
<tr>
<th>Error No.</th>
<th>Failed Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Error 0</td>
<td>NC error</td>
</tr>
<tr>
<td>Error 1</td>
<td>Non-volatile RAM RD0 section checksum failed</td>
</tr>
<tr>
<td>Error 2</td>
<td>Non-volatile RAM CONFIG section checksum failed</td>
</tr>
<tr>
<td>Error 3</td>
<td>Non-volatile RAM CAL section checksum failed</td>
</tr>
<tr>
<td>Error 4</td>
<td>Non-volatile RAM STATE section checksum failed</td>
</tr>
<tr>
<td>Error 5</td>
<td>Non-volatile RST section checksum failed</td>
</tr>
<tr>
<td>Error 10</td>
<td>RAM selftest</td>
</tr>
<tr>
<td>Error 11 to 14</td>
<td>VDAC/IDAC selftest 1 to 4</td>
</tr>
<tr>
<td>Error 15</td>
<td>OVDAC selftest</td>
</tr>
<tr>
<td>Error 80</td>
<td>Digital I/O selftest error</td>
</tr>
</tbody>
</table>

Table 4-2. Power-On Selftest Errors

Runtime Error Messages

Appendix C lists other error messages that may appear at runtime. If the front panel display shows OVLD, this indicates that the output voltage or current is beyond the range of the meter readback circuit. If the front panel display indicates -- -- -- -- -- -- --, an GPIB measurement is in progress.

Line Fuse

If the DC source appears "dead" with a blank display and the fan not running, check your power source to be certain line voltage is being supplied to the DC source. If the power source is normal, the DC source fuse may be defective.

1. Turn off the front panel power switch and unplug the power cord.
2. Remove the fuse from the rear panel.
3. If the fuse is defective, replace it with a fuse of the same type (see "Input Connections" in chapter 3).
4. Turn on the DC source and check the operation.

NOTE: If the DC source has a defective fuse, replace it only once. If it fails again, the DC source requires service.
Front panel Operation

Introduction

Here is what you will find in this chapter:

* a complete description of the front panel controls
* front panel programming examples

NOTE: The dc source must be in set to Local mode to use the front panel controls. Press the Local key on the front panel to put the unit in local mode.

Front Panel Description

Figure 5-1. Front Panel, Overall View
5 - Front Panel Operation

① Display
14-character vacuum fluorescent display for showing output measurements and programmed values.

② Annunciators
Annunciators light to indicate operating modes and status conditions:
CV  The dc source output is in constant-voltage mode.
CC  The dc source output is in constant-current mode.
Unr The dc source output is in an unregulated state.
Dis The dc source output is disabled (off).
OCP The overcurrent protection state is enabled.
Prot One of the dc source’s output protection features is activated.
Cal The dc source is in calibration mode.
Shift The Shift key is pressed to access an alternate key function.
Rmt The selected interface (GPIB or RS-232) is in a remote state.
Addr The interface is addressed to talk or to listen.
Err There is a message in the SCPI error queue.
SRQ The interface is requesting service from the controller.

③ Rotary Control
The rotary control lets you set the output voltage or current as well as menu parameters. Press ◀ and ▶ to select the resolution, then adjust the value with the knob.

④ Output Connectors
Front panel binding posts let you connect loads to the front of the unit.
Before using the front panel binding posts, make sure that the sense switch on the back of the unit is set to Local.

⑤ Line
This turns the dc source on or off.

⑥ System Keys
The system keys let you:
Return to Local mode (front panel control)
Set the dc source GPIB address
Set the RS-232 interface communication baud rate and parity bit
Display SCPI error codes and clear the error queue
Save and recall up to 4 instrument operating configurations

⑦ Function Keys
Function access command menus that let you:
Enable or disable the output
Select metering functions
Program output voltage and current
Display the protection status state
Set and clear protection functions
Set the output state at power-on
Calibrate the dc source
▲ and ▼ scroll through the front panel menu commands

⑧ Entry Keys
Entry keys let you:
Enter programming values
Increment or decrement programming values
▲ and ▼ select the front panel menu parameters
System Keys

Refer to the examples later in this chapter for more details on the use of these keys.

![System Keys Diagram]

**Figure 5-2. System Keys**

This is the blue, unlabeled key, which is also shown as $\text{Shift}$ in this guide. Pressing this key accesses the alternate or shifted function of a key (such as $\text{ERROR}$). Release the key after you press it. The $\text{Shift}$ annunciator is lit, indicating that the shifted keys are active.

Press to change the dc source's selected interface from remote operation to local (front panel) operation. Pressing the key will have no effect if the interface state is already Local, Local-with-Lockout, or Remote-with-Lockout.

Press to access the system address menu. This menu lets you configure the dc source's interface. Address Menu entries are stored in non-volatile memory.

<table>
<thead>
<tr>
<th>Display</th>
<th>Command Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADDRESS &lt;value&gt;</td>
<td>Sets the GPIB Address</td>
</tr>
<tr>
<td>INTF &lt;char&gt;</td>
<td>Selects an interface (GPIB or RS232)</td>
</tr>
<tr>
<td>BAUDRATE &lt;value&gt;</td>
<td>Selects baud rate (300, 600, 1200, 2400, 4800, 9600)</td>
</tr>
<tr>
<td>PARITY &lt;char&gt;</td>
<td>Message parity (NONE, EVEN, ODD, MARK, SPACE)</td>
</tr>
<tr>
<td>FLOW &lt;char&gt;</td>
<td>Flow control (XON-XOFF, RTS-CTS, DTR-DSR, NONE)</td>
</tr>
<tr>
<td>LANG &lt;char&gt;</td>
<td>Selects language (SCPI or COMP)</td>
</tr>
</tbody>
</table>

value = a numeric value  
char = a character string parameter  

Use $\text{Up}$ and $\text{Down}$ to scroll through the command list.  
Use $\text{Up}$ and $\text{Down}$ to scroll through the parameter list.

Press to place the dc source into a previously stored state. You can recall up to 4 (0 through 3) previously stored states.

Press to display the system error codes stored in the SCPI error queue. This action also clears the queue. If there is no error in the queue, 0 is displayed.

Press to store an existing dc source state in non-volatile memory. The parameters saved are listed under "SAV in the dc source Programming Guide. You can save up to 4 states (0 through 3).
Function Keys

Refer to the examples later in this chapter for more details on the use of these keys.

![Function Keys Diagram]

**Figure 5-3. Function Keys**

**Immediate Action Keys**

Immediate action keys immediately execute their corresponding function when pressed. Other function keys have commands underneath them that are accessed when the key is pressed.

- **Output On/Off**
  This key toggles the output of the dc source between the on and off states. It immediately executes its function as soon as you press it. When off, the dc source output is disabled and the Dis annunciator is on.

- **Shift Prot Clr**
  Press this key to reset the protection circuit and allow the unit to return to its last programmed state. The condition that caused the protection circuit to become active must be removed prior to pressing this key, or the unit will shut down again and display the Prot annunciator again. (If FS protection is displayed on the front panel, the unit must be opened and an internal fuse replaced as described in the Service manual.)

- **Shift OCP**
  Press this key to toggle between OCP enabled and disabled. If OCP is enabled the output will become disabled if the output mode changes from CV to CC mode. The OCP annunciator indicates the state of OCP.

**Scrolling Keys**

Scrolling keys let you move through the commands in the presently selected function menu.

- **Press** to bring up the next command in the list. Press **to go back to the previous command in the list. Function menus are circular; you can return to the starting position by continuously pressing either key. The following example shows the commands in the Input function menu:

  - **CURR:RANGE <char>**
  - **CURR:DET <char>**
**Metering Keys**

Metering keys control the metering functions of the dc source. When the unit is operating in front panel meter mode, all front panel measurements are calculated from a total of 2048 readings taken at a 46.8 microsecond sampling rate. Therefore, the total acquisition time for a single front panel measurement is about 100 milliseconds. Refer to “Making Front Panel Measurements” for more information.

**NOTE:** You can vary the both the sampling rate and the number of data points in each measurement when controlling the unit over the GPIB interface. (Refer to chapter 3 in the Programming Guide).

Press this key to access the meter menu list. Also use this key to exit a menu at any time and return to meter mode.

### Display

<table>
<thead>
<tr>
<th>Display</th>
<th>Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;reading&gt;V</td>
<td>Measures output dc voltage and current</td>
</tr>
<tr>
<td>&lt;reading&gt;V MAX</td>
<td>Measures peak output voltage¹</td>
</tr>
<tr>
<td>&lt;reading&gt;V MIN</td>
<td>Measures minimum output voltage¹</td>
</tr>
<tr>
<td>&lt;reading&gt;V HIGH</td>
<td>Measures the high level of a voltage pulse waveform¹</td>
</tr>
<tr>
<td>&lt;reading&gt;V LOW</td>
<td>Measures the low level of a voltage pulse waveform¹</td>
</tr>
<tr>
<td>&lt;reading&gt;V RMS</td>
<td>Measures rms voltage¹</td>
</tr>
<tr>
<td>&lt;reading&gt;A MAX</td>
<td>Measures peak output current¹</td>
</tr>
<tr>
<td>&lt;reading&gt;A MIN</td>
<td>Measures minimum output current¹</td>
</tr>
<tr>
<td>&lt;reading&gt;A HIGH</td>
<td>Measures the high level of a current pulse waveform¹</td>
</tr>
<tr>
<td>&lt;reading&gt;A LOW</td>
<td>Measures the low level of a current pulse waveform¹</td>
</tr>
<tr>
<td>&lt;reading&gt;A RMS</td>
<td>Measures rms current¹</td>
</tr>
</tbody>
</table>

### Command Function

- **CURR:RANGE <char>** Select current range (AUTO, LOW or HIGH)
- **CURR:DET <char>** Select current measurement bandwidth (ACDC or DC)¹

**Notes:**

¹Not available on Agilent 6611C - 6614C or in Compatibility mode

reading = the returned measurement
value = a numeric value
char = a character string parameter

Use ▲ and ▼ to scroll through the menu commands.
Use ▲ and ▼ to scroll through the menu parameters.
Use ▲ and ▼ to select a digit in a numeric entry field.
5 - Front Panel Operation

Output Control Keys

Output control keys control the output functions of the dc source.

**Voltage**

Press this key to access the voltage menu.

**Display**

<table>
<thead>
<tr>
<th>Command Function</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>VOLT &lt;value&gt;</strong></td>
</tr>
</tbody>
</table>

**Current**

Press this key to access the current menu.

**Display**

<table>
<thead>
<tr>
<th>Command Function</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CURR &lt;value&gt;</strong></td>
</tr>
</tbody>
</table>

**Output**

Press this key to access the output menu list.

