N6700 Series Low-Profile Modular Power System

N6700C, N6701C, N6702C Mainframes
N6731B-N6736B, N6741B-N6746B, N6751A-N6756A, N6761A-N6766A, N6773A-N6777A, N6781A-N6786A, N6791A, N6792A Power Modules

KEYSIGHT

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Legal and Safety Information

Legal Notices

Safety Notices

Safety Symbols

Legal Notices

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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.

Product Category: With reference to the equipment types in the WEEE directive Annex 1, this product is classified as "Monitoring and Control instrumentation" product.

Do not dispose in domestic household waste.

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Safety Symbols

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

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

Direct current

Alternating current

Frame or chassis terminal

Standby supply. Unit is not completely disconnected from AC mains when switch is off.

CAUTION Risk of electric shock

CAUTION Refer to accompanying documents

Earth ground terminal

The CE mark is a registered trademark of the European Community.

The ETL mark is a registered trademark of Intertek.

The RCM mark is a registered trademark of the Spectrum Management Agency of Australia.

South Korean Class A EMC Declaration
This equipment has been conformity assessed for use in business environments. In a residential environment this equipment may cause radio interference. This EMC statement applies to the equipment only for use in business environments.

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이 기기는 업무용 환경에서 사용할 목적으로 적합성평가를 받은 기기로서 가정용 환경에서 사용하는 경우 전파간섭의 우려가 있습니다.

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Contains one or more of the 6 hazardous substances above the maximum concentration value (MCV), 40 Year EPUP.

ISM1-A — This text indicates that the instrument is an Industrial Scientific and Medical Group 1 Class A product (CISPER 11, Clause 4).

ICES/NMB-001 — This text indicates product compliance with the Canadian Interference- Causing Equipment Standard (ICES-001).

Safety Notices

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. Keysight Technologies assumes no liability of the customer's failure to comply with the requirements.

WARNING 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 operating instructions.

WARNING Environmental Conditions
Never use the instrument outside of the specified environmental conditions described in the **Environmental Characteristics** of the specifications.

WARNING Ground the Instrument
This product is provided with protective earth terminals. To minimize shock hazard, the instrument must be connected to the AC 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 injury or death.

WARNING Before Applying Power
Verify that all safety precautions are taken. All connections must be made with the unit turned off, and must be performed by qualified personnel who are aware of the hazards involved. Improper actions can cause fatal injury as well as equipment damage. Note the instrument's external markings described under "Safety Symbols".

WARNING Some power modules generate voltages exceeding 60 VDC
Ensure that instrument connections, load wiring, and load connections are either insulated or covered so that no accidental contact with lethal output voltages can occur.

WARNING Do Not Operate in an Explosive Atmosphere
Do not operate the instrument in the presence of flammable gases or fumes.

WARNING Do Not Remove the Instrument Cover
Only qualified, service-trained personnel who are aware of the hazards involved should remove instrument covers. Disconnect the power cable and any external circuits before removing instrument covers.

WARNING

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

WARNING

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

WARNING

Cleaning
To prevent electric shock, always 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.

WARNING

In Case of Damage
Instruments that are not functioning correctly, appear damaged or defective should be made inoperative and secured against unintended operation until they can be repaired by qualified service personnel.

Symboles de sécurité

Les consignes de sécurité présentées dans cette section doivent être appliquées au cours des différentes phases d'utilisation de cet appareil. Le non-respect de ces précautions ou des avertissements spécifiques mentionnés dans ce manuel constitue une violation des normes de sécurité établies lors de la conception, de la fabrication et de l'usage normal de l'instrument. Keysight Technologies ne saurait être tenu pour responsable du non-respect de ces consignes.

L'équipement est destiné à un usage industriel. Les opérateurs de l'équipement sont soumis à toutes les règles de sécurité applicables. Parallèlement aux avertissements et aux consignes de sécurité contenues dans ce manuel, toutes les réglementations pertinentes en matière de sécurité, de prévention des accidents et d'environnement doivent également être respectées. En particulier, les opérateurs de l'équipement :

- Doivent être informés des règles de sécurité pertinentes.
- Doivent avoir lu et compris le manuel d'utilisation avant d'utiliser l'équipement.
- Doivent utiliser l'équipement de sécurité désigné et recommandé.

AVERTISSEMENT

Généralités
N'utilisez ce produit que de la manière préconisée par le fabricant. Les fonctions de sécurité de ce produit risquent d'être endommagées si vous ne respectez pas les instructions d'utilisation.

AVERTISSEMENT

Conditions environnementales
N'utilisez jamais l'instrument en dehors des conditions environnementales spécifiées décrites dans les Conditions ambiantes des spécifications.

