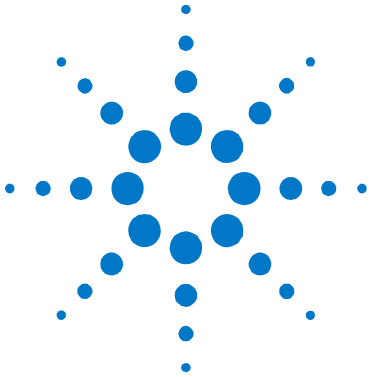

Agilent Technologies DC Power Analyzer

Model N6705A

User's Guide

Agilent Technologies

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Manual Editions

Manual Part Number: N6705-90001
Fourth Edition, January, 2008
Printed in Malaysia.

Reprints of this manual containing minor corrections and updates may have the same printing date. Revised editions are identified by a new printing date.

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

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

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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 or instructions 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

Do not use this product in any manner not specified by the manufacturer. The protective features of this product may be impaired if it is used in a manner not specified in the operation instructions.

Before Applying Power

Verify that all safety precautions are taken. Make all connections to the unit before applying power. Note the instrument's external markings described under "Safety Symbols"

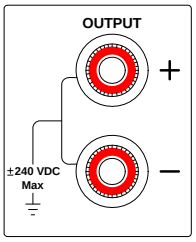
Ground the Instrument

This product is a Safety Class 1 instrument (provided with a protective earth terminal). 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.

Load Connections

Power supplies can output high currents and high voltages. Make sure that the load or device under test can safely handle the output current and voltage. Also, make sure that the connection leads can safely withstand the expected currents and are insulated for the expected voltages.

Power supply outputs may be connected so as to float relative to earth ground. Isolation or floating voltage ratings are indicated on the instrument, near the output connectors (see example below).



Do not float the power supply output on the line-voltage mains. Observe all safety markings and protection limits.

Fuses

The instrument contains an internal fuse, which is not customer accessible.

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

Only qualified, service-trained personnel who are aware of the hazards involved should remove instrument covers. Always disconnect the power cable and any external circuits before removing the instrument cover.

Do Not Modify the Instrument

Do not install substitute parts or perform any unauthorized modification to the product. Return the product to an Agilent Sales and Service Office for service and repair to ensure that safety features are maintained.

In Case of Damage

Instruments that appear damaged or defective should be made inoperative and secured against unintended operation until they can be repaired by qualified service personnel.

Cleaning

Clean the outside of the instrument with a soft, lint-free, slightly dampened cloth. Do not use detergent or solvents.

Safety Symbols and Notices

⎓	Direct current
~	Alternating current
≂	Direct and alternating current
3~	3-phase alternating current
⏚	Earth (ground) terminal
⏚	Protective earth terminal
⏚	Frame or chassis terminal
⊥	Terminal is at earth potential
N	Neutral conductor on permanently installed equipment
L	Line conductor on permanently installed equipment.
	On supply
○	Off supply
⏻	Standby supply - unit is not completely disconnected from AC mains when switch is off
▭	In position of a bi-stable push switch
▭	Out position of a bi-stable push switch
⚡	Caution, risk of electric shock
♨	Caution, hot surface
!	Caution, refer to accompanying description

CAUTION

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

WARNING

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

Agilent Technologies	**DECLARATION OF CONFORMITY** According to ISO/IEC Guide 22 and CEN/CENELEC EN 45014	CE

	Responsible Party	**Alternate Manufacturing Site**
Manufacturer's Name:	Agilent Technologies, Inc.	Agilent Technologies (Malaysia) Sdn. Bhd
Manufacturer's Address:	550 Clark Drive, Suite 101 Budd Lake, New Jersey 07828 USA	Malaysia Manufacturing Bayan Lepas Free Industrial Zone, PH III 11900 Penang, Malaysia

Declares under sole responsibility that the product as originally delivered

Product Name: Modular Power System

Model Numbers: N6700A, N6700B, N6710A, N6731B, N6732B, N6733B, N6734B, N6735B, N6736B, N6731A, N6732A, N6733A, N6734A, N6735A, N6741B, N6742B, N6743B, N6744B, N6745B, N6746B, N6742A, N6743A, N6744A, N6745A, N6751A, N6752A, N6761A, N6762A, N6701A, N6702A, N6773A, N6774A, N6775A, N6776A, N6705A, N6753A, N6754A,

Product Options: This declaration covers all options of the above product(s)

complies with the essential requirements of the following applicable European Directives, and carries the CE marking accordingly:

Low Voltage Directive (73/23/EEC, amended by 93/68/EEC)
EMC Directive (89/336/EEC, amended by 93/68/EEC)

and conforms with the following product standards:

EMC	**Standard** IEC 61326 :1997+A1 :1998+A2 :2000 EN 61326 :1997+A1 :1998+A2 :2001	**Limit**
	CISPR 11:1997 / EN 55011:1998	Group 1 Class A
	IEC/EN 61000-4-2:1995+A1:1998 +A2:2001	4 kV CD, 8 kV AD
	IEC/EN 61000-4-3:2002	3 V/m, 80-1000 MHz, 80% AM
	IEC 61000-4-4:1995+A1 :2000 / EN 61000-4-4:1995+A1 :2001	0.5 kV signal lines, 1 kV power lines
	IEC 61000-4-5:1995+A1 :2000 / EN 61000-4-5:1995+A1 :2001	0.5 kV differential, 1 kV common mode
	IEC 61000-4-6:1996+A1 :2000 / EN 61000-4-6:1996+A1 :2001	3 Vrms, 0.15-80 MHz, 80% AM
	IEC 61000-4-11:1994+A1 :2000 / EN 61000-4-11:1994+A1 :2001	100%/20 ms
	Canada: ICES-001:1998 Australia/New Zealand: AS/NZS 2064.1	
	The product was tested in a typical configuration with Agilent Technologies test systems.	
Safety	IEC 61010-1:2001 / EN 61010-1:2001 Canada: CSA C22.2 No. 1010.1 1992 UL 61010B-1 2003	

This DoC applies to above-listed products placed on the EU market after:

March 19, 2007

Date

Bill Darcy
Product regulations manager

For further information, please contact your local Agilent Technologies sales office, agent or distributor, or Agilent Technologies Deutschland GmbH, Herrenberger Straße 130, D 71034 Böblingen, Germany.

Template: A5971-5302-2, Rev. B.00 **{Document number}** **DoC Revision**

In this Book

Specific chapters in this manual contain the following information:

- Quick Reference – Chapter 1 is a quick reference section that helps you quickly become familiar with your Agilent N6705A DC Power Analyzer. It describes the differences between the various power modules in the DC Power Analyzer.
- Installation – Chapter 2 describes how to install your DC Power Analyzer. It describes how to connect loads to the output. It also discusses 4-wire sensing.
- Operating the DC Power Analyzer – Chapter 3 describes how to use the advanced features of the DC Power Analyzer using the front panel. It also describes how to use the built-in file system.
- System Utilities – Chapter 4 describes how to use the system utilities. It also describes how to configure the remote interface, and how to use the digital control port.
- Operating and Connections Tutorial – Chapter 5 discusses load connections, including information on reducing or eliminating sources of output noise as well as obtaining the best output regulation from your instrument. Information about measurement capabilities is also included.
- Specifications – Appendix A describes specifications and supplemental characteristics.
- Error Messages – Appendix B describes the error messages.
- SCPI Commands – Appendix C summarizes the SCPI commands.
- Output Synchronization – Appendix D describes how to configure output turn-on/turn-off synchronization.

For complete details on the SCPI (Standard Commands for Programmable Instruments) commands, refer to the Programmer's Reference Help file included on the Agilent N6705A Product Reference CD. This CD-ROM is shipped along with your instrument.

NOTE

You can contact Agilent Technologies at one of the following telephone numbers for warranty, service, or technical support information.
In the United States: (800) 829-4444
In Europe: 31 20 547 2111
In Japan: 0120-421-345
Or use our Web link for information on contacting Agilent in your country or specific location: www.agilent.com/find/assist
Or contact your Agilent Technologies Representative.

The web contains the most up to date version of the manual. Go to http://www.agilent.com/find/N6705 to get the latest version of the manual.

Go to http://www.agilent.com/find/N6705firmware to get the latest version of the firmware

Contents

1 Quick Reference

This chapter concisely describes the operation of the Agilent N6705A DC Power Analyzer.

This chapter does not describe every operating feature in detail. It is simply a quick reference guide to quickly become familiar with the operating features of the Agilent N6705A DC Power Analyzer.

For complete details on the SCPI (Standard Commands for Programmable Instruments) commands, refer to the Programmer's Reference Help file included on the Agilent N6705A Product Reference CD. This CD-ROM is shipped along with your instrument.

NOTE Unless otherwise noted, the Agilent N6705A DC Power Analyzer will also be referred to as "DC Power Analyzer" throughout this manual.

The Agilent N6705A DC Power Analyzer – At a Glance

The Agilent N6705A DC Power Analyzer is a multi-functional power system that combines the functions of a multiple-output DC voltage source with the waveform/data capturing capability of an oscilloscope and data logger.

As a multiple-output DC source, the Agilent N6705A provides up to four configurable outputs. Available power modules have power levels of 50 W, 100 W, and 300 W, various voltage and current combinations, and provide a variety of performance features as described under "Power Module Capabilities". Each output also has arbitrary (Arb) waveform generation capability, which lets you program up to seven predefined voltage waveforms – or define your own voltage or current waveform.

As a measurement system, the Agilent N6705A displays the average output voltage and current on a 4 or 5 digit Meter View. Waveforms can be displayed using the Scope View, which you can adjust using vertical and horizontal controls. The Data Logger View measures and charts average and peak voltage and current measurements over an extended time period.

Source Features

Color-coded display and output controls	Correspondence between color-coded information on the display and front panel connectors and keys.
Programmable voltage and current	Full programming capability is provided for the entire range of output voltage and current for all power modules.
Low output noise	Output noise is <4.5 mV peak-to-peak for autoranging and precision power modules, which is comparable to linear supplies.
Fast up/down programming	1.5 millisecond response time from 10% to 90% of the output rating for autoranging and precision power modules.
Fast transient response	Transient response is less than 100 microseconds for autoranging and precision power modules.
Autoranging capability	Autoranging supplies the maximum rated power over a continuous range of voltage and current settings for autoranging and precision power modules.
Output On/Off sequencing	A turn-on/turn-off delay capability for each output allows output on/off sequencing.
Front panel binding posts	+ and – output and + and – sense terminals are provided for each output. Sense terminals provide 4-wire voltage measurements.
Output protection	Outputs have over-voltage, over-current, and over-temperature protection.
Emergency shut-off	An emergency stop button to quickly shut down all outputs.

Measurement Features

Multiple-output/Single-output meter display	Switch between a 4-output summary view and a 1- output detailed view of power supply information. All power modules display real-time output voltage and current measurements as well as status information.
Scope-like display	Voltage and/or current waveforms of all outputs can be simultaneously displayed. Adjustable markers provide calculated measurements.
Data logging display	Average, minimum, and maximum voltage and current values can be logged over an extended time period to the display. Adjustable markers provide calculated measurements. A summary view provides a snapshot of the displayed data.
Math functions	Average, minimum, and maximum values are provided for all voltage and current measurements. Output power (Watts) is calculated for all outputs in 1-output meter view.

System Features

Choice of three interfaces	GPIB (IEEE-488), LAN, and USB remote programming interfaces are built in Menus let you set up GPIB and LAN parameters from the front panel.
Built-in Web server	A built-in Web server lets you control the instrument directly from an internet browser on your computer.
SCPI language	The instrument is compatible with the Standard Commands for Programmable Instruments (SCPI).
Savable instrument data	A file management system saves display bitmaps, instrument states, scope results, test results, and data log results.
Memory port	Front panel USB memory port allows data files to be saved to an external USB memory device.
Trigger connectors	Rear panel trigger in/out BNC connectors
Low acoustic noise	Low acoustic noise for quiet bench operation.

Power Module Features

Feature (● = available)	Precision Modules		High-Performance Autoranging Modules			DC Power Modules		
	N6761A	N6762A	N6751A	N6752A	N6754A	N6731B-N6736B	N6741B-N6746B	N6773A-N6776A
50 W output rating	●		●			●		
100 W output rating		●		●			●	
300 W output rating					●			●
Double-wide (occupies 2 channel locations)					●			
Autoranging output capability	●	●	●	●	●			
Large gate array			Opt. LGA[1]	Opt. LGA[1]				
Output On/Off relays	Opt. 761	Opt. 761	Opt. 761	Opt. 761	Opt. 761	Opt. 761	Opt. 761	Opt. 761
Polarity reversal relays					Opt. 760	Opt. 760	Opt. 760[2]	Opt. 760
Arbitrary waveform generation	●	●	●	●	●	●	●	●
Precision voltage and current measurements	●	●						
Low voltage output and measurement range	●	●						
Low current output and measurement range	●	●						
100 microampere measurement range	Opt. 1UA	Opt. 1UA						
200 microampere measurement range	Opt. 2UA	Opt. 2UA						
Voltage or current turn-on priority	●	●						
Voltage or current scope traces	●	●	●	●	●	●	●	●
Simultaneous voltage and current scope traces	●	●						
Interleaved voltage and current data logging[3]	●	●	●	●	●	●	●	●
Simultaneous voltage and current data logging[3]	●	●						
SCPI command list capability[4]	●	●	Opt. 054	Opt. 054	Opt. 054			
SCPI command array readback[4]	●	●	Opt. 054	Opt. 054	Opt. 054			
SCPI command programmable sample rate[4]	●	●	Opt. 054	Opt. 054	Opt. 054			

Notes:

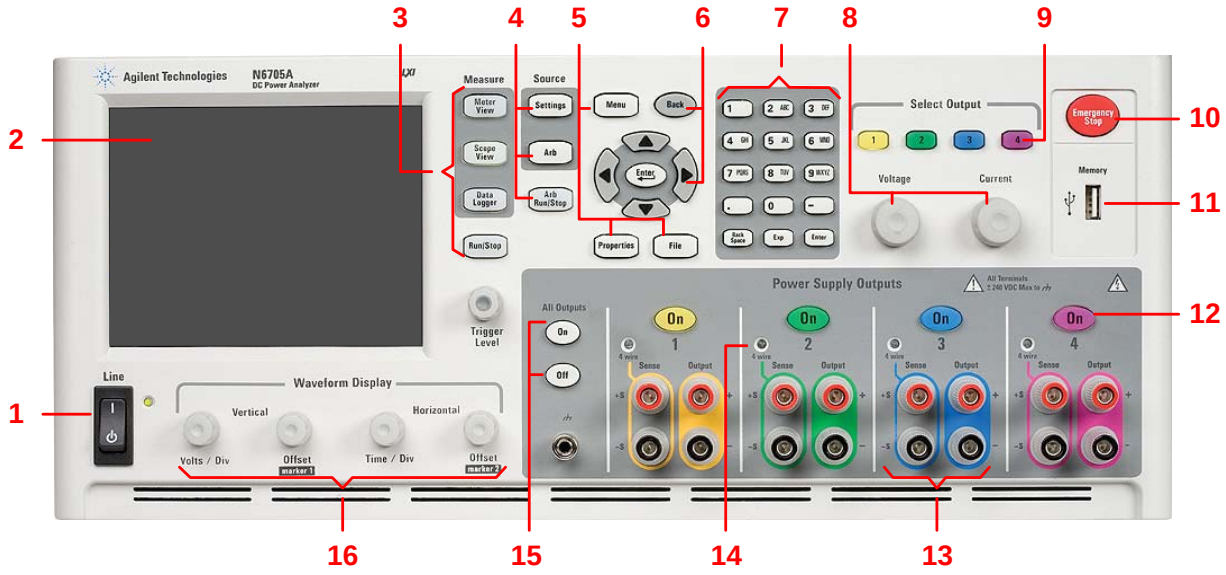
[1]Option LGA is required on Models N6751A and N6752A.

[2]Option 760 is not available on Model N6741B.

[3]Option 055 deletes the Data Logger function on Model N6705A.

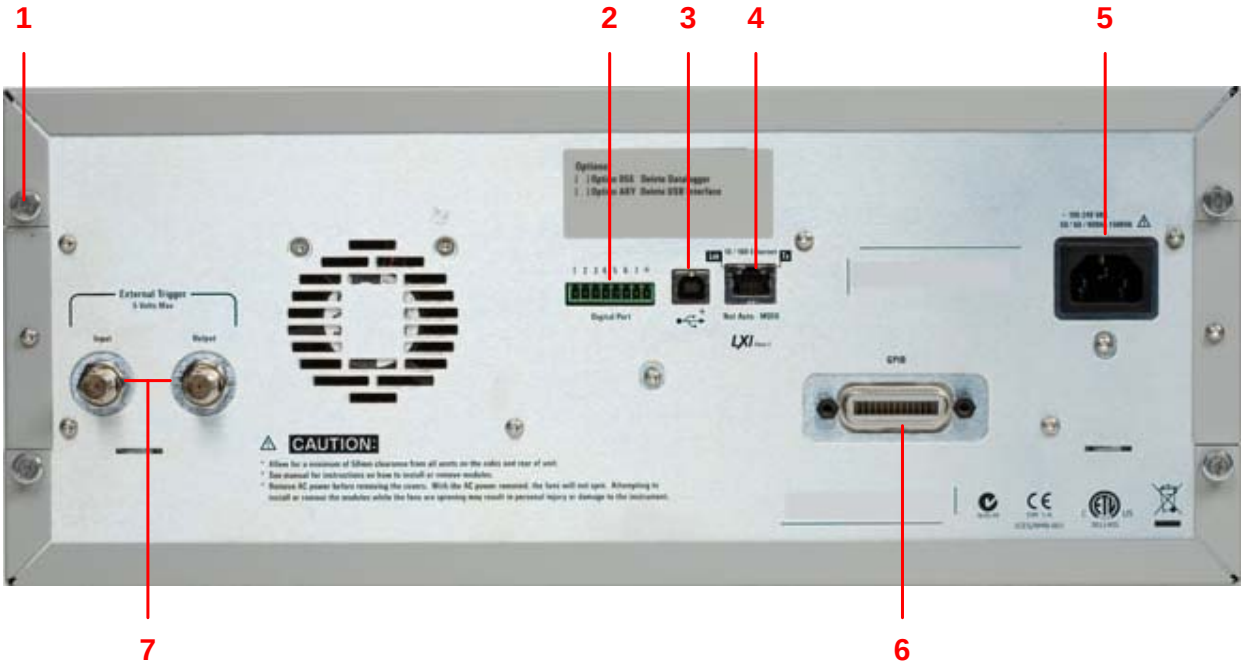
[4]Only available when using the remote interfaces; not the front panel.

The Front Panel - At a Glance



1	**Line switch**	Turns the instrument On or Off.
2	**Display**	Displays all instrument functions - information changes based on selected function.
3	**Measure keys**	Selects the measurement function - Meter View, Scope View, or Data Logger. Run/Stop key starts or stops the scope or data log measurement.
4	**Source keys**	Programs the source function – Source Settings or Arbitrary waveform. Arb Run/Stop key starts or stops the arbitrary waveform function.
5	**Menu, Properties, File keys**	Menu key accesses all mode controls via a hierarchical command menu. Properties key displays information specific to the active view (this is a menu shortcut). File key lets you save the current display, instrument settings, and measurements.
6	**Navigation keys**	Navigate through the control dialog windows; press the Enter key to select a control. Cancel key cancels the values entered into the dialog and backs out of the control.
7	**Numeric/Alpha Entry keys**	Enters numeric and alpha values. Alpha keys automatically become active on fields that allow alpha character entry. Repeatedly pressing the key scrolls thorough the selections.
8	**Voltage/Current knobs**	Sets the voltage and current of the selected output.
9	**Select Output keys**	Selects an output to control. The lit key indicates the selected output.
10	**Emergency Stop**	Turns off all outputs without any delays; aborts any arbitrary waveforms.
11	**Memory port**	USB Memory device connector. Option AKY deletes the connector.
12	**On keys**	Turns individual outputs On or Off; outputs are on when the key is lit.
13	**Binding posts**	+ and – output and sense banana terminals for all outputs.
14	**4 Wire**	Indicates that 4 Wire sensing is enabled on the output.
15	**All Outputs On/Off keys**	Turns all outputs On and Off according to the specified turn-on and turn-off delays.
16	**Waveform Display controls**	Controls the scope and data logging views. Vertical knobs make the waveform bigger or smaller vertically and move it up and down. Horizontal knobs stretch and shrink the waveform horizontally and move it left or right. The Trigger knob moves the trigger level up or down. Press this knob to autoscale.

The Rear Panel – At a Glance



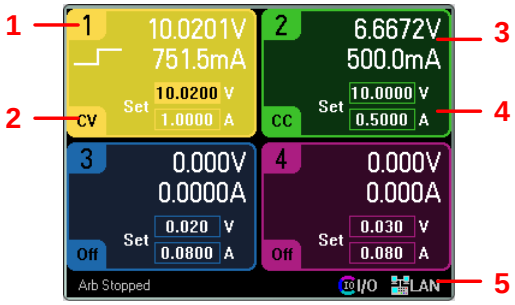
1	**Cover screw**	Facilitates top and bottom cover removal for power module installation.
2	**Digital Port connector**	Connects to the 8-pin digital port. Port functions are user-configurable. Refer to chapter 4 for details.
3	**USB interface connector**	Connects to USB interface. May be disabled from front panel menu. Option AKY deletes the connector.
4	**LAN interface connector**	Connects to 10/100 Base-T interface. Left LED indicates activity. Right LED indicates link integrity. May be disabled from front panel menu.
5	**AC input connector**	3-pin IEC 320 AC input connector. Power cord requires ground conductor.
6	**GPIB interface connector**	Connects to GPIB interface. May be disabled from front panel menu.
7	**Trigger connectors**	BNC connectors for trigger in and trigger out signals. Refer to Appendix A for signal descriptions.

WARNING **SHOCK HAZARD The power cord provides a chassis ground through a third conductor. Be certain that your power outlet is of the three-conductor type with the correct pin connected to earth ground.**

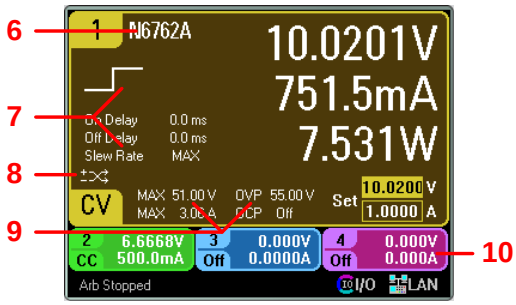
Meter View

Press Meter View

This key toggles between multiple and single output views



Multiple Output View



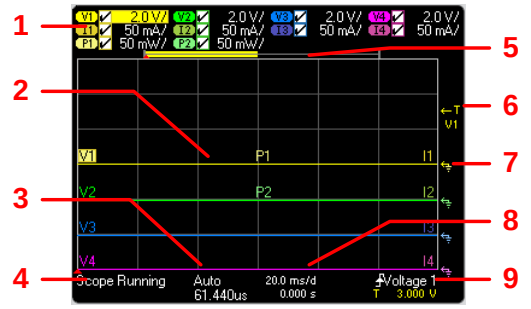
Single Output View

1	**Output Identifier**	Identifies the output. When an output is selected, the background becomes highlighted. The selected output is displayed in an enlarged format in single output view.
2	**Output Status**	Off – output is off CV – output is in constant voltage mode CC – output is in constant current mode OV – over-voltage protection tripped OC – over-current protection tripped OT – over-temperature protection tripped PF – a power-fail condition occurred CP+ - a positive power limit condition CP– - a negative power limit condition Inh – an external inhibit signal received Unr – the output is unregulated Prot – a coupled output condition occurred
3	**Output Meters**	Displays the actual output voltage and current. Also displays output power in single output view.
4	**Output Settings**	Displays the present output voltage and current settings. Turn the front panel voltage or current knob to adjust these settings. Can also be changed using the numeric keypad.
5	**Interface Status**	Identifies the present interface status as follows: Error = an error has occurred (press the Menu key, select Utilities, then Error Log) Lan = the LAN is connected and has been configured IO = there is activity on one of the remote interfaces
6	**Model Number**	Identifies the model number of the power module connected to this output.
7	**Arb, Delay, & Slew Rate**	Displays the Arb waveform that is presently configured for this output. If no Arb is configured, no waveform will be displayed. Also displays the Output On and Output Off delay settings as well as the slew rate setting.
8	**Polarity Reverse**	Indicates that the output and sense polarities are reversed.
9	**Ratings & Protection**	Displays the maximum voltage and current ratings of the output. Also displays the present over-voltage protection setting and whether over-current protection is on or off.
10	**Other Outputs**	Displays the actual voltage, current, and status of the other outputs.

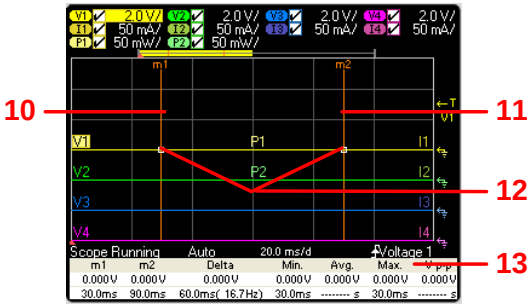
Scope View

Press Scope View

This key toggles between standard and marker views.



Standard View



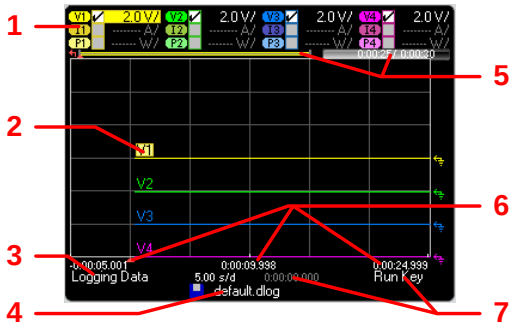
Marker View

1	**Trace Controls**	Identifies the voltage or current trace that will be displayed. Dashes (----) indicate that the specified trace is turned off. Select the trace and press Enter to turn it on or off.
2	**Output Traces**	V1, V2, V3, and V4 indicate voltage traces. I1, I2, I3, and I4 indicate current traces. P1 and P2 indicate power traces. Press Trigger Level knob to autoscale all traces.
3	**Trigger Mode**	Identifies the trigger mode setting. This can be selected by pressing the Properties key.
4	**Scope Status**	Indicates whether the scope is idle, running, or waiting for a trigger.
5	**Data Bar**	The highlighted area shows how much of the entire measurement is actually shown on the display. Use the Horizontal Time/Div knob and Offset knob to adjust the display
6	**Trigger Level**	Identifies the trigger level through which the waveform must pass before the scope will trigger. This can be adjusted using the Trigger Level knob.
7	**Ground**	Identifies the ground reference level for the trace. This can be adjusted using the Vertical Offset knob. The initial vertical offset of each trace is set to a different level to prevent the traces from overlapping.
8	**Horizontal Time-base**	Identifies the horizontal time-base settings. These can be adjusted using the front panel Horizontal Time/Div and Offset knobs.
9	**Trigger Source**	Identifies the trigger source and trigger level. Voltage 1 indicates a voltage level on output 1 is the trigger source (see #6).
10	**M1 Marker**	Measurement Marker 1 enabled. Adjust using Marker 1 knob. Press knob to reset.
11	**M2 Marker**	Measurement Marker 2 enabled. Adjust using Marker 2 knob. Press knob to reset.
12	**Intersect Point**	Shows where the measurement markers intersect the waveform.
13	**Measurements**	Shows the calculations of the waveform data between Marker 1 and Marker 2.

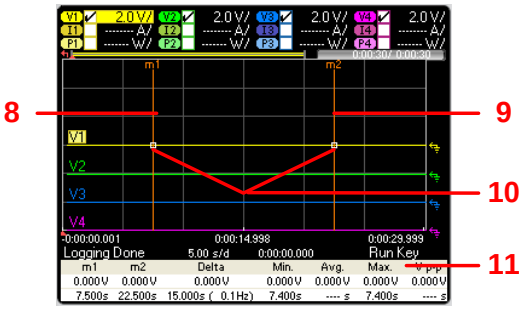
Data Logger

NOTE Option 055 deletes the Data Logger function on Model N6705A.

Press
Data Logger
This key toggles between standard and marker views



Standard View



Marker View

1	**Trace Controls**	Identifies the voltage or current trace that will be displayed. Dashes (----) indicate that the specified trace is turned off. Select the trace and press Enter to turn it on or off.
2	**Output Traces**	Voltage, current, or power traces. Voltage traces V1,V2, V3 and V4 shown. Press Trigger Level knob to autoscale all traces.
3	**Status**	Indicates whether the Data Logger is logging data, done logging, or is empty.
4	**Filename**	Indicate the file to which the data is being logged.
5	**Data Bar & Time Elapsed**	Displays the progress of the data logger. The yellow bar is the data that has been logged. Numbers to the right indicate time elapsed/total duration.
6	**Timebase Information**	Displays the time remaining before the trigger point; the time at the center line of the grid in relation to trigger point; and the time elapsed since the trigger.
7	**Trigger**	Identifies the trigger source and trigger offset. The trigger offset is specified in % of the total duration, but shown in seconds on the display.
8	**M1 Marker**	Measurement Marker 1 enabled. Adjust using Marker 1 knob. Press knob to reset.
9	**M2 Marker**	Measurement Marker 2 enabled. Adjust using Marker 2 knob. Press knob to reset.
10	**Intersect Point**	Shows where the measurement markers intersect the waveform.
11	**Measurements**	Shows the calculations of the waveform data between Marker 1 and Marker 2.

Front Panel Menu Reference

Menu Heading	Description
Source Settings ►	
Voltage and Current Settings...	Configures the voltage and current settings, voltage slew, and range. Reverses the polarity of the output and sense terminals on modules with option 760.
Protection...	Configures the over-voltage, over-current, and output inhibit function. Enables output coupling so ALL outputs are disabled when a fault occurs. Also clears output protection.
Output On/Off Delays...	Configures output on/off delays.
Output Grouping...	Groups identical outputs for output paralleling function.
Output Coupling...	Couples specific outputs for the output on/off and delay function.
Ratings...	Displays power module ratings, serial number, firmware, and option information.
Arb ►	
Arb Preview	Displays the present status of the arbitrary waveforms that have been configured.
Arb Selection...	Assigns arbitrary waveforms for each output. Additional windows configure specific waveforms. Also lets you select a trigger source.
Meter ►	
All Outputs Meter View	Displays the Meter View of all outputs.
Single Output Meter View	Displays the Meter View of the selected output.
Meter Properties...	Configures the Meter View current ranges.
Scope ►	
Standard View	Displays the standard scope view including vertical, horizontal, and trigger settings.
Marker View	Displays the measurement markers and measurement calculations area.
Scope Properties...	Configures the scope trace for individual outputs; also configures the trigger source, mode, and horizontal offset. Trace configures the scope traces.
Datalogger ►	
Standard View	Displays the data log strip chart view including vertical, horizontal, and progress settings.
Marker View	Displays the measurement markers and measurement calculations area.
Summary View	Displays a summary view of the voltage and current data for each output. Also displays envelope information.
Datalogger Properties...	Configures the data log properties for all outputs; including duration, sample interval, dc measurements and display. Trace configures which signals are logged.
File ►	
Save...	Saves an instrument state or a scope measurement.
Load...	Loads an instrument state, scope data, or logged data.
Export...	Exports scope data, logged data, or a user-defined arbitrary waveform
Import...	Imports s user-defined arbitrary waveform.
Screen Capture...	Captures the screen that was active when the File key was pressed.
File Management...	Accesses additional file functions: New Folder, Delete, Rename, Copy, File Details.
Reset/Recall/Power-On State...	Resets the instrument to factory defaults; Saves/recalls instrument states; and specifies the power-on turn on state.

Front Panel Menu Reference (continued)

Menu Heading	Description
Utilities ►	
Error Log...	Lists all error messages.
I/O Configuration ►	Configures the LAN, USB, and GPIB interfaces.
User Preferences ►	Configures user preferences. Includes screen-saver preferences and front panel key clicks.
Administrative Tools ►	Accesses the password-protected administrative functions. These include calibration, remote interface configuration and access, NVRam reset, disk management, and others.
Digital I/O...	Configures the digital port. All seven pins of the digital port can be individually configured.
Help ►	
Overview...	A brief overview.
Quick Start ►	How to quickly get started.
Using the Agilent N6705A ►	How to use the Agilent N6705A.
Using the Utilities ►	How to use the utilities.
Front Panel Controls ►	How to use the front panel controls.
Front Panel Navigation...	How to navigate the front panel display.
Module Capabilities/Ratings...	How to obtain module capabilities/ratings.