**Display**

<table>
<thead>
<tr>
<th>Command Function</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>#RST</strong></td>
</tr>
<tr>
<td><strong>PON:STATE &lt;char&gt;</strong></td>
</tr>
<tr>
<td><strong>RI &lt;char&gt;</strong></td>
</tr>
<tr>
<td><strong>DFI &lt;char&gt;</strong></td>
</tr>
<tr>
<td><strong>DFI:SOUR &lt;char&gt;</strong></td>
</tr>
<tr>
<td><strong>PORT &lt;char&gt;</strong></td>
</tr>
<tr>
<td><strong>DIGIO &lt;char&gt;</strong></td>
</tr>
<tr>
<td><strong>RELAY &lt;char&gt;</strong></td>
</tr>
<tr>
<td><strong>REL:POL &lt;char&gt;</strong></td>
</tr>
<tr>
<td><strong>PROT:DLY &lt;value&gt;</strong></td>
</tr>
</tbody>
</table>

**Protect**

Press this key to display protection status.

**Display**

<table>
<thead>
<tr>
<th>Command Function</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>OC OT OV RI FS</strong></td>
</tr>
<tr>
<td>-- -- -- -- --</td>
</tr>
</tbody>
</table>

**Shift**

Press this key to access the overvoltage protection menu.

**Display**

<table>
<thead>
<tr>
<th>Command Function</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>VOLT:PROT &lt;value&gt;</strong></td>
</tr>
</tbody>
</table>

**Shift**

This key accesses the calibration menu (Refer to Appendix B for details).

Notes:

¹These parameters are stored in non-volatile memory
²These status summary bits are explained in chapter 3 of the Programming Guide
³Not available on Agilent 66312A
⁴value = a numeric value
⁵char = a character string parameter
⁶Use ▲ and ▼ to scroll through the menu commands.
⁷Use ▲ and ▼ to scroll through the menu parameters.
⁸Use ◀ and ▶ to select a digit in a numeric entry field.
Entry Keys

Refer to the examples later in this chapter for more details on the use of these keys.

**Figure 5-4. Entry Keys**

These keys let you scroll through choices in a parameter list that apply to a specific command. Parameter lists are circular; you can return to the starting position by continuously pressing either key. If the command has a numeric range, these keys increment or decrement the existing value. In meter mode, these keys can be used to adjust the magnitude of the output voltage or current. Only the flashing digit is changed by these keys. Use the ← and → keys to move the flashing digit.

These keys move the flashing digit in a numeric entry field to the right or left. This lets you increment or decrement a specific digit in the entry field using the ↑ and ↓ keys or the RPG knob.

Used only to access a third level key function - the numeric entry keys. These third level function keys are labeled in green.

0 through 9 are used for entering numeric values. . is the decimal point. – is the minus sign. For example, to enter 33.6 press: Enter Number, 3, 3, ., 6, Enter.

The backspace key deletes the last digit entered from the keypad. This key lets you correct one or more wrong digits before they are entered.

This key aborts a keypad entry by clearing the value. This key is convenient for correcting a wrong value or aborting a value entry. The display then returns to the previously set function.

This key executes the entered value or parameter of the presently accessed command. Until you press this key, the parameters you enter with the other Entry keys are displayed but not entered into the dc source. Before pressing Enter, you can change or abort anything previously entered into the display. After Enter is pressed, the dc source returns to Meter mode.
Examples of Front Panel Programming

You will find these examples on the following pages:
1. Setting the output voltage and current
2. Querying and clearing output protection
3. Making front panel measurements
4. Programming the digital port
5. Programming the output relay (option 760 only)
6. Setting the GPIB address or RS-232 parameters
7. Saving and recalling operating states

Similar examples are given in the dc source Programming Guide using SCPI commands.

1 - Setting the Output Voltage and Current

Set the output voltage

<table>
<thead>
<tr>
<th>Action</th>
<th>Display</th>
</tr>
</thead>
<tbody>
<tr>
<td>To enter an approximate value without using the voltage menu: On the Entry keypad, press ← or → to select the 1’s digit in the voltage field. Then rotate the front panel RPG knob to obtain 7 V. If the unit is in CC mode, you won’t see the output voltage change until the voltage setting is low enough to cause the unit to go into CV mode.</td>
<td>7.003 V 0.004 A</td>
</tr>
<tr>
<td>The easiest way to enter an accurate value: On the Function keypad, press Voltage. On the Entry keypad, press 7, Enter.</td>
<td>VOLT 7.000</td>
</tr>
<tr>
<td>To make minor changes to an existing value: On the Function keypad, press Voltage. On the Entry keypad, press ← or → to select the digit in the numeric field that you wish to change. For example, move the flashing digit to the ones column to change a value in this column. Then, press ↑ to scroll from 7.000 to 8.000. Then press Enter.</td>
<td>VOLT 8.000</td>
</tr>
</tbody>
</table>

Set the output current

<table>
<thead>
<tr>
<th>Action</th>
<th>Display</th>
</tr>
</thead>
<tbody>
<tr>
<td>To enter an approximate value without using the current menu: On the Entry keypad, press ← or → to select the tenths digit in the current field. Rotate the front panel RPG knob to obtain 0.4A. If the unit is in CV mode, you won’t see the output current change until the current setting is low enough to cause the unit to go into CC mode.</td>
<td>8.003 V 0.400 A</td>
</tr>
<tr>
<td>The easiest way to enter an accurate value: On the Function keypad, press Current. On the Entry keypad, press ↓, 4, Enter.</td>
<td>CURR 0.400</td>
</tr>
<tr>
<td>To make minor changes to an existing value: On the Function keypad, press Current. On the Entry keypad, press ← or → to select the digit in the numeric field that you wish to change. For example, move the flashing digit to the tenths column to change a value in this column. Then, press ↑ to scroll from 0.400 to 0.500. Then press Enter.</td>
<td>CURR 0.500</td>
</tr>
</tbody>
</table>

Enable the output

<table>
<thead>
<tr>
<th>Action</th>
<th>Display</th>
</tr>
</thead>
<tbody>
<tr>
<td>On the Function keypad, press Output On/Off to enable the output. The Dis annunciator will go off, indicating that the voltage is now applied to the output terminals. The A display indicates the actual output current.</td>
<td>8.003 V 0.500 A</td>
</tr>
</tbody>
</table>
2 - Querying and Clearing Output Protection

The dc source will disable its output if it detects an overvoltage or overcurrent fault condition. Other automatic fault conditions (such as overtemperature) also will disable the output.

**Query and clear the dc source overcurrent protection feature as follows:**

<table>
<thead>
<tr>
<th>Action</th>
<th>Display</th>
</tr>
</thead>
<tbody>
<tr>
<td>On the Function keypad, press <strong>Protect</strong>. In this example, OC indicates that an overcurrent condition has occurred. Other protection indicators are: OT (overtemperature), OV (overvoltage), RI (remote inhibit), and FS (internal fuse is open).</td>
<td>OC -- -- --</td>
</tr>
<tr>
<td>On the Function keypad, press <strong>Current</strong>. This displays the present output current limit. (13% of the maximum rating is the default current limit setting).</td>
<td>CURR 0.2045</td>
</tr>
<tr>
<td>To restore normal operation after the cause of the overcurrent condition has been removed, press <strong>Shift</strong>, <strong>Prot Clr</strong>. The OCP annunciator then will go off.</td>
<td>(2 amp unit)</td>
</tr>
</tbody>
</table>

3 - Making Front Panel Measurements

When the dc source is operating in front panel meter mode, all front panel measurements are calculated from a total of 2048 readings taken at a 46.8 microsecond sampling rate. The unit alternates between voltage and current measurements. Therefore, the data acquisition time for a single front panel voltage or current measurement is about 100 milliseconds. The sample rate and number of data points are fixed, and there are no trigger controls for front panel measurements. This fixed sampling rate and data acquisition time combined with a built-in windowing function, reduces errors due to sampling a non-integral number of cycles of a waveform for frequencies of 25 Hz or greater. Note that the windowing function is less accurate when measuring output waveforms for frequencies less than 25 Hz, causing the front panel meter to jitter.

When controlling the unit over the GPIB interface, you can vary both the sampling rate and the number of data points in each measurement. If you are using the Agilent 66312A dc source to measure waveform data, the GPIB interface also lets you qualify the triggers that initiate the measurements. With this flexibility, measurement accuracy can be improved for waveforms with frequencies as low as several Hertz. Refer to chapter 3 in the Programming Guide for more information.

Two current measurement ranges can be selected in the Input menu. A high current range is available for measuring output currents up to 30% higher than the maximum rating of the dc source. A low current range is available for improved resolution when measuring output currents below 20 milliamperes. The low current measurement range is accurate to 0.1% of the reading ±2.5 microamperes. When the current Range is set to AUTO, the unit automatically selects the range that provides the best measurement resolution.

---

**NOTE:**

If the front panel display indicates OVL.D, the output has exceeded the measurement capability of the instrument. If the front panel display indicates -- -- -- -- -- -- , an GPIB measurement is in progress.

As previously mentioned, the Agilent 66312A dc source has the capability of measuring output waveform parameters such as peak, minimum, high level, and low level as illustrated in the following figure.
5 - Front Panel Operation

![Diagram of Front Panel Pulse Measurement Parameters]

**Figure 5-5. Front Panel Pulse Measurement Parameters (Agilent 66312A only)**

Use the **Meter** menu for making front panel measurements:

<table>
<thead>
<tr>
<th>Action</th>
<th>Display</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. For current measurements, press <strong>Shift</strong>, <strong>Input</strong>. Then press ⏯ until you obtain the CURR:RANG AUTO command. Press <strong>Enter</strong> to activate autoranging. Two other selections are also available. Select the High range when measuring currents above 20 mA. Select the Low range for improved resolution when measuring currents below 20 mA.</td>
<td>CURR:RANG AUTO</td>
</tr>
<tr>
<td>2. For output waveform measurements, press <strong>Shift</strong>, <strong>Input</strong>. Then press ⏯ until you obtain the CURR:DET command. Check to make sure that the ACDC current detector is selected. This provides the best accuracy for waveform measurements. Only select the DC current detector if you are making dc current measurements and you require a dc measurement offset better than 1 mA on the High current measurement range.</td>
<td>CURR:DET ACDC</td>
</tr>
</tbody>
</table>

**Note:** In the Low current measurement range, the current detector is fixed at DC. With the current detector in dc, accurate current measurements cannot be made on waveforms with frequency contents over a few kilohertz.

3. On the Function keypad press **Meter** and press ⏯ repeatedly to access the following measurement parameters:

- dc voltage and current
- peak voltage
- minimum voltage
- high level of a voltage pulse waveform
- low level of a voltage pulse waveform
- rms voltage
- peak current
- minimum current
- high level of a current pulse waveform
- low level of a current pulse waveform
- rms current

1 Agilent 66312A only

4 - Programming the Digital Output Port
Your dc source is shipped with the output port function set to RIDFI mode. In this mode the port functions as a remote inhibit input with a discrete fault indicator output signal. You can also configure the port to act as a Digital Input/Output device.