AVERTISSEMENT

Poids élevé
Danger pour les mains et les pieds. Pour éviter les blessures et les dommages à l'instrument, utilisez toujours un chariot robuste ou tout autre dispositif approprié pour déplacer l'instrument. Ne soulevez pas l'instrument seul ; soulevez toujours les instruments avec deux personnes.

AVERTISSEMENT

RISQUE DE CHOCS Mise à la terre de l'instrument
Ce produit comporte une borne de terre de protection. Afin de réduire les risques d'électrocution, l'instrument doit être relié à une source de courant alternatif par l'intermédiaire d'un cordon d'alimentation secteur pourvu d'un fil de terre connecté fermement à une terre électrique (terre de sécurité) au niveau de la prise de courant. Toute interruption du conducteur de protection (mise à la terre) ou toute déconnexion de la borne de terre de protection vous expose à un risque d'électrocution susceptible de provoquer des blessures ou la mort.

AVERTISSEMENT

Avant la mise sous tension
Vérifiez que vous avez bien respecté toutes les consignes de sécurité. Toutes les connexions doivent être effectuées lorsque l'appareil éteint et doivent être effectuées par du personnel qualifié qui connaît les dangers inhérents. Toute action incorrecte peut entraîner des blessures mortelles ainsi que des dommages matériels. Lisez les mentions apposées sur l'extérieur de l'instrument décrites à la section « Symboles de sécurité ».

AVERTISSEMENT

RISQUE D'ÉLECTROCUTION, TENSIONS LÉTALES Certains modèles génèrent des tensions allant jusqu'à 160 V CC. Assurez-vous que les connexions, les fils de charge et les connexions de charge de l'appareil sont isolés ou couverts de sorte qu'aucun accident par contact ne puisse se produire.

AVERTISSEMENT

RISQUE DE CHOCS Ne touchez jamais les câbles ou les connexions immédiatement après avoir éteint l'appareil. En fonction du modèle, des tensions létales demeurent aux bornes de sortie pendant plusieurs secondes après la mise hors tension. Vérifiez qu'il n'y a pas de tension dangereuse sur les bornes de sortie ou de mesure avant de les toucher.

AVERTISSEMENT

RISQUE DE CHOCS avec les sources d'énergie externes
Étant donné que l'instrument peut être utilisé comme charge pour courant absorbé, des tensions dangereuses provenant d'une source d'énergie externe telles qu'une batterie peuvent être présentes sur les bornes de sortie même si l'appareil est éteint. Prévoyez de débrancher la source d'énergie externe avant de toucher les bornes de sortie ou de mesure.

AVERTISSEMENT

RISQUE DE CHOCS en cas d'installation ou de retrait de modules
Ne jamais mettre l'instrument sous tension sans que les six emplacements de modules soient occupés par des modules et/ou des panneaux de remplissage. Ne jamais tenter de retirer ou d'insérer un module ou un panneau de remplissage lorsque l'instrument est sous tension. L'interrupteur d'alimentation doit être éteint et le câble d'alimentation secteur doit être débranchée de l'instrument avant de retirer ou d'installer des modules ou des panneaux de remplissage.

AVERTISSEMENT

Ne pas utiliser en atmosphère explosive
N'utilisez pas l'instrument en présence de gaz ou de vapeurs inflammables.

AVERTISSEMENT

Ne pas démonter le capot de l'instrument
Seules des personnes qualifiées, formées à la maintenance et conscientes des risques d'électrocution encourus peuvent démonter les capots de l'instrument. Débranchez toujours le cordon d'alimentation et tous les circuits externes avant de démonter le capot de l'instrument.

AVERTISSEMENT

Ne pas modifier l'instrument
N'installez pas de composants de remplacement et n'apportez aucune modification non autorisée à l'appareil. Pour garantir les caractéristiques de sécurité de l'instrument, retournez-le à votre bureau de vente et d'après-vente Keysight le plus proche en vue d'une opération de maintenance et de réparation.

AVERTISSEMENT

Lectures et Etat affiché sur par la page de Contrôle Web du Navigateur
En cas de problèmes de communication réseau, les lectures signalées et l'état de l'instrument affichés dans la page de Contrôle Web du Navigateur peuvent ne pas représenter les lectures ou l'état réel de l'instrument. Ne vous fiez pas aux lectures signalées par le Navigateur de Contrôle Web pour déterminer si un circuit pouvant contenir des tensions dangereuses est mis hors tension en toute sécurité. Ne modifiez jamais les connexions de l'instrument lorsque l'alimentation est appliquée.