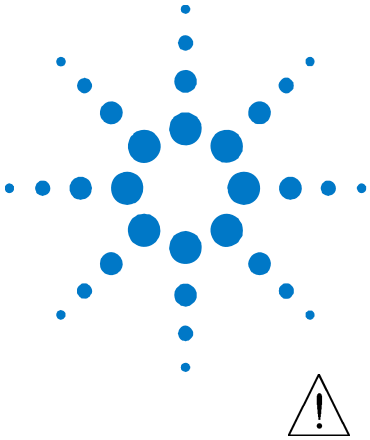
Instrument Settings

Interface Settings

Factory-shipped non-volatile LAN settings			
Get IP Address	Automatic	Dynamic DNS naming service	Enabled
IP Address	169.254.67.0	NetBIOS naming service	Enabled
Subnet Mask	255.255.0.0	Domain name	Blank
Default Gateway	0.0.0.0	TCP keepalive	Enabled
Obtain DNS server from DHCP	Enabled	TCP keepalive seconds	1800
DNS server	Blank	Ethernet Auto-negotiation	Enabled
Host name	A-N67xxx-xxxxx	Ping server	Enabled
		Web password	Blank
Other factory-shipped non-volatile settings			
Admin/Calibration password	0 (zero)	LAN interface	Enabled
Calibration date	March 5, 2007	Output Inhibit mode	Off
Channel grouping	No groups	Saved states	*RST command
Digital port function (all pins)	Digital In	Voltage and Current knobs	Unlocked
Digital port polarity (all pins)	Positive	Screen saver	Enabled
Front panel lockout	Disabled	Screen saver delay	60 minutes
Front panel meter view	Single-channel	USB interface	Enabled
GPIB Address	5	Wake on I/O	Enabled
Key clicks	Enabled	Web server	Enabled

Power On Settings

These settings are set by the Reset (*RST) command			
ARB:COUNt	1	DIGital:OUTPut:DATA	0
ARB:CURRent:UDEFined:BOSTep	OFF	DISPlay:VIEW	METER1
ARB:CURRent:UDEFined:DWELl	0.001	INITiate:CONTinuous:TRANsient	OFF
ARB:CURRent:UDEFined:LEVel	MIN	LIST:COUNt	1
ARB:FUNCtion	NONE	LIST:CURRent	MIN
ARB:TERMinate:LAST	OFF	LIST:DWELl	0.001
ARB:VOLTage:EXPonential:END	MIN	LIST:STEP	AUTO
ARB:VOLTage:EXPonential:STARt	MIN	LIST:TERMinate:LAST	OFF
ARB:VOLTage:EXPonential:STARt:TIMe	0	LIST:TOUTput:BOST	OFF
ARB:VOLTage:EXPonential:TCONstant	1	LIST:TOUTput:EOST	OFF
ARB:VOLTage:EXPonential:TIMe	1	LIST:VOLTage	MIN
ARB:VOLTage:PULSe:END	0	OUTPut	OFF
ARB:VOLTage:PULSe:STARt	MIN	OUTPut:COUPle	OFF
ARB:VOLTage:PULSe:STARt:TIMe	0	OUTPut:DELay:FALL	0
ARB:VOLTage:PULSe:TOP	MIN	OUTPut:DELay:RISE	0
ARB:VOLTage:PULSe:TOP:TIMe	1	OUTPut:PMODe	VOLT
ARB:VOLTage:RAMP:END	MIN	OUTPut:PROTection:COUPle	OFF
ARB:VOLTage:RAMP:END:TIMe	0	OUTPut:PROTection:DELay	0.02
ARB:VOLTage:RAMP:RTIMe	1	OUTPut:RELay:POLarity	NORM
ARB:VOLTage:RAMP:STARt	MIN	POWer:LIMit	MAX
ARB:VOLTage:RAMP:STARt:TIMe	0	SENSe:CURRent:COMpensate	ON
ARB:VOLTage:SINusoid:AMPLitude	MIN	SENSe:CURRent:RANGe	MAX
ARB:VOLTage:SINusoid:FREQuency	1	SENSe:DLOG:FUNCtion:CURRent	OFF
ARB:VOLTage:SINusoid:OFFSet	0	SENSe:DLOG:FUNCtion:MinMax	OFF
ARB:VOLTage:STAircase:END	MIN	SENSe:DLOG:FUNCtion:VOLTage	ON
ARB:VOLTage:STAircase:END:TIMe	0	SENSe:DLOG:OFFset	0
ARB:VOLTage:STAircase:NSTeps	10	SENSe:DLOG:TIME	30
ARB:VOLTage:STAircase:STARt	MIN	SENSe:DLOG:TINTerval	0.1
ARB:VOLTage:STAircase:STAR:TIMe	0	SENSe:FUNCtion	“VOLT”
ARB:VOLTage:STAircase:TIMe	1	SENSe:SWEep:POINts	1024
ARB:VOLTage:STEP:END	MIN	SENSe:SWEep:OFFSet:POINts	0
ARB:VOLTage:STEP:STARt	MIN	SENSe:SWEep:TINTerval	20.48E–6
ARB:VOLTage:STEP:STARt:TIMe	0	SENSe:VOLTage:RANGe	MAX
ARB:VOLTage:TRAPezoid:END:TIMe	0	SENSe:WINDow	RECT
ARB:VOLTage:TRAPezoid:FTIMe	1	STEP:TOUTput	FALSE
ARB:VOLTage:TRAPezoid:RTIMe	1	TRIGger:ACQuire:SOURce	BUS
ARB:VOLTage:TRAPezoid:STARt	MIN	TRIGger:ARB:SOURce	IMM
ARB:VOLTage:TRAPezoid:STARt:TIMe	0	TRIGger:DLOG:CURRent	MIN
ARB:VOLTage:TRAPezoid:TOP	MIN	TRIGger:DLOG:CURRent:SLOPe	POS
ARB:VOLTage:TRAPezoid:TOP:TIMe	1	TRIGger:DLOG:SOURce	IMM
ARB:VOLTage:UDEFined:BOSTep	OFF	TRIGger:DLOG:VOLTage	MIN
ARB:VOLTage:UDEFined:DWELl	0.001	TRIGger:DLOG:VOLTage:SLOPe	POS
ARB:VOLTage:UDEFined:LEVel	MIN	TRIGger:TRANsient:SOURce	BUS
CALibrate:STATe	OFF	VOLTage	MIN
CURRent	0.08 or MIN	VOLTage:MODE	FIX
CURRent:MODE	FIX	VOLTage:PROTection	MAX
CURRent:PROTection:STATe	OFF	VOLTage:RANGe	MAX
CURRent:RANGe	MAX	VOLTage:SLEW	9.9E+37
CURRent:TRIGger	MIN	VOLTage:TRIGger	MIN



2
Installation

This chapter describes how to install your DC Power Analyzer. It discusses rack mounting and line cord connections.

This chapter also discusses how to connect your load to the output terminals.

Inspecting the Unit

When you receive your DC Power Analyzer, inspect it for obvious damage that may have occurred during shipment. If there is damage, notify the shipping carrier and nearest Agilent Sales and Support Office immediately. Refer to www.agilent.com/find/assist.

Until you have checked out the DC Power Analyzer, save the shipping carton and packing materials in case the unit has to be returned. Check the list under "Items Supplied" and verify that you have received these items with your instrument. If anything is missing, please contact your nearest Agilent Sales and Support Office.

Models

Agilent Model	Description
N6705A	600 W DC Power Analyzer mainframe - without power modules
N6715A	Build-to-order DC Power Analyzer system - includes mainframe with installed power modules
N6751A / N6752A / N6754A	50 W / 100 W / 300 W High-Performance Autoranging DC Power Module
N6761A / N6762A	50 W / 100 W Precision DC Power Module
N6731B / N6741B	50 W / 100 W 5 V DC Power Module
N6732B / N6742B	50 W / 100 W 8 V DC Power Module
N6733B / N6743B / N6773A	50 W / 100 W / 300 W 20 V DC Power Module
N6734B / N6744B / N6774A	50 W / 100 W / 300 W 35 V DC Power Module
N6735B / N6745B / N6775A	50 W / 100 W / 300 W 60 V DC Power Module
N6736B / N6746B / N6776A	50 W / 100 W / 300 W 100 V DC Power Module

Optional Items

Mainframe Options	Description
ABA	English Manual Set. Contains User's Guide and Service Guide. Also available as p/n N6705-90000.
ABD	German Manual Set. Contains User's Guide and Service Guide. Also available as p/n N6705-90401.
ABF	French Manual Set. Contains User's Guide and Service Guide. Also available as p/n N6705-90402.
ABJ	Japanese Manual Set. Contains User's Guide and Service Guide. Also available as p/n N6705-90403.
AB1	Korean Manual Set. Contains User's Guide and Service Guide. Also available as p/n N6705-90406.
AB2	Chinese Manual Set. Contains User's Guide and Service Guide. Also available as p/n N6705-90408.
AKY	Deletes the front and rear panel USB connector.
055	Deletes the Data Logger function.
908	Rack Mount Kit. For mounting in a 19-inch EIA rack cabinet. Also available as p/n 5063-9215.
909	Rack Mount Kit with handles. Also available as p/n 5063-9222.
Power Module Options	
054	High speed test extensions. Adds SCPI commands for digitized measurements and output lists. Available for Models N6751A/N6752A. Not required for use in the DC Power Analyzer.
760	Output disconnect/polarity reversal. Disconnects the + and – output and sense terminals. Switches the + and – output and sense polarities. Not available on Models N6741B, N675xA, or N676xA.
761	Output disconnect. Disconnects + and – output and sense terminals. Available for all power modules
LGA	Large gate array. Required on Models N6751A/N6752A for use in the DC Power Analyzer.
1UA or 2UA	100 or 200 microampere measurement range. Only available on Agilent Models N676xA.

Items Supplied

Item	Description	Part Number
Power Cord	A power cord suitable for your location. Shipped w/mainframe	Call Agilent Sales & Support Office
Digital Connector	8-pin connector for connecting signal lines to the digital port. Shipped w/ mainframe	Agilent 1253-6408 Phoenix Contact MC 1,5/8-ST-3,5
Product Reference CD-ROM	Includes software and documentation. Shipped w/ mainframe	Agilent N6705-13601
Automation-Ready CD-ROM	Contains Agilent IO Libraries Suite. Shipped w/ mainframe	Agilent E2094N
T-10 Torx tool	Hex key for installing or removing power modules. Shipped w/ mainframe. (A flat blade screwdriver can also be used.)	Agilent 8710-2416
Power Module Calibration Certificate	A certificate of calibration referenced to the serial number. Shipped w/ power module	N/A

Installing the Unit

Safety Considerations

This DC Power Analyzer is a Safety Class 1 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 Power Analyzer and review this guide for safety warnings and instructions. Safety warnings for specific procedures are located at appropriate places throughout this Guide.

Environment

WARNING **Do not operate the instrument in the presence of flammable gasses or fumes**

The environmental conditions of the instrument are documented in Appendix A. Basically, the instrument should only be operated indoors in a controlled environment.

The dimensions of your instrument as well as an outline diagram are given in Appendix A. Fans cool the DC Power Analyzer by drawing air through the side and exhausting it out the opposite side and back. The instrument must be installed in a location that allows sufficient space at the sides and back of the unit for adequate air circulation.

Power Module Location

Detailed information about installing and removing the power modules is provided in the Agilent N6705A Service Guide. It is recommended that this be done by qualified service personnel.

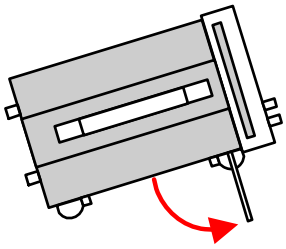
The location of the power modules inside the mainframe determines to which front panel output terminals they are connected. To view the power module/output terminal assignments, turn the unit on, press the Settings key, then press Properties. The power modules are listed under each output channel.

Outputs that are not connected to a power module will not be displayed in the Meter view.

Bench Installation

Do not block the air intake and exhaust at the sides, or the exhaust at the rear of the unit. Refer to the outline diagram in Appendix A. Minimum clearances for bench operation are 2 inches (51 mm) along the sides and back.

For easier display viewing and binding post access, you can tilt the front of the unit up by rotating the extension bar down.



Rack Installation

CAUTION Use Rack Mount kit (Option 908 or Option 909 with handles) to rack mount the instrument.

Agilent N6705A DC Power Analyzer mainframes can be mounted in a 19-inch EIA rack cabinet. They are designed to fit in four rack-units (4U) of space.

Remove the feet before rack mounting the unit. Do not block the air intake and exhaust at the sides of the unit, or the exhaust at the rear of the unit.

Cleaning

WARNING **SHOCK HAZARD To prevent electric shock, unplug the unit before cleaning.**

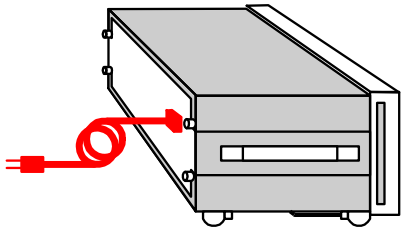
Use a dry cloth or one slightly dampened with water to clean the external case parts. Do not use detergent or chemical solvents. Do not attempt to clean internally.

Connecting the Line Cord

WARNING **FIRE HAZARD Use only the power cord that was supplied with your instrument. Using other types of power cords may cause overheating of the power cord, resulting in fire.**

SHOCK HAZARD The power cord provides a chassis ground through a third conductor. Be certain that your power outlet is of the three-conductor type with the correct pin connected to earth ground.

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.



The AC input on the back of your unit is a universal AC input. It accepts nominal line voltages in the range of 100 VAC to 240 VAC. The frequency can be 50 Hz, 60 Hz, or 400 Hz.

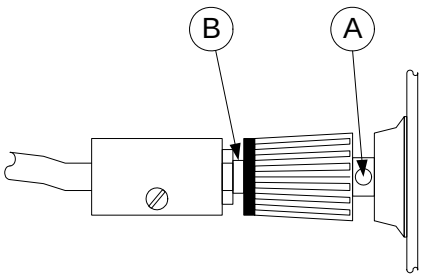
NOTE The detachable power cord may be used as an emergency disconnecting device. Removing the power cord will disconnect AC input power to the unit.

Connecting the Outputs

WARNING **SHOCK HAZARD Turn off all outputs before making front or rear panel connections. All wires and straps must be properly connected with the binding posts securely tightened.**

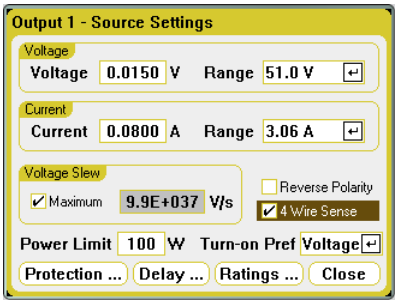
The binding posts accept wires sizes up to AWG 14 in location (A). Securely fasten all wires by hand-tightening the binding posts.

You can also insert standard banana plugs into the front of the connectors as shown in (B). A chassis ground binding post is located on the front panel for convenience.



4-Wire Sense Connections

The DC Power Analyzer includes built-in relays that connect or disconnect the ± sense terminals from their corresponding ± output terminals. As shipped from the factory, the sense terminals are internally connected to the output terminals. This configuration is referred to as Local sensing.

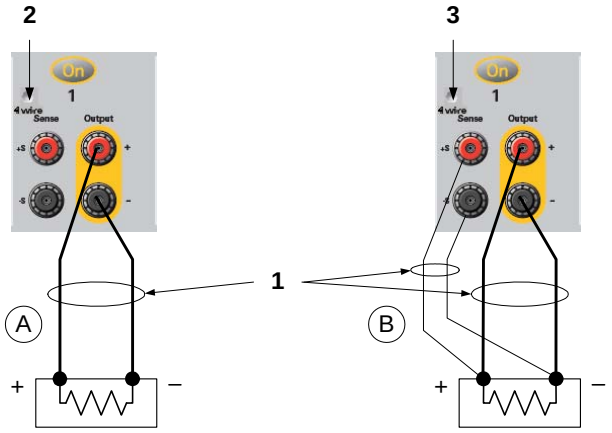


To use the ± sense terminals for 4-wire remote voltage sensing, click the Settings key to display the Source Settings window. Check the box labeled **4-Wire Sense**. This disconnects the sense terminals from the output terminals. Repeat this for all outputs for which you wish to use 4-wire remote sensing.

The following figures illustrate load connections using local sensing (A), and 4-wire remote sensing (B). When the **4-wire** indicator above the sense terminals is on, it indicates that the sense terminals must be connected to the load. 4-wire remote sensing improves the voltage regulation at the load by monitoring the voltage at the load instead of at the output terminals. This allows the DC Power Analyzer to automatically compensate for the voltage drop in the load leads.

Connect the sense leads as close to the load as possible. Connect each load to the output terminals using separate connecting wires. This minimizes mutual coupling effects and takes full advantage of the DC Power Analyzer's low output impedance. Keep each pair of wires as short as possible and twist or bundle them to reduce lead inductance and noise pickup.

Refer to chapter 5 for more information about remote sensing as well as additional information about load connections such as wire sizing, noise reduction techniques, and series/parallel connections.

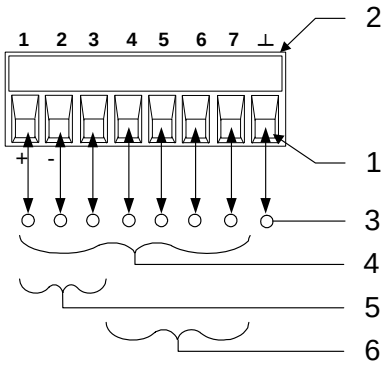


1. Twist leads
2. 4-wire disabled (indicator is off)
3. 4-wire enabled (indicator is on)

Connecting the Digital Port

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.

An 8-pin connector and a quick-disconnect connector plug are provided for accessing the digital port functions. The connector plug accepts wires sizes from AWG 14 to AWG 30. Wire sizes smaller than AWG 24 are not recommended. Disconnect the connector plug to make your wire connections.



1. Insert wires
2. Tighten screws
3. Signal common
4. Digital I/O signals
5. FLT/INH signals
6. Output Couple controls

Information on configuring the digital port is discussed in chapter 4. The electrical characteristics are described in Appendix A.

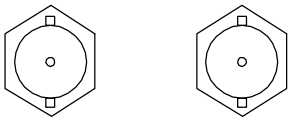
Connecting the BNC Connectors

The rear panel BNC connectors let you apply trigger signals to the instrument as well as generate trigger signals from the instrument. This also applies to the digital port.

Trigger Input - Allows a negative-going or positive-going external signal to trigger the instrument. The signal must have a minimum pulse width of 2 microseconds. Trigger input signals are used by the Arb, Scope, and Data Logger functions.

Trigger Output - Generates a negative-going or positive-going 10-microsecond pulse when a triggered event has occurred on the instrument. Trigger output signals can be generated by the user-defined voltage or current Arb functions.

Information on configuring external triggers is found in chapter 4 under “Configuring the Digital Port”. The electrical characteristics are described in Appendix A.



Input **Output**

Connecting the Interfaces

CAUTION Electrostatic discharges greater than 1 kV near the interface connectors may cause the unit to reset and require operator intervention.

The DC Power Analyzer supports GPIB, LAN, and USB interfaces. All three interfaces are live at power-on. Connect your interface cable to the appropriate interface connector. Information on configuring the interfaces is found in chapter 4.

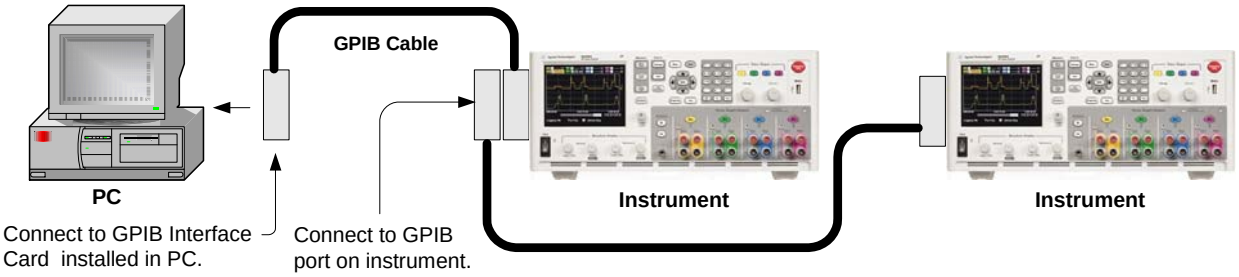
The front panel **IO** indicator comes on whenever there is activity on the interfaces. The front panel **LAN** indicator comes on when the LAN port is connected and configured.

The DC Power Analyzer provides Ethernet connection monitoring. With Ethernet connection monitoring, the instrument's LAN port is continually monitored, and automatically reconfigured when the instrument is unplugged for a minimum of 20 seconds and then reconnected to a network.

GPIB/USB Interfaces

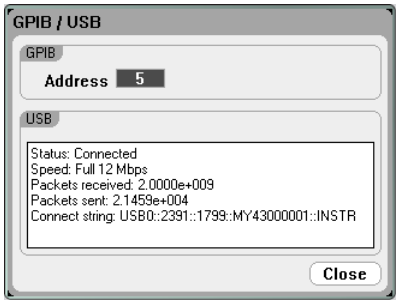
NOTE For detailed information about GPIB and USB interface connections, refer to the Agilent Technologies *USB/LAN/GPIB Interfaces Connectivity Guide,* located on the Automation-Ready CD that is shipped with your product.

The following steps will help you quickly get started connecting your instrument to the **GPIB** (General Purpose Interface Bus). The following figure illustrates a typical GPIB interface system.



1. If you have not already done so, install the Agilent IO Libraries Suite from the Automation-Ready CD that is shipped with your product.
2. If you do not have a GPIB interface card installed on your computer, turn off your computer and install the GPIB card.
3. Connect your instrument to the GPIB interface card using a GPIB interface cable.
4. Use the Connection Expert utility of the Agilent IO Libraries Suite to configure the installed GPIB interface card's parameters.

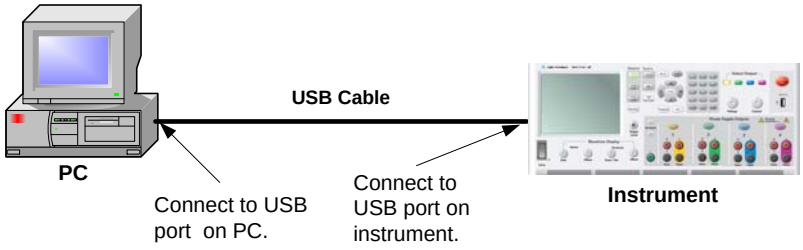
5 The DC Power Analyzer is shipped with its GPIB address set to 5. If you need to change the GPIB address, press the Menu key, select **Utilities**, then **I/O Configuration**, then **GPIB/USB**.



Use the numeric keys to enter a value in the GPIB address field. Valid addresses are from 0 to 30. Press Enter to enter the value.

6 You can now use Interactive IO within the Connection Expert to communicate with your instrument, or you can program your instrument using the various programming environments.

The following steps will help you quickly get started connecting your USB-enabled instrument to the **USB** (Universal Serial Bus). The following figure illustrates a typical USB interface system.



1 If you have not already done so, install the Agilent IO Libraries Suite from the Automation-Ready CD that is shipped with your product.

2 Connect the USB device port located on the back of your instrument to the USB port on your computer.

3 With the Connection Expert utility of the Agilent IO Libraries Suite running, the computer will automatically recognize the instrument. This may take several seconds. When the instrument is recognized, your computer will display the VISA alias, IDN string, and VISA address. This information is located in the USB folder.

You can also view the instrument's VISA address from the front panel. Use the front panel menu to access the **GPIB/USB** window as described above. The VISA address is shown in the connect string field.

4 You can now use Interactive IO within the Connection Expert to communicate with your instrument, or you can program your instrument using the various programming environments.

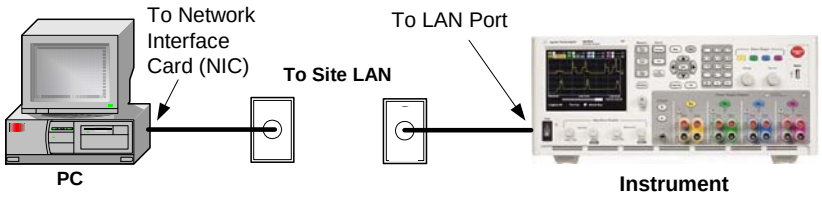
LAN Interface

NOTE For detailed information about LAN interface connections, refer to the Agilent Technologies *USB/LAN/GPIB Interfaces Connectivity Guide*, located on the Automation-Ready CD that is shipped with your product.

The following steps will help you quickly get started connecting and configuring your instrument on a local area network. The two types of local area networks connections that are discussed in this section are site networks and private networks.

Connecting to a Site LAN

A site LAN is a local area network in which LAN-enabled instruments and computers are connected to the network through routers, hubs, and/or switches. They are typically large, centrally-managed networks with services such as DHCP and DNS servers.



1 If you have not already done so, install the Agilent IO Libraries Suite from the Automation-Ready CD that is shipped with your product.

2 Connect the instrument to the site LAN. The factory-shipped instrument LAN settings are configured to automatically obtain an IP address from the network using a DHCP server (DHCP is set On). Note that this may take up to one minute. The DHCP server will register the instrument's hostname with the dynamic DNS server. The hostname as well as the IP address can then be used to communicate with the instrument. The front panel **LAN** indicator will come on when the LAN port has been configured.

NOTE If you need to manually configure any instrument LAN settings, refer to "Configuring the LAN Parameters" in chapter 4 for information about configuring the LAN settings from the front panel of the instrument.

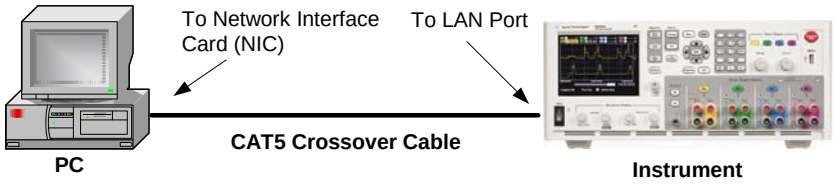
3 Use the Connection Expert utility of the Agilent IO Libraries Suite to add the N6705A DC Power Analyzer and verify a connection. To add the instrument, you can request the Connection Expert to discover the instrument. If the instrument cannot be found, add the instrument using the instrument's hostname or IP address.

NOTE If this does not work, refer to the chapter on "Troubleshooting Guidelines" in the Agilent Technologies *USB/LAN/GPIB Interfaces Connectivity Guide*.

4 You can now use Interactive IO within the Connection Expert to communicate with your instrument, or you can program your instrument using the various programming environments. You can also use the Web browser on your computer to connect to the instrument as described under “Connecting to the Web Server”.

Connecting to a Private LAN

A private LAN is a network in which LAN-enabled instruments and computers are directly connected, and not connected to a site LAN. They are typically small, with no centrally-managed resources.



1 If you have not already done so, install the Agilent IO Libraries Suite from the Automation-Ready CD that is shipped with your product.

2 Connect the instrument to the computer using a LAN crossover cable. Alternatively, connect the computer and the instrument to a standalone hub or switch using regular LAN cables.

NOTE Make sure your computer is configured to obtain its address from DHCP and that NetBIOS over TCP/IP is enabled. Note that if the computer had been connected to a site LAN, it may still retain previous network settings from the site LAN. Wait one minute after disconnecting it from the site LAN before connecting it to the private LAN. This allows Windows to sense that it is on a different network and restart the network configuration. (Windows 98 requires you to manually release the settings.)

3 The factory-shipped instrument LAN settings are configured to automatically obtain an IP address from a site network using a DHCP server, then to automatically choose an IP address using auto-IP if a DHCP server is not present. The instrument and computer are each assigned an IP address from the block 169.254.nnn. Note that this may take up to one minute. The front panel **LAN** indicator will come on when the LAN port has been configured.

4 Use the Connection Expert utility of the Agilent IO Libraries Suite to add the N6705A DC Power Analyzer and verify a connection. To add the instrument, you can request the Connection Expert to discover the instrument. If the instrument cannot be found, add the instrument using the instrument’s hostname or IP address.

NOTE If this does not work, refer to the chapter on “Troubleshooting Guidelines” in the Agilent Technologies *USB/LAN/*GPIB *Interfaces Connectivity Guide*.

5 You can now use Interactive IO within the Connection Expert to communicate with your instrument, or you can program your instrument using the various programming environments. You can also use the Web browser on your computer to connect to the instrument as described under “Connecting to the Web Server”.

Connecting to the Web Server

Your Agilent N6705A DC Power Analyzer has a built-in Web server that lets you control it directly from an internet browser on your computer. Up to **two** simultaneous connections are allowed. With additional connections, performance will be reduced.

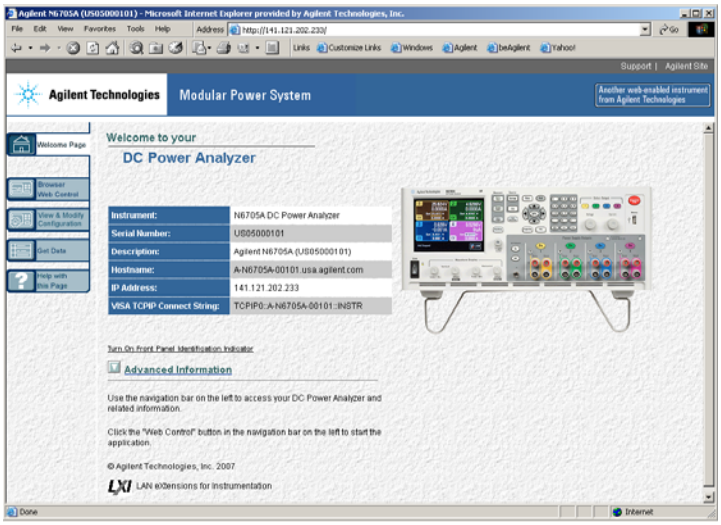
With the Web server, you can access the front panel control functions including the LAN configuration parameters. This is a convenient way to communicate with the DC Power Analyzer without using I/O libraries or drivers.

NOTE The built-in Web server only operates over the LAN interface. It requires Internet Explorer 6+, Netscape 6.2+, or Firefox2+. You also need the Java (Sun) Plug-in. This is included in the Java Runtime Environment. Refer to Sun Microsystem’s website. If you are using Internet Explorer 7, the tab functionality does not work with multiple connections. Open a separate browser window for each connection.

The Web server is enabled when shipped. To launch the Web server:

1 Open the internet browser on your computer.

2 Enter the instrument’s hostname or IP address into the browser’s Address field to launch the Web server. The following home page will appear:



3 Click on the Browser Web Control button in the navigation bar on the left to begin controlling your instrument.

4 For additional help about any page, click Help with this Page.

If desired, you can control access to the Web server using password protection. As shipped from the factory, no password is set. To set a password, click on the View & Modify Configuration button. Refer to the on-line help for additional information about setting a password.

Connecting Using Telnet

The Telnet utility (as well as sockets), is another way to communicate with the DC Power Analyzer without using I/O libraries or drivers. In all cases, you must first establish a LAN connection from your computer to the DC Power Analyzer as previously discussed.

In an MS-DOS Command Prompt box type: *telnet hostname 5024* where *hostname* is the N6705A hostname or IP address, and 5024 is the instrument's telnet port. You should get a Telnet session box with a title indicating that you are connected to the DC Power Analyzer. Type the SCPI commands at the prompt.

Connecting Using Sockets

NOTE Agilent N6705A mainframes allow any combination of up to **four** simultaneous data socket, control socket, and telnet connections to be made.

Agilent instruments have standardized on using port 5025 for SCPI socket services. A **data socket** on this port can be used to send and receive ASCII/SCPI commands, queries, and query responses. All commands must be terminated with a newline for the message to be parsed. All query responses will also be terminated with a newline.

The socket programming interface also allows a **control socket** connection. The control socket can be used by a client to send device clear and to receive service requests. Unlike the data socket, which uses a fixed port number, the port number for a control socket varies and must be obtained by sending the following SCPI query to the data socket: `SYSTem:COMMunicate:TCPip:CONTrol?`

After the port number is obtained, a control socket connection can be opened. As with the data socket, all commands to the control socket must be terminated with a newline, and all query responses returned on the control socket will be terminated with a newline.

To send a device clear, send the string "DCL" to the control socket. When the DC Power Analyzer has finished performing the device clear it echoes the string "DCL" back to the control socket.

Service requests are enabled for control sockets using the Service Request Enable register. Once service requests have been enabled, the client program listens on the control connection. When SRQ goes true the instrument will send the string "SRQ +nn" to the client. The "nn" is the status byte value, which the client can use to determine the source of the service request.

3
Operating the DC Power Analyzer

This chapter contains examples on how to operate your DC Power Analyzer. The examples provided show you how to use the:

- Power supply function
- Arbitrary waveform generator
- Scope measurement function
- Data logging function
- File functions

Appendix C lists the SCPI commands that can be used to program the instrument. Note however, that many front panel functions do not have any equivalent SCPI commands and are not able to be programmed other than from the front panel.

NOTE For complete details on programming the instrument using SCPI commands, refer to the Programmer's Reference Help file included on the Agilent N6705A Product Reference CD. This CD-ROM is shipped along with your instrument.

Turning the Unit On

After you have connected the line cord, turn the unit on with the Line switch. The front panel display lights up after a few seconds. When the front panel output display appears, use the front panel knobs to enter voltage and current values. Output 1 is selected by default.

NOTE A *power-on* self-test occurs automatically when you turn the unit on. This test assures you that the instrument is operational. If the self-test fails, the front panel will display any errors. Refer to the Service Guide for further information.

Using the Power Supply

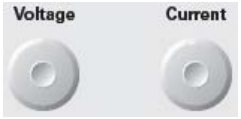
Select an Output

Press one of the Select Output keys to select an output to control.

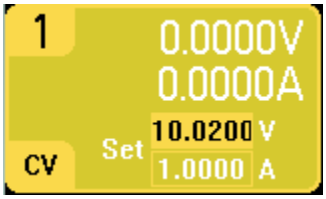
Set the Output Voltage and Current

There are a number of ways to set the output voltage and current.

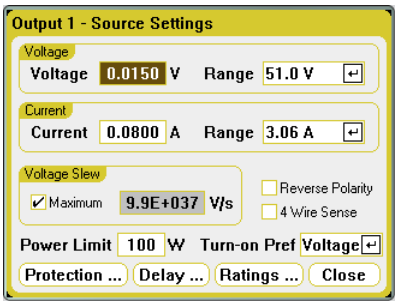
1. Turn the Voltage and Current knobs; the output changes when they are turned. These knobs are active in Meter View, Scope View, and Data Logger mode.



2. You can also enter the voltage and current values directly in the numeric entry fields (the Set fields) of the Meter-view display. Use the navigation keys to select the field; use the numeric entry keys to enter the value. The value does not become active until you press Enter.



3. Press the Settings key to access the Source Settings window. Use the navigation keys to highlight the **Voltage** or **Current** fields. Then enter the voltage and current values with the numeric keys. Press Enter to enter the value.



Note that you can also use the Voltage and Current knobs to adjust the values in the Voltage and Current fields. Press Enter to enter the value.

Enable the Output

Press the 

key to enable an individual output. When an output is On, the corresponding On key for that output is lit. When an output is Off, the corresponding On key is dark.

Emergency Stop 

Emergency Stop turns all outputs off immediately without any output off delays. Press any key to resume operation.

Set Additional Properties

The Source Settings window shown above also lets you program a number of additional output functions.

For outputs with multiple ranges, you can select a lower range if you need better output resolution. Use the navigation keys to highlight the **Range** field. Press the Enter key to access the dropdown Range list.

To program a voltage slew rate, enter the rate in the **Voltage Slew** field. Use the numeric entry keys to enter the value in volts/second. Check **Max Voltage Slew** to program the fastest rate.

NOTE When the maximum or very fast slew rates are selected, the slew rate will be limited by the analog performance of the output circuit. Also, the slowest or minimum slew rate is a function of the full-scale voltage range. For a model with a 50 V range, the minimum slew rate is about 4.76 V/s. For other voltage ranges the minimum slew rate is proportional to this value, so for a model with a 5 V range the minimum slew rate is about 0.476 V/s.