**To configure the RIDFI mode of the port, proceed as follows:**

<table>
<thead>
<tr>
<th>Action</th>
<th>Display</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. On the Function keypad, press <strong>Output</strong></td>
<td>*RST</td>
</tr>
<tr>
<td>2. Scroll through the Output menu by pressing ↘. The PORT command lets you select either the RIDFI or the DIGIO function.</td>
<td>PORT RIDFI</td>
</tr>
<tr>
<td>3. Scroll to the RI command to configure the Remote INHibit indicator. Use the ↑ and ↓ keys to select either LIVE or LATCHING, either of which enable the RI indicator. With RI enabled, a low-true on the INH input will disable the output of the unit. LIVE causes the output of the unit to track the state of the INH input. LATCHING latches the output of the unit off in response to the inhibit signal.</td>
<td>RI LIVE</td>
</tr>
<tr>
<td></td>
<td>RI LATCHING</td>
</tr>
<tr>
<td>4. Access the Output menu again and scroll through the menu. The DFI command lets you enable the Discrete Fault Indicator. Use the ↘ key and select ON to enable the FLT output. With the FLT output enabled, the open-collector logic signal can be used to signal external devices when a fault condition is detected.</td>
<td>DFI ON</td>
</tr>
<tr>
<td>5. Scroll to the DFI:SOUR command to select the internal source that drives this signal. Use the ↘ key to select from the RQS or ESB bits, or the Operation or Questionable status registers. Status summary bits are explained in chapter 3 of the Programming Guide.</td>
<td>DFI:SOUR RQS</td>
</tr>
<tr>
<td></td>
<td>DFI:SOUR ESB</td>
</tr>
<tr>
<td></td>
<td>DFI:SOUR OPER</td>
</tr>
<tr>
<td></td>
<td>DFI:SOUR QUES</td>
</tr>
</tbody>
</table>

**To configure the DIGIO mode of the port, proceed as follows:**

<table>
<thead>
<tr>
<th>Action</th>
<th>Display</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. On the Function keypad, press <strong>Output</strong></td>
<td>*RST</td>
</tr>
<tr>
<td>2. Scroll through the Output menu by pressing ↘. The PORT command lets you select either the RIDFI or the DIGIO function.</td>
<td>PORT DIGIO</td>
</tr>
<tr>
<td>3. Scroll to the DIGIO command to set and read the Digital Input/Output Port. Press <strong>Enter Number</strong> and enter a number from 0 to 7 to program the four bits (0 programs all bits low; 7 programs all bits high). Press <strong>Enter</strong> when done.</td>
<td>DIGIO 5</td>
</tr>
</tbody>
</table>
5 - Front Panel Operation

5 - Programming the Output Relay (option 760 only)

Units with option 760 have isolation and polarity reversal relays connected to the output and sense terminals. (Option 750 is not available on Agilent 66312A units.)

To control the relays independently of the Output On/Off switch, proceed as follows:

<table>
<thead>
<tr>
<th>Action</th>
<th>Display</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. On the Function keypad, press Output, and scroll through the Output menu until you get to the RELAY command. The display indicates whether the relay is presently closed (ON), or open (OFF).</td>
<td>RELAY ON</td>
</tr>
<tr>
<td>2. Use the ↑ and ↓ keys to select either ON to close the relay or OFF to open the relay. Note that the output relays always open or close whenever the Output On/Off key is pressed.</td>
<td>RELAY OFF</td>
</tr>
</tbody>
</table>

To control the polarity of the output relays, proceed as follows:

<table>
<thead>
<tr>
<th>Action</th>
<th>Display</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. On the Function keypad, press Output, and scroll through the Output menu until you get to the REL:POL command. The display indicates the present condition of the relay (either normal or reversed).</td>
<td>REL:POL NORM</td>
</tr>
<tr>
<td>2. Use the ↑ and ↓ keys to select either NORM or REV. NORMal causes the relay polarity to be the same as the dc source output. REVerse causes the relay polarity to be opposite to that of the dc source output.</td>
<td>RELAY OFF</td>
</tr>
</tbody>
</table>

6 - Setting the GPIB Address and RS-232 Parameters

Your dc source is shipped with the GPIB address set to 5. This address can only be changed from the front panel using the Address menu located under the Address key. This menu is also used to select the RS-232 interface and specify RS-232 parameters such as baud rate and parity.

Set the GPIB address as follows:

<table>
<thead>
<tr>
<th>Action</th>
<th>Display</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. On the System keypad, press Address.</td>
<td>ADDRESS 5</td>
</tr>
<tr>
<td>2. Enter the new address. For example, Press Enter Number, 7, Enter.</td>
<td>ADDRESS 7</td>
</tr>
</tbody>
</table>

Configure the RS-232 interface as follows:

<table>
<thead>
<tr>
<th>Action</th>
<th>Display</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. On the System keypad, press Address.</td>
<td>ADDRESS 5</td>
</tr>
<tr>
<td>2. Scroll through the Address menu by pressing ▼. The interface command lets you select the RS-232 interface. The baudrate command lets you select the baudrate. The parity command lets you select the parity. The flow command selects the flow control options.</td>
<td>INTF RS232 BAUDRATE 9600 PARITY EVEN XON-XOFF</td>
</tr>
<tr>
<td>3. The ↑ and ↓ keys let you select the command parameters.</td>
<td></td>
</tr>
</tbody>
</table>

46
7 - Saving and Recalling Operating States

NOTE: This capability is only available when the unit is set to the SCPI programming language.

You can save up to 4 states (from location 0 to location 3) in non-volatile memory and recall them from the front panel. All programmable settings are saved.

**Save an operating state in location 1 as follows:**

**Action**

1. Set the instrument to the operating state that you want to save.
2. Save this state to location 1. Press **Save, Enter Number, 1, Enter**.

**Display**

*SAV 1

**Recall a saved state as follows:**

**Action**

1. Recall the state saved in location 1 by pressing **Recall, Enter Number, 1, Enter**

**Display**

*RCL 1

**Select the power-on state of the dc source as follows:**

**Action**

1. On the Function keypad, press **Output**, and scroll through the Output menu until you get to the PON state command.
2. Use the ‹ and › keys to select either RST or RCL0. RST sets the power-on state of the unit as defined by the *RST command. RCL0 sets the power-on state of the unit to the state saved in *RCL location 0.

**Display**

PON:STATE RST

**Clear the non-volatile memory of the dc source as follows:**

**Action**

1. On the Function keypad, press **Output, Enter**. This returns the unit to the factory-default settings.
2. Save these settings to location 1. Press **Save, Enter Number, 1, Enter**.
3. Repeat step #2 for memory locations 2 through 4.

**Display**

*RST

*SAV 1

*SAV 2

*SAV 3

*SAV 4
Specifications

Table A-1 lists the specifications of the dc source. Specifications are warranted over the ambient temperature range of 0 to 55 °C. Unless otherwise noted, specifications apply when measured at the rear terminals after a 30-minute warm-up period.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Agilent 6611C</th>
<th>Agilent 6612C</th>
<th>Agilent 6612A</th>
<th>Agilent 6613C</th>
<th>Agilent 6614C</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Output Ratings</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Voltage:</td>
<td>0 – 8 V</td>
<td>0 – 20 V</td>
<td>0 – 50 V</td>
<td>0 – 100 V</td>
<td>0 – 0.5 A</td>
</tr>
<tr>
<td>Current:</td>
<td>0.5 A</td>
<td>2 A</td>
<td>1 A</td>
<td>0.75 A</td>
<td>0.5 mA</td>
</tr>
<tr>
<td><strong>Programming Accuracy</strong> (@ 25°C ±5°C)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Voltage:</td>
<td>5 mV</td>
<td>10 mV</td>
<td>20 mV</td>
<td>50 mV</td>
<td>50 mV</td>
</tr>
<tr>
<td>+Current:</td>
<td>0.05% +</td>
<td>1 mA</td>
<td>0.75 mA</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>DC Measurement Accuracy</strong> (via GPIB or front panel meters with respect to actual output @ 25°C ±5°C)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Voltage:</td>
<td>2 mV²</td>
<td>3 mV²</td>
<td>6 mV²</td>
<td>12 mV²</td>
<td></td>
</tr>
<tr>
<td>Low Current range:</td>
<td>2.5 μA³</td>
<td>2.5 μA³</td>
<td>2.5 μA³</td>
<td>2.5 μA³</td>
<td></td>
</tr>
<tr>
<td>High Current range:</td>
<td>0.5 mA⁴</td>
<td>0.25 mA⁴</td>
<td>0.2 mA⁴</td>
<td>0.1 mA⁴</td>
<td></td>
</tr>
<tr>
<td>Voltage:</td>
<td>1.1 mA</td>
<td>0.85 mA</td>
<td>0.8 mA</td>
<td>0.7 mA</td>
<td></td>
</tr>
<tr>
<td>Low Current range:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Ripple and Noise</strong> (in the range of 20 Hz to 20 MHz with outputs ungrounded or with either terminal grounded)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Voltage (rms/p-p):</td>
<td>0.5 mV³/3 mV</td>
<td>0.5 mV³/3 mV²</td>
<td>0.5 mV³/4 mV</td>
<td>0.5 mV³/5 mV</td>
<td></td>
</tr>
<tr>
<td>Current (rms):</td>
<td>2 mA</td>
<td>1 mA</td>
<td>1 mA</td>
<td>1 mA</td>
<td></td>
</tr>
<tr>
<td><strong>Load Regulation</strong> (change in output voltage or current for any load change within ratings)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Voltage:</td>
<td>2 mV</td>
<td>2 mV</td>
<td>4 mV</td>
<td>5 mV</td>
<td></td>
</tr>
<tr>
<td>Current:</td>
<td>1 mA</td>
<td>0.5 mA</td>
<td>0.5 mA</td>
<td>0.5 mA</td>
<td></td>
</tr>
<tr>
<td><strong>Line Regulation</strong> (change in output voltage or current for any line change within ratings)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Voltage:</td>
<td>0.5 mV</td>
<td>0.5 mV</td>
<td>1 mV</td>
<td>1 mV</td>
<td></td>
</tr>
<tr>
<td>Current:</td>
<td>0.5 mA</td>
<td>0.5 mA</td>
<td>0.25 mA</td>
<td>0.25 mA</td>
<td></td>
</tr>
<tr>
<td><strong>Transient Response Time</strong> (for the output voltage to recover to its previous level within 0.1% of the voltage rating of the unit or 20 millivolts following a change in load current of up to 50% of the output current rating)</td>
<td>&lt; 100 μs</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1.0.05% + 3.32 mA (Agilent 6611C), 1.53 mA (Agilent 6612A/12C), 1.01 mA (Agilent 6613C), 0.063 mA (Agilent 6614C) when programming between zero and 0.05% of full scale current.
2. Applies for output voltages greater than 10 mV (Agilent 6611C/12C), 25 mV (Agilent 6613C), and 50 mV (Agilent 6614C).
3. This specification may degrade slightly when the unit is subjected to an RF field ≥3 V/meter.
4. For Agilent 6612A: applies in SCPI mode, with current detector set to DC. With current detector set to ACDC, accuracy is 0.2% + four times the fixed error value. In COMPatability mode, accuracy is 0.2% + six times the fixed error value.
5. For Agilent 6612A (from 1 MHz to 20 MHz) = 0.5 mV/15 mV.
6. Applies at rear terminals with unit set to remote sensing and with sense terminals externally jumpered to their respective output terminals.
A - Specifications

Supplemental Characteristics

Table A-2 lists the supplemental characteristics, which are not warranted but are descriptions of typical performance determined either by design or type testing.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Agilent 6611C</th>
<th>Agilent 6612C</th>
<th>Agilent 6613C</th>
<th>Agilent 6614C</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Input Rating</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>47 – 63 Hz (at full load)</td>
<td>100 Vac mains: 2.2 A, 120 W</td>
<td>1.6 A, 100 W</td>
<td>1.6 A, 100 W</td>
<td>1.6 A, 100 W</td>
</tr>
<tr>
<td></td>
<td>(87-106 Vac)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>115 Vac mains: 2 A, 120 W</td>
<td>1.4 A, 100 W</td>
<td>1.4 A, 100 W</td>
<td>1.4 A, 100 W</td>
</tr>
<tr>
<td></td>
<td>(104-127 Vac)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>220 Vac mains: 1.1 A, 120 W</td>
<td>0.8 A, 100 W</td>
<td>0.8 A, 100 W</td>
<td>0.8 A, 100 W</td>
</tr>
<tr>
<td></td>
<td>(191-233 Vac)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>230 Vac mains: 1 A, 120 W</td>
<td>0.75 A, 100 W</td>
<td>0.75 A, 100 W</td>
<td>0.75 A, 100 W</td>
</tr>
<tr>
<td></td>
<td>(207-253 Vac)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Output Programming Range</strong></td>
<td>Voltage: 0 – 8.190 V</td>
<td>0 – 20.475 V</td>
<td>0 – 51.188 V</td>
<td>0 – 102.38 V</td>
</tr>
<tr>
<td></td>
<td>Current: 0 – 5.118 A</td>
<td>0 – 2.0475 A</td>
<td>0 – 1.0238 A</td>
<td>0 – 0.5118 A</td>
</tr>
<tr>
<td></td>
<td>OVP: 12 V</td>
<td>0 – 22 V</td>
<td>0.55 V</td>
<td>0 – 110 V</td>
</tr>
<tr>
<td><strong>Average Programming Resolution</strong></td>
<td>Voltage: 2 mV</td>
<td>5 mV</td>
<td>12.5 mV</td>
<td>25 mV</td>
</tr>
<tr>
<td></td>
<td>Current: 1.25 mA</td>
<td>0.5 mA</td>
<td>0.25 mA</td>
<td>0.125 mA</td>
</tr>
<tr>
<td></td>
<td>OVP: 60 mV</td>
<td>100 mV</td>
<td>250 mV</td>
<td>500 mV</td>
</tr>
<tr>
<td><strong>OVP Accuracy</strong></td>
<td>2.4 % +</td>
<td>200 mV</td>
<td>240 mV</td>
<td>600 mV</td>
</tr>
<tr>
<td><strong>Maximum Current Measurement</strong></td>
<td>7 A</td>
<td>2.43 A</td>
<td>1.28 A</td>
<td>0.7 A</td>
</tr>
<tr>
<td><strong>Average Current Measurement</strong></td>
<td>High Range: 213 µA</td>
<td>74 µA</td>
<td>39 µA</td>
<td>21 µA</td>
</tr>
<tr>
<td></td>
<td>Low Range: 0.6 µA</td>
<td>0.6 µA</td>
<td>0.6 µA</td>
<td>0.6 µA</td>
</tr>
<tr>
<td><strong>Sink Current</strong></td>
<td>- 3 A</td>
<td>- 1.2 A</td>
<td>- 0.6 A</td>
<td>- 0.3 A</td>
</tr>
<tr>
<td><strong>Programming Accuracy</strong></td>
<td>Voltage: 0.01% +</td>
<td>0.15 mV</td>
<td>0.25 mV</td>
<td>0.5 mV</td>
</tr>
<tr>
<td></td>
<td>Current: 0.01% +</td>
<td>30 µA</td>
<td>12 µA</td>
<td>6 µA</td>
</tr>
<tr>
<td></td>
<td>OVP: 0.015% +</td>
<td>2 mV</td>
<td>4 mV</td>
<td>10 mV</td>
</tr>
<tr>
<td><strong>Readback Accuracy</strong></td>
<td>Voltage: 0.01% +</td>
<td>60 µV</td>
<td>150 µV</td>
<td>500 µV</td>
</tr>
<tr>
<td><strong>Temperature Coefficient</strong></td>
<td>Current (DC): 0.02% +</td>
<td>25 µA</td>
<td>10 µA</td>
<td>5 µA</td>
</tr>
<tr>
<td></td>
<td>Current (ACDC): 0.05% +</td>
<td>190 µA</td>
<td>80 µA</td>
<td>40 µA</td>
</tr>
<tr>
<td></td>
<td>Current (Low Range): 0.01% +</td>
<td>0.3 µA</td>
<td>0.3 µA</td>
<td>0.3 µA</td>
</tr>
<tr>
<td><strong>Drift</strong></td>
<td>Voltage: 0.01% +</td>
<td>0.25 mV</td>
<td>0.5 mV</td>
<td>1 mV</td>
</tr>
<tr>
<td></td>
<td>Current: 0.01% +</td>
<td>50 µA</td>
<td>20 µA</td>
<td>10 µA</td>
</tr>
<tr>
<td><strong>Output Voltage Rise/Fall Time</strong></td>
<td>2 ms</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Output Voltage Settling Time</strong></td>
<td>6 ms</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1 Agilent 6611C Option 760 = 2.4% + 500mV.
2 The sink current does not track the programmed current.
3 Following a 30 minute warm-up, the change in output over 8 hours, under constant ambient, load and line operating conditions.
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Agilent 66312A</th>
<th>Agilent 6611C - 6614C</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dynamic Measurement Accuracy</strong></td>
<td>Instantaneous Voltage: 0.03% + 5 mV</td>
<td>not applicable</td>
</tr>
<tr>
<td></td>
<td>Instantaneous Current: 0.6% + 1 mA</td>
<td></td>
</tr>
<tr>
<td><strong>Dynamic Measurement System</strong></td>
<td>Buffer Length: 4096 points</td>
<td>not applicable</td>
</tr>
<tr>
<td></td>
<td>Sampling Rate Range: 15.6 μs – 31200 s</td>
<td></td>
</tr>
<tr>
<td><strong>Measurement Time</strong></td>
<td>50 ms average (includes the default time of 30 ms² for acquiring data, and a 20 ms data processing overhead)</td>
<td></td>
</tr>
<tr>
<td>(voltage or current)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Command Processing Time</strong></td>
<td>4 ms average (for output to begin to change following receipt of digital data)</td>
<td></td>
</tr>
<tr>
<td><strong>Remote Sense Capability</strong></td>
<td>Up to 2 V can be dropped across each load lead. (add 2 mV to the voltage load regulation specification for each 1 V change in the positive output lead due to load current change.)</td>
<td></td>
</tr>
<tr>
<td><strong>Savable Instrument States</strong></td>
<td>4 (in locations 0 to 3)</td>
<td></td>
</tr>
<tr>
<td>(applies only in SCPI mode)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>RS-232 Interface Capabilities</strong></td>
<td>Baud rates: 300 600 1200 2400 4800 9600</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Data formats: 7 bits even or odd parity; 8 bits without parity</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Language: SCPI or COMPatibility¹</td>
<td></td>
</tr>
<tr>
<td><strong>GPIB Interface Capabilities</strong></td>
<td>Language: SCPI or COMPatibility³</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Interface: AH1, C0, DC1, DT1, E1, L4, PP0, RL1, SH1, SR1, T6</td>
<td></td>
</tr>
<tr>
<td><strong>INH/FLT Characteristics</strong></td>
<td>Maximum ratings: 16.5 Vdc between terminals 1 and 2; 3 and 4; and from terminals 1 or 2 to chassis ground</td>
<td></td>
</tr>
<tr>
<td></td>
<td>FLT Terminals: Low-level output current = 1.25 mA max. Low-level output voltage = 0.5 V max.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>INH Terminals: Low-level input voltage = 0.8 V max. High-level input voltage = 2 V min. Low-level input current = 1 mA Pulse width = 100 μs min. Time delay = 4 ms typical</td>
<td></td>
</tr>
<tr>
<td><strong>Digital I/O Characteristics</strong></td>
<td>Maximum ratings: same as INH/FLT Characteristics</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Digital OUT Port 0, 1, 2 (open collector)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Output leakage @ 16V = 0.1 mA (ports 0, 1) = 12.5 mA (port 2)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Output leakage @ 5V = 0.1 mA (ports 0, 1) = 0.25 mA (port 2)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Low-level output sink current @ 0.5 V = 4 mA Low-level output sink current @ 1 V = 50 mA</td>
<td></td>
</tr>
</tbody>
</table>

¹For full scale current changes with a risetime of 20 μs, an additional 0.5% error exists in the first data point in the buffer after the change. The error percentage increases proportionally with the decrease in risetime.

²This time may be reduced by changing the default conditions of 2048 data points, however, measurement accuracy will be reduced.