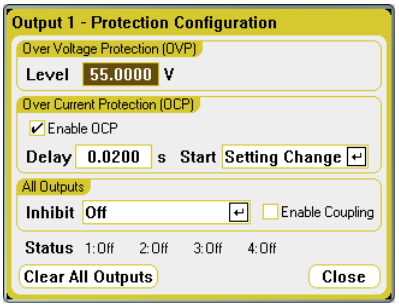
If an output has Option 760 installed, you can reverse the polarity of the output and sense terminals. Check **Reverse Polarity** to reverse the polarity. The output is briefly turned off while the output and sense terminal polarities are switched. Note that when this option is installed, the maximum output current is limited to 10A.

When the output and sense polarities are reversed, the following symbol appears on the front panel display: 

Checking the box labeled **4-Wire Sense** disconnects the sense terminals from the output terminals. This lets you use 4-wire remote voltage sensing.

Set the Protection Functions

Protection functions are configured in the Protection Configuration window. Press the Settings key to access the Source Settings window. Navigate to and select **Protection**. Then press Enter.



For over-voltage protection, enter an over-voltage value in the **Level** field. Over-voltage protection disables the output if the output voltage reaches the OVP level.

To enable over-current protection, check the **Enable OCP** box. With over-current protection, the DC Power Analyzer disables the output if the output current reaches the current limit setting causing a transition from CV to CC mode. Note that you can specify a **Delay**, to prevent momentary CV-to-CC status changes from tripping the over-current protection. The delay can be programmed from 0 to 0.255 seconds. You can specify if the **Start** of the delay is initiated only by a settings change in voltage, current, or output state, or by any transition into CC mode.

You can also program the **Inhibit** input (pin 3) on the rear panel to act as an external protection shutdown signal. The behavior of this signal can be set to either Latched or Live (non-latched). Off disables the remote inhibit. Refer to chapter 5 for further information. Checking the **Enable Coupling** box lets you configure the instrument so that when a protection fault occurs on one output, ALL outputs will be turned off.

The **Status** indicator shows the status for all outputs. This indicator also appears in the lower left corner of each output in Meter View. When a protection function trips, the status indicator shows which protection function was activated (e.g. OV, OC, OT, INH, PF, CP+).

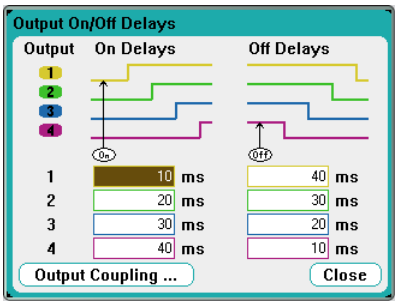
When the Protection function trips:

If an over-voltage, over-current, over-temperature, inhibit signal, a power-fail condition, or on some modules, a power-limit condition occurs, the DC Power Analyzer disables the affected output.

To clear the protection function, first remove that condition that caused the protection fault. Then press the Settings key to access the Source Settings window. Navigate to and select **Protection**, then select **Clear All Outputs**. This clears the protection function and returns the output to its previous operating state.

Configure a Turn-On/Turn-Off Sequence

Turn-on and turn-off delays control the turn-on and turn-off sequencing of the outputs in relation to each other. Press the Settings key twice to access the Output On/Off Delays window.

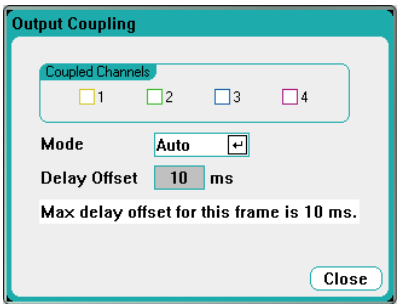


Enter the **On Delays** and **Off Delays** in milliseconds. Values can range from 0 milliseconds to 1023 milliseconds in 1-millisecond increments.

Once output delays have been set, use the **All Outputs** On key to start the On delay sequence. Use the **All Outputs** Off key to start the Off delay sequence.

All power modules have an internal delay that applies from the time that the command to turn on the output is received until the output actually turns on. This turn on delay is automatically added to the On delay values that you specify in the Output On/Off Delays window.

Click on **Output Coupling** to find out what the maximum delay offset is for the power modules that are installed in the DC Power Analyzer.



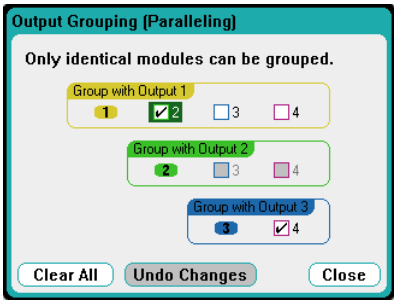
This window lets you further customize the operation of the Output On/Off Delays. Refer to Appendix D for further information.

Output Grouping

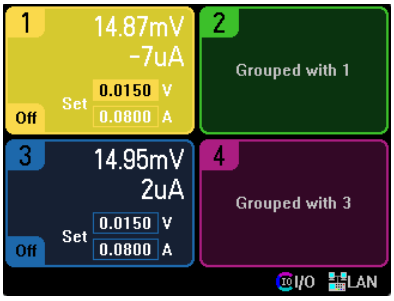
Up to four identical outputs can be configured or "grouped" to create a single output with higher current and power capability. This capability is available with firmware revision A.02.00 or later. The following conditions apply for grouped outputs:

- Only *identical* outputs can be grouped. Outputs without identical model numbers and options will be unavailable for grouping.
- Grouped outputs *must* be connected in parallel (see chapter 5).
- On Agilent N676xA power modules, low current measurement ranges cannot be used with grouped outputs. Low current output ranges, however, *can* be used.
- Current-level triggering is unavailable for grouped outputs.
- Over-current protection delay has a slightly slower response time (~10 ms) and slightly less resolution than an ungrouped output.
- The power limit setting for Agilent N673xB, N674xB, and N677xA power modules must be set to its maximum value.

To group outputs, press the Menu key. Select **Source Settings**, then **Output Grouping**. Check the outputs that you wish to group.



Grouped outputs are controlled using the output number of the **lowest** output in the group. As shown in the figures, output 1 is grouped with output 2 and output 3 is grouped with output 4.

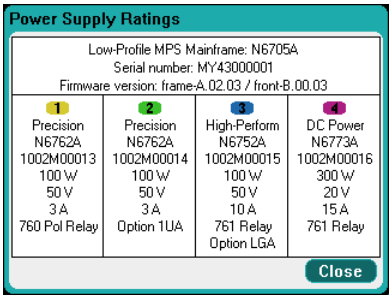


To return grouped outputs back to an ungrouped state, remove the parallel connections between outputs. Then uncheck the check boxes.

Cycle AC power to the unit for the grouping or ungrouping changes to take effect. Grouped settings are saved in non-volatile memory.

Output Ratings

You can quickly view the output ratings, model numbers and options of all power modules installed in your instrument. Press the Settings key and then press the Properties key. The Power Supply Ratings window will appear.



Power Limit

For the majority of Agilent N6705A DC Power Analyzer configurations, full power is available from all installed power modules or outputs. However, it is possible to configure a DC Power Analyzer in which the combined ratings of the outputs exceed the power rating of the mainframe; which is 600 W.

NOTE Note that the DC Power Analyzer will operate normally as long as the combined output power is within the power rating of the mainframe.

Mainframe Power Limit

If the combined power drawn from all of the outputs exceeds the mainframe's power rating of 600 W, a power fault protection event will occur. This causes ALL outputs to turn off and remain off until a protection clear command is given. A status bit (PF) will indicate that a power fault protection event has occurred.

The power allocation function lets you limit the power that can be sourced from individual outputs, thereby preventing the combined power from exceeding the mainframe's rated output power and causing all the outputs to turn off.

Output Power Limit

When the power limit has been set to a value less than the maximum rating of an output, and either the output voltage or the output current increases to a point where the module exceeds the power limit setting, the module's power limit function will activate.

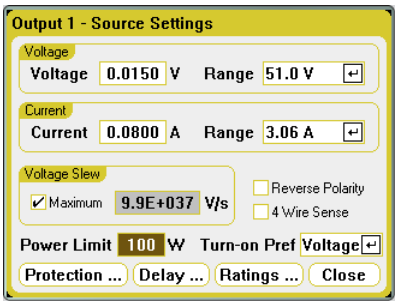
NOTE If the power limit is left at the maximum rating, the power module will not enable its power limit function.

On Agilent N675xA, and N676xA power modules, the power limit function limits the output power at its programmed setting. A status bit (CP+) will indicate that the output is in power limit mode. When the power drawn by the load is reduced below the power limit setting, the output returns to normal operation. Note that these power modules contain an active down-programmer circuit, which is limited to about 7 W continuous power. A status bit (CP-) will indicate that the output has reached the negative limit.

On Agilent N673xB, N674xB, and N677xA power modules, the power limit function turns the output off after a power limit condition persists for about 1 millisecond. A status bit (CP+) will indicate that the output has been turned off because of a power limit condition. To restore the output, you must first adjust the load so that it draws less power. Then you must clear the protection function as previously explained. On these models, it may be preferable to use the current or voltage setting to limit the output power so as to avoid turning the output off.

NOTE When Agilent N673xB, N674xB, and N677xA power modules are grouped or paralleled, you must set their power limit setting to its maximum value.

To program the power limit function, press the Settings key. Scroll down and select **Power Limit**. Enter the power limit for the specified output in Watts.



Turn-on Preference

NOTE Only applies to Agilent N676xA power modules.

This function sets the preferred mode for output on or output off transitions. It allows output state transitions to be optimized for either constant voltage or constant current operation. Selecting Voltage minimizes output on/off voltage overshoots in constant voltage operation. Selecting Current minimizes output on/off current overshoots in constant current operation.

To program the Turn-on Preference, press the Settings key. Scroll down and select the **Turn-on Pref** drop-down list. Select either Voltage or Current priority as the turn-on preference.

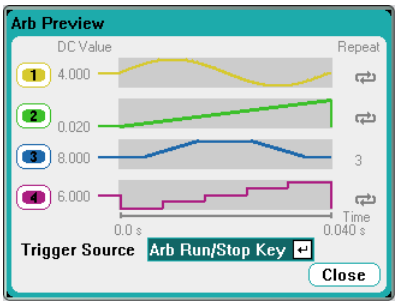
Using the Arbitrary Waveform Generator

The DC Power Analyzer lets you generate arbitrary waveforms (Arb) on any output. When the arbitrary waveform runs, the front panel voltage and current controls as well as any remote voltage and current commands are ignored until after the Arb completes. To program an arbitrary waveform:

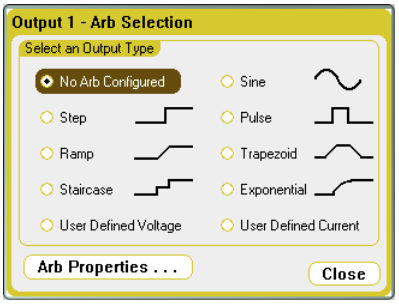
1. Select the arbitrary waveform that you wish to run.
2. Configure the parameters of the selected Arb.
3. Select the Arb trigger source.
4. Select Meter view or Scope view to display the Arb measurement.
5. Trigger the arbitrary waveform.

Select the Arbitrary Waveform

Press the Arb key to access the Arb Preview window. This lets you view all of the arbitrary waveforms that have been configured.



Arbitrary waveforms are configured in the Arb Selection window. Press the Arb key again or press the Properties key to access the Arb Selection window.



Navigate to and select one of the Output Types listed: Sine, Step, Pulse, Ramp, Trapezoid, Staircase, Exponential, or User Defined Voltage or Current. To configure the parameters of the Arb, press the Properties key or select the **Arb Properties** button.

Select **No Arb Configured** if you do not wish to configure an Arbitrary waveform for the selected output. In this case, the output will continue to respond to the conventional output voltage and current controls. To configure arbitrary waveforms for other outputs, select a different output using the Select Output keys.

Configure the Arbitrary Waveform

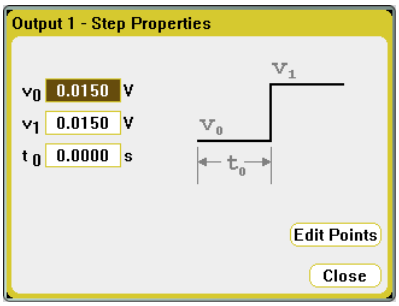
Common Properties

The following properties are common to all Arb functions:

Parameter:	Description:
Return to DC Value	The voltage returns to the DC value that was in effect prior to the Arb.
Last Arb Value	The voltage remains at the V1 value after the Arb completes.
Edit Points	Creates a user-defined Arb from the present Arb property values.
Continuous	The ramp repeats continuously.
Repeat Count	The number of times the ramp repeats.
Close	Saves and closes the Properties window.

Step Properties

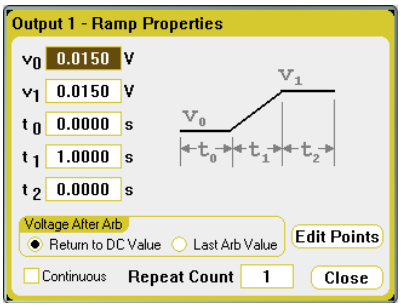
The following window programs the Step properties:



Parameter:	Description:
Start Voltage (V_0)	The voltage before the step.
End Voltage (V_1)	The voltage after the step.
Delay (T_0)	The delay after the trigger is received before the step occurs.

Ramp Properties

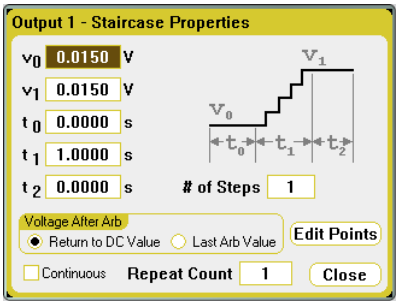
The following window programs the Ramp properties:



Parameter:	Description:
Start Voltage (V_0)	The voltage before the ramp.
End Voltage (V_1)	The voltage after the ramp.
Delay (T_0)	The delay after the trigger is received.
Ramp Time (T_1)	The time that the voltage ramps up.
End Time (T_2)	The time V1 persists after the ramp.

Staircase Properties

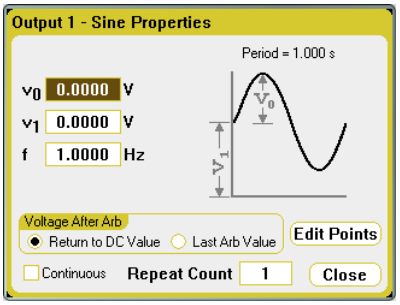
The following window programs the Staircase properties:



Parameter:	Description:
Start Voltage (V_0)	The voltage before the staircase.
End Voltage (V_1)	The voltage after the final stair step (the difference between V0 and V1 is divided equally between the steps).
Delay (T_0)	The delay after the trigger is received.
Step Time (T_1)	The time to complete all staircase steps.
End Time (T_2)	The time V1 persists after the staircase.
# of Steps	The total number of staircase steps.

Sine Properties

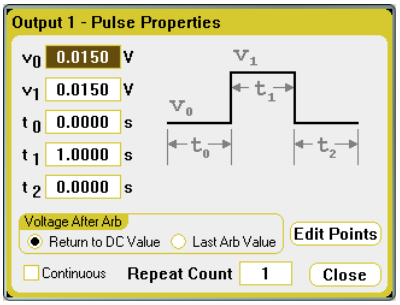
The following window programs the Sine properties:



Parameter:	Description:
Amplitude (V_0)	The amplitude or peak value.
Frequency (f)	The frequency of the sine wave.
Offset (V_1)	The offset from zero. *Because the output cannot generate negative voltages, the offset cannot be less than the amplitude.*

Pulse Properties

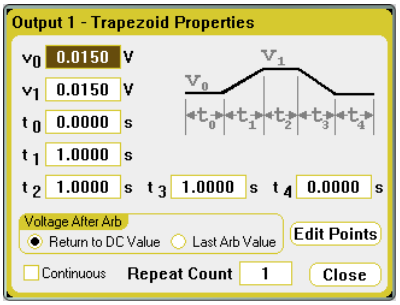
The following window programs the Pulse properties:



Parameter:	Description:
Start Voltage (V_0)	The voltage before and after the pulse.
Pulse Voltage (V_1)	The voltage of the pulse.
Delay (T_0)	The delay after the trigger is received.
Pulse Width (T_1)	The width of the pulse.
End Time (T_2)	The time V0 persists after the pulse.

Trapezoid Properties

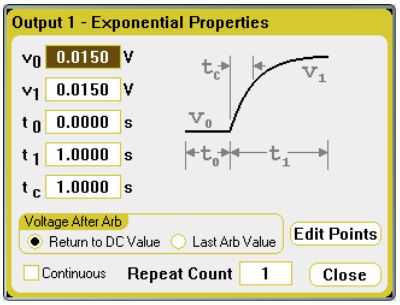
The following window programs the Trapezoid properties:



Parameter:	Description:
Start Voltage (V_0)	The voltage before and after the trapezoid.
Peak Voltage (V_1)	The peak voltage.
Delay (T_0)	The delay after the trigger is received.
Ramp Up (T_1)	The time that the voltage ramps up.
Peak Width (T_2)	The width of the peak.
Ramp Down (T_3)	The time that the voltage ramps down.
End Time (T_4)	The time V0 persists after the ramp.

Exponential Properties

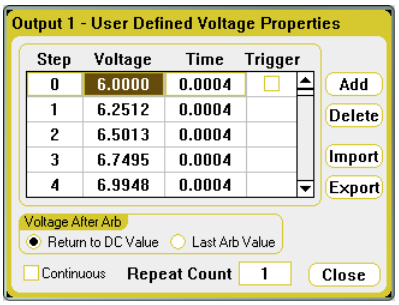
The following window programs the Exponential properties:



Parameter:	Description:
Start Voltage (V_0)	The voltage before the waveform.
End Voltage (V_1)	The ending voltage of the waveform.
Delay (T_0)	The delay after the trigger is received.
Time (T_1)	Time for the voltage to go from V0 to V1.
Time Constant (T_C)	The time constant of the curve.

User-Defined Properties

You can configure either a voltage or a current waveform. The following window shows the voltage waveform properties.



Parameter:	Description:
Step <n>	Each part of the waveform is defined as a step consisting of a voltage or current, dwell time, and trigger option. The total number of steps determines Arb length.
Voltage (voltage waveforms only)	The voltage value of the step.
Current (current waveforms only)	The current value of the step.
Time	The time that the output stays at the step.
Trigger	Generates an external trigger signal at the start of the step when checked.
Add	Inserts a step below the selected step; values are copied from the previous step.
Delete	Deletes the presently selected step.
Import (.csv format)	Imports a current or voltage Arb list.
Export (.csv format)	Exports a voltage or current Arb list.

TIP When multiple steps are displayed, use the up and down navigation keys to scroll through the list.

Converting Data from a Standard Arb to a User-Defined Arb

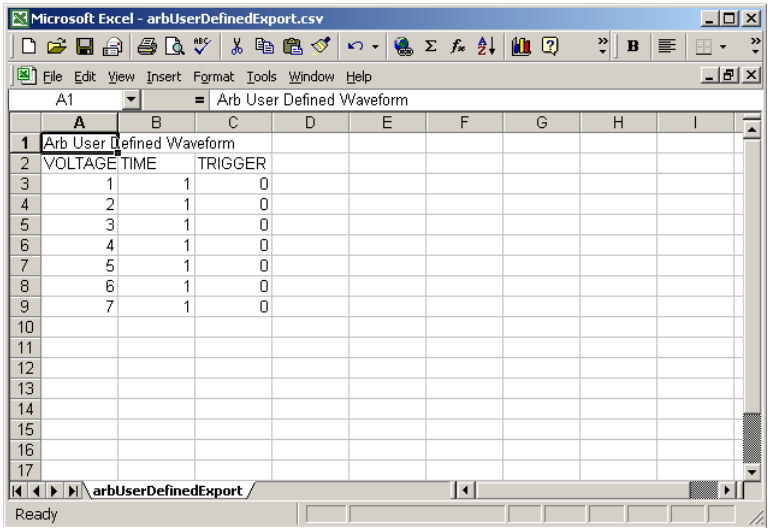
You can populate the User-Defined voltage or current Arb with values from a previously configured “standard” arbitrary waveform. This lets you edit specific points in the standard arbitrary waveform.

To convert one of the standard Arbs, select an Arb and specify the Arb parameters. Then select the **Edit Points** button. This populates the User-Defined Arb with the values from the properties that you specified in the standard Arb. You either edit the steps directly in the User-Defined Properties window or export the Arb to a spreadsheet for editing using the Export function as explained later in this chapter.

Creating a User-Defined Arb Using a Spreadsheet

You can also create a User-Defined arbitrary waveform in a Microsoft Excel spreadsheet and import it into the instrument using the Import function as explained later in this chapter.

As shown in the following Microsoft Excel example, the file format for User-Defined arbitrary waveforms consists of a notes section, a header row, and data rows formatted into three columns.



	A	B	C
1	Arb User Defined Waveform		
2	VOLTAGE	TIME	TRIGGER
3	1	1	0
4	2	1	0
5	3	1	0
6	4	1	0
7	5	1	0
8	6	1	0
9	7	1	0

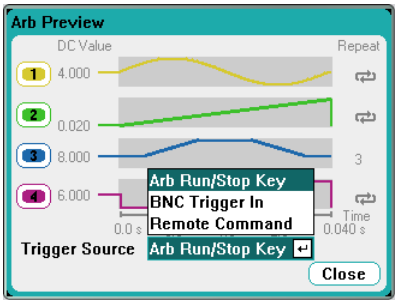
The notes section can contain text to describe the file. It can also contain empty rows. Notes rows are generally one column wide.

The header row must have 3 columns and contain the following headings: VOLTAGE or CURRENT, TIME, and TRIGGER. All rows following the header row are considered data rows.

Data rows must have 3 columns. The data in the column must match the type of information described by the header for the column. The VOLTAGE or CURRENT column contains either voltage or current values. The TIME column specifies the dwell time of the step in seconds. The TRIGGER column requires a value of zero as the default. If you want the Arb to generate an external trigger signal at the start of the step, replace the zero with a one. Note that the data section can also have empty rows.

Select the Arb Trigger Source

Specify a Trigger source for the arbitrary waveforms. The same trigger source will be used to trigger all of the arbitrary waveforms. Press the Arb key, then select the **Trigger Source** field.



Trigger Source:	Description:
Arb Run/Stop key	The front panel Run/Stop key
BNC Trigger in	The rear trigger input BNC connector
Remote Command	A remote interface command.

Note that the arbitrary waveforms that you have already configured should appear in the Arb Preview window. The **DC Value** column indicates the present output voltage or current setting. This value appears at the output before the Arb is run. The output will revert to this value when the Arb completes unless the **Last Arb value** box has been checked.

The **Repeat** column indicates how many times the Arb will be repeated if it has been configured to repeat. If the column is blank, the Arb will only run once. The symbol indicates Arb will run continuously.

Select the Arb Measurement View

There are two ways to view the arbitrary waveforms.

Meter View – Press the Meter View key to view the output voltage and current values when the Arb is generated. The voltage and current meters automatically update.

Scope View – Press the Scope View key to view the output voltage and current waveforms when the Arb is generated. Note that in Scope View, you must select the type of waveforms you wish to view for each output. Press the Properties key and select which waveforms you wish to display in the Display Trace area. You must also specify the Trigger Source and Trigger Mode. The trigger source should be the same as the Arb trigger source previously selected. The trigger mode should be set to Single.

Trigger the Arb

NOTE For the arbitrary waveform to appear at the output terminals, the selected output must be turned on *before* the Arb is run.

Depending upon the selected trigger source, you can trigger the arbitrary waveforms as follows:

Trigger Source:	Description:
Arb Run/Stop key	Press the Arb Run/Stop key to start the Arb waveform. Press the key again to stop the Arb waveform.
Rear Trigger input	Provide a low-true signal to the rear trigger input BNC connector. The signal must persist for at least 10 milliseconds.
Remote command	Send a remote trigger command over one of the three interfaces (i.e. *TRG).

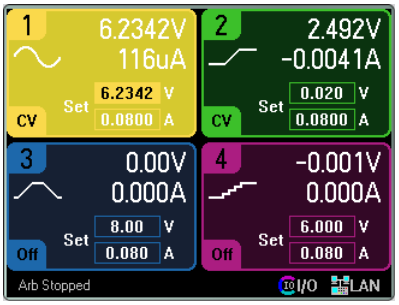
Once configured, the instrument will wait indefinitely for the trigger signal. If the trigger does not occur, and you wish to cancel the arbitrary waveform, press the Arb Run/Stop key to stop the Arb.

After a trigger is received and the arbitrary waveform completes, the Voltage After Arb setting determines what the output does. If the **Return to DC Value** box is checked, the output voltage and current return to the settings that were in effect before the arbitrary waveform started. If the **Last Arb Value** box is checked, the output will remain at the last Arb setting.

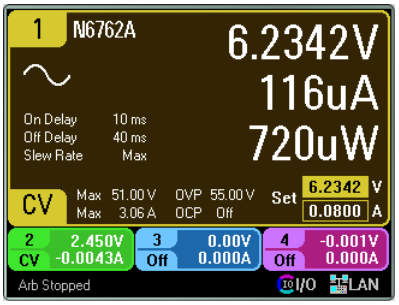
Using the Measurement Functions

Meter View

Each output has its own measurement capability. Whenever the meter view is displayed, the measurement system continuously measures the output voltage and current. The measurement system acquires a specified number of samples at a specified time interval, and *averages* the samples. The default meter view displays all four outputs.

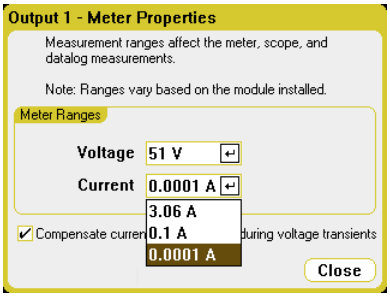


A single-output view displays more information about the selected output. Press the Meter View key to toggle between the two views.



Measurement Ranges

Some power modules have multiple voltage and current measurement ranges (see chapter 1 under "Power Module Capabilities"). To specify a measurement range, press the Meter View key, then press Properties. Selecting a lower measurement range provides greater measurement accuracy, provided the measurement does not exceed the range. If the measurement exceeds the range, an "Overload" error will occur.



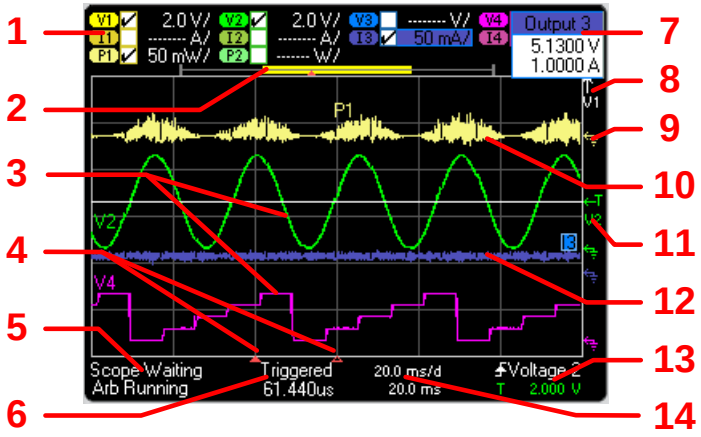
For information about compensating current measurements during voltage transients, see chapter 5 under "Dynamic Current Correction".

Scope View

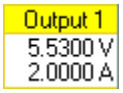
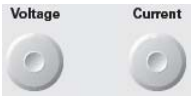
Press the Scope View key to view the scope. This key toggles between the Standard view shown below, and Marker view, which enables markers and marker calculations. Whenever the Scope View is displayed, the measurement system continuously measures the specified output voltage or current signals.

You can configure the Scope View to display voltage or current waveforms for all outputs. Power waveforms can only be displayed for Agilent Models N6761A and N6762A as these models have simultaneous voltage and current measurement capability. Note that in the Scope View there is only one time-base and trigger configuration for all outputs.

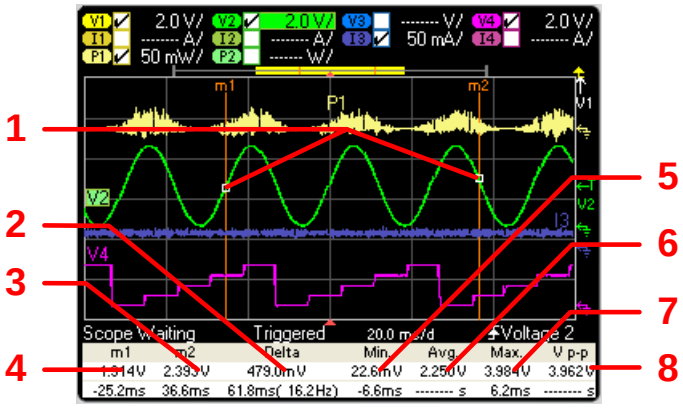
Standard View



Symbol/Field:	Description:
1 Trace Controls	Identifies the volt/div. or curr/div. setting of the trace. √ indicates the trace is on. ---- indicates the trace is off. Select the trace and press Enter to turn it on or off.
2 Data Bar 	The data bar represents all of the waveform data that has been collected. The yellow part of the bar indicates the portion of the data that is actually shown on the display The dark portion of the bar represents the data not shown.
3 Voltage Traces	Labels for the voltage traces appear on the left side of the grid (V1, V2, V3, V4). Traces are color coded according to output. Push the Trigger Level knob to autoscale the traces.
4 Trigger Point 	Shows the position of the trigger with respect to the captured waveform. In this example, the trigger has been offset to the left of the original point. The trigger point corresponds to the offset reference when the offset is zero.
Offset Reference 	Indicates the original trigger reference point. In this example, the reference is centered.

Symbol/Field:	Description:
5 Scope/Arb Status	Indicates whether the scope is Running, Stopped, or Waiting for a trigger.
6 Trigger Mode	Indicates the trigger mode (Auto, Single, or Triggered).
Sample Rate	The indicated scope sample rate is based on the horizontal time/div. setting. When the time/div. setting is less than 20 ms/division, the scope will sample at its fastest rate: 20.48 microseconds.
7 Output Pop-up 	If you turn the voltage and current knobs, a pop-up dialog will indicate the present output settings. 
8 Out of View Arrows 	Indicates that the trace, V1 in this example, is out of view. Use the Vertical Volt/Div knob or the Vertical Offset knob to bring the trace into view. Push the Trigger Level knob to autoscale the traces so that all of them will appear on the display.
9 Ground Reference 	The ground reference of the trace. Ground references are offset so that they do not overlap. The ground reference offset value is referenced to the horizontal center line of the grid.
10 Power Traces	Labels for the power traces appear on the center of the grid (P1, P2, P3, P4). Traces are color coded according to output. Note that only Agilent Models N6761A/N6762A. can display power traces. Push the Trigger Level knob to autoscale the traces.
11 Trigger Level 	Shows the location of the voltage or current trigger level and output. In this example, the voltage trigger level of output 2 is shown. The trigger source and amplitude are shown at the bottom right of the display.
12 Current Trace	Labels for the current traces appear on the right side of the grid (I1, I2, I3, I4). Traces are color coded according to output. Push the Trigger Level knob to autoscale the traces so that all of them will appear on the display.
13 Trigger Source	The scope's trigger source. In this example, the trigger source is a voltage level on output 2.  Indicates the measurement will be triggered on the up-slope (positive).  Indicates the measurement will be triggered on the down-slope (negative).
Amplitude	If the trigger source is set to a voltage or current level, the amplitude of the trigger level is indicated below the trigger source. In this example, the voltage trigger level is set to 4.5V.
14 Time/Div.	Identifies the horizontal time-base setting. This can be adjusted using the front panel Horizontal Time/Div knob.
Trigger Offset	The trigger offset indicates the time from the trigger point to the offset reference. Use the front panel Horizontal Offset knob to adjust.

Marker View



Symbol/Field:	Description:
1 **m1/m2 points**	Shows where the measurement markers intersect the selected waveform. Data values at the bottom of the display are referenced to the intersect locations of the markers. Calculations are based on the data points in between the intersect locations.
2 **Delta**	Indicates the delta between the markers in units (volts, amps, or watts) and in time (seconds). The value in parenthesis is the frequency, which is the reciprocal of the time (1/time).
3 **m2**	Indicates the **m2** marker value in volts, amps, or watts at the intersection point. Also indicates the distance in time that the m2 marker is in relation to the present trigger position.
4 **m1**	Indicates the **m1** marker value in volts, amps, or watts at the intersection point. Also indicates the distance in time of the m1 marker in relation to the present trigger position.
5 **Min**	Indicates the minimum data value (in volts, amps, or watts) between the marker locations of the selected waveform. Also indicates the distance in time of the minimum value in relation to the present trigger position.
6 **Avg**	Calculates the average data value (in volts, amps, or watts) between the marker locations of the selected waveform. Time information is not valid for calculated values.
7 **Max**	Indicates the maximum data value (in volts, amps, or watts) between the marker locations of the selected waveform. Also indicates the distance in time of the maximum value in relation to the present trigger position.
8 **I p-p**	Calculates the difference between the maximum and minimum values. Time information is not valid for calculated values.

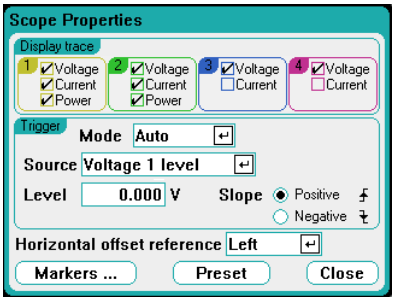
Using the Waveform Display Knobs

Knob:	Description:
Vertical Volts/Div	Makes the waveform bigger or smaller vertically in relation to its ground reference. Specified in volts/division or amps/division on the y axis. If the vertical gain causes the trace to be out of view, arrow symbols  will indicate the direction of the trace.
Vertical Offset	Moves the ground reference of the trace up or down in relation to the horizontal *center line* of the grid. The offset popup that appears in the upper right corner of the display shows how far the ground reference of the selected trace is above or below the horizontal center line of the grid. Positive values indicate how far the center line is *above* the ground reference. Negative values indicate how far the center line is *below* the ground reference.
Horizontal Time/Div	Stretches or shrinks the waveform horizontally around the horizontal offset reference. Specified in time/division on the x axis. The time-base applies to ALL output traces.
Horizontal Offset	Moves the waveform to the right or left of the horizontal offset reference. The trigger point of the waveform is indicated by the solid arrow. 
Trigger Level	Moves the trigger level up and down when a voltage or current level is the trigger source. The trigger level is identified by the  symbol. If the trigger level is out of view, an arrow symbol  will indicate the direction of the trigger level.
Marker 1/Marker 2	Moves the measurement markers right or left on the display. Press Scope View to display the markers. Values at the bottom of the display are referenced to the intersection of the markers. If a marker is out of view, an arrow symbol indicates the direction of the marker. Push the Market1/Marker2 knobs to reset the markers. 