³COMPatibility language is used to program the Agilent 663xA Series power supplies.
### Table A-2. Supplemental Characteristics (continued)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Agilent 66312A</th>
<th>Agilent 6611C - 6614C</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Digital I/O Characteristics</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(continued)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Digital IN Port 2:</td>
<td>Low-level input current @ 0.4 V = 1.25 mA</td>
<td></td>
</tr>
<tr>
<td>(internal pull-up)</td>
<td>High-level input current @ 5 V = 0.25 mA</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Low-level input voltage = 0.8 V max.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>High level input voltage = 2.0 V min.</td>
<td></td>
</tr>
<tr>
<td><strong>Isolation to Ground</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Maximum from either:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>output terminal to chassis)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>50 Vdc</td>
<td>240 Vdc</td>
</tr>
<tr>
<td><strong>Recommended Calibration</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interval</td>
<td>1 year</td>
<td>(from the date the unit is put into service)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Regulatory Compliance</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Listing pending:</td>
<td>UL 3111-1</td>
<td></td>
</tr>
<tr>
<td>Certified to:</td>
<td>CSA 22.2 No. 1010.1</td>
<td></td>
</tr>
<tr>
<td>Conforms to:</td>
<td>IEC 1010-1</td>
<td></td>
</tr>
<tr>
<td>Complies with:</td>
<td>EMC directive 89/336/EEC (ISM Group1 Class B)</td>
<td></td>
</tr>
<tr>
<td><strong>Dimensions</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(see figure 3-1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Height:</td>
<td>88.1 mm (3.5in.)</td>
<td>88.1 mm (3.5in.)</td>
</tr>
<tr>
<td>Width:</td>
<td>212.8 mm (8.4in.)</td>
<td>212.8 mm (8.4in.)</td>
</tr>
<tr>
<td>Depth:</td>
<td>444.4 mm (17.5 in.)</td>
<td>368.3 mm (14.5 in.)</td>
</tr>
<tr>
<td><strong>Net weight</strong></td>
<td>8.8 kg (19.5 lbs.)</td>
<td>8.2 kg (18.16 lbs.)</td>
</tr>
<tr>
<td><strong>Shipping weight</strong></td>
<td>11.1 kg (24.5 lbs.)</td>
<td>10.6 kg (23.5 lbs.)</td>
</tr>
</tbody>
</table>
Verification and Calibration

Introduction

This appendix includes verification and calibration procedures for the Agilent 66312A, 6611C, 6612C, 6613C and 6614C dc source. Instructions are given for performing the procedures either from the front panel or from a controller over the GPIB.

The verification procedures do not check all the operating parameters, but verify that the dc source is performing properly. Performance Tests, which check all the specifications of the dc source, are given in the applicable dc source Service Manual.

**Important** Perform the verification procedures before calibrating your dc source. If the dc source passes the verification procedures, the unit is operating within its calibration limits and does not need to be recalibrated.

Equipment Required

The equipment listed in the following table, or the equivalent to this equipment, is required for verification and calibration.

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Characteristics</th>
<th>Recommended Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Digital Voltmeter</td>
<td>Resolution: 10 nV @ 1 V</td>
<td>Agilent 3458A</td>
</tr>
<tr>
<td></td>
<td>Readout: 8.5 digits</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Accuracy: &gt;20 ppm</td>
<td></td>
</tr>
<tr>
<td>Current Monitor 1</td>
<td>15 A (0.1 Ω), ±0.04%, TC=5ppm/°C</td>
<td>Guildline 9230/15</td>
</tr>
<tr>
<td>Load Resistor (3 W min. TC=20ppm/°C)</td>
<td>400 Ω (Agilent 6611C calibration and all models verification)</td>
<td>p/n 0811-2878</td>
</tr>
<tr>
<td></td>
<td>1.1 kΩ (Agilent 6612C &amp; 66312A calibration)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2500 Ω (Agilent 6613C calibration)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5000 Ω (Agilent 6614C calibration)</td>
<td></td>
</tr>
<tr>
<td>Power Supply</td>
<td>8 V @ 5 A</td>
<td>Agilent 6611C or Agilent 6631B</td>
</tr>
<tr>
<td>GPIB Controller</td>
<td>Full GPIB capabilities</td>
<td>HP Series 200/300 or equivalent</td>
</tr>
</tbody>
</table>

1The 4-terminal current shunt is used to eliminate output current measurement error caused by voltage drops in the load leads and connections. It has special current-monitoring terminals inside the load connection terminals. Connect the voltmeter directly to these current-monitoring terminals.

Test Setup

Figure B-1 shows the setup for the tests. Be certain to use load leads of sufficient wire gauge to carry the full output current (see chapter 3).
Performing the Verification Tests

**NOTE:** The verification procedure can only be performed using the SCPI language commands. Use either the front panel Address key to access the LANG command, or use the SYSTEM:LANGUAGE command to change the programming language to SCPI.

The following procedures assume you understand how to operate the dc source from the front panel as explained in chapter 5.

When performing the verification tests from an GPIB controller, you may have to consider the relatively slow settling times and slew rates of the dc source as compared to computer and system voltmeters. Suitable WAIT statements can be inserted into the test program to give the dc source time to respond to the test commands.

Perform the following tests for operation verification in the order indicated.
1. Turn-On Checkout
2. Voltage Programming and Measurement Accuracy
3. Current Programming and Measurement Accuracy
Table B-2. Verification Programming Values

<table>
<thead>
<tr>
<th></th>
<th>Full scale Voltage</th>
<th>Full Scale Current</th>
<th>Imax</th>
<th>Isink</th>
</tr>
</thead>
<tbody>
<tr>
<td>6611C</td>
<td>8</td>
<td>5</td>
<td>5.1188</td>
<td>- 3 A</td>
</tr>
<tr>
<td>6612C/66312A</td>
<td>20</td>
<td>2</td>
<td>2.0475</td>
<td>- 1.2 A</td>
</tr>
<tr>
<td>6613C</td>
<td>50</td>
<td>1</td>
<td>1.0238</td>
<td>- 0.6 A</td>
</tr>
<tr>
<td>6614C</td>
<td>100</td>
<td>0.5</td>
<td>0.5118</td>
<td>- 0.3 A</td>
</tr>
</tbody>
</table>

Turn-On Checkout

Perform the Turn-On Checkout as directed in chapter 4.

NOTE: The dc source must pass turn-on self-test before you can proceed with the verification tests.

Voltage Programming and Measurement Accuracy

This test verifies the voltage programming, GPIB measurement, and front panel meter functions. Values read back over the GPIB should be the same as those displayed on the front panel. Measure the dc output voltage at the output terminals. Make sure the sense switch is set to remote and the sense terminals are directly jumpered to the output terminals.

<table>
<thead>
<tr>
<th>Action</th>
<th>Normal Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Turn off the dc source and connect a DMM to the output terminals.</td>
<td>Output voltage near 0 V. Output current near 0 A.</td>
</tr>
<tr>
<td>2. Turn on the dc source with no load on the output. Set the output voltage to 0 V and the output current to full scale (see table B-2). Press Output On/Off to enable the output.</td>
<td>Readings within low voltage limits (see table B-3, 4, 5 or 6).</td>
</tr>
<tr>
<td>3. Record voltage readings at the DMM and on the front panel display.</td>
<td>Output voltage near full scale.</td>
</tr>
<tr>
<td>4. Set the output voltage to the full scale rated voltage (see table B-2).</td>
<td>Readings within high voltage limits (see table B-3, 4, 5 or 6).</td>
</tr>
<tr>
<td>5. Record voltage readings at the DMM and on the front panel display.</td>
<td></td>
</tr>
</tbody>
</table>

Current Programming and Measurement Accuracy

This test verifies the current programming and measurement. Connect the appropriate current monitor (see table B-1) as shown in figure B-1A.

Current Programming and Measurement (High Range)

<table>
<thead>
<tr>
<th>Action</th>
<th>Normal Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Turn off the dc source and connect the DMM and current monitor as shown in figure B-1A.</td>
<td>CURR:DET DC</td>
</tr>
<tr>
<td>2. Turn on the dc source, access the Input menu, and set the current sense detector to DC.</td>
<td>Output current near 0 A.</td>
</tr>
<tr>
<td>3. Set the output voltage to 5 V and the current to 0 A. Press Output On/Off to enable the output.</td>
<td>Readings within low current</td>
</tr>
<tr>
<td>4. Divide the voltage drop across the current monitor by its resistance</td>
<td></td>
</tr>
</tbody>
</table>
B - Verification and Calibration

to convert the value to amperes. Record the value. limits (see table B-3, 4, 5 or 6).

5. Set the output current to full scale (see table B-2).

6. Divide the voltage drop across the current monitor by its resistance Readings within high current limits (see table B-3, 4, 5 or 6).

to convert the value to amperes. Record this value and the current reading on the front panel display.

Current Measurement (Low Range)

Action Normal Result

7. Turn off and connect the dc source as shown in Figure B-1B CURR:RANG LOW

using the 400 ohm load resistor. Set the DMM to operate in current mode.

8. Turn on the dc source, access the Input menu, and set the current Output current near 0 A.

range to LOW.

9. Set the output voltage to 0 V and the current to full scale (see Readings within low current measurement (see table B-3, 4, table B-2). Press Output On/Off to enable the output.

5 or 6).

10. Record the current reading from the DMM as well as from the Readings within high current measurement (see table B-3, 4, front panel display. Enter the difference between the two readings 5 or 6).

in the appropriate table.

11. Set the output voltage to 8 V. Output current near +20 mA.

12. Record the current reading from the DMM as well as from the Readings within high current measurement (see table B-3, 4, front panel display. Enter the difference between the two readings 5 or 6).

in the table.

Current Sink Measurement

Action Normal Result

13. Turn off the dc source and connect an external supply to the CURR:RANG LOW

output of the unit as shown in figure B-1C using the 400 ohm load resistor. Set the DMM to operate in current mode.

14. Turn on the dc source, access the Input menu, and set the current CURR:DET DC

range to LOW.

Output current near –20 mA.

15. Access the Input menu and set the current sense detector to DC. Readings within low current sink measurement (see table B-3, 4, 5 or 6).

16. Turn on the external supply and program it to 8 volts and 5 A. CURR:RANG HIGH

Program the dc source to 0 V and 1 A. Output current near –Isink (see table B-2)

Press Output On/Off to enable the output.

17. Record the current reading from the DMM as well as from the Readings within high current sink measurement (see table B-3, 4, 5 or 6).

front panel display. Enter the difference between the two readings in the table.

18. Access the Input menu and set the current range to HIGH.

19. Short out the load resistor by connecting a jumper across it.

20. Record the current reading from the DMM as well as from the Readings within high current sink measurement (see table B-3, 4, 5 or 6).

front panel display. Enter the difference between the two readings in the table.
Table B-3. Verification Test Record for Agilent 6611C

<table>
<thead>
<tr>
<th>Test Description</th>
<th>Minimum Specification</th>
<th>Recorded Results</th>
<th>Maximum Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Voltage Programming and Measurement</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low Voltage $V_{out}$</td>
<td>$-5 \text{ mV}$</td>
<td>_______V</td>
<td>$+5 \text{ mV}$</td>
</tr>
<tr>
<td>Front Panel measurement</td>
<td>$V_{out} - 2 \text{ mV}$</td>
<td>____mV</td>
<td>$V_{out} + 2 \text{ mV}$</td>
</tr>
<tr>
<td>High Voltage $V_{out}$</td>
<td>7.991 V</td>
<td>_______V</td>
<td>8.009 V</td>
</tr>
<tr>
<td>Front Panel measurement</td>
<td>$V_{out} - 4.4 \text{ mV}$</td>
<td>____mV</td>
<td>$V_{out} + 4.4 \text{ mV}$</td>
</tr>
</tbody>
</table>

| **Current Programming and Measurement (High Range)** |                       |                  |                       |
| Low Current $I_{out}$        | $-2 \text{ mA}$       | ____A            | 2 mA                  |
| High Current $I_{out}$       | 4.9955 A              | ____A            | 5.0045 A             |
| Front Panel measurement     | $I_{out} - 10.5 \text{ mA}$ | ____mA          | $I_{out} + 10.5 \text{ mA}$ |

| **Current Measurement (Low Range)** |                       |                  |                       |
| Low Current measurement     | $I_{out} - 2.5 \text{ µA}$ | ____µA         | $I_{out} + 2.5 \text{ µA}$ |
| High Current measurement    | $I_{out} - 22.5 \text{ µA}$ | ____µA         | $I_{out} + 22.5 \text{ µA}$ |

| **Current Sink Measurement** |                       |                  |                       |
| Low Current Sink measurement| $I_{sink} - 22.5 \text{ µA}$ | ____µA         | $I_{sink} + 22.5 \text{ µA}$ |
| High Current Sink measurement| $I_{sink} - 11.1 \text{ mA}$ | ____mA         | $I_{sink} + 11.1 \text{ mA}$ |

Table B-4. Verification Test Record for Agilent 66312A or Agilent 6612C

<table>
<thead>
<tr>
<th>Test Description</th>
<th>Minimum Specification</th>
<th>Recorded Results</th>
<th>Maximum Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Voltage Programming and Measurement</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low Voltage $V_{out}$</td>
<td>$-10 \text{ mV}$</td>
<td>_______V</td>
<td>$+10 \text{ mV}$</td>
</tr>
<tr>
<td>Front Panel measurement</td>
<td>$V_{out} - 3 \text{ mV}$</td>
<td>____mV</td>
<td>$V_{out} + 3 \text{ mV}$</td>
</tr>
<tr>
<td>High Voltage $V_{out}$</td>
<td>19.980 V</td>
<td>_______V</td>
<td>20.020 V</td>
</tr>
<tr>
<td>Front Panel measurement</td>
<td>$V_{out} - 9 \text{ mV}$</td>
<td>____mV</td>
<td>$V_{out} + 9 \text{ mV}$</td>
</tr>
</tbody>
</table>

| **Current Programming and Measurement (High Range)** |                       |                  |                       |
| Low Current $I_{out}$        | $-1 \text{ mA}$       | ____A            | 1 mA                  |
| High Current $I_{out}$       | 1.998 A               | ____A            | 2.002 A               |
| Front Panel measurement     | $I_{out} - 4.5 \text{ mA}$ | ____mA          | $I_{out} + 4.5 \text{ mA}$ |

| **Current Measurement (Low Range)** |                       |                  |                       |
| Low Current measurement     | $I_{out} - 2.5 \text{ µA}$ | ____µA         | $I_{out} + 2.5 \text{ µA}$ |
| High Current measurement    | $I_{out} - 22.5 \text{ µA}$ | ____µA         | $I_{out} + 22.5 \text{ µA}$ |

| **Current Sink Measurement** |                       |                  |                       |
| Low Current Sink measurement| $I_{sink} - 22.5 \text{ µA}$ | ____µA         | $I_{sink} + 22.5 \text{ µA}$ |
| High Current Sink measurement| $I_{sink} - 4.85 \text{ mA}$ | ____mA         | $I_{sink} + 4.85 \text{ mA}$ |
## B - Verification and Calibration

### Table B-5. Verification Test Record for Agilent 6613C

<table>
<thead>
<tr>
<th>Test Description</th>
<th>Minimum Specification</th>
<th>Recorded Results</th>
<th>Maximum Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Voltage Programming and Measurement</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low Voltage $V_{\text{in}}$</td>
<td>$-20 \text{ mV}$</td>
<td>$\text{_____ V}$</td>
<td>$+20 \text{ mV}$</td>
</tr>
<tr>
<td>Front Panel measurement</td>
<td>$V_{\text{out}} -6 \text{ mV}$</td>
<td>$\text{_____ mV}$</td>
<td>$V_{\text{out}} +6 \text{ mV}$</td>
</tr>
<tr>
<td>High Voltage $V_{\text{out}}$</td>
<td>$49.955 \text{ V}$</td>
<td>$\text{_____ V}$</td>
<td>$20.045 \text{ V}$</td>
</tr>
<tr>
<td>Front Panel measurement</td>
<td>$V_{\text{cap}} -21 \text{ mV}$</td>
<td>$\text{_____ mV}$</td>
<td>$V_{\text{out}} +21 \text{ mV}$</td>
</tr>
<tr>
<td><strong>Current Programming and Measurement (High Range)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low Current $I_{\text{out}}$</td>
<td>$-0.5 \text{ mA}$</td>
<td>$\text{_____ A}$</td>
<td>$0.5 \text{ mA}$</td>
</tr>
<tr>
<td>High Current $I_{\text{out}}$</td>
<td>$0.999 \text{ A}$</td>
<td>$\text{_____ A}$</td>
<td>$1.001 \text{ A}$</td>
</tr>
<tr>
<td>Front Panel measurement</td>
<td>$I_{\text{out}} -2.2 \text{ mA}$</td>
<td>$\text{_____ mA}$</td>
<td>$I_{\text{out}} +2.2 \text{ mA}$</td>
</tr>
<tr>
<td><strong>Current Programming and Measurement (Low Range)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low Current measurement</td>
<td>$I_{\text{out}} -2.5 \text{ µA}$</td>
<td>$\text{_____ µA}$</td>
<td>$I_{\text{out}} +2.5 \text{ µA}$</td>
</tr>
<tr>
<td>High Current measurement</td>
<td>$I_{\text{out}} -22.5 \text{ µA}$</td>
<td>$\text{_____ µA}$</td>
<td>$I_{\text{out}} +22.5 \text{ µA}$</td>
</tr>
<tr>
<td><strong>Current Sink Measurement</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low Current Sink measurement</td>
<td>$I_{\text{sink}} -22.5 \text{ µA}$</td>
<td>$\text{_____ µA}$</td>
<td>$I_{\text{sink}} +22.5 \text{ µA}$</td>
</tr>
<tr>
<td>High Current Sink measurement</td>
<td>$I_{\text{sink}} -2.8 \text{ mA}$</td>
<td>$\text{_____ mA}$</td>
<td>$I_{\text{sink}} +2.8 \text{ mA}$</td>
</tr>
</tbody>
</table>

### Table B-6. Verification Test Record for Agilent 6614C

<table>
<thead>
<tr>
<th>Test Description</th>
<th>Minimum Specification</th>
<th>Recorded Results</th>
<th>Maximum Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Voltage Programming and Measurement</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low Voltage $V_{\text{out}}$</td>
<td>$-50 \text{ mV}$</td>
<td>$\text{_____ V}$</td>
<td>$+50 \text{ mV}$</td>
</tr>
<tr>
<td>Front Panel measurement</td>
<td>$V_{\text{out}} -12 \text{ mV}$</td>
<td>$\text{_____ mV}$</td>
<td>$V_{\text{out}} +12 \text{ mV}$</td>
</tr>
<tr>
<td>High Voltage $V_{\text{out}}$</td>
<td>$99.900 \text{ V}$</td>
<td>$\text{_____ V}$</td>
<td>$100.100 \text{ V}$</td>
</tr>
<tr>
<td>Front Panel measurement</td>
<td>$V_{\text{out}} -42 \text{ mV}$</td>
<td>$\text{_____ mV}$</td>
<td>$V_{\text{out}} +42 \text{ mV}$</td>
</tr>
<tr>
<td><strong>Current Programming and Measurement (High Range)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low Current $I_{\text{out}}$</td>
<td>$-0.25 \text{ mA}$</td>
<td>$\text{_____ A}$</td>
<td>$0.25 \text{ mA}$</td>
</tr>
<tr>
<td>High Current $I_{\text{out}}$</td>
<td>$0.4995 \text{ A}$</td>
<td>$\text{_____ A}$</td>
<td>$0.5005 \text{ A}$</td>
</tr>
<tr>
<td>Front Panel measurement</td>
<td>$I_{\text{out}} -1.1 \text{ mA}$</td>
<td>$\text{_____ mA}$</td>
<td>$I_{\text{out}} +1.1 \text{ mA}$</td>
</tr>
<tr>
<td><strong>Current Programming and Measurement (Low Range)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low Current measurement</td>
<td>$I_{\text{out}} -2.5 \text{ µA}$</td>
<td>$\text{_____ µA}$</td>
<td>$I_{\text{out}} +2.5 \text{ µA}$</td>
</tr>
<tr>
<td>High Current measurement</td>
<td>$I_{\text{out}} -22.5 \text{ µA}$</td>
<td>$\text{_____ µA}$</td>
<td>$I_{\text{out}} +22.5 \text{ µA}$</td>
</tr>
<tr>
<td><strong>Current Sink Measurement</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low Current Sink measurement</td>
<td>$I_{\text{sink}} -22.5 \text{ µA}$</td>
<td>$\text{_____ µA}$</td>
<td>$I_{\text{sink}} +22.5 \text{ µA}$</td>
</tr>
<tr>
<td>High Current Sink measurement</td>
<td>$I_{\text{sink}} -1.7 \text{ mA}$</td>
<td>$\text{_____ mA}$</td>
<td>$I_{\text{sink}} +1.7 \text{ mA}$</td>
</tr>
</tbody>
</table>
Performing the Calibration Procedure

**NOTE:** The calibration procedure can only be performed using the SCPI language commands. Use either the front panel **Address** key to access the LANG command, or use the SYSTem:LANGuage command to change the programming language to SCPI.

Table B-1 lists the equipment required for calibration. Figure B-1 shows the test setup.

You do not have to do a complete calibration each time. If appropriate, you may calibrate only the voltage or current and proceed to "Saving the Calibration Constants". However, the voltage or current calibration sequence must be performed in its entirety. The following parameters may be calibrated:
- voltage programming and measurement
- overvoltage protection (OVP)
- current programming and measurement
- low range measurement
- ac current measurement

Front Panel Calibration Menu

The Entry keypad is used for calibration functions.

Press this key to access the calibration menu.

| Shift | Cal |

**Display**

<table>
<thead>
<tr>
<th>Command Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAL ON &lt;value&gt;</td>
</tr>
<tr>
<td>CAL OFF</td>
</tr>
<tr>
<td>CAL:LEV &lt;char&gt;</td>
</tr>
<tr>
<td>CAL:DATA &lt;value&gt;</td>
</tr>
<tr>
<td>CAL:VOLT</td>
</tr>
<tr>
<td>CAL:VOLT:PROT</td>
</tr>
<tr>
<td>CAL:CURR</td>
</tr>
<tr>
<td>CAL:CURR:MEAS:LOW</td>
</tr>
<tr>
<td>CAL:CURR:MEAS:AC</td>
</tr>
<tr>
<td>CAL:SAVE</td>
</tr>
<tr>
<td>CAL:PASS &lt;value&gt;</td>
</tr>
</tbody>
</table>

**Notes:**

- value = a numeric value
- char = a character string parameter

Use ▲ and ▼ to scroll through the menu commands.
Use ▲ and ▼ to scroll through the menu parameters.
Use ▲ and ▼ to select a digit in a numeric entry field.