Scope Properties

With the Scope View displayed, press the Properties key. In the Display Trace area, select which traces you wish to display. If no box is checked, no traces will be displayed for that output.

NOTE Voltage, current, and power traces can be displayed simultaneously on Agilent N676xA Power Modules. All other power modules can display only voltage or current traces, but not simultaneously.



Use the Trigger **Mode** dropdown list to select a trigger mode.

Mode:	Description:
Auto	Configures the scope to display a single-sweep measurement either when a trigger is received, or automatically if a trigger is not received. The scope continues running and waits for another trigger when the measurement completes.
Single	Configures the scope to display a single-sweep measurement when a trigger is received. The scope stops running when the measurement completes.
Triggered	Configures the scope to display a single-sweep measurement when a trigger is received. The scope continues running and waits for the next trigger when the measurement completes.

NOTE When the trigger mode is set to Auto, the scope triggers itself when it runs. Otherwise, you need to provide a trigger for the scope to make a measurement.

Use the Trigger **Source** dropdown list to select a trigger source. This trigger source will trigger all of the scope measurements. Depending upon the selected trigger source, you can trigger the scope as follows:

Trigger Source:	Description:
Voltage <1-4> level **Current <1-4> level**	Triggers the measurement when the voltage or current of the corresponding output passes through the specified level.
Arb Run/Stop key	Trigger the measurement when the Arb Run/Stop key is pressed.
Output On/Off key	Trigger the measurement when any of the Output On/Off keys are pressed. Also applies to the All Outputs On/Off key.
BNC Trigger In	Provide a low-true signal to the BNC trigger input connector. The signal must have a minimum pulse width of 2 microseconds.
Remote Command	Send a trigger command over one of the three interfaces (i.e. *TRG).

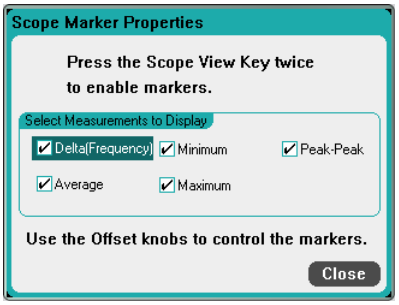
If a trigger source is grayed out, it is unavailable. This can happen on power modules that cannot simultaneously display voltage and current. For these power modules, if one of the traces has been turned on, you cannot use the other trace as the trigger source. Also, current levels are not available as trigger sources on outputs that have been grouped (paralleled). Note that a trace does not have to be enabled on the displayturned on for it to be used as a trigger source. This lets you reduce the number of traces on the display.

The **Level** field lets you specify a trigger level if you selected a Voltage level or Current level as the trigger source. Along with the level, you must also specify a **Slope** - if the measurement will be triggered on the positive (up-slope) or negative (down-slope) portion of the waveform.

The **Horizontal Offset Reference** places the trigger point on the left, right, or center of the display. Left lets you see the waveform after the trigger event (post trigger). Center lets you see the waveform before and after the trigger event (pre and post trigger). Right lets you see the waveform leading up to the trigger event (pre trigger).

Markers

Select the **Markers** button to configure the measurements that appear on the bottom of the display in Marker view. Measurements apply to the portion of the waveform between the two markers.



Preset

Select the **Preset** button to return the Scope View to the factory-shipped display settings. As shipped from the factory, the vertical offset of each trace is set to a different value. This is to prevent the traces from overlapping. The offset is referenced to the horizontal center line of the grid.

Data Logger View

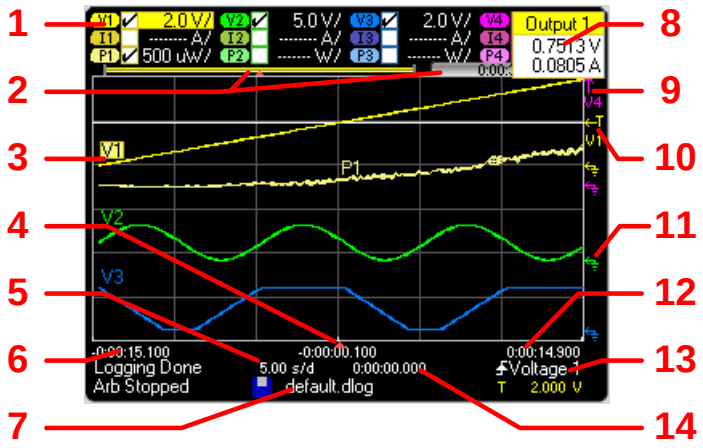
NOTE The Data Logger function is not available if Option 055 has been ordered.

Press the Data Logger key to access the Data Logger. This key toggles between the Standard view shown below, and Marker view, which enables markers and marker calculations. The Data Logger is similar to the Scope View function except that it lets you view and log output voltage and current data for up to 99,999 hours.

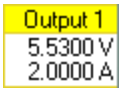
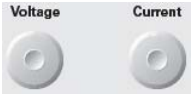
As in Scope View, you can configure the Data Logger View to display voltage or current waveforms for all outputs. Power waveforms can be displayed for *all* outputs because of the interleaved data logging capability. See "Data Logger Sampling Modes" later in this chapter.

The display functions like a strip chart recorder. Use the Waveform Display knobs to scroll through the data. Unless specified otherwise, data is automatically stored to a file named *default.dlog*.

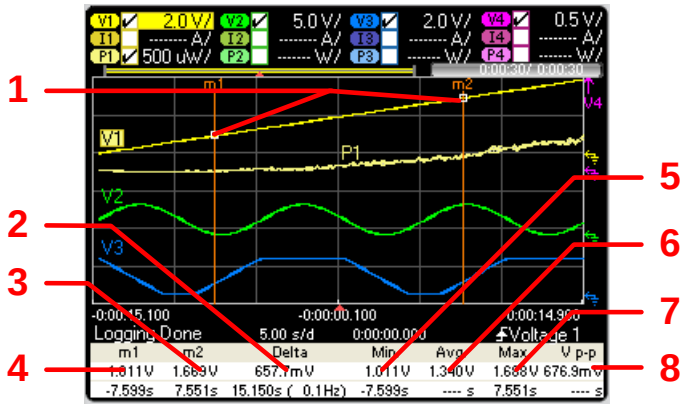
Standard View



Symbol/Field:	Description:
1 **Trace Controls**	Identifies the volt/div. or curr/div. setting of the trace. √ indicates the trace is on. Dashes (----) indicates the trace is off. Select the trace and press Enter to turn it on or off.
2 **Data Bar**	Represents all of the logged data. The yellow portion of the bar represents the data that is visible in the display area.
Time Elapsed	Indicates the time elapsed during the data log and the total duration. The values match when data logging finishes.
3 **Data Traces**	Voltage trace labels appear on the left side of the grid (V1 V2, V3, V4). Current trace labels appear on the right side of the grid (I1, I2, I3, I4). Power trace labels appear on the center of the grid (P1, P2, P3, P4). Traces are color coded according to output. Push the Trigger Level knob to autoscale the traces.

Symbol/Field:	Description:
4 Trigger Point 	Indicates the trigger position in the data log. In this example the trigger point was offset by 50%, and the pre trigger data and the post trigger data was logged. The time at the trigger point is always zero.
5 Time/Div.	Identifies the horizontal time-base setting. This can be adjusted using the front panel Horizontal Time/Div knob.
6 Left-Grid Time	Identifies the time at the left gridline in relation to the trigger point. If the trigger is at the left of the grid, the time will be zero.
7 Filename	Indicate the file to which the data is being logged. Data should always be logged to the internal drive.
8 Output Pop-up 	If you turn the voltage and current knobs,  a pop-up dialog will indicate the present output settings.
9 Out of View Arrows 	Indicates that the trace, V4 in this example, is out of view. Use the Vertical Volt/Div knob or the Vertical Offset knob to bring the trace into view. Push the Trigger Level knob to autoscale the traces.
10 Trigger Level 	Shows the location of the voltage or current trigger level and output. In this example, the voltage trigger level of output 1 is shown. The trigger source and amplitude are shown at the bottom right of the display.
11 Ground Reference 	The ground reference of the trace. Ground references are offset so that they do not overlap. The ground reference offset value is referenced to the horizontal center line of the grid.
12 Right-Grid Time	Identifies the time at the right gridline in relation to the trigger point. If the trigger point is at the start of the data log, the time will equal the total duration of the data log.
13 Trigger Source	Indicates the trigger source; in this example, the trigger source is a voltage level on output 1. The Data Logger starts logging data when the indicated level is reached.  indicates the Data Logger will be triggered on the up-slope (positive). indicates the Data Logger will b triggered on the down-slope (negative).
Amplitude	If the trigger source is set to a voltage or current level, the amplitude of the trigger level is indicated below the trigger source. In this example, the voltage trigger level is set to 2V.
14 Offset Time 	Indicates the time that the right gridline is offset or away from the end of the data log. When this value is zero, it means that the right gridline is positioned at the end of the datalog. Turning the offset knob will move the grid away from the end of the datalog, as indicated by the Offset Time. The yellow part of the bar represents the data visible on the grid. The dark portion represents the offset time.

Marker View



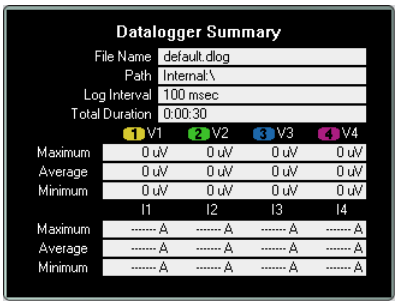
Symbol/Field:	Description:
1 **m1/m2 points**	Shows where the measurement markers intersect the selected waveform. Data values at the bottom of the display are referenced to the intersect locations of the markers. Calculations are based on the data points in between the intersect locations.
2 **Delta**	Indicates the delta between the markers in units (volts, amps, or watts) and in time (seconds). The value in parenthesis is the frequency, which is the reciprocal of the time (1/time).
3 **m2**	Indicates the **m2** marker value in volts, amps, or watts at the intersection point. Also indicates the distance in time that the m2 marker is in relation to the present trigger position.
4 **m1**	Indicates the **m1** marker value in volts, amps, or watts at the intersection point. Also indicates the distance in time of the m1 marker in relation to the present trigger position.
5 **Min**	Indicates the minimum data value (in volts, amps, or watts) between the marker locations of the selected waveform. Also indicates the distance in time of the minimum value in relation to the present trigger position.
6 **Avg**	Calculates the average data value (in volts, amps, or watts) between the marker locations of the selected waveform. Time information is not valid for calculated values.
7 **Max**	Indicates the maximum data value (in volts, amps, or watts) between the marker locations of the selected waveform. Also indicates the distance in time of the maximum value in relation to the present trigger position.
8 **I p-p**	Calculates the difference between the maximum and minimum values. Time information is not valid for calculated values.

Using the Waveform Display Knobs

Knob:	Description:
Vertical Volts/Div	Makes the waveform bigger or smaller vertically in relation to its ground reference. Specified in volts/division or amps/division on the y axis. If the vertical gain causes the trace to be out of view, arrow symbols V1 will indicate the direction of the trace.
Vertical Offset	Moves the ground reference of the trace up or down in relation to the horizontal *center line* of the grid. The offset popup that appears in the upper right corner of the display shows how far the ground reference of the selected trace is above or below the horizontal center line of the grid. V1 - Offset -8.100 V Positive values indicate how far the center line is *above* the ground reference. Negative values indicate how far the center line is *below* the ground reference.
Horizontal Time/Div	Zooms in or out of the data so that you can view waveform details. The numbers on the bottom of the display indicate the location of the data that is being viewed relative to the entire data log.
Horizontal Offset	Moves the grid area to the right or left along the logged data.
Trigger Level	Moves the trigger level up and down when a voltage or current level is the trigger source. The trigger level is identified by the ←T symbol. If the trigger level is out of view, an arrow symbol ↑T will indicate the direction of the trigger level. Note that trigger levels are not available in Normal (interleaved) data log mode.
Marker 1/Marker 2	Moves the measurement markers right or left on the display. Press Scope View to display the markers. Values at the bottom of the display are referenced to the intersection of the markers. If a marker is out of view, an arrow symbol indicates the direction of the marker. m2 > Push the Market1/Marker2 knobs to reset the markers.

Summary View

To access the Summary View, press the Menu key. Scroll down and select **Arb**, then select **Summary View**.



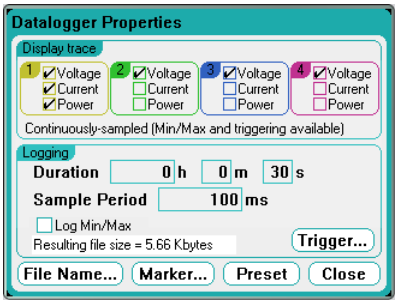
The Summary view displays the internal filename where the data is being saved, the working directory, the time interval between data samples, and the total duration of the data log session.

The Summary View also displays the average, minimum, and maximum voltage and current values of the data traces. The values in the Summary view only apply to the portion of the traces that actually appear in the Standard view window. This is useful if you need summary information when you are zooming in on a specific portion of the logged data. This is similar to the markers in Scope View except that the edges of the display act like the markers.

Data Logger Properties

With the Data Logger selected, press the Properties key. In the **Display Trace** area, select which signals to display. If no box is checked, no data logging will occur for that output.

NOTE Depending on which traces are enabled on specific power modules, the Data Logger function alternates between Continuously-sampled mode and Normal (interleaved) mode. Refer to "Data Logger Sampling Modes" for details.



The text area under the traces identifies the data logging mode. *Continuously-sampled* mode continuously samples the voltage or current data at a 20.48-microsecond rate and stores one data point per sample period. Selecting Log Min/Max also stores the minimum and maximum values per sample period. *Normal (interleaved)* mode alternates voltage and current measurements. One voltage and one current measurement is made during the sample period.

The **Duration** fields let you specify the duration of the data log in hours, minutes, and seconds. The maximum duration is 99,999 hours.

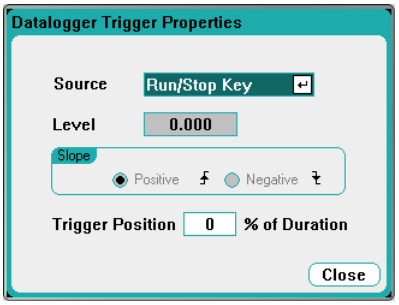
The **Sample period** specifies the interval between data samples in milliseconds, which can be set from 1 millisecond to 60 seconds.

Check **Log Min/Max** to log the minimum and maximum values to the data log file when in Continuously-sampled mode. When Log Min/Max is checked, it will triple the resulting file size.

The **Resulting file size** text box indicates the file size when the data log completes. The maximum file size is 2E9 bytes (1.87 Gbytes in Microsoft Windows units). If settings exceed this limit, the logging interval will automatically increase to keep the size within the limit. If the file size exceeds the available space on the drive to which it will be written, an error is generated and the Data Logger will not run.

Trigger

Select the **Trigger** button to configure the trigger properties. The Data Logger uses triggers to synchronize itself with an external event.



The **Source** dropdown list lets you select a trigger source. The same trigger source will be used to trigger all of the outputs that have been configured for data logging. Depending upon the selected trigger source, you can trigger the Data Logger as follows:

Trigger Source:	Description:
Voltage <1-4> level **Current <1-4> level**	Triggers the Data Logger when the voltage or current of the corresponding output passes through the specified level.
Run/Stop key	Trigger the Data Logger when the Run/Stop key is pressed. This is the default trigger source.
Arb Run/Stop key	Trigger the Data Logger when the Arb Run/Stop key is pressed.
Output On/Off key	Trigger the Data Logger when any of the Output On/Off keys are pressed. Also applies to the All Outputs On/Off key.
BNC Trigger input	Provide a low-true signal to the BNC trigger input connector. The signal must have a minimum pulse width of 2 microseconds.
Remote Command	Send a trigger command over one of the three interfaces (i.e. *TRG).

If a trigger source is grayed out, it is unavailable. For example, current levels are not available as trigger sources on outputs that have been grouped (paralleled). Note also that a trace *must* be turned on for it to be used as a trigger source. This differs from the way that current and voltage level trigger sources are selected in Scope View.

The **Level** field lets you specify a trigger level if you selected a Voltage level or Current level as the trigger source. Along with the level, you must also specify a **Slope** - if the measurement will be triggered on the positive (up-slope) or negative (down-slope) portion of the waveform.

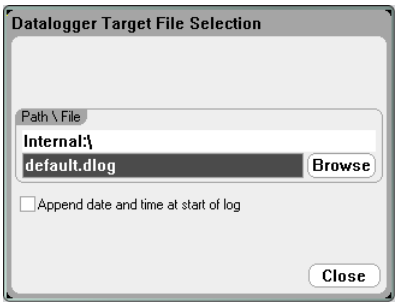
The **Trigger Position % of Duration** lets you specify a trigger offset. This allows the specified percent of pre-trigger data to be logged to the data file. The trigger position is expressed as a percentage of the data log duration.

For example, if you specified a data log duration of 30 minutes and a trigger position of 50%, the Data Logger will log 15 minutes of pre-trigger data to the file when the trigger occurs. Subsequently, 15 minutes of post-trigger data will then be logged to the data file.

NOTE Once the Data Logger has been triggered, do not change the display to Scope View; otherwise the Data Logger will stop.

Filename

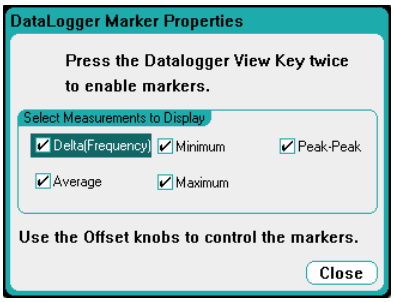
Select the **Filename** button to specify a filename in which to save the data. Data will be logged to this filename the next time the Data Logger runs. If you do not specify a filename, the data will be logged to *default.dlog*, which is overwritten each time the Data Logger runs.



Enter the filename in the Path\File field. Check Append date and time at start of log to include time-stamp information in the file.

Markers

Select the **Markers** button to configure the measurements that appear on the bottom of the display in Marker view. Measurements apply to the portion of the trace between the two markers.



Preset

Select the **Preset** button to return the Data Logger View to the factory-shipped display settings. As shipped from the factory, the vertical offset of each trace is set to a different value. This is to prevent the traces from overlapping. The offset is referenced to the horizontal center line of the grid.

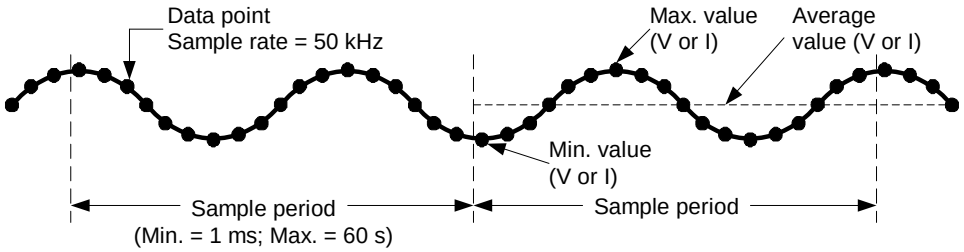
Data Logger Sampling Modes

The DC Power Analyzer provides two modes of data logging: Continuously-sampled - the default, and Standard (interleaved) mode. The mode is automatically selected based on the installed power module types and the selected measurements, and **applies to all outputs**. A text message in the Display Trace area of the Data Logger Properties window indicates which mode is in effect.

Continuously-sampled

Continuously-sampled continuously samples the voltage or current data at about 50 kHz. Both voltage **and** current can be continuously sampled on Agilent N676xA Power Modules. Power is calculated from the instantaneous voltage and current values. Only voltage **or** current can be continuously sampled on all other power modules. Continuous data sampling is used for the following Module/Trace selections:

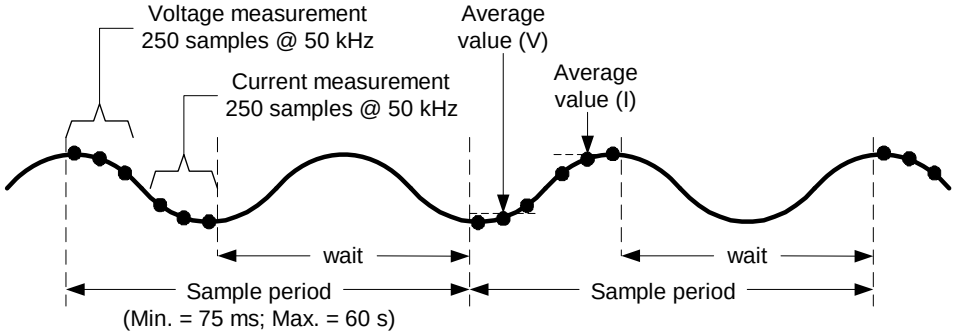
Power Module	Display Trace selection	Available capabilities set for ALL outputs
N676xA	Voltage, Current, and Power	• Sample period = 1 ms to 60 s
N673xB, N674xB	Voltage or Current	• Trigger source = all trigger sources available
N675xA, N677xA	Voltage or Current	• Trigger offset = 0 to 100%
		• Values logged = average, minimum, maximum (minimum/maximum values must be selected)



Standard (interleaved)

Standard (interleaved) mode only applies when **both** voltage and current measurement traces are selected on power modules other than Agilent N676xA. These other power modules cannot measure voltage and current simultaneously; hence, the voltage and current measurements must be interleaved. Each measurement is sampled for about 5 milliseconds at the beginning of every sample period. Power is calculated from the interleaved measurements. Standard data sampling is used for the following Module/Trace selections:

Power Module	Display Trace selection	Available capabilities set for ALL outputs
N673xB, N674xB	Voltage and Current, or Power	• Sample period = 75 ms to 60 s
N675xA, N677xA	Voltage and Current, or Power	• Trigger source = Run/Stop key only
		• Trigger offset = 0 (offset not available)
		• Values logged = average only



Scope and Data Logger Display Differences

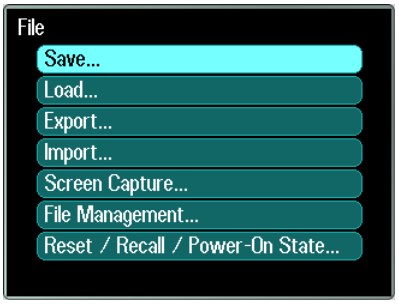
The Scope View and Data Logger displays are similar in many respects, such as the way traces are displayed, how traces are selected, and the marker controls - to name a few. This similarity makes it easier to program each function.

However, there are important differences in the Scope and Data Logger displays that may not be obvious at first glance. To help eliminate confusion when using both Scope and Data Logger, the following table lists the major differences in the display functions.

Function	Scope View	Data Logger
Graph	Waveform capture	Strip chart
Trace selection	Voltage, current, and power traces - for N676xA power modules Voltage or current trace - for all other power modules	*Continuous mode:* Voltage, current, and power traces - for N676xA power modules Voltage or current trace - for all other power modules *Interleaved mode:* Voltage and current, or power - for all power modules except N676xA
Trigger level selection	Voltage or current level of checked trace – for all power modules Note that current levels cannot be selected as triggers on outputs that have been grouped.	*Continuous mode:* Voltage or current level of checked trace - for all power modules *Interleaved mode:* Run Stop key only - for all power modules Note that current levels cannot be selected as triggers on outputs that have been grouped.
Trigger mode	Auto, single, or triggered	Does not apply
Trigger position	Turn the horizontal offset knob	Press Properties, select Trigger. Trigger position is specified as a % of the data log duration.
Horizontal trigger offset reference	Left, center, or right	Does not apply to strip chart
Trace save	Press File, select Save	Automatically saved to default.dlog file (A different file name can be specified prior to running the datalog.)

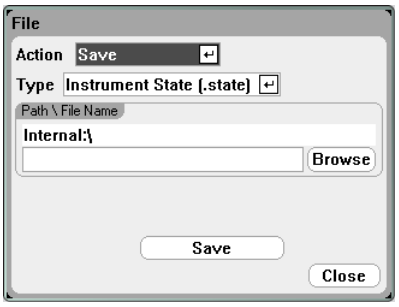
Using the File Functions

To access the file functions, press the File key, then scroll to and select from the following choices:



Save Function

To save the instrument state or the presently displayed scope measurement, press the File key, then scroll to and select **Save**.



Parameter:	Description:
Type	Specifies the data type: instrument state or scope data.
Path\File Name	Specifies a file name in which to save the data. Internal:\ specifies the instrument's internal memory. External:\ specifies the Memory port on the front panel. Enter a name in the text field. See "Enter the File Name"
Browse	Lets you browse another directory or USB memory device.
Save	Saves the data to the file name in binary format.

Enter the File Name

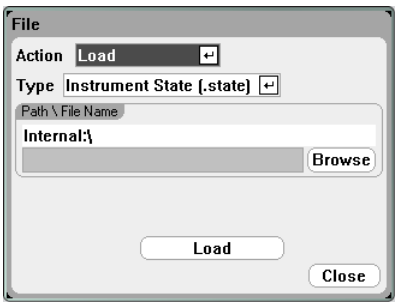
Use the navigation keys to scroll to and select the **File Name** field. Use the alpha/numeric keys to enter a file name.

Alpha keys automatically become active on data entry fields that allow alpha as well as numeric characters. Repeatedly pressing a key cycles through the choices. This is similar to the way cell phones work. For example, repeatedly pressing 2 ABC cycles as follows:
a, b, c, A, B, C, 2

After a brief pause, the cursor will accept the displayed character and move one position to the right. Use Backspace to back up and delete an entry. Use ▶ to enter a space. Press Enter when finished.

Load Function

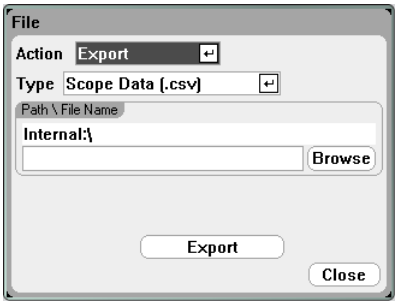
To load an instrument state, scope data, or logged data, press the File key, then scroll to and select **Load**. You can only load binary files. You cannot load data files that have been converted to .csv format.



Parameter:	Description:
Type	Data type: instrument state, scope data, or logged data.
Path\File Name	Displays the file where the data is located. Internal:\ specifies the instrument's internal memory. External:\ specifies the Memory port on the front panel.
Browse	Lets you browse another directory or USB memory device.
Load	Loads the data from the binary file into the instrument.

Export Function

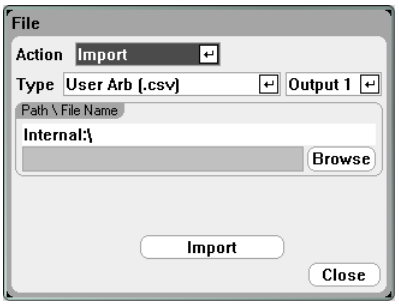
To export (and convert) scope data, logged data, or user-defined Arb, data, press the File key, then scroll to and select **Export**.



Parameter:	Description:
Type	Data type: scope data, logged data, or user-defined Arb. All data is exported in .csv format (comma separated values).
Path\File Name	Specifies a file name in which to export the data. Internal:\ specifies the instrument's internal memory. External:\ specifies the Memory port on the front panel. Enter a name in the text field. See "Enter the File Name"
Browse	Lets you browse another directory or USB memory device.
Export	Exports the data to the file name in .csv format.

Import Function

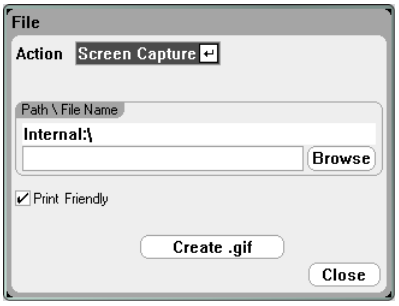
To import (and convert) User-Defined Arb data, press the File key, then scroll to and select **Import**.



Parameter:	Description:
Type	Data type: user-defined arbitrary waveform data. Imported data is converted from .csv format to an internal file format.
Output <1-4>	Specifies the output that will receive the Arb data.
Path\File Name	Displays the file where the data is located. Internal:\ specifies the instrument's internal memory. External:\ specifies the Memory port on the front panel.
Browse	Lets you browse another directory or USB memory device.
Import	Imports the .csv data from the file into the instrument.

Screen Capture

To capture a screen, press the File key, then scroll and select **Screen Capture**. This saves the screen that was active when you pressed File.

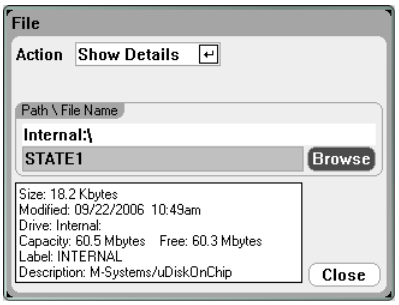


A copy of the current screen is saved whenever the File key is pressed.

Parameter:	Description:
Path\File Name	Specifies a file name in which to save the image. Screens are saved in .gif format (graphics interchange format). Internal:\ specifies the instrument's internal memory. External:\ specifies the Memory port on the front panel. Enter a name in the text field. See "Enter the File Name"
Browse	Lets you browse another directory or USB memory device.
Print Friendly	Check this box to save Scope View and Data Logger screens with a white instead of a dark background.
Create .gif	Saves the image to the specified .gif file.

Show Details

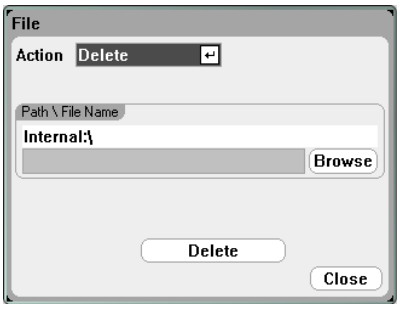
To view the details of a specific file, press the File key, then scroll to and select **File Management**.



Parameter:	Description:
Path\File Name	Specifies the file. Internal:\ specifies the instrument's internal memory. External:\ specifies the Memory port on the front panel.
Browse	Lets you browse another directory or USB memory device.
Details	File details are displayed in the text box.

Delete Function

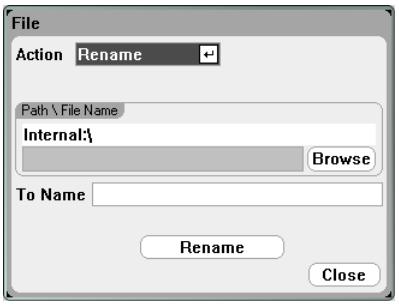
To delete a file, press the File key, then scroll to and select **File Management**. In the Action dropdown box, select **Delete**.



Parameter:	Description:
Path\File Name	Specifies the file or directory to be deleted. Internal:\ specifies the instrument's internal memory. External:\ specifies the Memory port on the front panel.
Browse	Lets you browse another directory or USB memory device.
Delete	Deletes the selected file.

Rename Function

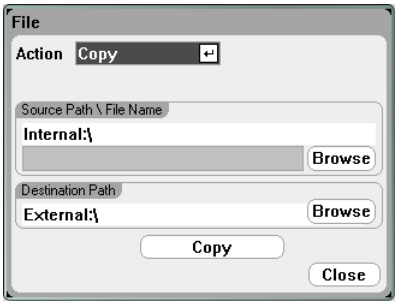
To rename a file, press the File key, then scroll to and select **File Management**. In the Action dropdown box, select **Rename**.



Parameter:	Description:
Path\File Name	Specifies the file or directory to be renamed. Internal:\ specifies the instrument's internal memory. External:\ specifies the Memory port on the front panel.
Browse	Lets you browse another directory or USB memory device.
To Name	Enter the name that you wish to rename the file to in this text field. See "Enter the File Name".
Rename	Renames the selected file.

Copy Function

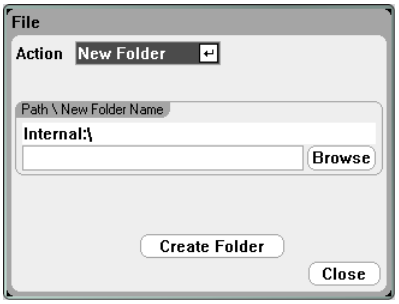
To copy the selected file to another directory or an external USB memory device, press the File key, then scroll to and select **File Management**. In the Action dropdown box, select **Copy**.



Parameter:	Description:
Source Path \File Name	Specifies the file to be copied. Internal:\ specifies the instrument's internal memory. External:\ specifies the memory port on the front panel.
Destination Path	Specifies a destination directory. Internal:\ specifies the instrument's internal memory. External:\ specifies the Memory port on the front panel.
Browse	Lets you browse another directory or USB memory device.
Copy	Copies the selected file to the specified destination.

New Folder

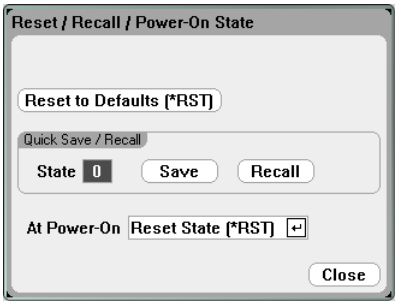
To create a new folder at the present directory level, press the File key, then scroll to and select **File Management**. In the Action dropdown box, select **New Folder**.



Parameter:	Description:
Path\New Folder Name	Specifies a name for the folder. Internal:\ specifies the instrument's internal memory. External:\ specifies the Memory port on the front panel. Enter the name in the text field. See "Enter the File Name"
Browse	Lets you browse another directory or USB memory device.
Create Folder	Creates the new folder in the specified location.

Reset/Recall/Power-On State

As shipped, the DC Power Analyzer is configured to automatically recall the Reset State (*RST) settings at power-on. However, you can configure the reset, recall, and power-on state of the instrument. Press the File key, then scroll and select **Reset/Recall/Power-On State**.



Selecting **Reset to Defaults** lets you immediately return the instrument to its factory default settings as described in chapter 1.

Quick Save/Recall lets you save and subsequently recall an instrument state in memory locations 0 through 9. This is the same as saving an instrument state to a file name, but quicker.

At Power-On lets you recall the Reset State (*RST), or recall the instrument state stored in location 0.

Using an External USB Memory Device

You can use an external USB memory device (commonly referred to as a flash drive) to transfer files to and from the DC Power Analyzer. Connect the memory device to the front panel Memory port, which is specifically designed for this purpose. The rear panel USB connector should only be used for connecting to a PC.

When using an external USB memory device, be aware of the following cautions:

- While the DC Power Analyzer supports the majority of USB memory devices, there may be differences in manufacturing standards of some devices that will prevent them from working in the DC Power Analyzer.
- It is recommended that you test your USB device by importing and exporting a file before you actually use it to save data directly from the test you will be running. If the USB memory device does not work in the DC Power Analyzer, try a device from a different manufacturer.

Exporting Data to a Spreadsheet

You can export scope data and logged data to a spreadsheet such as Microsoft Excel on your PC as follows:

1. Collect the scope or logged data using the DC Power Analyzer.
2. Insert a USB memory device into the Memory port on the front of the DC Power Analyzer.
3. Export the scope data or logged data to the memory device using the Export file function as previously discussed. Note that the export file format is .csv (comma separated values).
4. Inset the memory device into the USB port on your computer.
5. Run Microsoft Excel and select File, then Open. Navigate to the USB memory device. Under Files of type:, select Text Files (*.csv). Open the scope data or datalog file.

Logging Data Directly to the Memory Device

You can save logged data directly to the USB memory device rather than to the instrument's internal memory as follows:

1. Insert a USB memory device into the Memory port on the front of the DC Power Analyzer.
2. In the Datalogger Target File Selection window (located under Datalogger Properties/File Name), use the Browse button and select External:\. Enter a filename in the text field. The data will now be placed on the USB memory device.

NOTE Data is saved in binary format. To export in .csv format you must Load the data from the USB memory device back into the instrument and Export the data in .csv format as described under "Exporting Data to a Spreadsheet".

4
Using the System Utilities

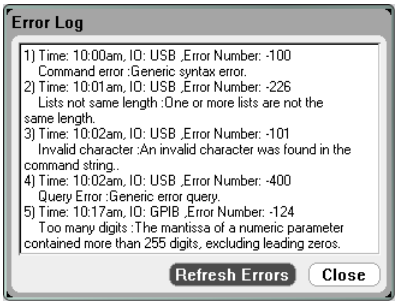
This chapter contains information about the following system utilities:

- Error reporting.
- Configuring the remote interfaces.
- Configuring user preferences.
- Using administrative functions, including security features that let you lock out the front panel and remote interfaces. Information on clearing the instrument's memory is also provided.
- Configuring the rear panel digital control port. This control port consists of seven user-configurable I/O pins.

NOTE Detailed information on configuring the remote interfaces is included in the Agilent Technologies *USB/LAN/GPIB Interfaces Connectivity Guide*, which is available on the Automation-Ready CD included with this product.

Error Reporting

The front panel **Error** indicator comes on if self-test fails or if other operating problems occur with your instrument. To display the list of errors, press the Menu key, scroll down and select the **Utilities** item, then select **Error Log**. Refer to Appendix B for information about specific errors.

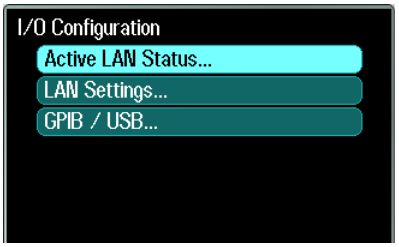


- Errors are stored in the order they are received. The error at the end of the list is the most recent error.
- If more errors have occurred than can fit in the queue, the last error stored (the most recent error) is replaced with -350,"Error queue overflow". No additional errors are stored until you remove errors from the queue. If no errors are in the queue, the instrument responds with +0,"No error".
- All errors are cleared when you exit the Error Log menu or when power is cycled.

If you suspect that there is a problem with the DC Power Analyzer, refer to the troubleshooting section in the N6700 Service Guide. The Service Guide is included as part of the optional Manual Set (Option 0L1). An electronic copy of the N6705A Service Guide is also included on the N6705A Product Reference CD-ROM.

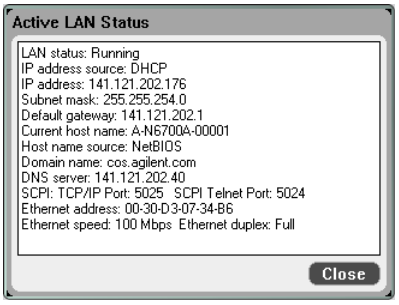
Configuring the Interfaces

To access the I/O configuration functions, press the Menu key, scroll down and select the **Utilities** item, then select **I/O Configuration**. Then scroll to and select one of the following functions:



Viewing the Active LAN Status

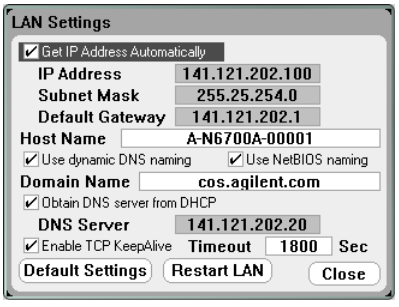
To view the currently active LAN settings, select **Active LAN Status**.



Note that the currently active LAN settings for the IP Address, Subnet Mask, and Default Gateway may be different from the settings specified in the “Modify LAN Settings” window - depending on the configuration of the network. If the settings are different, it is because the network has automatically assigned its own settings.

Modifying the LAN Settings

As shipped from the factory, the DC Power Analyzer’s pre-configured settings should work in most LAN environments. If you need to manually configure these settings, press the Menu key, scroll down and select **Utilities**, then **I/O Configuration**, then **LAN Settings**.



NOTE Either the Restart LAN button must be selected, or the DC Power Analyzer must be rebooted for any LAN parameter modifications to take effect.

You can configure the following items in the Modify LAN Settings window:

Get IP Address Automatically

With this box checked, the instrument will first try to obtain an IP address from a DHCP server. If a DHCP server is found, the DHCP server will assign an IP address, Subnet Mask, and Default Gateway to the instrument. If a DHCP server is unavailable, the instrument will try to obtain an IP address using AutoIP. AutoIP automatically assigns an IP address, Subnet Mask, and Default Gateway on networks that do not have a DHCP server.

With this box unchecked, you can configure the addresses manually by entering values in the following three fields.

IP Address

This value is the Internet Protocol (IP) address of the instrument. An IP address is required for all IP and TCP/IP communications with the instrument. An IP Address consists of 4 decimal numbers separated by periods. Each decimal number ranges from 0 through 255.

Subnet Mask

This value is used to enable the instrument to determine if a client IP address is on the same local subnet. When a client IP address is on a different subnet, all packets must be sent to the Default Gateway.

Default Gateway

This value is the IP Address of the default gateway that allows the instrument to communicate with systems that are not on the local subnet, as determined by the subnet mask setting. A value of 0.0.0.0 indicates that no default gateway is defined.

Host Name

This field registers the supplied name with the selected naming service. If the field is left blank, no name is registered. A hostname may contain upper and lower case letters, numbers and dashes(-). The maximum length is 15 characters. Use the numeric/alpha keys to enter letters or numbers. Repeatedly pressing a key cycles through the list of choices. After a short delay the cursor automatically moves to the right.

Each DC Power Analyzer is shipped with a default hostname with the format: A-modelnumber-serialnumber, where *modelnumber* is the mainframe's 6-character model number (e.g. N6705A), and *serialnumber* is the last five characters of the 10-character mainframe serial number located on the label on the top of the unit (e.g. 45678 if the serial number is MY12345678). A-N6705A-45678 is an example of a hostname.

Use Dynamic DNS naming

Registers the hostname using the Dynamic DNS naming system.

Use NetBIOS naming

Registers the hostname using the RFC NetBIOS naming protocol.

Domain Name

Registers the Internet domain for the instrument. This is required if your DNS server requires an instrument to register not only the hostname, but also the domain name. The Domain must start with a letter and may contain upper and lower case letters, numbers, dashes(-) and dots(.). Use the numeric/alpha keys to enter letters or numbers. Repeatedly pressing a key cycles through the list of choices. After a short delay the cursor automatically moves to the right.

Obtain DNS server from DHCP DNS is an internet service that translates domain names into IP addresses. It is also needed for the instrument to find and display its hostname assigned by the network. Check this item to obtain the DNS server address from DHCP. You must have previously checked **Get IP Address Automatically**.

DNS server This value is the address of the DNS server. It is used if you are not using DHCP or if you need to connect to a specific DNS server.

Enable TCP Keepalive Check the Enable box to enable the TCP keepalive function. The instrument uses the TCP keepalive timer to determine if a client is still reachable. If there has been no activity on the connection after the specified time, the instrument will send keepalive probes to the client to determine if it is still alive. If not, the connection will be marked as down or "dropped." The instrument will release any resources that were allocated to that client.

Timeout This is the delay in seconds before TCP keepalive probes will be sent to the client. It is recommended that the largest value be used that still meets the application's need for unreachable client detection. Smaller keepalive time-out values will generate more keepalive probes (network traffic), using more of the available network bandwidth. Allowed values: 720 - 99999 seconds.

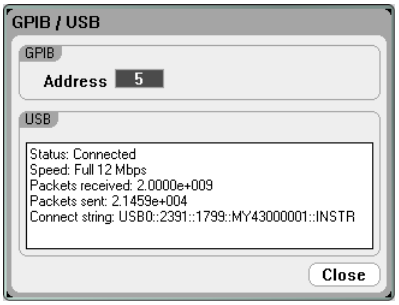
Default Settings Resets the LAN settings to the factory-shipped state. These settings are listed at the end of chapter 1.

Restart LAN Restarts networking to use the modified configuration settings.

GBIB/USB Settings

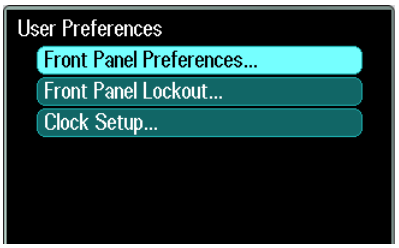
To view the currently active GPIB/USB settings, press the Menu key, scroll down and select the **Utilities** item, then select **I/O Configuration**, then **GPIB/USB**.

You may only change the GPIB address as previously explained in chapter 2 under “GPIB/USB Interfaces”.



Configuring User Preferences

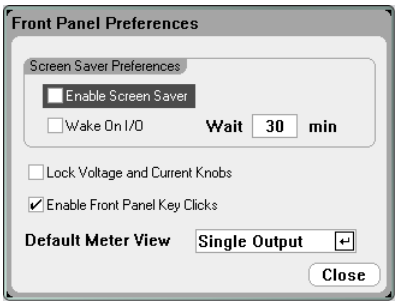
To configure the User Preferences, press the Menu key, scroll down and select the **Utilities** item, then select **User Preferences**. Then scroll to and select one of the following User Preferences:



Front Panel Preferences

The DC Power Analyzer has a front panel screen saver that increases the life of the LCD display by turning it off during periods of inactivity. As shipped from the factory, the screen saver comes on one hour after activity on the front panel or interface has ceased.

When the screen saver is active, the front panel display turns off, and the LED next to the Line switch changes from green to amber. To restore the front panel display, simply press one of the front panel keys.



Check **Enable Screen Saver** to enable the screen saver. Uncheck to disable the screen saver. When enabled, enter a value in minutes in the **Wait** field to specify the time when the screen saver will activate.

Check **Wake on I/O** to activate the display with I/O bus activity. If Wake on I/O is enabled, the display is restored whenever there is activity on the remote interface. This also resets the Wait timer.

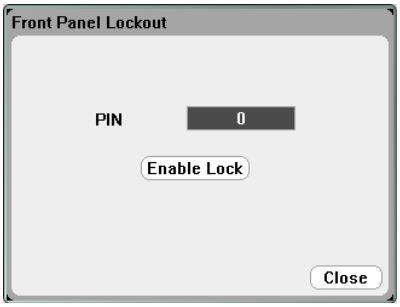
Check **Lock Voltage and Current Knobs** to disable the front panel voltage and current knobs. This is useful if you wish to prevent someone from changing the voltage or current settings if a test is in progress. Uncheck to enable the voltage and current knobs.

Check **Enable Front Panel Key Clicks** to enable key clicks. Uncheck to disable key clicks.

Under **Default Meter View**, you can specify if the instrument turns on with single-output view or all-outputs view.

Front Panel Lockout

You can password-protect the front panel keys to prevent unwanted control of the instrument from the front panel. The lock setting and password is saved in non-volatile memory so that the front panel remains locked even when AC power is cycled. To access the front panel lockout function press the Menu key, scroll down and select **Utilities**, then **User Preferences**, then **Front Panel Lockout**.

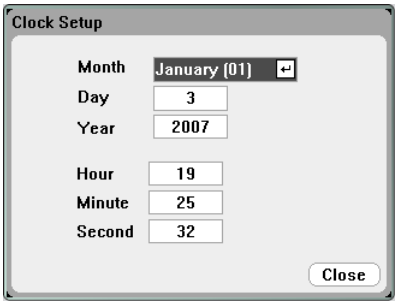


In the **PIN** text box, enter the numeric password that you wish to use to *unlock* the front panel. Then click **Enable Lock** to lock the front panel keys. A dialog prompting the user to unlock the front panel appears every time a key is pressed. Enter the password to unlock the front panel.

NOTE If the password is lost, the SYSTem:PASSword:FPANel:RESet command can reset the front panel lockout password. Refer to the Programmer's Reference Help file on your Agilent N6705A Product Reference CD for more information.

Clock Setup

When shipped from the factory, the DC Power Analyzer's clock is set to Greenwich mean time. To access the clock function press the Menu key, scroll down and select **Utilities**, then **User Preferences**, then **Clock Setup**.



Select a **Month** from the dropdown list. Enter the **Day**. Then enter the **Year**.

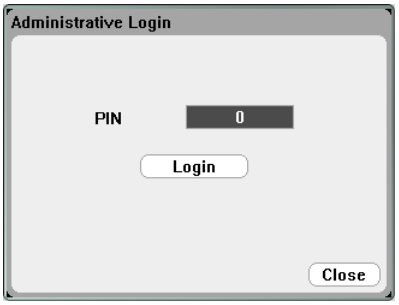
Enter the **Hour**, **Minute**, and **Second**. The time becomes active when the values are entered.

Using the Administrative Tools

To enter the Administrative Utilities menu, press the Menu key, scroll down and select **Utilities**, then select **Administrative Tools**. Access to the Administrative Tools menu is password protected. Select **Administrator Logout/Login** to enter the password.

Administrator Login/Logout

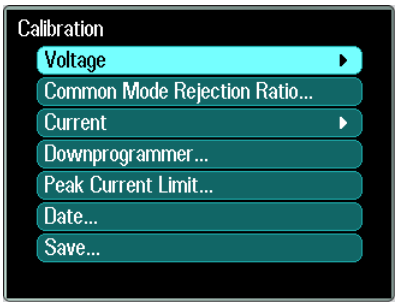
If a password is required, enter it in to the PIN field, select the **Login** button and press [Enter].



As shipped from the factory, the password is 0 (zero). If the PIN field shows 0; simply select the **Login** button and press [Enter].

Instrument Calibration

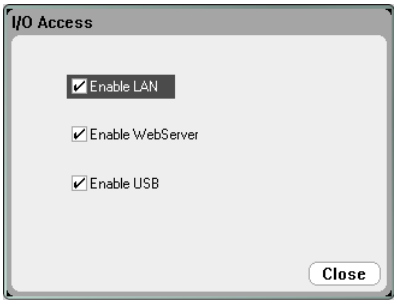
The calibration functions are located in the Administration Tools menu and are password-protected from unauthorized use.



For complete information about calibrating the instrument, refer to the calibration section in the N6705A Service Guide. The Service Guide is included with the optional Manual Set (Option 0L1). An electronic copy is included on the N6705A Product Reference CD.

Securing the USB, LAN, and Web Server

The USB interface, LAN interface, and the Web server are enabled when shipped. Log into the **Administrative Tools** menu to secure or allow access to the LAN, USB, or Web server.



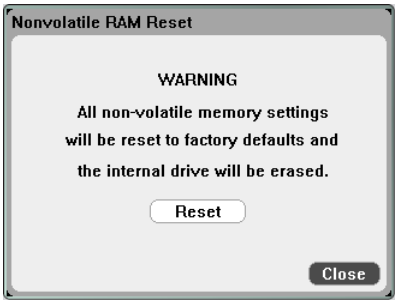
Check the **Enable LAN** box to enable the LAN. Uncheck this box to disable the LAN.

Check the **Enable WebServer** box to enable the Web server. Uncheck this box to disable the Web server. If the **Enable LAN** box is not checked, the Web server will not be available.

Check the **Enable USB** box to enable the USB. Uncheck this box to disable the USB.

Restoring the Non-volatile Factory Settings

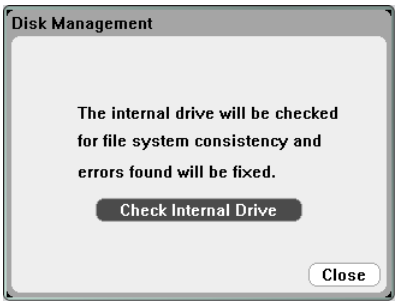
To erase all files on the internal drive and restore the factory-shipped settings and the non-volatile settings, log into the **Administrative Tools** menu. Select **Nonvolatile RAM Reset** and press the **Reset** button.



Disk Management

The Disk Management function checks the internal drive for file system consistency and file integrity. Any file errors or discrepancies are automatically fixed.

To access the disk management utilities, log into the **Administrative Tools** menu, then select **Disk Management**. Press the **Check Internal Drive** button to check the internal drive.

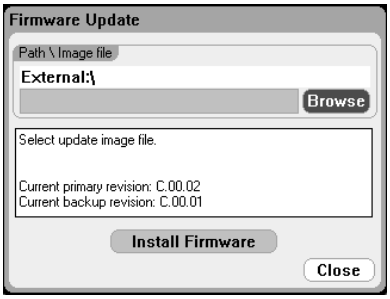


Updating the Firmware

The easiest way to update the firmware on your DC Power Analyzer if to go the web at http://www.agilent.com/find/N6705firmware and download the firmware to a USB memory device connected to your computer.

After the file has been downloaded to the USB memory device, remove the device and insert it into USB port on the front of the DC Power Analyzer.

Log into the **Administrative Tools** menu, then select **Firmware Update**.



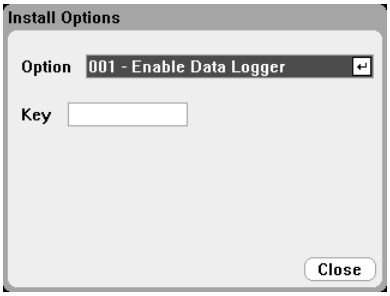
Click the **Browse** button and navigate to the firmware file on the External USB memory Device. Press the **Install Firmware** button to update the firmware.

A message will then appear instructing you to reboot the instrument and activate the firmware. Press Reboot or cycle AC power.

Installing Options

The Install Options function lets you install firmware options into the DC Power Analyzer. At present, the only option that can be installed in the instrument after it has been purchased is Option 001, Data Logger Software. Note that this option can only be installed if the instrument had been purchased with Option 055, Delete Data Logger.

To access the disk management utilities, log into the **Administrative Tools** menu, then select **Install Options**. From the dropdown menu, select the option you wish to install and enter the Access Key number from your software license documentation.



Obtaining the License

To obtain the license, you must first purchase the option. After you have purchased the option, you will receive a Software Entitlement Certificate. When this is received, you can obtain the license.

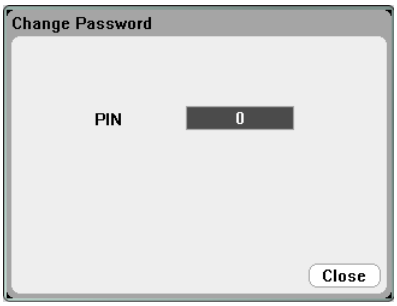
To obtain the software license for the Option 001 Data Logger Software, go to: http://www.agilent.com/find/softwarelicense and follow the on-screen directions.

1. Log in by entering the Order number and Certificate number. These appear in the upper right corner of your Software Entitlement Certificate. Click Next.
2. Under **Request License(s) for**, check the box labeled “One or more products on a single instrument or host computers”. Click Next.
3. In the **Please Select Products** dropdown list, select “N6705V-001”. Click Add. Then enter the Agilent instrument serial number of the DC Power Analyzer for which you wish to license the Data Logger Software. The serial number is located on the rear panel of the instrument. You can also view the serial number by pressing Settings then Properties. Click Next.
4. Review your selections. Click Next.
5. Enter the e-mail address you want the license emailed to. Click Submit.

After finishing the license request procedure, an Access Key will be emailed to you shortly. Enter the Access Key into the Key field of the Install Options window shown on the previous page.

Changing the Password

To password-protect or change the password for the Administrative Tools menu, log into the Administrative Tools menu as previously described ands select **Change Password**. Select a password that is numeric and up to 15 digits long. Enter it into the PIN field and press [Enter]. When done, select **Administrator Login/Logout** to log out of the Administrative Tools menu and activate the password. You can now only enter the Administrative Tools menu by providing the new password.



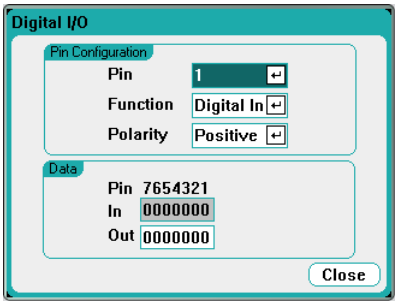
If the password is lost or forgotten, access to the Administrative Tools menu can be restored by setting an internal switch to reset the password to 0. If the message “Locked out by internal switch setting” or “Calibration is inhibited by switch setting” appears, the internal switch is set to prevent the password from being changed (Refer to the Service Guide).

Configuring the Digital Port

The following table describes the possible pin configurations for the digital port functions. For a complete description of the electrical characteristics of the digital port, refer to Appendix A.

Pin Function	Available configurable pins
Digital I/O and Digital In	Pins 1 through 7
External Trigger In/Out	Pins 1 through 7
Fault Out	Pins 1 and 2
Inhibit In	Pin 3
Output Couple	Pins 4 through 7
Common (⊥)	Pin 8

To configure the bi-directional digital I/O, press the Menu key, scroll down and select the Utilities item, then select **Digital I/O**.



Select the pin you wish to configure from the **Pin** dropdown list.

Select a function for the pin the from the **Function** dropdown list. Select from Digital In, Digital I/O, Trigger Out Trigger In Refer to the following descriptions of each of the digital I/O functions.

Configure the polarity for each pin by selecting the **Polarity** dropdown menu. When positive polarity is selected, a logical true signal is a voltage high at the pin. When negative polarity is selected, a logical true signal is a voltage low at the pin.

The **Data** fields only apply to the Digital I/O and Digital In functions.

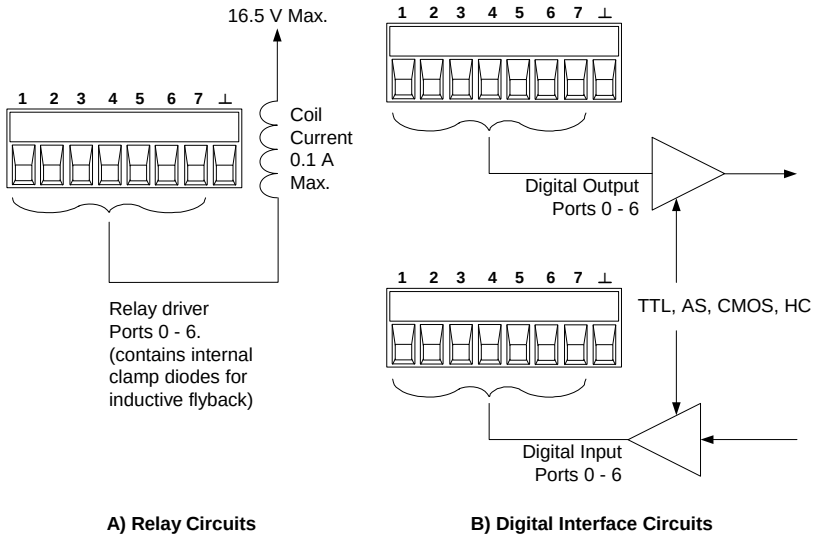
Digital I/O

Each of the seven pins can be configured as general-purpose bi-directional digital inputs and outputs. The ground reference for the pins is Signal Common on pin 8. Bit assignments are as follows:

Pin	7	6	5	4	3	2	1
Bit	6	5	4	3	2	1	0

Enter the value of the digital word into the **Out** field of the Digital I/O Properties window. The **In** field reflects the condition of the external signal that is applied to the pin.

The I/O pins can be used to control both relay circuits as well as digital interface circuits, as illustrated in the following figure.



For a complete description of the electrical characteristics of the digital port, see Appendix A.

Digital In

Each of the seven pins can be configured as digital input only. The ground reference for the input pins is Signal Common on pin 8.

The **In** field of the Digital I/O Properties window reflects the condition of the external signal that is applied to the pin. The pin state is not affected by the value of the digital output word.

Fault Out

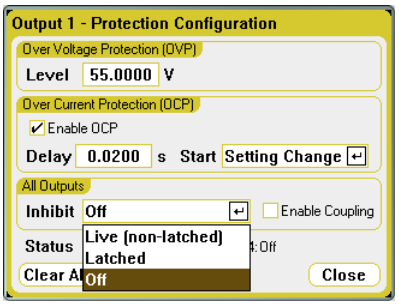
Pins 1 and 2 can be configured as a fault-output pair. The Fault Out function lets a fault condition on any output generate a fault signal on the digital port. The following conditions will generate a fault event: over-voltage, over-current, over-temperature, inhibit signal, power-fail condition, or on some models, a power-limit condition.

When this function is selected, both pins 1 and 2 are dedicated to this function. Pin 1 is the Fault output; pin 2 is common for pin 1. This provides for an optically-isolated output. Note that Pin 2 must also be connected to pin 8. Pin 2's selected function is ignored. The Fault output signal will remain latched until the fault condition is cleared. You must also clear the protection circuit.

Inhibit In

Pin 3 can be configured as a remote inhibit input. The Inhibit In function lets an external input signal control the output state of all of the outputs in the mainframe. The input is level-triggered. The signal latency is 5 microseconds. Pin 8 is common for pin 3.

After you have configured pin 3 as the remote inhibit input, you must also configure the operating mode of the inhibit signal. Press the Settings key to access the Source Settings. Navigate to and select **Protection**. Then press Enter.



Select the **Inhibit** dropdown list. The inhibit signal can be live, latched, or off. The Inhibit operating mode is stored in non-volatile memory.

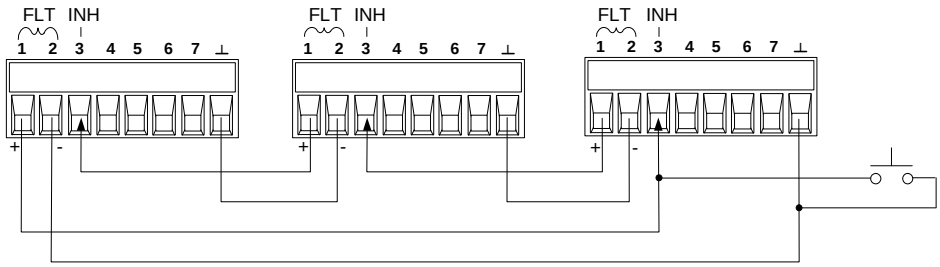
Inhibit Function	Description
Live	Allows the enabled outputs to follow the state of the Inhibit input. When the Inhibit input is true, the outputs are disabled. When the Inhibit input is false, the outputs are re-enabled.
Latched	Causes a logic-true transition on the Inhibit input to disable all outputs, which will remain disabled.
Off	The Inhibit input is ignored.

Outputs can only be controlled by the inhibit signal if they have previously been turned on by the front panel On/Off key or a remote command. If an output is turned on while the Inhibit input is true, the output will remain off.

When an Inhibit signal turns off the outputs, the front panel **INH** indicator comes on and the INH bit is set in the Questionable Status Event register. To re-enable the outputs if the inhibit signal was latched, you must clear the protection function as explained in chapter 3.

Fault/Inhibit System Protection

As shown in the following figure, when the Fault outputs and Inhibit inputs of several mainframes are daisy-chained, an internal fault condition in one of the mainframes will disable all of them without intervention by either the controller or external circuitry. Note that when using the Fault/Inhibit signals in this manner, both signals must be set to the same polarity.



As shown above, you can also connect the Inhibit input to a manual switch or external control signal that will short the Inhibit pin to common whenever it is necessary to disable all output channels in the mainframe. Negative polarity must be programmed for all pins in this case. You can also use the Fault output to drive an external relay circuit or signal other devices whenever a user-definable fault occurs.

Clearing a System Protection Fault

To restore all instruments to a normal operating condition when a fault condition occurs in a daisy-chained system protection configuration, two fault conditions must be removed:

1. The initial protection fault or external Inhibit signal.
2. The subsequent daisy-chained fault signal (sourced by the Inhibit signal), as previously explained under "Inhibit Input".

NOTE Even when the initial fault condition or external signal is removed, the Inhibit fault signal is still active and will continue to shut down all mainframe outputs.

To clear the daisy-chained fault signal if the operating mode of the Inhibit input is Live, simply clear the output protection on any ONE mainframe as explained in chapter 3. If the operating mode of the Inhibit input is Latched, turn off the Inhibit input on ALL mainframes individually. To re-enable the chain, re-program the Inhibit input on each mainframe to Latched mode.

Trigger In

Any of the Digital Control pins can be programmed to function as a trigger input. All pins are referenced to the Signal Common pin.

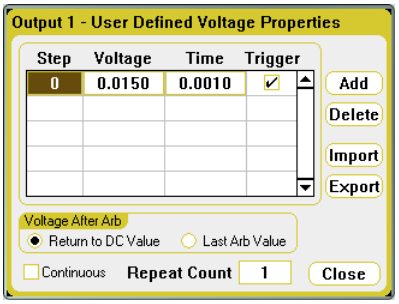
To input an external trigger signal, you can apply either a negative-going or a positive-going pulse to the designated trigger input pin. The trigger latency is 5 microseconds. The minimum pulse width is 2 microseconds. The pin's polarity setting determines which edge generates a trigger-in event. Positive means a rising edge and Negative means a falling edge.

You can configure the Scope and the Data Logger to be triggered by external trigger signals. Simply select **BNC Trigger In** as the trigger source when configuring the Scope or Data Logger properties. This will enable input trigger signals on both the configured digital pin as well as on the BNC trigger input connector.

Trigger Out

Any of the Digital Control pins can be programmed to function as a trigger output. All pins are referenced to the Signal Common pin.

When configured as a trigger output, the designated trigger pin will generate a 10-microsecond trigger pulse in response to a trigger event. The polarity setting can be either positive-going (rising edge) or negative-going (falling edge) when referenced to common.



Trigger out signals can be generated when configuring user-defined voltage or current arbitrary waveforms. If you check the Trigger box, an output trigger signal will be generated on the configured digital pin as well as on the BNC trigger output connector at the start of the voltage or current step.

Output Couple Controls

This function lets you connect multiple Agilent N6705A mainframes together and synchronize the output on/off sequence across mainframes.

NOTE Only pins 4 through 7 can be configured as synchronization pins. You cannot configure more than one On Couple and one Off Couple pin per mainframe. The polarity of the pins is not programmable.

Refer to Appendix D for a complete description of the output on/off synchronization function as well as an illustration showing the On Couple and Off Couple pin connections.

5
Operation and Connections Tutorial

This chapter discusses the difference between constant voltage and constant current operating modes; what you need to know about wire sizes and how to compensate for voltage drops in the load leads. It includes information to help you reduce or eliminate sources of output noise as well as obtain the best output regulation from your instrument. It also describes various loads configurations and how to connect the output terminals in series and parallel.

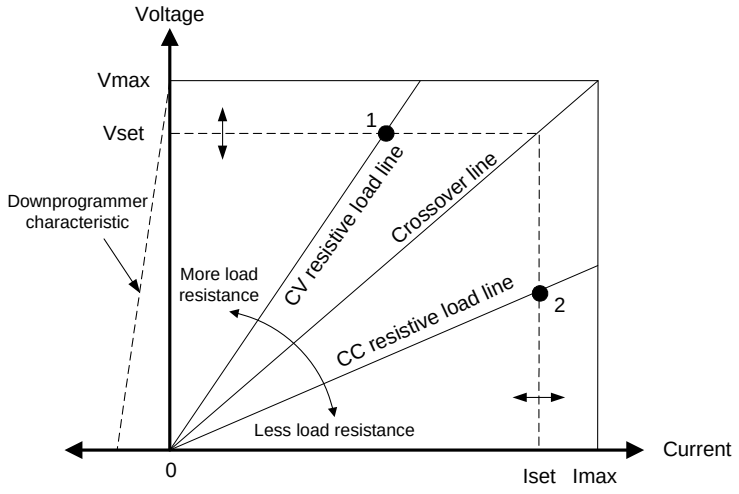
WARNING **SHOCK HAZARD Turn off all outputs before making front or rear panel connections. All wires must be properly connected with the binding posts securely tightened.**

Operating Modes

The DC Power Analyzer can operate in either constant voltage (CV) or constant current (CC) over the rated output voltage and current. Constant voltage mode is defined as an operating mode in which the dc source maintains its output voltage at the programmed voltage setting in spite of changes in load, line, or temperature. Thus, when the load resistance changes, the output voltage remains constant while the output current changes to accommodate the change in load.

Constant current mode is defined as an operating mode in which the dc source maintains its output current at the programmed current limit in spite of changes in load, line, or temperature. Thus, when the load resistance changes, the output current remains constant while the output voltage changes to accommodate the change in load.

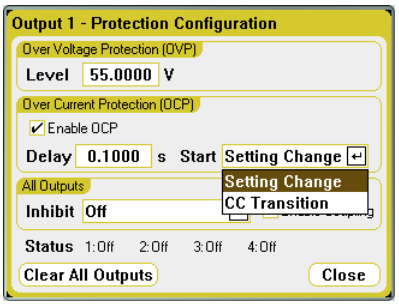
Although the DC Power Analyzer can operate in either mode, it is designed as a *constant voltage* source. This means that the specifications and operating characteristics are optimized for constant voltage mode operation. Note that the unit cannot be programmed to operate in a specific mode. At turn-on, the operating mode of the unit will be determined by the voltage setting, current setting, ***and*** the load resistance. In the following figure, operating point 1 is defined by a fixed load line traversing the positive operating quadrant in the constant voltage region. Operating point 2 is defined by a fixed load line traversing the positive operating quadrant in the constant current region.