Front Panel Calibration
B - Verification and Calibration

These procedures assume you understand how to operate front panel keys (see chapter 5).

Enable Calibration Mode

<table>
<thead>
<tr>
<th>Action</th>
<th>Display</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Reset the unit by selecting <strong>Output</strong>, scrolling to <em>RST</em> and pressing <strong>Enter</strong>.</td>
<td><em>RST</em></td>
</tr>
<tr>
<td>2. Press <strong>Output On/Off</strong> to enable the output.</td>
<td>00.003V 0.0006A</td>
</tr>
<tr>
<td>3. To begin calibration press <strong>Shift Cal</strong>, scroll to CAL ON and press <strong>Enter</strong>.</td>
<td>CAL ON 0.0</td>
</tr>
<tr>
<td>4. Enter the calibration password from Entry keypad and press <strong>Enter</strong>. If the password is correct the <strong>CAL</strong> annunciator will come on. If CAL DENIED appears, then an internal switch has been set to prevent the calibration from being changed. (See the Service Manual.) If the password is incorrect, an error occurs. If the active password is lost, the calibration function can be recovered by setting an internal switch that defeats password protection. (See the Service Manual.)</td>
<td>CAL DENIED OUT OF RANGE</td>
</tr>
</tbody>
</table>

Voltage Programming and Measurement Calibration

<table>
<thead>
<tr>
<th>Action</th>
<th>Display</th>
</tr>
</thead>
<tbody>
<tr>
<td>5. Connect the DMM (dc volts mode) directly to the dc source. Do not connect the load resistor or current shunt.</td>
<td>CAL:VOLT</td>
</tr>
<tr>
<td>6. Press <strong>Shift Cal</strong>, scroll to CAL VOLT, and press <strong>Enter</strong>.</td>
<td>CAL:LEV P1</td>
</tr>
<tr>
<td>7. Press <strong>Shift Cal</strong>, scroll to CAL LEV, and press <strong>Enter</strong> to select the first calibration point.</td>
<td>CAL:DATA 0.00</td>
</tr>
<tr>
<td>8. Press <strong>Shift Cal</strong>, scroll to CAL DATA, press <strong>Enter Number</strong> and enter the voltage value displayed on the DMM.</td>
<td>CAL:LEV P2</td>
</tr>
<tr>
<td>9. Press <strong>Shift Cal</strong>, scroll to CAL LEV, use &lt; to scroll to P2 (the second calibration point), and press <strong>Enter</strong>.</td>
<td>CAL:DATA 0.00</td>
</tr>
<tr>
<td>10. Press <strong>Shift Cal</strong>, scroll to CAL DATA, press <strong>Enter Number</strong> and enter the second voltage value displayed on the DMM.</td>
<td></td>
</tr>
</tbody>
</table>

Overvoltage Protection Calibration

<table>
<thead>
<tr>
<th>Action</th>
<th>Display</th>
</tr>
</thead>
<tbody>
<tr>
<td>11. Press <strong>Shift Cal</strong>, scroll to CAL VOLT PROT, and press <strong>Enter</strong>.</td>
<td>CAL:VOLT: PROT</td>
</tr>
<tr>
<td>12. Wait for the dc source to compute the OVP calibration constant. The display returns to Meter mode when the calculation is complete.</td>
<td></td>
</tr>
</tbody>
</table>
Current Programming and High-Range Measurement Calibration

<table>
<thead>
<tr>
<th>Action</th>
<th>Display</th>
</tr>
</thead>
<tbody>
<tr>
<td>13. Connect the appropriate current monitor as shown in figure B-1A.</td>
<td></td>
</tr>
<tr>
<td>Connect the DMM (in dc mode) across the current shunt.</td>
<td></td>
</tr>
<tr>
<td>14. Press <strong>Shift Cal</strong>, scroll to CAL CURR, and press <strong>Enter</strong>.</td>
<td>CAL:CURR</td>
</tr>
<tr>
<td>15. Press <strong>Shift Cal</strong>, scroll to CAL LEV, and press <strong>Enter</strong> to select</td>
<td>CAL:LEV P1</td>
</tr>
<tr>
<td>the first calibration point.</td>
<td></td>
</tr>
<tr>
<td>16. Press <strong>Shift Cal</strong> and scroll to CAL DATA. Wait for the DMM reading</td>
<td>CAL:DATA 0.00</td>
</tr>
<tr>
<td>to stabilize. Then read the DMM and compute the first current value</td>
<td></td>
</tr>
<tr>
<td>(DMM reading + shunt resistance). Press <strong>Enter Number</strong> and enter the</td>
<td></td>
</tr>
<tr>
<td>first current value.</td>
<td></td>
</tr>
<tr>
<td>17. Press <strong>Shift Cal</strong>, scroll to CAL LEV, use ⬇ to scroll to P2 (the</td>
<td>CAL:LEV P2</td>
</tr>
<tr>
<td>second calibration point), and press <strong>Enter</strong>.</td>
<td></td>
</tr>
<tr>
<td>18. Press <strong>Shift Cal</strong> and scroll to CAL DATA. Wait for the DMM reading</td>
<td>CAL:DATA 0.00</td>
</tr>
<tr>
<td>to stabilize. Then read the DMM and compute the second current value</td>
<td></td>
</tr>
<tr>
<td>(DMM reading + shunt resistance). Press <strong>Enter Number</strong> and enter the</td>
<td></td>
</tr>
<tr>
<td>second current value.</td>
<td></td>
</tr>
</tbody>
</table>

Low-Range Current Measurement Calibration

<table>
<thead>
<tr>
<th>Action</th>
<th>Display</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Enter</strong>.</td>
<td></td>
</tr>
<tr>
<td>20. Connect the appropriate calibration load resistor as shown in</td>
<td></td>
</tr>
<tr>
<td>figure B-1B. Connect the DMM (in current mode) in series with the load.</td>
<td></td>
</tr>
<tr>
<td>21. Press <strong>Shift Cal</strong>, scroll to CAL LEV, and press <strong>Enter</strong> to select</td>
<td>CAL:LEV P1</td>
</tr>
<tr>
<td>the first calibration point.</td>
<td></td>
</tr>
<tr>
<td>22. Press <strong>Shift Cal</strong> and scroll to CAL DATA. Wait for the DMM reading</td>
<td>CAL:DATA 0.00</td>
</tr>
<tr>
<td>to stabilize. Then press <strong>Enter Number</strong> and enter the current reading</td>
<td></td>
</tr>
<tr>
<td>displayed on the DMM.</td>
<td></td>
</tr>
</tbody>
</table>

AC Current Measurement Calibration (Agilent 66312A only)

<table>
<thead>
<tr>
<th>Action</th>
<th>Display</th>
</tr>
</thead>
<tbody>
<tr>
<td>23. Disconnect all loads from the dc source.</td>
<td></td>
</tr>
<tr>
<td><strong>Enter</strong>.</td>
<td></td>
</tr>
<tr>
<td>25. Wait for the dc source to compute the ac current calibration</td>
<td></td>
</tr>
<tr>
<td>constant. The display returns to Meter mode when the calculation</td>
<td></td>
</tr>
<tr>
<td>is complete.</td>
<td></td>
</tr>
</tbody>
</table>
B - Verification and Calibration

Saving the Calibration Constants

**WARNING:** Storing calibration constants overwrites the existing ones in non-volatile memory. If you are not sure you want to permanently store the new constants, omit this step. The dc source calibration will then remain unchanged.

<table>
<thead>
<tr>
<th>Action</th>
<th>Display</th>
</tr>
</thead>
<tbody>
<tr>
<td>26. Press <strong>Shift Cal</strong>, scroll to CAL SAVE, and press <strong>Enter</strong>.</td>
<td>CAL:SAVE</td>
</tr>
<tr>
<td>27. Press <strong>Shift Cal</strong>, select CAL OFF, and press <strong>Enter</strong> to exit Calibration mode.</td>
<td>CAL OFF</td>
</tr>
</tbody>
</table>

* RST and *RCL will also set the calibration state to OFF.

**Calibration Error Messages**

Errors that can occur during calibration are shown in the following table.

<table>
<thead>
<tr>
<th>Error</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>401</td>
<td>CAL switch prevents calibration (This is a hardware disable, see the Service Manual.)</td>
</tr>
<tr>
<td>402</td>
<td>CAL password is incorrect</td>
</tr>
<tr>
<td>403</td>
<td>CAL not enabled</td>
</tr>
<tr>
<td>404</td>
<td>Computed readback cal constants are incorrect</td>
</tr>
<tr>
<td>405</td>
<td>Computed programming cal constants are incorrect</td>
</tr>
<tr>
<td>406</td>
<td>Incorrect sequence of calibration commands</td>
</tr>
</tbody>
</table>

**Changing the Calibration Password**

The factory default password is 0. You can change the password when the dc source is in calibration mode (which requires you to enter the existing password). Proceed as follows:

<table>
<thead>
<tr>
<th>Action</th>
<th>Display</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Begin by pressing <strong>Shift Cal</strong> and scrolling to the CAL ON command.</td>
<td>CAL ON 0.0</td>
</tr>
<tr>
<td>2. Enter the existing password from Entry keypad and press <strong>Enter</strong></td>
<td></td>
</tr>
<tr>
<td>3. Press <strong>Shift Cal</strong> and scroll to the CAL PASS command.</td>
<td>CAL:PASS 0</td>
</tr>
<tr>
<td>4. Enter the new password from the keypad. You can use any number with up to six digits and an optional decimal point. If you want the calibration function to operate without requiring any password, change the password to 0 (zero).</td>
<td></td>
</tr>
</tbody>
</table>

**NOTE:** If you want the calibration function to operate without requiring any password, change the password to 0 (zero).
Calibration Over the GPIB

You can calibrate the dc source by using SCPI commands within your controller programming statements. Be sure you are familiar with calibration from the front panel before you calibrate from a controller. Each front panel calibration command has a corresponding SCPI command. When you write your calibration program, perform the calibration procedure in the same order as the front panel procedure documented in this appendix.