CC Mode Delay

The power supply may momentarily cross into CC mode when it is first turned on, when a new output value is programmed, or if a load is connected. In most cases this temporary condition would not be considered an over-current protection fault, and having an OCP condition disable the output would be a nuisance. Delay prevents a CC condition from being detected for a specific time period.

To program a delay, press the Settings key to access the Source Settings. Navigate to and select **Protection**. Then press Enter.



You can specify if the **Start** of the delay is initiated only by a settings change in voltage, current, or output state, or by *any* transition such as an output load change that causes the unit to cross into CC mode.

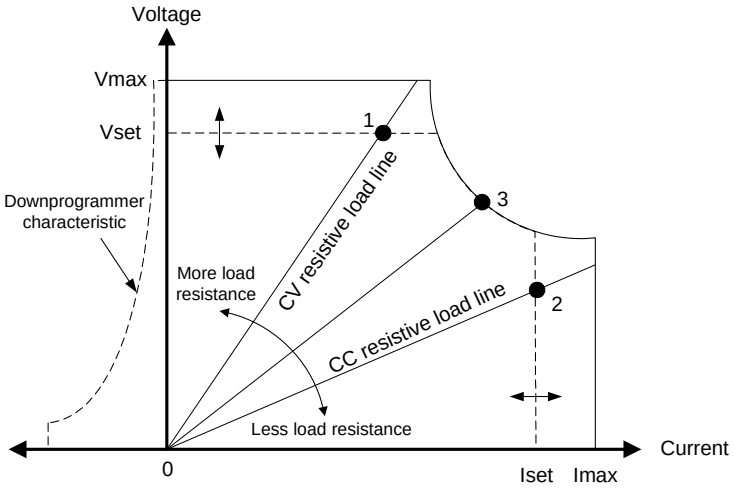
Factors that influence how long the settings change or output load change may last include: difference between old output value and new output value, current or voltage limit, and output load capacitance (in CV mode) or output inductance (in CC mode). The delay required must be determined empirically; the programming-response times in Appendix A may be used as guidelines.

Current Sinking

As shown by the dashed line on the left in the figures, the DC Power Analyzer is capable of sinking current over the output voltage range from zero volts to the rated voltage. This negative current sinking capability provides fast downprogramming of the output. It can also be used to sink current from a battery charger, thus providing battery charger test capability. The negative current is not programmable.

Autoranging Boundary

The following figure illustrates the autoranging output characteristic of the Agilent N675xA and N676xA DC Power Modules. This shows a situation in which the voltage and current settings are high enough that the operating locus is limited by the maximum output power boundary of the output (operating point 3). Depending on the power module, this may be greater than the output power rating of the module. In this situation, the output is not guaranteed to meet its operating specifications because it is operating in an area that is outside its specified power rating.



Wire Size

WARNING **FIRE HAZARD Select a wire size large enough to carry short-circuit current without overheating. To satisfy safety requirements, load wires must be heavy enough not to overheat while carrying the short-circuit output current of the unit (refer to the following table).**

Along with conductor temperature, you must also consider voltage drop when selecting wire sizes. The following table lists the resistance for various wire sizes and the maximum lengths to limit the voltage drop to 1.0 V per lead for various currents.

Note that the minimum wire size required to prevent overheating may not be large enough to prevent over-voltage tripping or maintain good regulation. Under most conditions, the load wires should also be heavy enough to limit the voltage drop to no more than l.0 V per lead.

To help prevent nuisance tripping of the over-voltage circuit, select a wire size sufficient to handle the FULL output current of the unit no matter what the intended load current or current limit setting

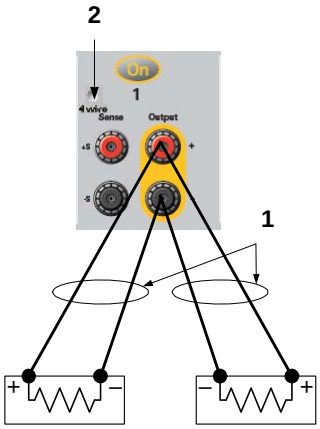
Load lead resistance is also an important factor relating to the CV stability of the instrument when remote sensing capacitive loads. If high capacitance loads are expected, you should not use wire gauges heavier than 12 to 14 AWG for long runs of load lead.

Wire size	Current-carrying capacity in Amps for stranded copper wire		Resistance	Max. Length to Limit Voltage to 1 V/Lead			
				for 5 A	for 10 A	for 20A	for 50 A
AWG	**2 wires bundled**	**4 wires bundled**	**Ω/foot**	**Wire length in feet**			
20	7.8	6.9	0.0102	20	x	x	x
18	14.5	12.8	0.0064	30	15	x	x
16	18.2	16.1	0.0040	50	25	x	x
14	29.3	25.9	0.0025	80	40	20	x
12	37.6	33.2	0.0016	125	63	30	x
10	51.7	45.7	0.0010	200	100	50	20
8	70.5	62.3	0.0006	320	160	80	32
6	94	83	0.0004	504	252	126	50
Area in mm²	**2 wires bundled**	**4 wires bundled**	**Ω/meter**	**Wire length in meters**			
0.5	7.8	6.9	0.0401	5	x	x	x
0.75	9.4	8.3	0.0267	7.4	x	x	x
1	12.7	11.2	0.0200	10	5	x	x
1.5	15.0	13.3	0.0137	14.6	7.2	x	x
2.5	23.5	20.8	0.0082	24.4	12.2	6.1	x
4	30.1	26.6	0.0051	39.2	19.6	9.8	3.9
6	37.6	33.2	0.0034	58	29	14.7	5.9
10	59.2	52.3	0.0020	102	51	25	10.3

Notes: 1. Capacity for AWG wires derived from MIL-W-5088B. Max. ambient temp: 55°C. Max. wire temp: 105°C.
2. Capacity for metric wires are derived from IE Publication 335-1.
3. Capacity of aluminum wire is approximately 84% of that listed for copper wire.
4. “x” indicates wire is not rated for the maximum output current of the power module.
5. Because of wire inductance considerations, it is also recommended that you keep your load leads twisted, tie wrapped, or bundled together and less than 50 feet (14.7 meters) in length per lead.

Multiple Loads

If you are using local sensing and are connecting multiple loads to one output, connect each load to the output terminals using separate connecting wires as shown in the following figure.



1. Twist leads
2. 4-wire disabled (indicator is off)

This minimizes mutual coupling effects and takes full advantage of the DC Power Analyzer's low output impedance. Keep each pair of wires as short as possible and twist or bundle them to reduce lead inductance and noise pickup.

If load considerations require the use of distribution terminals that are located away from the instrument, connect the output terminals to the remote distribution terminals by a pair of twisted or bundled wires. Connect each load to the distribution terminals separately. 4-wire sensing is recommended under these circumstances. Sense either at the remote distribution terminals or, if one load is more sensitive than the others, directly at the critical load.

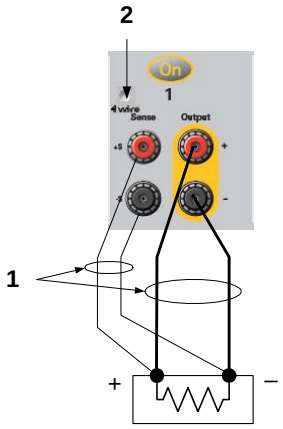
4-Wire Sense Considerations

4-wire or remote sensing improves the voltage regulation at the load by monitoring the voltage at the load rather than at the output terminals. This automatically compensate for the voltage drop in the load leads, which is especially useful for CV operation with load impedances that vary or have significant lead resistance. Remote sensing has no effect during CC operation.

4-wire sensing is implemented using relay switches that are located behind the front panel output terminals. Because it is independent of other DC Power Analyzer functions, 4-wire sensing can be used regardless of how the instrument is programmed.

To enable 4-wire sensing, press the Settings key and check the box labeled Enable 4-Wire Sensing. Then make your output connections as shown in the following figure. Connect the sense leads as close to the load as possible. Refer to the “Wire Size” section for information about selecting the proper wire size. Best results are obtained by using the shortest load leads practical. Keep the load leads under 14.7 meters (50 feet) per lead because of inductance effects.

The sense leads carry only a few milliamperes of current and can be a lighter gauge than the load leads. However, note that any voltage drop in the sense leads can degrade the voltage regulation of the instrument. Try to keep the sense lead resistance less than about 0.5Ω per lead (this requires 20 AWG or heavier for a 50 foot length).



1. Twist leads
2. 4-wire enabled (indicator is on)

Open Sense Leads

The sense leads are part of the output's feedback path. Connect them in such a way so that they do not inadvertently open. The DC Power Analyzer includes protection resistors that reduce the effect of open sense leads during 4-wire sensing. If the sense leads open during 4-wire sensing, the DC Power Analyzer returns to local sensing mode, with the voltage at the output terminals approximately 1% higher than the programmed value.

Over-voltage Protection Considerations

You must take into account any voltage drop in the load leads when setting the over-voltage trip point. This is because the OVP circuit senses at the output terminals and not at the sense terminals. Due to the voltage drop in the load leads, the voltage sensed by the OVP circuit could be higher than the voltage being regulated at the load.

Output Noise Considerations

Any noise picked up on the sense leads will appear at the output terminals and may adversely affect CV load regulation. Twist the sense leads to minimize the pickup of external noise. In extremely noisy environments it may be necessary to shield the sense leads. Ground the shield at the DC Power Analyzer end only; do not use the shield as one of the sensing conductors.

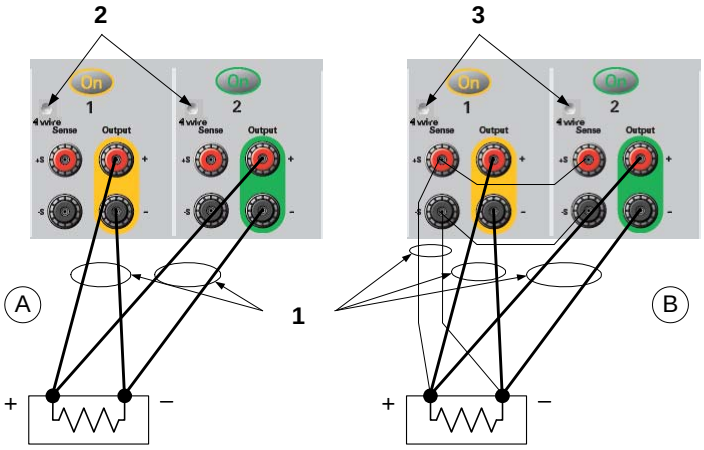
The noise specifications in Appendix A apply at the output terminals when using local sensing. However, voltage transients may be produced at the load by noise induced in the leads or by load current transients acting on the inductance and resistance of the load lead. If it is desirable to keep voltage transient levels to a minimum, place an aluminum or tantalum capacitor, with an approximate value of 10 μF per foot (30.5 cm) of load lead, right across the load.

Parallel Connections

CAUTION Only connect outputs that have identical voltage and current ratings in parallel.

Connecting outputs in parallel provides a greater current capability than can be obtained from a single output.

The following figures show how to connect two outputs in parallel. The figure on the left illustrates local sensing. If voltage drop in the load leads is a concern, the figure on the right shows how to connect the sense leads directly at the load (4-wire sensing).



1. Twist leads
2. 4-wire disabled (indicator is off)
3. 4-wire enabled (indicator is on)

Grouping the Outputs

Once outputs have been connected in parallel, they can be configured or “grouped” to act as a single, higher-power output. This applies when programming via the front panel or using SCPI commands. How to group outputs that have been connected in parallel is discussed in Chapter 3 under “Using the Power Supply - Output Grouping”.

Effect on Specifications

Specifications for outputs operating in parallel can be obtained from the specifications for single outputs. Most specifications are expressed as a constant or as a percentage (or ppm) plus a constant. For parallel operation, the percentage portion remains unchanged while constant portions or any constants are changed as indicated below. For current readback accuracy and temperature coefficient of current readback, use the minus current specifications:

Current All parallel specifications referring to current are twice the single output specification except for programming resolution, which is the same for both single output and parallel output operation.

Voltage All parallel specifications referring to voltage are the same as for a single output except for CV load effect, CV load cross regulation, CV source effect, and CV short term drift. These are all twice the voltage programming accuracy (including the percentage portion) at all operating points.

Load Transient Recovery Time Load transient specifications are typically twice the single output.

Series Connections

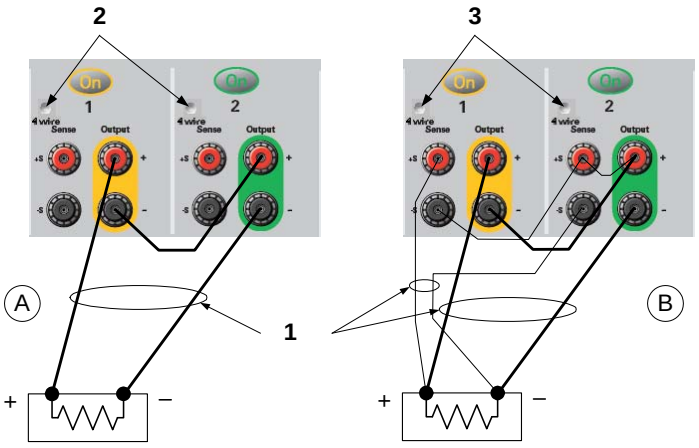
WARNING **SHOCK HAZARD Floating voltages must not exceed 240 VDC. No output terminal may be more than 240 VDC from chassis ground.**

CAUTION Only connect outputs that have identical voltage and current ratings in series. To prevent reverse currents from damaging the DC Power Analyzer when the load is connected, always turn series-connected outputs on and off together. Do not leave one output on while the other is off.

NOTE You can only use the series-connected outputs in "standard" power supply mode. You cannot generate arbitrary waveforms, make scope measurements or use data logging on outputs that are connected in series.

Connecting outputs in series provides a greater voltage capability than can be obtained from a single output. Because the current is the same through each element in a series circuit, outputs connected in series must have equivalent current ratings.

The following figures show how to connect two outputs in series to a single load. If voltage drop in the load leads is a concern, connect the sense leads of output 1 and output 2 for remote sensing as shown in the figure on the right. Connecting the +S terminal of output 2 to the -S terminal of output 1 and connecting a jumper between +S and + on output 2 compensates for the IR drop in the load lead from output 2 to output 1.



1. Twist leads
2. 4-wire disabled (indicator is off)
3. 4-wire enabled (indicator is on)

Setting the Outputs

To program outputs connected in series, first program the current limit of each output to the total desired current limit point. Then program the voltage of each output so that the sum of both voltages equals the total desired operating voltage. The simplest way to accomplish this is to program each output to one half of the total desired operating voltage.

NOTE The operating mode of each output is determined by the output's programmed settings, operating point, and load condition. Because these conditions may change during series operation, the operating status indicators on the front panel will reflect these changes. This is normal. Momentary status changes are also normal.

Effect on Specifications

Specifications for outputs operating in series can be obtained from the specifications for single outputs. Most specifications are expressed as a constant or a percentage (or ppm) plus a constant. For series operation, the percentage portion remains unchanged while constant portions or any constants are changed as indicated.

Voltage All series specifications referring to voltage are twice the single output specification except for programming resolution, which is the same as for a single output.

Current All series specifications referring to current are the same as for a single output except for CC load effect, CC load cross regulation, CC source effect, and CC short term drift. These are twice the current programming accuracy (including the percentage portion) at all operating points.

Load Transient Recovery Time Load transient specifications are typically twice the single output.

Additional Load Considerations

Response Time with an External Capacitor

When programming with an external capacitor, voltage response time may be longer than that specified in Appendix A. Use the following formula to estimate the additional up-programming response time:

$$\text{Response Time} = \frac{(\text{Added Output Capacitor}) \times (\text{Change in Vout})}{\text{Current Limit Setting}}$$

Note that programming into an external output capacitor may cause the DC Power Analyzer to briefly enter constant current or constant power operating mode, which adds additional time to the estimation.

Positive and Negative Voltages

Either positive or negative voltages can be obtained from the output by grounding (or "commoning") one of the output terminals. Always use two wires to connect the load to the output regardless of where or how the system is grounded. The instrument can be operated with any output terminal ± 240 VDC including output voltage from ground.

Protecting Sensitive Loads from AC Power Switching Transients

NOTE If your load is connected directly to the output binding posts and is **not** connected to chassis ground in any way, you do not need to worry about AC power switching transients appearing at the output binding posts.

Operating the AC line switch can inject common mode current spikes into the DC output leads, resulting in voltage spikes that may damage loads that are highly sensitive to voltage or current transients. Note that any electronic device meeting international standards for EMI compliance is likely to generate similar current spikes. This situation arises from the presence of EMI filters at both the AC input and the DC output of the DC Power Analyzer. These filters typically include common mode capacitors connected to the chassis of the DC Power Analyzer. Since the AC input has an earth ground, any load that is also earth-grounded provides a possible return path for common mode currents.

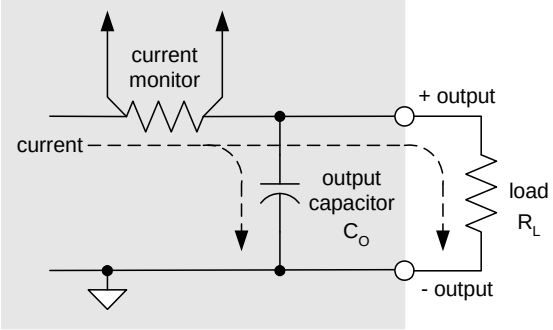
The following steps will help mitigate common mode current spikes appearing at the output binding posts when the DC Power Analyzer is turned on or off by the AC line switch:

- Install a separate “bonding” wire from the load’s common point, to the ground terminal of the DC Power Analyzer. This provides a lower impedance path that helps direct injected currents away from the DC output leads (and the sensitive load).
- Disconnect the load from the output *before* turning the DC Power Analyzer on or off. This will **always** protect the load from common mode currents.

Measurement Considerations

Dynamic Current Correction

The DC Power Analyzer measures the output current across an internal current monitor. This current monitor is located on the positive output rail on the inboard side of the output capacitor (see figure). This current measurement scheme is used by the majority of power supplies on the market today.



For the majority of power supply applications this method of measuring output current yields accurate measurements. However, with an output capacitor, when there is a significant change in voltage over time, the additional output current does not all flow into the user's load; some of it flows through the output capacitor. Thus, in this momentary situation, the instrument's measurement circuit is not only measuring the output current going to the user's load, but also the output current flowing through the output capacitor. Because the load never sees this additional current, this results in an inaccurate output current measurement.

Normally when the output current is measured and averaged over a number of samples, this inaccuracy is insignificant. However, because the DC Power Analyzer has built-in scope and data logging functions, which can sample the output current at up to about 50 kHz, this inaccuracy becomes evident.

Dynamic Current Correction compensates for the current flowing into the output capacitor. This feature is turned on by default. The DC Power Analyzer automatically calculates what the additional current is, and subtracts it from the current measurement. Thus, with compensation mode on, the DC Power Analyzer measures the output current flowing through the user's load accurately.

Note that turning the current compensation circuit on increases the peak to peak noise in current measurements on some power modules. It may also limit the measurement bandwidth as explained in the next section. If either condition is a significant factor in your application, you should turn Dynamic Current Correction off.

To turn Dynamic Current Correction off for each output, press the Meter View key, then Properties . Uncheck the box labeled "Compensate current measurements during voltage transients".

Measurement System Bandwidth

NOTE The following discussion only applies when making dynamic voltage or current measurements; not when making static (or DC) measurements.

The measurement bandwidth of the DC Power Analyzer is dependent on the following factors:

- Whether the power module that is making the measurement has an anti-aliasing filter
- Whether voltage or current is being measured.
- The setting of the "Compensate current measurements during voltage transients" control

The following table documents the bandwidth for the above-mentioned factors.

Power Module	"Compensate current measurements" ON (the default setting)	"Compensate current measurements" OFF
	Voltage measurements	
N675xA, N676xA	10 kHz BW (– 3dB)	10 kHz BW (– 3dB)
N673xB, N674xB, N677xA	10 kHz BW (– 3dB)	25 kHz [Note]
	Current measurements	
N6751A, N6752A	2 kHz BW (– 3dB)	10 kHz BW (– 3dB)
N6761A, N6762A	2 kHz BW (– 3dB)	2 kHz BW (– 3dB)
N6754A	10 kHz BW (– 3dB)	10 kHz BW (– 3dB)
N673xB, N674xB, N677xA	2 kHz BW (– 3dB)	25 kHz [Note]

[Note] Nyquist-limited to 25 kHz due to 50 kHz digitization rate.

Note that with the "Compensate current measurements" control turned off, you will see additional current in the output current measurement as the output capacitor charges and discharges when changing from one voltage value to another voltage value.

The values in the shaded areas of the table will change based on the resistance of the output load. The values specified in the table only apply when the output load resistance is at or close to zero ohms. At larger resistance values, errors are introduced into the measurement due to the interaction of the output load and the power module's output capacitor. Use the following formula to calculate the largest frequency that can be measured without errors.

$$f = \frac{1}{2\pi C_O R_L}$$

f = maximum measurable frequency without measurement errors
C_O = the output capacitor value (from the following table)
R_L = the load resistance

Power Module	C_0 Value	Power Module	C_0 Value
N675xA, N676xA	25.4 µF	N6731B, N6741B	30 µF
N6754A	4.7 µF	N6732B, N6742B	23.5 µF
N6773A	13.2 µF	N6733B, N6743B	13.4 µF
N6774A	11.2 µF	N6734B, N6744B	9.8 µF
N6775A	4.02 µF	N6735B, N6745B	12.8 µF
N6776A	3.54 µF	N6736B, N6746B	3.52 µF

For example, if you are measuring the output current on an Agilent N6731B with a 10 ohm load connected to the output and with "Compensate current measurements" turned off, the largest frequency that can be measured without introducing measurement errors is 530 Hz. If a 1 ohm load were connected to the output, the largest frequency that could be measured without errors would be 5.3 kHz.

For frequencies above the maximum measurable frequency, the current flowing in the output capacitor causes the measured current to be greater than the actual output current by a factor of +20 dB per decade increase of frequency.

Averaged Measurements

Measurement values returned in Meter View, Scope View, and by the Data Logger are averaged. Each measurement value is an arithmetic average of all the data points in the specified sample period. The average is calculated as follows:

$$A = \frac{\sum_{i=1}^{N} x_i}{N}$$

A = the average
N = the number of data points
x_i = the i^{th} data point

The sample period of the Meter View is fixed at 21 ms @ 50 kHz and cannot be adjusted. The sample period of the Scope View can be adjusted indirectly by using the Horizontal Time/Div knob to adjust the horizontal timebase. The sample period of the Data Logger can be adjusted by pressing Data Logger, then Properties, and entering a value in the Sample Period field.

Note that in the Scope Marker View, you can view the average value as well as the minimum and maximum value of the sample period that is located between the two markers.

The Data Logger Summary View also displays the minimum and maximum value as well as the average value from the measurement period displayed in the Data Logger View.

Appendix A
Specifications

This chapter lists the specifications and supplemental characteristics of the Agilent N6705A DC Power Analyzer. A dimensional line drawing of the mainframe is included at the end of the chapter.

Unless otherwise noted, specifications are warranted over the ambient temperature range of 0 to 55°C after a 30-minute warm-up period, with each module's sense terminals internally connected to its output terminals (local sensing).

Supplemental characteristics are not warranted but are descriptions of performance determined either by design or by type testing. All supplemental characteristics are typical unless otherwise noted.

Agilent Models N6751A/N6752A, N6754A, N6761A/N6762A

Performance Specifications

	N6751A / N6752A	N6754A	N6761A / N6762A
DC Output Ratings:			
Voltage	50 V	60 V	50 V
Current (derated 1% per °C above 40°C)	5 A / 10A	20 A	1.5 A / 3 A
Power	50 W / 100 W	300 W	50 W / 100 W
Output Ripple and Noise (PARD): (from 20 Hz – 20 MHz)			
CV peak-to-peak	4.5 mV	6 mV	4.5 mV
CV rms	0.35 mV	1 mV	0.35 mV
Load Effect (Regulation) (for any output load change, with a maximum load-lead drop of 1V/lead)			
Voltage	2 mV	2 mV	0.5 mV
Current	2 mA	5 mA	30 μA (@ 0 - 7 V) 65 μA (@ 0 - 50 V)
Source Effect (Regulation):			
Voltage	1 mV	1.2 mV	0.5 mV
Current	1 mA	2 mA	30 μA
Programming Accuracy: (@ 23 °C ±5 °C after 30 min. warm-up. Applies from min. to max. programming range)			
Voltage high range	0.06% + 19 mV	0.06 + 25 mV	0.016% + 6 mV
Voltage low range (≤ 5.5 V)	N/A	N/A	0.016% + 1.5 mV
Current high range	0.1% + 20 mA	0.1% + 12 mA	0.04% + 200 μA
Current low range (≤ 100mA, @ 0 - 7 V) (≤ 100mA, @ 0 – 50 V)	N/A N/A	N/A N/A	0.04% + 15 μA 0.04% + 55 μA
Voltmeter/Ammeter Measurement Accuracy: (at 23 °C ±5 °C)			
Voltage high range	0.05% + 20 mV	0.05 + 25 mV	0.016% + 6 mV
Voltage low range (≤ 5.5 V)	N/A	N/A	0.016% + 1.5 mV
Current high range	0.1% + 4 mA	0.1% + 8 mA	0.04% + 160 μA
Current low range (≤ 100mA, @ 0 – 7 V) (≤ 100mA, @ 0 – 50 V)	N/A N/A	N/A N/A	0.03% + 15 μA NOTE 1 0.03% + 55 μA
100μA or 200μA current range (Option 1UA or 2UA)	N/A	N/A	0.5% + 100 nA
Load Transient Recovery Time: (time to recover to within the settling band following a load change - from 60% to 100% and from 100% to 60% of full load for models N6751A & N6761A - from 50% to 100% and from 100% to 50% of full load for models N6752A, N6762A, & N6754A.)			
Voltage settling band	± 75 mV NOTE 2	± 90 mV NOTE 3	± 75 mV
Time	< 100 μs	< 100 μs	< 100 μs

[1] Applies when measuring 4096 data points (SENSe:SWEep:POINts = 4096).

[2] When relay option 761 is installed, the settling band is ±125 mV for Model N6752A.

[3] When relay option 760 or 761 is installed, the settling band is ±350 mV for Model N6754A.

Supplemental Characteristics

	N6751A / N6752A	N6754A	N6761A / N6762A
Programming Ranges:			
Voltage high range	20 mV – 51 V	25 mV – 61.2 V	15 mV – 51 V
Voltage low range (≤ 5.5 V)	N/A	N/A	12 mV – 5.5 V
Current high range	10 mA – 5.1A/10 mA- 10.2A	20 mA- 20.4 A	1 mA – 1.53 A/1 mA – 3.06 A
Current low range (≤ 0.1 A)	N/A	N/A	0.1 mA – 0.1 A NOTE 1
Programming Resolution:			
Voltage high range	3.5 mV	4.2 mV	880 μV
Voltage low range (≤ 5.5 V)	N/A	N/A	90 μV
Current high range	3.25 mA	6.5 mA	60 μA
Current low range (≤ 0.1 A)	N/A	N/A	2 μA
Measurement Resolution:			
Voltage high range	1.8 mV	2.2 mV	440 μV
Voltage low range (≤ 5.5 V)	N/A	N/A	44 μV
Current high range	410 μA	0.82 mA	30 μA
Current low range (≤ 0.1 A)	N/A	N/A	1 μA
100 μA current range (Option 1UA)	N/A	N/A	2 nA
200 μA current range (Option 2UA)	N/A	N/A	4 nA
Programming Temperature Coefficient per °C:			
Voltage high range	18 ppm + 160 μV	20 ppm + 50 μV	18 ppm + 140 μV
Voltage low range (≤ 5.5 V)	N/A	N/A	40 ppm + 70 μV
Current high range	100 ppm + 45 μA	60ppm + 200 μA	33 ppm + 10 μA
Current low range (≤ 0.1 A)	N/A	N/A	60 ppm + 1.5 μA
Measurement Temperature Coefficient per °C:			
Voltage high range	25 ppm + 35 μV	20 ppm + 50 μV	23 ppm + 40 μV
Voltage low range (≤ 5.5 V)	N/A	N/A	30 ppm + 40 μV
Current high range	60 ppm + 3 μA	60 ppm + 12 μA	40 ppm + 0.3 μA
Current low range (≤ 0.1 A)	N/A	N/A	50 ppm + 0.3 μA
100 μA current range (Option 1UA)	N/A	N/A	100 ppm + 2 nA/°C
200 μA current range (Option 2UA)	N/A	N/A	100 ppm + 3 nA/°C
Oscilloscope Measurement Accuracy: (@t 23 °C ±5 °C, accuracy of any individual point in the trace) NOTE 2			
Voltage	0.05% + 32 mV	0.05% + 34 mV	0.016% + 16 mV
Current high range w/Compensation on	0.1% + 14 mA	0.1% + 16 mA	0.04% + 10 mA
Current high range w/Compensation off	0.1% + 8 mA	0.1% + 16 mA	0.04% + 1 mA
Current low range w/Compensation on	N/A	N/A	0.03% + 10 mA
Current low range w/Compensation off	N/A	N/A	0.03% + 0.175 mA
Up-programming Time with full resistive load: (time from 10% to 90% of total voltage excursion)			
Small voltage step	0 V to 10 V	0 V to 15 V	0 V to 10 V
Time	0.2 ms	0.35 ms	0.6 ms
Large voltage step	0 V to 50 V	0 V to 60 V	0 V to 50 V
Time	1.5 ms	2 ms	2.2 ms

[1] If you are operating the unit below 255 μA in constant current mode, the output may become unregulated with the following load conditions: The load resistance is <175 mΩ **and** the load inductance is >20 μH. If this occurs, an UNRegulated flag will be generated and the output current may rise above the programmed value but will remain less than 255 μA.

[2] Compensation on and Compensation off refers to the control labeled "Compensate current measurements during voltage transients" located in the Meter View, Properties window.

Supplemental Characteristics (continued)

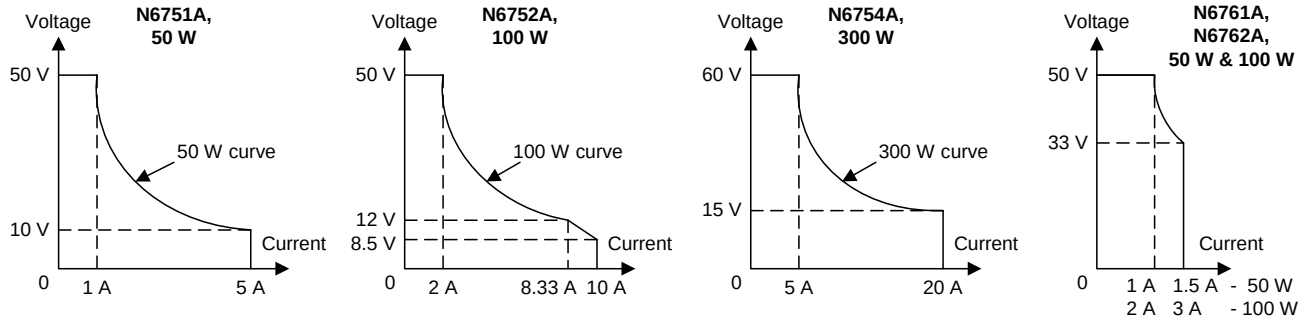
	N6751A / N6752A	N6754A	N6761A / N6762A
Up-programming Settling Time with full resistive load: (time from start of voltage change to 0.1% of full scale value)			
Small voltage step	0 V to 10 V	0 V to 15 V	0 V to 10 V
Time	0.5 ms	0.8 ms	0.9 ms
Large voltage step	0 V to 50 V	0 V to 60 V	0 V to 50 V
Time	4 ms	4.2 ms	4 ms
Down-programming Time with no load: (time from start of voltage change to output voltage < 0.5 V)			
Small voltage step	10 V to 0 V	15 V to 0 V	10 V to 0 V
Time	0.3 ms	0.6 ms	0.3 ms
Large voltage step	50 V to 0 V	60 V to 0 V	50 V to 0 V
Time	1.3 ms	2.2 ms	1.3 ms
Down-programming Settling Time with no load: (time from start of voltage change to 0.1% of full scale value)			
Small voltage step	10 V to 0 V	15 V to 0 V	10 V to 0 V
Time	0.45 ms	0.8 ms	0.45 ms
Large voltage step	50 V to 0 V	60 V to 0 V	50 V to 0 V
Time	1.4 ms	2.3 ms	1.4 ms
Down-programming Time with Capacitive load: (time from start of voltage change to output voltage < 0.5 V)			
Small voltage step	10 V to 0 V	15 V to 0 V	10 V to 0 V
Time	2.1 ms	2.3 ms	4.5 ms
Large voltage step	50 V to 0 V	60 V to 0 V	50 V to 0 V
Time	11 ms	10 ms	23 ms
Capacitive load	1000μF [NOTE 3]	680μF [NOTE 4]	1000μF [NOTE 3]
Down-programming Capability:			
Continuous power	7 W	12.5 W	7 W
Peak current	7 A	6 A	3.8 A
Over-voltage Protection:			
Accuracy	0.25% + 0.25 V	0.25% + 0.6 V [NOTE 5]	0.25% + 0.25 V
Maximum setting	55 V	66 V	55 V
Response time	50 μs from occurrence of over-voltage condition to start of output shutdown		
Output Ripple and Noise: (PARD)			
CC rms:	2 mA	4 mA	2 mV
Common Mode Noise: (from 20 Hz – 20 MHz; from either output to chassis)			
rms	500 μA	750 μA	500 μA
peak-to-peak	< 2 mA	< 3 mA	< 2 mA
Remote Sense Capability:			
	Outputs can maintain specifications with up to a 1-volt drop per load lead.		
Series and Parallel Operation:			
	Identically rated outputs can be operated directly in parallel or be connected for straight series operation. Auto-series and auto-parallel operation is not available.		

[3] Modules can discharge a 1000μF capacitor from fill scale to 0V at a rate of 4 times/second.

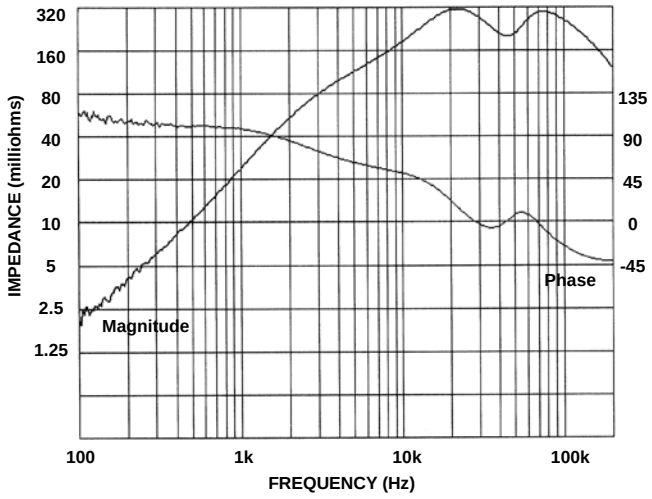
[4] Modules can discharge a 680μF capacitor from fill scale to 0V at a rate of 4 times/second.

[5] Accuracy is 0.25% + 600 mV with relay option 760 or 761 installed.

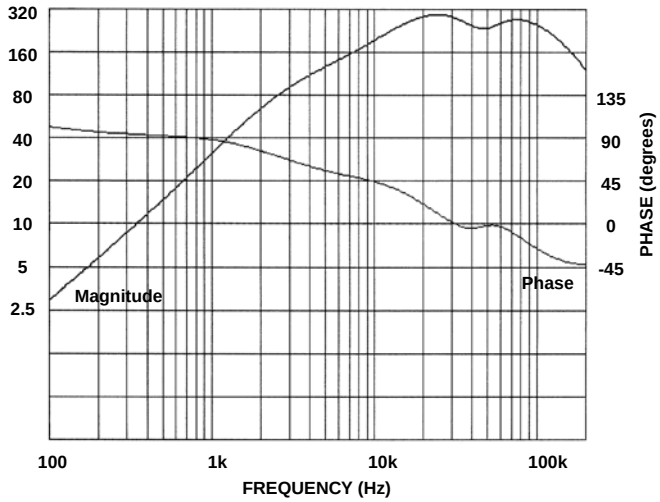
Autoranging Characteristic



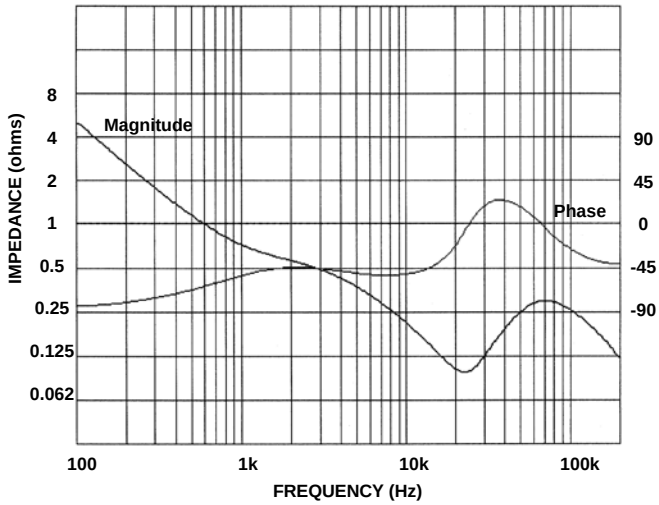
Output Impedance Graphs



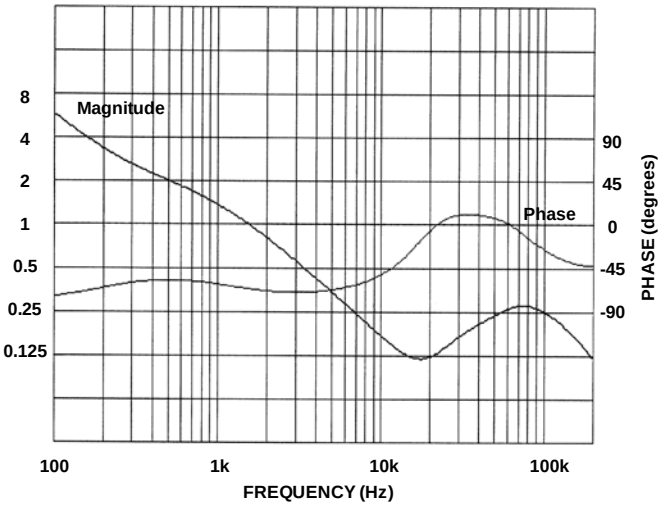
Model N6752A, CV Mode, @50V, 2A



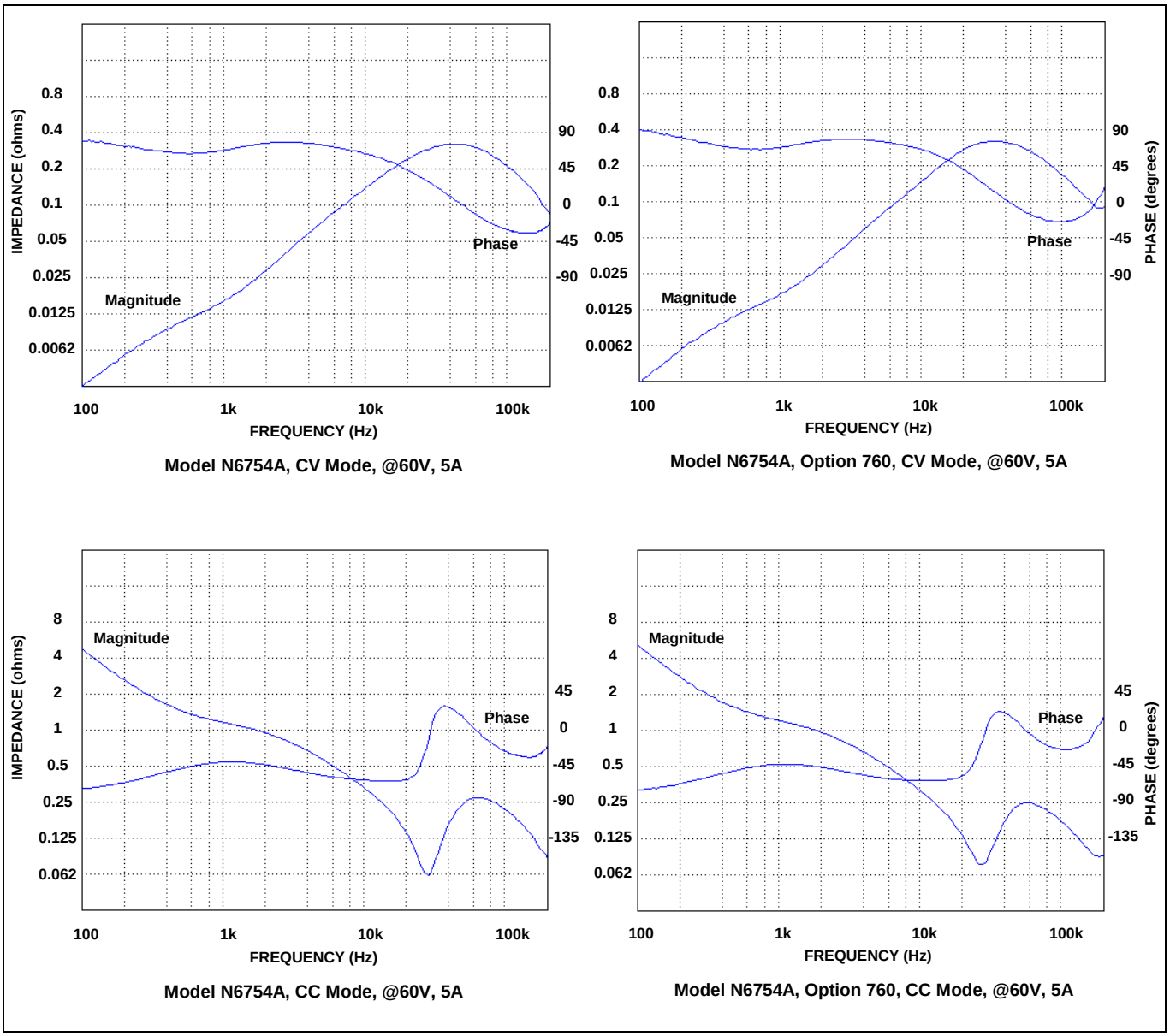
Model N6762A, CV Mode, @50V, 2A



Model N6752A, CC Mode, @50V, 2A



Model N6762A, CC Mode, @50V, 2A


IMPEDANCE (ohms)
0.8
0.4
0.2
0.1
0.05
0.025
0.0125
0.0062
Magnitude
Phase
90
45
0
-45
-90
100
1k
10k
100k
FREQUENCY (Hz)
PHASE (degrees)
Model N6754A, CV Mode, @60V, 5A
Model N6754A, Option 760, CV Mode, @60V, 5A
8
4
2
1
0.5
0.25
0.125
0.062
135
-135
Model N6754A, CC Mode, @60V, 5A
Model N6754A, Option 760, CC Mode, @60V, 5A

Agilent Models N6731B - N6736B and N6741B - N6746B

Performance Specifications

	N6731B/ N6741B	N6732B/ N6742B	N6733B/ N6743B	N6734B/ N6744B	N6735B/ N6745B	N6736B/ N6746B
DC Output Ratings:						
Voltage	5 V	8 V	20 V	35 V	60 V	100 V
Current NOTE 1	10 A / 20 A	6.25 A / 12.5 A NOTE 2	2.5 A / 5 A	1.5 A / 3 A	0.8 A / 1.6 A	0.5 A / 1 A
Power	50 W / 100 W	50 W / 100 W	50 W / 100 W	52.5W / 105W	50 W / 100 W	50 W / 100 W
Output Ripple and Noise (PARD): (from 20 Hz – 20 MHz)						
CV peak-to- peak	10 mV / 11mV	12 mV	14 mV	15 mV	25 mV	30 mV
CV rms	2 mV	2 mV	3 mV	5 mV	9 mV	18 mV
Load Effect (Regulation): (with output change from no load to full load, up to a maximum load-lead drop of 1V/lead)						
Voltage	5 mV	6 mV	9 mV	11 mV	13 mV / 16 mV	20 mV / 30 mV
Current	2 mA	2 mA	2 mA	2 mA	2 mA	2 mA
Source Effect (Regulation):						
Voltage	1 mV	2 mV	2 mV	4 mV	6 mV	10 mV
Current	1 mA	1 mA	1 mA	1 mA	1 mA	1 mA
Programming Accuracy: (@ 23 °C ±5 °C after 30 minute warm-up. Applies from minimum to maximum programming range)						
Voltage	0.1% + 19 mV	0.1% + 19 mV	0.1% + 20 mV	0.1% + 35 mV	0.1% + 60 mV	0.1% +100 mV
Current	0.15% + 20 mA	0.15% + 20 mA	0.15% + 20 mA	0.15% + 20 mA	0.15% + 20 mA	0.15% + 10mA
Voltmeter/Ammeter Measurement Accuracy: (at 23 °C ±5 °C)						
Voltage	0.1% + 20 mV	0.1% + 20 mV	0.1% + 20 mV	0.1% + 35 mV	0.1% + 60 mV	0.1% +100 mV
Current	0.15% + 20 mA	0.15% + 10 mA	0.15% + 5 mA	0.15% + 4 mA	0.15% + 4 mA	0.15% + 2 mA
Load Transient Recovery Time: (time to recover to within the settling band following a load change from 50% to 100% and from 100% to 50% of full load.)						
Voltage settling band	±0.08 V / 0.1 V NOTE 3	±0.08 V / 0.1 V NOTE 3	± 0.2 V / 0.3 V	± 0.2 V / 0.3 V	± 0.4 V / 0.5 V	± 0.5 V / 1.0 V
Time	< 200 µs	< 200 µs	< 200 µs	< 200 µs	< 200 µs	< 200 µs

[1] Output current is derated 1% per °C above 40°C.

[2] When relay option 760 is installed on Model N6742B, the maximum output current will be limited to 10 A.

[3] When relay option 760 or 761 is installed, the settling band is ±0.10V/0.125 V. Option 760 is not available on Model N6741B.

Supplemental Characteristics

	N6731B/ N6741B	N6732B/ N6742B	N6733B/ N6743B	N6734B/ N6744B	N6735B/ N6745B	N6736B/ N6746B
Programming Ranges:						
Voltage	15 mV – 5 .1 V	15 mV – 8 .16 V	30 mV – 20.4 V	40 mV – 35.7 V	70 mV – 61.2 V	100 mV – 102 V
Current	60 mA – 10.2 A/ 60 mA – 20.4 A	40 mA –6.375 A/ 40 mA – 12.75 A	10 mA – 2.55 A/ 10 mA – 5.1 A	5 mA – 1.53 A/ 5 mA – 3.06 A	2.5mA – 0.85 A/ 2.5m A – 1.7 A	1.5 mA – 0.51A/ 1.5 mA – 1.02 A
Programming Resolution:						
Voltage	3.5 mV	4 mV	7 mV	10 mV	18 mV	28 mV
Current	7 mA	4 mA	3 mA	2 mA	1 mA	0.5 mA
Measurement Resolution:						
Voltage	3 mV	4 mV	10 mV	18 mV	30 mV	50 mV
Current	10 mA	7 mA	3 mA	2 mA	1 mA	0.5 mA
Programming Temperature Coefficient per °C:						
Voltage	0.005% + 0.1mV	0.005% + 0.1 mV	0.005% + 0.2 mV	0.005% + 0.5 mV	0.005% + 0.5 mV	0.005% + 1 mV
Current	0.005% + 1 mA	0.005% + 0.5 mA	0.005% + 0.1 mA	0.005% + 0.05 mA	0.005% + 0.02 mA	0.005% + 0.02 mA
Measurement Temperature Coefficient per °C:						
Voltage	0.01% + 0.1mV	0.01% + 0.1 mV	0.01% + 0.2 mV	0.01% + 0.2 mV	0.01% + 0.5 mV	0.01% + 0.5 mV
Current	0.01% + 1 mA	0.01% + 0.5 mA	0.01% + 0.1 mA	0.01% + 0.05 mA	0.01% + 0.02 mA	0.01% + 0.02 mA
Oscilloscope Measurement Accuracy: (@t 23 °C ±5 °C; accuracy of any individual point in the trace) NOTE 1						
Voltage	0.1% + 25 mV	0.1% + 30 mV	0.1% + 45 mV	0.1% + 75 mV	0.1% + 130 mV	0.1% + 190 mV
Current w/Comp. on	0.15% + 70 mA	0.15% + 40 mA	0.15% + 20 mA	0.15% + 14 mA	0.15% + 12 mA	0.15% + 7 mA
Current w/Comp. off	0.15% + 50 mA	0.15% + 30 mA	0.15% + 15 mA	0.15% + 10 mA	0.15% + 9 mA	0.15% + 5 mA
Up-programming and Down-programming Time with full resistive load: (time from 10% to 90% of total voltage excursion; for voltage setting from 0V to full scale and full scale to 0V)	20 ms	20 ms	20 ms	20 ms	20 ms	20 ms
Up-programming and Down-programming Settling Time with full resistive load: (time from start of voltage change to 0.1% of full-scale value; for voltage setting from 0V to full scale and full scale to 0V)	100 ms	100 ms	100 ms	100 ms	100 ms	100 ms
Over-voltage Protection:						
Accuracy	0.25% + 50mV	0.25% + 50 mV	0.25% + 75 mV	0.25% + 100 mV	0.25% + 200 mV	0.25% + 250 mV
Accuracy w/opt 760	0.25%+600mV	0.25% + 600 mV	0.25% + 350 mV	0.25% + 250 mV	0.25% + 300 mV	0.25% + 300 mV
Accuracy w/opt 761	0.25%+600mV	0.25% + 600 mV	0.25% + 350 mV	0.25% + 250 mV	0.25% + 300 mV	0.25% + 300 mV
Maximum setting	7.5 V	10 V	22 V	38.5 V	66 V	110 V
Response time	50 µs from occurrence of over-voltage condition to start of output shutdown					
Output Ripple and Noise (PARD):						
CC rms	8 mA	4 mA	2 mA	2 mA	2 mA	2 mA
Common Mode Noise: (from 20 Hz – 20 MHz; from either output to chassis)						
Rms	1 mA	1 mA	1 mA	1 mA	1 mA	1 mA
Peak-to- peak	< 15 mA	< 10 mA	< 10 mA	< 10 mA	< 10 mA	< 10 mA
Remote Sense Capability:	Outputs can maintain specifications with up to a 1-volt drop per load lead.					
Series and Parallel Operation:	Identically rated outputs can be operated directly in parallel or can be connected for straight series operation. Auto-series and auto-parallel operation is not available.					

[1] Comp. (compensation) on and Comp. off refers to the control labeled "Compensate current measurements during voltage transients" located in the Meter View, Properties window.

Agilent Models N6773A - N6776A

Performance Specifications

	N6773A	N6774A	N6775A	N6776A
DC Output Ratings:				
Voltage	20 V	35 V	60 V	100 V
Current NOTE 1	15 A NOTE 2	8.5 A	5 A	3 A
Power	300 W	300W	300 W	300 W
Output Ripple and Noise (PARD): (from 20 Hz – 20 MHz)				
CV peak-to- peak	20 mV	22 mV	35 mV	45 mV
CV rms	3 mV	5 mV	9 mV	18 mV
Load Effect (Regulation): (with output change from no load to full load, up to a maximum load-lead drop of 1V/lead)				
Voltage	13 mV	16 mV	24 mV	45 mV
Current	6 mA	6 mA	6 mA	6 mA
Source Effect (Regulation):				
Voltage	2 mV	4 mV	6 mV	10 mV
Current	1 mA	1 mA	1 mA	1 mA
Programming Accuracy: (@ 23 °C ±5 °C after 30 minute warm-up. Applies from minimum to maximum programming range)				
Voltage	0.1% + 20 mV	0.1% + 35 mV	0.1% + 60 mV	0.1% +100 mV
Current	0.15% + 60 mA	0.15% + 60 mA	0.15% + 60 mA	0.15% + 30 mA
Voltmeter/Ammeter Measurement Accuracy: (at 23 °C ±5 °C)				
Voltage	0.1% + 20 mV	0.1% + 35 mV	0.1% + 60 mV	0.1% +100 mV
Current	0.15% + 15 mA	0.15% + 12 mA	0.15% + 12 mA	0.15% + 6 mA
Load Transient Recovery Time: (time to recover to within the settling band following a load change from 50% to 100% and from 100% to 50% of full load.)				
Voltage settling band	± 0.3 V NOTE 3	± 0.3 V NOTE 3	± 0.5 V	± 1.0 V
Time	< 250 µs	< 250 µs	< 250 µs	< 250 µs

[1] Output current is derated 1% per °C above 40°C.

[2] When relay Option 760 is installed, the maximum output current will be limited to 10 A.

[3] When relay Option 760 or 761 is installed, the settling band is ±0.35 V.

Supplemental Characteristics

	N6773A	N6774A	N6775A	N6776A
Programming Ranges:				
Voltage	30 mV – 20.4 V	40 mV – 35.7 V	70 mV – 61.2 V	100 mV – 102 V
Current	30 mA – 15.3 A	15 mA – 8.67 A	7.5 mA – 5.1 A	4.5 mA – 3.06 A
Programming Resolution:				
Voltage	7 mV	10 mV	18 mV	28 mV
Current	9 mA	6 mA	3 mA	1.5 mA
Measurement Resolution:				
Voltage	10 mV	18 mV	30 mV	50 mV
Current	9 mA	6 mA	3 mA	1.5 mA
Programming Temperature Coefficient per °C:				
Voltage	0.01% + 0.2 mV	0.01% + 0.5 mV	0.01% + 0.5 mV	0.01% + 1 mV
Current	0.01% + 0.5 mA	0.01% + 0.5 mA	0.01% + 0.1 mA	0.01% + 0.1 mA
Measurement Temperature Coefficient per °C:				
Voltage	0.01% + 0.2 mV	0.01% + 0.2 mV	0.01% + 0.5 mV	0.01% + 0.5 mV
Current	0.01% + 0.5 mA	0.01% + 0.5 mA	0.01% + 0.05 mA	0.01% + 0.05 mA
Oscilloscope Measurement Accuracy: (@ 23 °C ±5 °C; accuracy of any individual point in the trace) NOTE 1				
Voltage	0.1% + 45 mV	0.1% + 75 mV	0.1% + 120 mV	0.1% + 160 mV
Current w/Comp. on	0.15% + 45 mA	0.15% + 27 mA	0.15% + 22 mA	0.15% + 12 mA
Current w/Comp. off	0.15% + 35 mA	0.15% + 22 mA	0.15% + 19 mA	0.15% + 9 mA
Up-programming and Down-programming Time with full resistive load: (time from 10% to 90% of total voltage excursion; for voltage setting from 0V to full scale and full scale to 0V)	20 ms	20 ms	20 ms	20 ms
Maximum Up-programming and Down-programming Settling Time with full resistive load: (time from start of voltage change to 0.1% of full-scale value; for voltage setting from 0V to full scale and full scale to 0V)	100 ms	100 ms	100 ms	100 ms
Over-voltage Protection:				
Accuracy	0.25% +100 mV	0.25% + 130 mV	0.25% + 260 mV	0.25% + 650 mV
Accuracy w/opt 760	0.25% + 700 mV	0.25% + 700 mV	0.25% + 400 mV	0.25% + 650 mV
Accuracy w/opt 761	0.25% + 500 mV	0.25% + 350 mV	0.25% + 350 mV	0.25% + 650 mV
Maximum setting	22 V	38.5 V	66 V	110 V
Response time	50 μs from occurrence of over-voltage condition to start of output shutdown			
Output Ripple and Noise (PARD):				
CC rms	6 mA	6 mA	6 mA	6 mA
Common Mode Noise: (from 20 Hz – 20 MHz; from either output to chassis)				
Rms	2 mA	2 mA	2 mA	2 mA
Peak-to- peak	< 20 mA	< 20 mA	< 20 mA	< 20 mA
Remote Sense Capability:	Outputs can maintain specifications with up to a 1-volt drop per load lead.			
Series and Parallel Operation:	Identically rated outputs can be operated directly in parallel or can be connected for straight series operation. Auto-series and auto-parallel operation is not available.			

[1] Comp. (compensation) on and Comp. off refers to the control labeled “Compensate current measurements during voltage transients” located in the Meter View, Properties window.

Agilent N6705A DC Power Analyzer Mainframe

Supplemental Characteristics

	N6705A
Maximum Output Power: (sum of total module output power)	
	600 W
Command Processing Time:	
	≤ 1 ms from receipt of command to start of output change
Protection Response Characteristics:	
INH input	5 μs from receipt of inhibit to start of shutdown
Fault on coupled outputs	< 10 μs from receipt of fault to start of shutdown
Data Storage:	
Internal flash memory	64 Mbytes
Digital Port Characteristics:	
Maximum voltage ratings	+16.5 VDC/– 5 VDC between pins (pin 8 is internally connected to chassis ground).
Pins 1 and 2 as FLT output	Maximum low-level output voltage = 0.5 V @ 4 mA Maximum low-level sink current = 4 mA Typical high-level leakage current = 1 mA @ 16.5 VDC
Pins 1 - 7 as digital/trigger outputs (pin 8 = common)	Maximum low-level output voltage = 0.5 V @ 4 mA; 1 V @ 50 mA; 1.75 V @ 100 mA Maximum low-level sink current = 100 mA Typical high-level leakage current = 0.8 mA @ 16.5 VDC
Pins 1 - 7 as digital/trigger inputs and pin 3 as INH input (pin 8 = common)	Maximum low-level input voltage = 0.8 V Minimum high-level input voltage = 2 V Typical low-level current = 2 mA @ 0 V (internal 2.2k pull-up) Typical high-level leakage current = 0.12 mA @ 16.5 VDC
Interface Capabilities:	
GPIB	SCPI - 1993, IEEE 488.2 compliant interface
LXI Compliance	Class C (only applies to units with LXI label on front panel)
USB 2.0	Requires Agilent IO Library version M.01.01 or 14.0 and up
10/100 LAN	Requires Agilent IO Library version L.01.01 or 14.0 and up
Built-in Web server	Requires Internet Explorer 5+ or Netscape 6.2+
Regulatory Compliance:	
EMC	Complies with EMC directive for Class A test and measurement products. Complies with Australian standard and carries C-Tick mark. This ISM device complies with Canadian ICES-001. Cet appareil ISM est conforme à la norme NMB-001 du Canada. **Electrostatic discharges greater than 1 kV near the I/O connectors may cause the unit to reset and require operator intervention.**
Safety	Complies with European Low Voltage Directive and carries the CE-marking. Complies with US and Canadian safety standards for test and measurement products.

Supplemental Characteristics (continued)

	N6705A
Environmental Conditions	
Operating environment	Indoor use, installation category II (for AC input), pollution degree 2
Temperature range	0°C to 55°C (output current is derated 1% per °C above 40°C ambient temperature)
Relative humidity	Up to 95%
Altitude	Up to 2000 meters
Storage temperature	-30°C to 70°C
LED statement	Any LEDs in this unit are Class 1 LEDs as per IEC 825-1
Acoustic Noise Declaration:	
This statement is provided to comply with the requirements of the German Sound Emission Directive, from 18 January 1991.	Sound Pressure Lp <70 dB(A), At Operator Position, Normal Operation, According to EN 27779 (Type Test). Schalldruckpegel Lp <70 dB(A), Am Arbeitsplatz, Normaler Betrieb, Nach EN 27779 (Typprüfung).
Output Terminals:	
Maximum current rating	20 A
Isolation	No output terminal may be more than 240 VDC from any other terminal or chassis ground.
BNC Trigger Connectors:	
I/O	Digital TTL level compatible
Maximum voltage	5 V
USB Current Ratings:	
Front panel USB connector	200 mA
Rear panel USB connector	300 mA
AC Input:	
Nominal Input Ratings	100 VAC – 240 VAC; 50/60/400Hz
Input Range	86 VAC – 264 VAC
Power Consumption	1500 VA (mainframe has power factor correction)
Fuse	Internal fuse - not customer accessible.
Dimensions:	
Height	194.7 mm / 7.665 in.
Width	425.6 mm / 16.756 in.
Depth	313 mm / 12.319 in.
Net Weight:	
N6705A with 4 modules (typical)	16 kg / 35 lbs
Single power module (typical)	1.23 kg / 2.71 lbs

Arbitrary Waveform Generator Maximum Bandwidth

The following tables characterize the maximum bandwidth of the arbitrary waveform generator. The maximum bandwidth is based on a sinewave into a resistive load and apples to any output current. The following definitions apply in the frequency tables:

V p-p = Voltage peak-to-peak

3 dB max. = Max. frequency where the voltage drops to 3 dB below its setting

6 dB max. = Max. frequency where the voltage drops to 6 dB below its setting

THD 3 dB = The total harmonic distortion at 3 dB max. frequency

THD 3 dB = The total harmonic distortion at 6 dB max. frequency

THD < 1.5% = The frequency below which the THD is less than 1.5%.

	N6751 & N6752A			N6761 & N6762A		
Voltage	3 dB max	THD 3 dB	THD < 1.5%	3 dB max	THD 3 dB	THD < 1.5%
0.5 Vp-p	4000 Hz	12%	440 Hz	4500 Hz	14%	450 Hz
1.0 Vp-p	2200 Hz	21%	440 Hz	3600 Hz	14%	450 Hz
2.5 Vp-p	900 Hz	25%	265 Hz	1300 Hz	25%	340 Hz
5.0 Vp-p	500 Hz	27%	160 Hz	600 Hz	25%	250 Hz
50.0 Vp-p	340 Hz	22%	25 Hz	350 Hz	22%	30 Hz

	N6754A		
Voltage	3 dB max	THD 3 dB	THD < 1.5%
0.6 Vp-p	3600 Hz	6.0%	2100 Hz
1.2 Vp-p	2600 Hz	10%	1280 Hz
3.0 Vp-p	1700 Hz	17%	800 Hz
6.0 Vp-p	1000 Hz	17%	480 Hz
60.0 Vp-p	340 Hz	22%	30 Hz

	N6731B & N6741B			
Voltage	3 dB max	THD 3 dB	6 dB max	THD 6 dB
0.1 Vp-p	175 Hz	1.0%	260 Hz	3.0%
0.1 Vp-p	125 Hz	1.0%	175 Hz	3.0%
0.3 Vp-p	75 Hz	6.0%	100 Hz	6.0%
0.5 Vp-p	40 Hz	9.0%	55 Hz	9.0%
5.0 Vp-p	20 Hz	10%	37 Hz	10%

	N6732B & N6742B			
Voltage	3 dB max	THD 3 dB	6 dB max	THD 6 dB
0.1 Vp-p	125 Hz	1.0%	200 Hz	3.0%
0.2 Vp-p	125 Hz	1.0%	180 Hz	3.0%
0.4 Vp-p	75 Hz	6.0%	100 Hz	6.0%
0.8 Vp-p	40 Hz	8.5%	60 Hz	8.5%
8.0 Vp-p	20 Hz	10%	37 Hz	10%

Arbitrary Waveform Generator Maximum Bandwidth (continued)

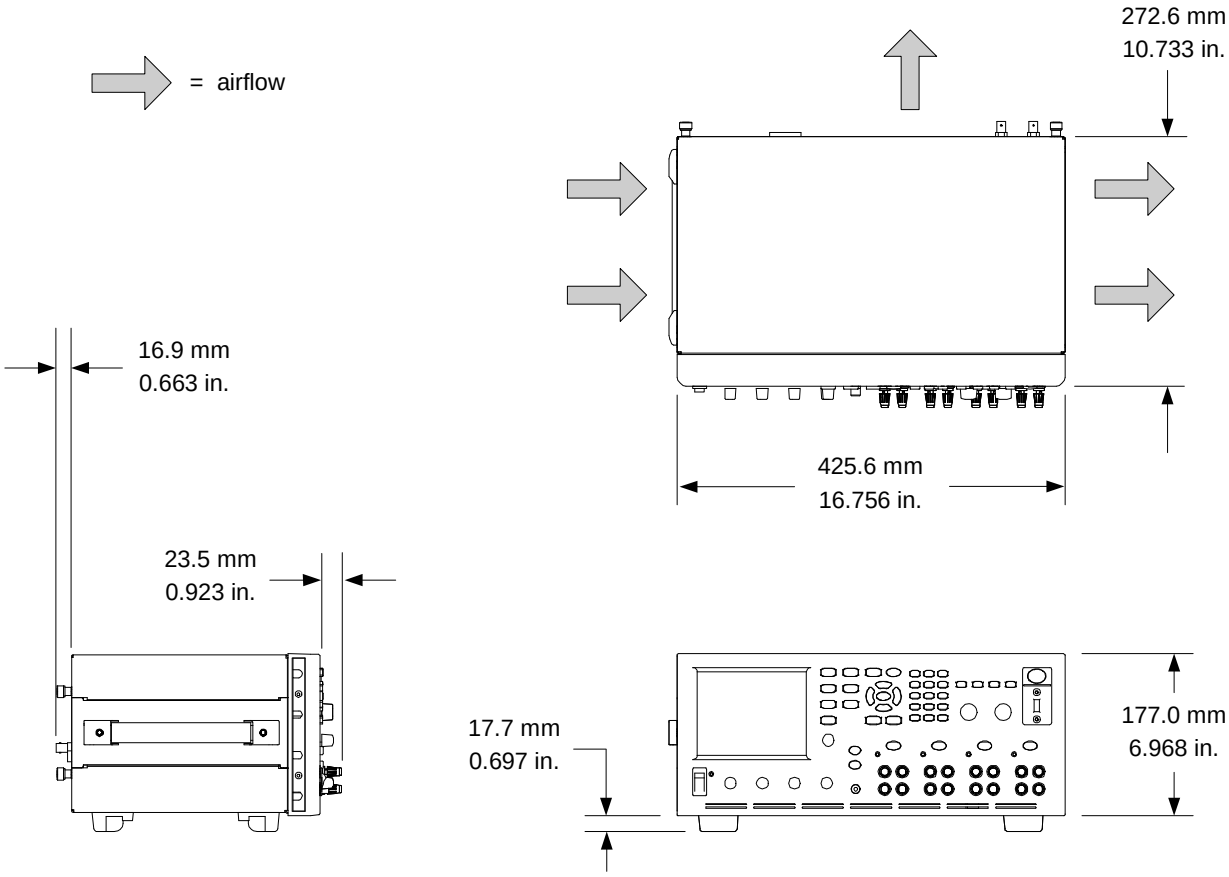
	N6733B & N6743B				N6773A			
Voltage	3 dB max	THD 3 dB	6 dB max	THD 6 dB	3 dB max	THD 3 dB	6 dB max	THD 6 dB
0.2 Vp-p	110 Hz	1.0%	190 Hz	3.0%	125 Hz	1.5%	210 Hz	4.0%
0.4 Vp-p	110 Hz	1.0%	160 Hz	3.0%	125 Hz	1.5%	180 Hz	4.0%
1.0 Vp-p	72 Hz	6.0%	95 Hz	6.0%	75 Hz	6.0%	95 Hz	6.0%
2.0 Vp-p	40 Hz	8.0%	55 Hz	8.5%	42 Hz	9.0%	60 Hz	9.0%
20.0 Vp-p	20 Hz	10%	37 Hz	10%	20 Hz	10%	37 Hz	10%

	N6734B & N6744B				N6774A			
Voltage	3 dB max	THD 3 dB	6 dB max	THD 6 dB	3 dB max	THD 3 dB	6 dB max	THD 6 dB
0.4 Vp-p	125 Hz	1.0%	200 Hz	1.0%	125 Hz	1.0%	200 Hz	1.0%
0.7 Vp-p	125 Hz	1.0%	175 Hz	3.5%	125 Hz	1.0%	160 Hz	3.0%
1.8 Vp-p	72 Hz	6.0%	100 Hz	6.0%	75 Hz	6.0%	95 Hz	6.0%
3.5 Vp-p	40 Hz	8.0%	55 Hz	8.5%	40 Hz	8.5%	55 Hz	8.5%
35.0 Vp-p	20 Hz	8.0%	37 Hz	8.5%	20 Hz	10%	37 Hz	10%

	N6735B & N6745B				N6775A			
Voltage	3 dB max	THD 3 dB	6 dB max	THD 6 dB	3 dB max	THD 3 dB	6 dB max	THD 6 dB
0.6 Vp-p	100 Hz	1.0%	180 Hz	1.0%	120 Hz	1.0%	200 Hz	1.0%
1.2 Vp-p	100 Hz	1.0%	160 Hz	3.0%	120 Hz	1.0%	160 Hz	3.0%
3.0 Vp-p	70 Hz	5.5%	92 Hz	5.5%	70 Hz	5.0%	95 Hz	6.0%
6.0 Vp-p	40 Hz	8.0%	55 Hz	8.0%	40 Hz	8.5%	55 Hz	8.5%
60.0 Vp-p	20 Hz	8.0%	37 Hz	8.0%	20 Hz	10%	35 Hz	10%

	N6736B & N6746B				N6776A			
Voltage	3 dB max	THD 3 dB	6 dB max	THD 6 dB	3 dB max	THD 3 dB	6 dB max	THD 6 dB
1.0 Vp-p	90 Hz	1.0%	160 Hz	1.5%	75 Hz	1.0%	160 Hz	1.0%
2.0 Vp-p	90 Hz	1.0%	150 Hz	3.0%	75 Hz	1.0%	150 Hz	3.0%
5.0 Vp-p	62 Hz	4.5%	85 Hz	6.0%	55 Hz	4.0%	75 Hz	6.0%
10.0 Vp-p	37 Hz	8.0%	50 Hz	8.0%	35 Hz	8.0%	45 Hz	8.0%
100 Vp-p	20 Hz	8.0%	35 Hz	8.0%	N/A	N/A	35 Hz	8.0%

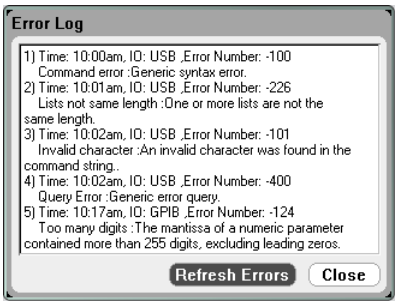
Outline Diagram



Appendix B
Error Messages

This appendix gives the some of the error numbers and descriptions that are returned by the Agilent N6705A DC Power Analyzer. Note that this list does not document every error that can occur on the DC Power Analyzer.