The SCPI calibration commands are explained in chapter 3 of the dc source Programming Guide. Calibration error messages that can occur during GPIB calibration are shown in table B-3.
Error Messages

Error Number List

This appendix gives the error numbers and descriptions that are returned by the dc source. Error numbers are returned in two ways:

- Error numbers are displayed on the front panel
- Error numbers and messages are read back with the SYSTem:ERRor? query. SYSTem:ERRor? returns the error number into a variable and returns two parameters: an NR1 and a string.

The following table lists the errors that are associated with SCPI syntax errors and interface problems. It also lists the device dependent errors. Information inside the brackets is not part of the standard error message, but is included for clarification.

When errors occur, the Standard Event Status register records them in bit 2, 3, 4, or 5 as described in the following table:

<table>
<thead>
<tr>
<th>Error Number</th>
<th>Error String [Description/Explanation/Examples]</th>
</tr>
</thead>
<tbody>
<tr>
<td>-100</td>
<td>Command error [generic]</td>
</tr>
<tr>
<td>-101</td>
<td>Invalid character</td>
</tr>
<tr>
<td>-102</td>
<td>Syntax error [unrecognized command or data type]</td>
</tr>
<tr>
<td>-103</td>
<td>Invalid separator</td>
</tr>
<tr>
<td>-104</td>
<td>Data type error [e.g., &quot;numeric or string expected, got block data&quot;]</td>
</tr>
<tr>
<td>-105</td>
<td>GET not allowed</td>
</tr>
<tr>
<td>-108</td>
<td>Parameter not allowed [too many parameters]</td>
</tr>
<tr>
<td>-109</td>
<td>Missing parameter [too few parameters]</td>
</tr>
<tr>
<td>-112</td>
<td>Program mnemonic too long [maximum 12 characters]</td>
</tr>
<tr>
<td>-113</td>
<td>Undefined header [operation not allowed for this device]</td>
</tr>
<tr>
<td>-121</td>
<td>Invalid character in number [includes &quot;9&quot; in octal data, etc.]</td>
</tr>
<tr>
<td>-123</td>
<td>Numeric overflow [exponent too large; exponent magnitude &gt;32 k]</td>
</tr>
<tr>
<td>-124</td>
<td>Too many digits [number too long; more than 255 digits received]</td>
</tr>
<tr>
<td>-128</td>
<td>Numeric data not allowed</td>
</tr>
<tr>
<td>-131</td>
<td>Invalid suffix [unrecognized units, or units not appropriate]</td>
</tr>
</tbody>
</table>
### Error Messages

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>-138</td>
<td>Suffix not allowed</td>
</tr>
<tr>
<td>-141</td>
<td>Invalid character data [bad character, or unrecognized]</td>
</tr>
<tr>
<td>-144</td>
<td>Character data too long</td>
</tr>
<tr>
<td>-148</td>
<td>Character data not allowed</td>
</tr>
<tr>
<td>-150</td>
<td>String data error</td>
</tr>
<tr>
<td>-151</td>
<td>Invalid string data [e.g., END received before close quote]</td>
</tr>
<tr>
<td>-158</td>
<td>String data not allowed</td>
</tr>
<tr>
<td>-160</td>
<td>Block data error</td>
</tr>
<tr>
<td>-161</td>
<td>Invalid block data [e.g., END received before length satisfied]</td>
</tr>
<tr>
<td>-168</td>
<td>Block data not allowed</td>
</tr>
<tr>
<td>-170</td>
<td>Expression error</td>
</tr>
<tr>
<td>-171</td>
<td>Invalid expression</td>
</tr>
<tr>
<td>-178</td>
<td>Expression data not allowed</td>
</tr>
</tbody>
</table>

#### Execution Errors –200 through –299 (sets Standard Event Status Register bit #4)

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>-200</td>
<td>Execution error [generic]</td>
</tr>
<tr>
<td>-222</td>
<td>Data out of range [e.g., too large for this device]</td>
</tr>
<tr>
<td>-223</td>
<td>Too much data [out of memory; block, string, or expression too long]</td>
</tr>
<tr>
<td>-224</td>
<td>Illegal parameter value [device-specific]</td>
</tr>
<tr>
<td>-225</td>
<td>Out of memory</td>
</tr>
<tr>
<td>-270</td>
<td>Macro error</td>
</tr>
<tr>
<td>-272</td>
<td>Macro execution error</td>
</tr>
<tr>
<td>-273</td>
<td>Illegal macro label</td>
</tr>
<tr>
<td>-276</td>
<td>Macro recursion error</td>
</tr>
<tr>
<td>-277</td>
<td>Macro redefinition not allowed</td>
</tr>
</tbody>
</table>

#### System Errors –300 through –399 (sets Standard Event Status Register bit #3)

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>-310</td>
<td>System error [generic]</td>
</tr>
<tr>
<td>-350</td>
<td>Too many errors [errors beyond 9 lost due to queue overflow]</td>
</tr>
</tbody>
</table>

#### Query Errors –400 through –499 (sets Standard Event Status Register bit #2)

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>-400</td>
<td>Query error [generic]</td>
</tr>
<tr>
<td>-410</td>
<td>Query INTERRUPTED [query followed by DAB or GET before response complete]</td>
</tr>
<tr>
<td>-420</td>
<td>Query UNTERMINATED [addressed to talk, incomplete programming message received]</td>
</tr>
<tr>
<td>-430</td>
<td>Query DEADLOCKED [too many queries in command string]</td>
</tr>
<tr>
<td>-440</td>
<td>Query UNTERMINATED [after indefinite response]</td>
</tr>
</tbody>
</table>
### Selftest Errors 0 through 99 (sets Standard Event Status Register bit #3)

<table>
<thead>
<tr>
<th>Error Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No error</td>
</tr>
<tr>
<td>1</td>
<td>Non-volatile RAM RDO section checksum failed</td>
</tr>
<tr>
<td>2</td>
<td>Non-volatile RAM CONFIG section checksum failed</td>
</tr>
<tr>
<td>3</td>
<td>Non-volatile RAM CAL section checksum failed</td>
</tr>
<tr>
<td>4</td>
<td>Non-volatile RAM STATE section checksum failed</td>
</tr>
<tr>
<td>5</td>
<td>Non-volatile RST section checksum failed</td>
</tr>
<tr>
<td>10</td>
<td>RAM selftest</td>
</tr>
<tr>
<td>11</td>
<td>VDAC/IDAC selftest 1</td>
</tr>
<tr>
<td>12</td>
<td>VDAC/IDAC selftest 2</td>
</tr>
<tr>
<td>13</td>
<td>VDAC/IDAC selftest 3</td>
</tr>
<tr>
<td>14</td>
<td>VDAC/IDAC selftest 4</td>
</tr>
<tr>
<td>15</td>
<td>OVDAC selftest</td>
</tr>
<tr>
<td>80</td>
<td>Digital I/O selftest error</td>
</tr>
</tbody>
</table>

### Device-Dependent Errors 100 through 32767 (sets Standard Event Status Register bit #3)

<table>
<thead>
<tr>
<th>Error Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>213</td>
<td>Ingrid receiver buffer overrun</td>
</tr>
<tr>
<td>216</td>
<td>RS-232 receiver framing error</td>
</tr>
<tr>
<td>217</td>
<td>RS-232 receiver parity error</td>
</tr>
<tr>
<td>218</td>
<td>RS-232 receiver overrun error</td>
</tr>
<tr>
<td>220</td>
<td>Front panel uart overrun</td>
</tr>
<tr>
<td>221</td>
<td>Front panel uart framing</td>
</tr>
<tr>
<td>222</td>
<td>Front panel uart parity</td>
</tr>
<tr>
<td>223</td>
<td>Front panel buffer overrun</td>
</tr>
<tr>
<td>224</td>
<td>Front panel timeout</td>
</tr>
<tr>
<td>401</td>
<td>CAL switch prevents calibration</td>
</tr>
<tr>
<td>402</td>
<td>CAL password is incorrect</td>
</tr>
<tr>
<td>403</td>
<td>CAL not enabled</td>
</tr>
<tr>
<td>404</td>
<td>Computed readback cal constants are incorrect</td>
</tr>
<tr>
<td>405</td>
<td>Computed programming cal constants are incorrect</td>
</tr>
<tr>
<td>406</td>
<td>Incorrect sequence of calibration commands</td>
</tr>
<tr>
<td>407</td>
<td>CV or CC status is incorrect for this command</td>
</tr>
<tr>
<td>408</td>
<td>Output mode switch must be in NORMAL position</td>
</tr>
<tr>
<td>601</td>
<td>Too many sweep points</td>
</tr>
<tr>
<td>602</td>
<td>Command only applies to RS-232 interface</td>
</tr>
<tr>
<td>603</td>
<td>CURRent or VOLTage fetch incompatible with last acquisition</td>
</tr>
<tr>
<td>604</td>
<td>Measurement overrange</td>
</tr>
</tbody>
</table>
Line Voltage Conversion

**WARNING:** *Shock Hazard* Operating personnel must not remove instrument covers. Component replacement and internal adjustments must be made only by qualified service personnel.

**Open the Unit**
- Turn off ac power and disconnect the power cord from the unit.
- Loosen the two screws on the rear bezel and remove the bezel (use a #15 Torx drive).
- Remove the two screws on the bottom of the unit (use a #15 Torx drive).
- Pull the cover back to remove it from the unit.

**Configure the Power Transformer**
- Locate the ac input wiring harness on the left side of the transformer
- Use a needlenose pliers and connect the ac input wiring harness according to the information in the following figure:

![Diagram of Power Transformer AC Input Connections](image)

*Figure D-1, Power Transformer AC Input Connections*
D - Line Voltage Conversion

**Install the Correct Line Fuse**

- Unscrew the line fuse cap from the rear panel and install the correct fuse.
  
  **For 100/120 Vac operation:** 2.5 AT (time delay); part number 2110-0633  
  **For 220/230 Vac operation:** 1.25 AT (time delay); part number 2110-0788  

- Mark the voltage setting that the unit has been set to on the rear panel label.

**Close the Unit**

- Replace the outer cover.
- Reconnect the power cord and turn on the unit.
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Technical data is subject to change.
Manual Updates

The following updates have been made to this manual since the November 1997 printing indicated on the Printing History page.

7/8/99

The Isink rating referred to on page 20 has been corrected. Additional information about CV mode operation has also been added to this page.

Notes have been added to Table A-1 for the Ripple and Noise specifications as well as the DC Measurement Accuracy Voltage specification.

A note has been added to table A-2 for the OVP Accuracy characteristic, and the Isolation to Ground characteristic has been corrected.

Steps 19 and 20 on page 61 under Low Range Current Measurement Calibration have been switched.

1/7/00

All references to HP have been changed to Agilent.

All references to HP-IB have been changed to GPIB.

A note about magnetic fields has been added to page 22.

On page 49 the model reference for note 3 has been corrected.

2/21/01

Fuse part numbers on page 21 and 68 have been corrected.

A note has been added to Table A-1 for the Programming Accuracy specification.