To display the list of errors, press the Menu key, scroll down and select the Utilities item, then select **Error Log**.



Error List

Error	**Device-dependent Errors** (these errors set Standard Event Status register bit #3)
0	**No error** This is the response to the ERR? query when there are no errors.
100	**Too many channels** You have specified more channels than are installed in the mainframe.
101	**Calibration state is off** Calibration is not enabled. The instrument will not accept calibration commands.
102	**Calibration password is incorrect** The calibration password is incorrect.
103	**Calibration is inhibited by switch setting** Calibration mode is locked out by the calibration switch.
104	**Bad sequence of calibration commands** Calibration commands have not been entered in the proper sequence.
105	**Unexpected output current** The measured output current is outside the acceptable range.
106	**Zero measurement out of range error** The “zero” measurement value is outside the acceptable range.
107	**Programming cal constants out of range** The programmed calibration constant is outside the acceptable range.
108	**Measurement cal constants out of range** The measurement calibration constant is outside the acceptable range.
109	**Over voltage cal constants out of range** The over voltage calibration constant is outside the acceptable range.
110	**Wrong V+I** The instrument was unable to set the correct voltage or current value.
111	**Aux vloc cal constants out of range** Calibration constants on the internal auxiliary local ADC are outside the acceptable range.
112	**Aux vrem cal constants out of range** Calibration constants on the internal auxiliary remote ADC are outside the acceptable range.
113	**Aux imon cal constants out of range** Calibration constants on the internal auxiliary imon ADC are outside the acceptable range.
200	**Hardware error channel <channel>** A hardware error has occurred on the specified channel.
201	**Invalid configuration, empty slots** There is an empty slot between modules. This configuration is not allowed.
202	**Selftest Fail** A selftest failure has occurred. See selftest failure list for details.
203	**Compatibility function not implemented** The requested compatibility function is not available.
204	**NVRAM checksum error** A checksum error has occurred in the instrument’s nonvolatile random access memory.
205	**NVRAM full** The nonvolatile random access memory of the instrument is full.
206	**File not found** The internal calibration file or the internal channel attribute file was not found in NVRAM.

	Device-dependent Errors (continued)
207	**Cal file version error** The calibration file was written or read using old firmware. Firmware must be updated.
302	**Option not installed** The option that is programmed by this command is not installed.
303	**There is not a valid acquisition to fetch from** There is no valid data in the measurement buffer.
304	**Volt and curr in incompatible transient modes** Voltage and current cannot be in Step and List mode at the same time.
305	**A triggered value is on a different range** A triggered value is on a different range than the one that is presently set.
306	**Too many list points** Too many list points have been specified.
307	**List lengths are not equivalent** One or more lists are not the same length.
308	**This setting cannot be changed while transient trigger is initiated** Setting cannot be changed while the instrument is waiting for or executing a trigger sequence.
309	**Cannot initiate, voltage and current in fixed mode** Cannot initiate the transient generator because either the voltage or the current function is set to Fixed mode.

	Command Errors (these errors set Standard Event Status register bit #5)
–100	**Command error** Generic syntax error.
–101	**Invalid character** An invalid character was found in the command string.
–102	**Syntax error** Invalid syntax was found in the command string. Check for blank spaces.
–103	**Invalid separator** An invalid separator was found in the command string. Check for proper use of , ; :
–104	**Data type error** A different data type than the one allowed was found in the command string.
–105	**GET not allowed** A group execute trigger is not allowed in a command string.
–108	**Parameter not allowed** More parameters were received than were expected.
–109	**Missing parameter** Fewer parameters were received than were expected.
–110	**Command header error** An error was detected in the header.
–111	**Header separator error** A character that was not a valid header separator was found in the command string.
–112	**Program mnemonic too long** The header contains more than 12 characters.
–113	**Undefined header** A command was received that was not valid for this instrument.
–114	**Header suffix out of range** The value of the numeric suffix is not valid.

	Command Errors (continued)
–120	**Numeric data error** Generic numeric data error.
–121	**Invalid character in number** An invalid character for the data type was found in the command string.
–123	**Exponent too large** The magnitude of the exponent was larger than 32000.
–124	**Too many digits** The mantissa of a numeric parameter contained more than 255 digits, excluding leading zeros.
–128	**Numeric data not allowed** A numeric parameter was received but a character string was expected.
–130	**Suffix error** Generic suffix error
–131	**Invalid suffix** A suffix was incorrectly specified for a numeric parameter.
–134	**Suffix too long** The suffix contains more than 12 characters.
–138	**Suffix not allowed** A suffix is not supported for this command.
–140	**Character data error** Generic character data error
–141	**Invalid character data** Either the character data element contains an invalid character, or the element is not valid.
–144	**Character data too long** The character data element contains more than 12 characters.
–148	**Character data not allowed** A discrete parameter was received, but a string or numeric parameter was expected.
–150	**String data error** Generic string data error
–151	**Invalid string data** An invalid character string was received. Check that the string is enclosed in quotation marks.
–158	**String data not allowed** A character string was received, but is not allowed for this command.
–160	**Block data error** Generic block data error
–161	**Invalid block data** The number of data bytes sent does not match the number of bytes specified in the header.
–168	**Block data not allowed** Data was sent in arbitrary block format but is not allowed for this command.
–170	**Expression error** Generic expression error
–171	**Invalid expression data** The expression data element was invalid.
–178	**Expression data not allowed** Expression data element was sent but is not allowed for this command.

	Execution Errors (these errors set Standard Event Status register bit #4)
–200	**Execution error** Generic syntax error
–220	**Parameter error** A data element related error occurred.
–221	**Settings conflict** A data element could not be executed because of the present instrument state.
–222	**Data out of range** A data element could not be executed because the value was outside the valid range.
–223	**Too much data** A data element was received that contains more data than the instrument can handle.
–224	**Illegal parameter value** An exact value was expected but not received.
–225	**Out of memory** The device has insufficient memory to perform the requested operation.
–226	**Lists not same length** One or more lists are not the same length.
–230	**Data corrupt or stale** Possible invalid data. A new reading was started but not completed.
–231	**Data questionable** The measurement accuracy is suspect.
–232	**Invalid format** The data format or structure is inappropriate.
–233	**Invalid version** The version of the data format is incorrect to the instrument.
–240	**Hardware error** The command could not be executed because of a hardware problem with the instrument.
–241	**Hardware missing** The command could not be executed because of missing hardware, such as an option.
–260	**Expression error** An expression program data element related error occurred.
–261	**Math error in expression** An expression program data element could not be executed due to a math error.

	Query Errors (these errors set Standard Event Status register bit #2)
–400	**Query Error** Generic error query
–410	**Query INTERRUPTED** A condition causing an interrupted query error occurred.
–420	**Query UNTERMINATED** A condition causing an unterminated query error occurred.
–430	**Query DEADLOCKED** A condition causing a deadlocked query error occurred.
–440	**Query UNTERMINATED after indefinite response** A query was received in the same program message after a query indicating an indefinite response was executed.

	Selftest Errors (these errors set Standard Event Status register bit #3)
202	**Selftest Fail Aux Adc 0 expected <n1> to <n2>, measured <n3>, chan <n4>** Auxiliary ADC failed. n1 and n2 are the expected limits. n3 is the measured value. n4 is the channel location of the failed module.
202	**Selftest Fail DACs 0 expected <n1> to <n2>, measured <n3>, chan <n4>** Both voltage and current DACs are at zero. n1 and n2 are the expected limits. n3 is the measured value. n4 is the channel location of the failed module.
202	**Selftest Fail DACs 1 expected <n1> to <n2>, measured <n3>, chan <n4>** Voltage DAC is at zero; current DAC is at full scale. n1 and n2 are the expected limits. n3 is the measured value. n4 is the channel location of the failed module.
202	**Selftest Fail DACs 2 expected <n1> to <n2>, measured <n3>, chan <n4>** Voltage DAC is at full scale; current DAC is at zero. n1 and n2 are the expected limits. n3 is the measured value. n4 is the channel location of the failed module.
202	**Selftest Fail DACs 3 expected <n1> to <n2>, measured <n3>, chan <n4>** Both voltage and current DACs are at full scale. n1 and n2 are the expected limits. n3 is the measured value. n4 is the channel location of the failed module.

Appendix C
SCPI Commands

This appendix gives the list of SCPI commands that are used to program the Agilent N6705A DC Power Analyzer.

NOTE For complete details on programming the instrument using SCPI commands, refer to the Programmer's Reference Help file included on the Agilent N6705A Product Reference CD. This CD-ROM is shipped along with your instrument.

SCPI Command Summary

NOTE Some [optional] commands have been included for clarity. All settings commands have a corresponding query. Not all commands apply to all models.

SCPI Command	Description
ABORt	
:ACQuire (@chanlist)	Resets the measurement trigger system to the Idle state
:DLOG	Stops a running data log (only on N6705A)
:TRANsient (@chanlist)	Resets the transient trigger system to the Idle state
CALibrate	
:CURRent	
[:LEVel] <NRf>, (@channel)	Calibrates the output current programming
:MEASure <NRf>, (@channel)	Calibrates the current measurement
:PEAK (@channel)	Calibrates the peak current limit (only on N675xA/N676xA)
:DATA <NRf>	Enters the calibration value
:DATE <SPD>, (@channel)	Sets the calibration date
:DPRog (@channel)	Calibrates the current downprogrammer
:LEVel P1 | P2 | P3	Advances to the next calibration step
:PASSword <NRf>	Sets the numeric calibration password
:SAVE	Saves the new cal constants in non-volatile memory
:STATE <Bool> [,<NRf>]	Enables/disables calibration mode
:VOLTage	
[:LEVel] <NRf>, (@channel)	Calibrates the output voltage programming
:CMRR (@channel)	Calibrates common mode rejection ratio (only N675xA/N676xA)
:MEASure <NRf>, (@channel)	Calibrates the voltage measurement
DISPlay	
[:WINDow]:VIEW METER1 | METER4	Selects 1-channel or 4-channel meter view
FETCh	(FETCh commands only on N6761A/62A and Opt. 054)
[:SCALar]	
:CURRent [:DC]? (@chanlist)	Returns the average output current
:VOLTage [:DC]? (@chanlist)	Returns the average output voltage
:ARRay	
:CURRent [:DC]? (@chanlist)	Returns the instantaneous output current
:VOLTage [:DC]? (@chanlist)	Returns the instantaneous output voltage
HCOPy	(HCOPy commands only on Agilent N6705A)
:SDUMp:DATA?	Returns an image of the display in .gif format
INITiate	
[:IMMediate]	
:ACQuire (@chanlist)	Enables measurement triggers (only N6761A/62A and Opt. 054)
:DLOG "filename"	Enables the Data Logger function (only on N6705A)
:TRANsient (@chanlist)	Enables output triggers
:CONTinuous	
:TRANsient <Bool>, (@chanlist)	Enables/disables continuous transient triggers

SCPI Command	Description
MEASure	
[:SCALar]	
:CURRent [:DC]? (@chanlist)	Takes a measurement; returns the average output current
:VOLTage [:DC]? (@chanlist)	Takes a measurement; returns the average output voltage
:ARRay	(ARRay commands only on N6761A/62A and Opt. 054)
:CURRent [:DC]? (@chanlist)	Takes a measurement; returns the instantaneous output current
:VOLTage [:DC]? (@chanlist)	Takes a measurement; returns the instantaneous output voltage
MMEMory	(MMEMory commands only on N6705A)
:ATTRibute? "object", "attribute"	Gets the attributes of a file system object
:DATA[:DEFinite]? "filename"	Gets the file contents; response is a definite length binary block
:DELete "filename"	Deletes a file
:EXPort:DLOG "filename"	Exports a data log from the display to a file
OUTPut	
[:STATe] <Bool> [,NORelay], (@chanlist)	Enables/disables the specified output channel(s)
:COUPle	
[:STATe] <Bool>	Enables/disables channel coupling for output synchronization
:CHANNel [<NR1> {,<NR1>}]	Selects which channels are coupled
:DOFFset <NRf>	Specifies a maximum delay offset to synchronize output changes
:MODE AUTO | MANual	Specifies the output delay coupling mode (only on N6705A)
:MAX:DOFFset?	Returns the maximum delay offset required for a mainframe
:DELay	
:FALL <NRf+>, (@chanlist)	Sets the output turn-off sequence delay
:RISE <NRf+>, (@chanlist)	Sets the output turn-on sequence delay
:PMODe VOLTage | CURRent, (@chanlist)	Sets the mode for turn on/off transitions (only on N6761A/62A)
:INHibit:MODE LATChing | LIVE | OFF	Sets the remote inhibit input
:PON:STATe RST | RCL0	Programs the power-on state
:PROTection	
:CLEar (@chanlist)	Resets latched protection
:COUPle <Bool>	Enables/disables channel coupling for protection faults
:DELay <NRf+>, (@chanlist)	Sets over-current protection programming delay
:RELay:POLarity NORMal | REVerse, (@chanlist)	Sets the output relay polarity (only on Opt. 760)
SENSe	
:CURRent	
[:DC]:RANGe [:UPPer] <NRf+>, (@chanlist)	Selects the current measurement range (only on N6761A/62A)
CCOMpensate <Bool>, (@chanlist)	Enables/disables the capacitive current compensation
:DLOG	(DLOG commands only on N6705A)
:FUNCtion	
:CURRent <Bool>, (@chanlist)	Enables/disables current data logging
:MINMax <Bool>	Enables/disables min/max data logging
:VOLTage <Bool>, (@chanlist)	Enables/disables voltage data logging
:OFFSet <NR1>	Sets trigger offset as a percent from start of data log duration
:TIME <NRf+>	Sets the duration of the data log in seconds
:TINTerval <NRf+>	Sets the time interval between data log samples
:FUNCtion "VOLTage" | "CURRent", (@chanlist)	Selects the measurement function
:SWEep	(SWEep commands only on N6761A/62A and Opt. 054)
:OFFSet:POINts <NRf+>, (@chanlist)	Defines the trigger offset in the measurement sweep
:POINts <NRf+>, (@chanlist)	Defines the number of data points in the measurement
:TINTerval <NRf+>, (@chanlist)	Sets the measurement sample interval
:VOLTage[:DC]:RANGe [:UPPer] <NRf+>, (@chanlist)	Selects the voltage measurement range (only on N6761A/62A)
:WINDow [:TYPE] HANNing | RECTangular, (@chanlist)	Selects the window type (only on N6761A/62A and Opt. 054)

SCPI Command	Description
[SOURce:]	
ARB	(ARB commands only on N6705A)
:COUNt <NRf+> | INFinity, (@chanlist)	Sets the Arb repeat count
:CURRent	
:UDEFined	
:BOSTep[:DATA] <Bool> {,<Bool>}, (@chanlist)	Generate triggers at the Beginning Of STep
:POINts? (@chanlist)	Returns the number of BOST points
:DWELl <NRf> {,<NRf>}, (@chanlist)	Sets the user-defined dwell values
:POINts? (@chanlist)	Returns the number of dwell points
:LEVel <NRf> {,<NRf>}, (@chanlist)	Sets the user-defined current values
:POINts? (@chanlist)	Returns the number of current points
:FUNCtion STEP | RAMP | STAircase | SINusoid | PULSe | TRAPezoid | EXPonential | UDVoltage | UDCurrent | NONE, (@chanlist)	Selects the ARB function
:TERMinate:LAST <Bool>, (@chanlist)	Sets the ARB termination mode
:VOLTage	
:CONVert (@channel)	Converts the selected ARB to a user-defined list
:EXPonential	
:END[:LEVel] < NRf+>, (@channel)	Sets the end voltage of the exponential ARB
:STARt	
[:LEVel] < NRf+>, (@channel)	Sets the initial voltage of the exponential ARB
:TIMe < NRf+>, (@channel)	Sets the length of the start time or delay
:TCONstant < NRf+>, (@channel)	Sets the time constant of the exponential ARB
:TIMe < NRf+>, (@channel)	Sets the time of the exponential ARB
:PULSe	
:END:TIMe < NRf+>, (@channel)	Sets the length of the end time
:STARt	
[:LEVel] < NRf+>, (@channel)	Sets the initial voltage of the pulse
:TIMe < NRf+>, (@channel)	Sets the length of the start time or delay
:TOP	
[:LEVel] < NRf+>, (@channel)	Sets the top level voltage of the pulse
:TIMe < NRf+>, (@channel)	Sets the length of the pulse
:RAMP	
:END	
[:LEVel] < NRf+>, (@channel)	Sets end voltage of the ramp
:TIMe < NRf+>, (@channel)	Sets the length of the end time
:RTIMe < NRf+>, (@channel)	Sets the rise time of the ramp
:STARt	
[:LEVel] < NRf+>, (@channel)	Sets the initial voltage of the ramp
:TIMe < NRf+>, (@channel)	Sets the length of the start time or delay
:SINusoid	
:AMPLitude < NRf+>, (@channel)	Sets the amplitude of the sine wave
:FREQuency < NRf+>, (@channel)	Sets the frequency of the sine wave
:OFFSet < NRf+>, (@channel)	Sets the DC offset of the sine wave
:STAircase	
:END	
[:LEVel] < NRf+>, (@channel)	Sets the end voltage of the staircase
:TIMe < NRf+>, (@channel)	Sets the length of the end time
:NSTeps < NRf+>, (@channel)	Sets the number of steps in the staircase
:STARt	
[:LEVel] < NRf+>, (@channel)	Sets the initial voltage of the staircase
:TIMe < NRf+>, (@channel)	Sets the length of the start time or delay
:TIMe <NRf+>, (@channel)	Sets the length of the staircase

SCPI Command	Description
[SOURce:]ARB continued	
:STEP	
:END[:LEVel] < NRf+>, (@channel)	Sets the end voltage of the step
:STARt	
[:LEVel] < NRf+>, (@channel)	Sets the initial voltage of the step
:TIMe < NRf+>, (@channel)	Sets the length of the start time or delay
:TRAPezoid	
:END:TIMe < NRf+>, (@channel)	Sets the length of the end time
:FTIMe < NRf+>, (@channel)	Sets the length of the fall time
:RTIMe < NRf+>, (@channel)	Sets the length of the rise time
:STARt	
[:LEVel] < NRf+>, (@channel)	Sets the initial voltage of the trapezoid
:TIMe < NRf+>, (@channel)	Sets the length of the start time or delay
:TOP	
[:LEVel] < NRf+>, (@channel)	Sets the top level voltage of the trapezoid
:TIMe < NRf+>, (@channel)	Sets the length of the top of the trapezoid
:UDEFined	
:BOSTep[:DATA] <Bool> {,<Bool>}, (@chanlist)	Generate triggers at the Beginning Of Step
:POINts? (@chanlist)	Returns the number of BOST points
:DWELl <NRf> {,<NRf>}, (@chanlist)	Sets the user-defined dwell values
:POINts? (@chanlist)	Returns the number of dwell points
:LEVel <NRf> {,<NRf>}, (@chanlist)	Sets the user-defined voltage values
:POINts? (@chanlist)	Returns the number of voltage points
CURRent	
[:LEVel]	
[:IMMediate][:AMPLitude] <NRf+>, (@chanlist)	Sets the output current
:TRIGgered [:AMPLitude] <NRf+>, (@chanlist)	Sets the triggered output current
:MODE FIXed | STEP | LIST | ARB, (@chanlist)	Sets the current trigger mode
:PROTection	
:DELay[:TIME]<NRf+> (@chanlist)	Sets the over-current protection programming delay
:STARt SCHange | CCTRans, (@chanlist)	Sets the over-current protection programming mode
:STATe <Bool>, (@chanlist)	Enables/disables over-current protection on the selected output
:RANGe <NRf+>, (@chanlist)	Sets the output current range (only on N6761A/62A)
DIGital	
:INPut:DATA?	Reads the state of the digital port pins
:OUTPut:DATA <NRf>	Sets the digital port
:PIN<1-7>	
:FUNCtion DIO | DINPut | TOUTput | TINPut | FAULt[1] | INHibit[2] | ONCouple | OFFCouple	Sets the selected pin's function ([1]PIN1 only; [2]PIN3 only)
:POLarity POSitive | NEGative	Sets the selected pin's polarity
LIST	(LIST commands only on N6761A/62A and Opt. 054)
:COUNt <NRf+> | INFinity, (@chanlist)	Sets the list repeat count
:CURRent [:LEVel] <NRf> {,<NRf>}, (@chanlist)	Sets the current list
:POINts? (@chanlist)	Returns the number of current list points
:DWELl <NRf> {,<NRf>}, (@chanlist)	Sets the list of dwell times
:POINts? (@chanlist)	Returns the number of dwell list points
:STEP ONCE | AUTO, (@chanlist)	Specifies how the list responds to triggers
:TERMinate:LAST <Bool>, (@chanlist)	Sets the list termination mode
:TOUTput	
:BOSTep[:DATA] <Bool> {,<Bool>}, (@chanlist)	Generate triggers at the Beginning Of STep
:POINts? (@chanlist)	Returns the number of BOST list points
:EOSTep[:DATA] <Bool> {,<Bool>}, (@chanlist)	Generate triggers at the End Of STep
:POINts? (@chanlist)	Returns the number of EOST list points

SCPI Command	Description
[SOURce:]LIST continued	
:VOLTage[:LEVel] <NRf> {,<NRf>}, (@chanlist)	Sets the voltage list
:POINts? (@chanlist)	Returns the number of voltage list points
POWer:LIMit <NRf+>, (@chanlist)	Sets the power limit on output channels
STEP:TOUTput <Bool>, (@chanlist)	Generate a trigger output on the voltage or current step
VOLTage	
[:LEVel]	
[:IMMediate][:AMPLitude] <NRf+>, (@chanlist)	Sets the output voltage
:TRIGgered [:AMPLitude] <NRf+>, (@chanlist)	Sets the triggered output voltage
:MODE FIXed | STEP | LIST | ARB, (@chanlist)	Sets the voltage trigger mode
:PROTection[:LEVel] <NRf+>, (@chanlist)	Sets the over-voltage protection level
:RANGe <NRf+>, (@chanlist)	Sets the output voltage range (only on N6761A/62A)
:SENSe:SOURce INTernal | EXTernal, (@chanlist)	Sets the remote sense relays (only on N6705A)
:SLEW[:IMMediate] <NRf+> | INFinity, (@chanlist)	Sets the output voltage slew rate
STATus	
:OPERation	
[:EVENt]? (@chanlist)	Returns the value of the operation event register
:CONDition? (@chanlist)	Returns the value of the operation condition register
:ENABle <NRf>, (@chanlist)	Enables specific bits in the Event register
:NTRansition <NRf>, (@chanlist)	Sets the Negative transition filter
:PTRansition <NRf>, (@chanlist)	Sets the Positive transition filter
:PRESet	Presets all enable and transition registers to power-on
:QUEStionable	
[:EVENt]? (@chanlist)	Returns the value of the questionable event register
:CONDition? (@chanlist)	Returns the value of the questionable condition register
:ENABle <NRf>, (@chanlist)	Enables specific bits in the Event register
:NTRansition <NRf>, (@chanlist)	Sets the Negative transition filter
:PTRansition <NRf>, (@chanlist)	Sets the Positive transition filter
SYSTem	
:CHANnel	
[:COUNt]?	Returns the number of output channels in a mainframe
:MODel? (@chanlist)	Returns the model number of the selected channel
:OPTion? (@chanlist)	Returns the option installed in the selected channel
:SERial? (@chanlist)	Returns the serial number of the selected channel
:COMMunicate	
:RLSTate LOCal | REMote | RWLock	Specifies the Remote/Local state of the instrument
:TCPip:CONTrol?	Returns the control connection port number
:DATE <yyyy>,<mm>,<dd>	Sets the date of the system clock (only on N6705A)
:ERRor?	Returns the error number and error string
:GROup	
:CATalog?	Returns the groups that have been defined
:DEFine (@chanlist)	Group multiple channels together to create a single output
:DELete <channel>	Removes the specified channel from a group
:ALL	Ungroups all channels
:PASSword:FPANel:RESet	Resets the front panel lock password to zero
:REBoot	Returns the unit to its power-on state
:TIME <hh>,<mm>,<ss>	Sets the time of the system clock (only on N6705A)
:VERSion?	Returns the SCPI version number

SCPI Command	Description
TRIGger	
:ACQuire	(ACQuire commands only on N6761A/62A and Opt. 054)
[:IMMediate] (@chanlist)	Triggers the measurement immediately
:SOURce BUS|PIN<1-7>|TRANsient<1-4>, (@chanlist)	Sets the measurement trigger source
:ARB	
:SOURce IMMediate | EXTernal | BUS	Sets the ARB trigger source (only on N6705A)
:DLOG	(DLOG commands only on N6705A)
[:IMMediate]	Triggers the data logger immediately
:CURRent	
[:LEVel] <NRf>, (@chanlist)	Sets the current trigger level of the data logger
:SLOPe POSitive | NEGative, (@chanlist)	Sets the current trigger slope of the data logger
:SOURce IMMediate | EXTernal | BUS | VOLTage<1-4> | CURRent<1-4>| ARSKey | OOOKey	Sets the source of data logger trigger
:VOLTage	
[:LEVel] <NRf>, (@chanlist)	Sets the voltage trigger level of the data logger
:SLOPe POSitive | NEGative, (@chanlist)	Sets the voltage trigger slope of the data logger
:TRANsient	
[:IMMediate] (@chanlist)	Triggers the output immediately
:SOURce BUS|PIN<1-7>|TRANsient<1-4>, (@chanlist)	Sets the output trigger source

Common Commands

Command	Description	Command	Description
*CLS	Clear status	*RST	Reset
*ESE <NRf>	Standard event status enable	*SAV <NRf>	Saves an instrument state
*ESR?	Return event status register	*SRE <NRf>	Set service request enable register
*IDN?	Return instrument identification	*STB?	Return status byte
*OPC	Enable "operation complete" bit in ESR	*TRG	Trigger
*OPT?	Return option number	*TST?	Performs self-test, then returns result
*RCL <NRf>	Recalls a saved instrument state	*WAI	Pauses additional command processing
*RDT?	Return output channel descriptions		until all device commands are done

Appendix D
Output On/Off Synchronization

Normally, all outputs in an Agilent N6705A mainframe are included in an output on/off delay sequence. Additionally, a delay offset is automatically calculated and applied by the firmware to synchronize the output turn-on delays.

Output on/off synchronization lets you manually select specific outputs to be synchronized as well as specify the delay offset, which serves as a reference for the user-programmed turn-on delays.

This makes it possible have some outputs excluded from an output on/off delay sequence and be available for other purposes. It also makes it possible to connect multiple Agilent N6705A mainframes together and program accurate turn-on delay sequences across multiple mainframes. Manually specifying a delay offset lets you configure shorter or longer offset delays than the delay offset that is automatically applied by the firmware.

NOTE There is no need to specify a delay offset when outputs turn off. Outputs start executing their turn-off delays as soon as an output Off command is received.

Output Coupling

Delay Offset

All power modules that are installed in an Agilent N6705A mainframe exhibit a minimum delay offset that applies from the time that a command to turn on the output is received until the output actually turns on. The minimum delay offset is shown in the following table.

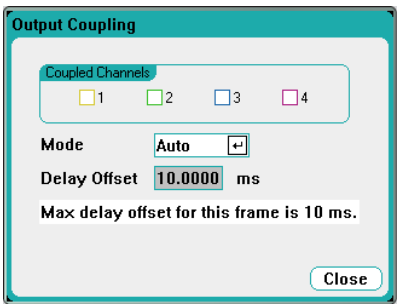
Power Modules	Options and Mode	Minimum Delay Offset
N673xB, N674xB, N677xA	Without relays	32 ms
	With relay option 760	58 ms
N6751A, N6752A	Without relays	25 ms
	With relay option 760	51 ms
N6754A	Without relays	18 ms
	With relay option 760	44 ms
N6761A, N6762A	Without relays	32 ms
	With relay option 760	58 ms
	Without relays; Current priority	23 ms
	With relay option 760; Current priority	45 ms

Normally, the firmware automatically calculates the delay offset for the entire mainframe, based on the *longest* minimum delay offset of the installed modules. However, If you will be excluding some modules (outputs) from participating in an output on/off delay sequence, you can manually adjust the delay offset based on the modules (outputs) that you will actually be using.

Procedure

1. Specify which Outputs will be Coupled

Select the outputs that will be coupled. Check Output Channels 1, 2, 3, or 4. When outputs are coupled in this manner, turning the output on or off on *any* coupled output will cause *all* coupled outputs to turn on or off according to their user-programmed delays. In this way, some outputs can be excluded from an output on/off delay sequence and be dedicated to other uses.



NOTE This is different from using the All Outputs On/Off key because the All Outputs On/Off keys will turn all outputs on or off, whether they are configured to participate in an output on/off delay sequence or not.

2. Specify the Delay Offset

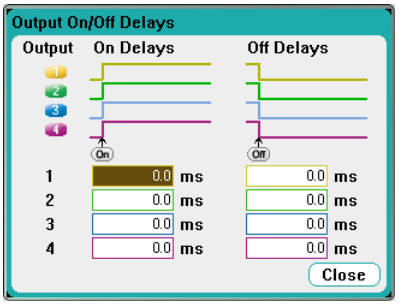
This step is optional. You can use the delay offset that is automatically calculated by the firmware and displayed in the **Max delay offset for this frame** field.

To program a different delay offset, first change the mode to Manual. Then, set the delay offset to the *longest* minimum delay offset of all the modules that you will be coupling. If you program a shorter value, you may experience improper synchronization across all outputs.

Note that you can also program a common delay that is longer than the maximum delay offset of the mainframe. You may choose a longer value to make your program flexible for future configurations that may have modules with longer delay offsets.

3. Specify the Turn-On Delays for the Coupled Outputs

Turn-on delays can be specified for all coupled outputs. Any delay sequence can be implemented. There are no restrictions on what the sequence is or what output comes up first.



Coupling Multiple Mainframes

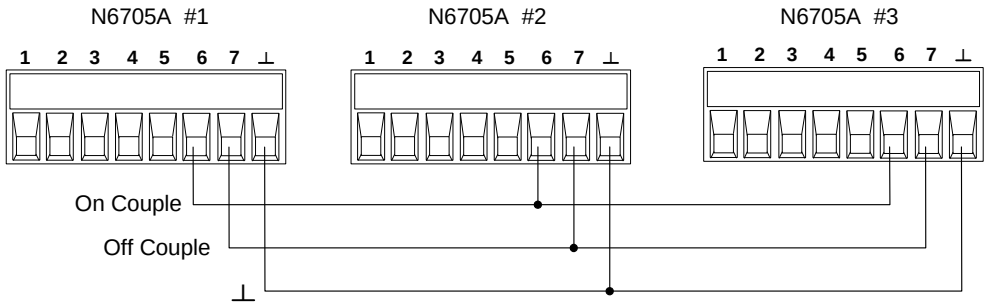
The output on/off delay function can be used across multiple Agilent N6705A mainframes that have coupled outputs. Each mainframe that will be synchronized must have at least one coupled output.

1. Configure the outputs on each mainframe as described in steps 1 through 3 of the previous procedure.
2. Set the delay offset of each individual mainframe to match the *largest* delay offset of the mainframe group.
3. Connect and configure the digital connector pins of the synchronized mainframes as described in this section.

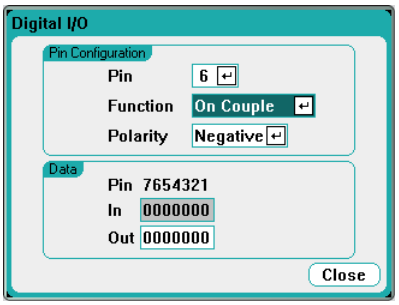
Digital Connections and Configuration

NOTE Only pins 4 through 7 can be configured as synchronization pins. You cannot configure more than one On Couple and one Off Couple pin per mainframe. The polarity of the pins is not programmable; it is set to Negative.

The digital connector pins of the synchronized mainframes that contain coupled outputs must be connected together as shown in the following figure. In this example, pin 6 will be configured as the output On control. Pin 7 will be configured as the output Off control. The ground or Common pins also need to be connected together.



Only *two* of the digital connector pins on each mainframe can be configured as "On Couple" and "Off Couple" on each synchronized mainframe. The designated pins will function as both an input and an output, with a negative transition on one pin providing the synchronization signal to the other pins.



Operation

Once configured and enabled, turning the output on or off on *any* coupled output will cause *all* coupled outputs on all configured mainframes to turn on or off according to their user-programmed delays. This applies to the front panel **On/Off** keys, the Web server, and to SCPI commands.

Turning the outputs on or off using the front panel **All Outputs On/Off** keys will cause all coupled outputs as well as non-coupled outputs *on that mainframe* to turn on or off.

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