AVERTISSEMENT

Fusibles
L'instrument contient un fusible interne non accessible à l'utilisateur.

AVERTISSEMENT

Nettoyage
Pour éviter toute électrocution, débranchez toujours la source de courant alternatif avant le nettoyage. Utilisez un chiffon sec ou légèrement humidifié avec de l'eau pour nettoyer les parties externes. N'utilisez pas de détergent ou de solvant. Ne tentez aucun nettoyage interne.

AVERTISSEMENT

En cas de dommages
Les instruments qui ne fonctionnent pas correctement, endommagés ou défectueux doivent être mis hors fonction et protégés contre toute utilisation involontaire jusqu'à ce qu'ils aient été réparés par un personnel qualifié.

1 Quick Reference

Legal and Safety Information

Introduction to the Instrument

Front Panel Menu Reference

Command Quick Reference

Models and Options

Specifications and Characteristics

This document includes user, service, and programming information for the Keysight N6700C Series Modular Power System .

Documentation and Firmware Revisions

You can download the latest version of this document at www.keysight.com/find/n6700-doc. The latest version is also available for mobile devices at www.keysight.com/find/n6700-mobilehelp. If you have feedback on this document, please contact Keysight at www.keysight.com/find/n6700-docfeedback.

This document describes firmware revision E.02.01 and up. For the latest firmware revision go to Firmware Updates .

Contacting Keysight Technologies

Use www.keysight.com/find/assist for information on contacting Keysight worldwide, or contact your Keysight Technologies representative.

If you find a Keysight product or solution is impacted by a cybersecurity issue, please report it using this link: Report a Product Cybersecurity Issue | Keysight.

Introduction to the Instrument

Features at a Glance

Front Panel at a Glance

Front Panel Display at a Glance

Front Panel Keys at a Glance

Rear Panel at a Glance

Features at a Glance

The Keysight N6700 Modular Power System is a configurable, one rack- unit (1U) platform that lets you mix and match power modules to create a power system optimized for your test system requirements.

Keysight N6700–N6702 MPS mainframes are available in power levels of 400 W, 600 W, and 1,200 W. Up to four power modules can be installed in each mainframe. Power modules come in power levels of 20 W through 500 W, have various voltage and current combinations, and provide the following performance features:

- N673xB, N674xB, and N677xA DC Power Modules provide programmable voltage and current, measurement, and protection features, making these economical models suitable for powering the device-under-test or system resources such as fixture controls.
- N675xA High-Performance, Autoranging DC Power Modules provide low noise, high accuracy, fast programming times, and advanced programming and measurement capabilities to speed test throughput.
- N676xA Precision DC Power Modules provide precise control and measurements in the milli- and micro-ampere region with the ability to simultaneously digitize voltage and current and capture those measurements into an oscilloscope-like data buffer.
- N678xA Source/Measure Units (SMU) have a multiple-quadrant power mesh with separate voltage and current priority source modes. These models are optimized for applications such as battery drain analysis and functional testing.
- N6783A Application-Specific DC Power Modules are two-quadrant low-wattage models specifically designed for battery charging/discharging and mobile communications applications.
- N679xA Electronic Load Modules are single-quadrant 100 W and 200 W models having constant current, constant voltage, constant power, and constant resistance operating capabilities. They also provide many of the existing measurement and protection features of the other power modules.

The output and system features are described in the following sections. Not all output features are available on every power module. The Model Differences section describes the features that apply only to specific power modules.

Output features

- Programmable voltage, current, power, or resistance - Full programming capability is provided for the entire range of output voltage and current for all power modules. Power and resistance programing is available on Keysight N679xA load modules.
- Low output noise - Available on Keysight N676xA and N675xA power modules. Output noise is less than 4.5 mV peak-to-peak, which is comparable to linear supplies.
- Arbitrary waveform generation - This allows the output to act as a DC bias transient generator or an arbitrary waveform generator.
- Fast up/down programming - Available on Keysight N675xA, N676xA, and N678xA SMU power modules. Response time is less than 1.5 millisecond from 10% to 90% of the output rating.
- Fast transient response - Available on Keysight N675xA, N676xA, and N678xA SMU power modules. Transient response is less than 100 µs.
- Output autoranging capability - Available on Keysight N676xA and N675xA power modules. Autoranging supplies the maximum rated power over a continuous range of voltage and current settings
- Output On/Off sequencing - A turn-on/turn-off delay capability for each output allows output on/off sequencing.
- Remote voltage sensing - Two remote sensing terminals are provided for each output. When shipped, the remote sense jumpers are included in a separate bag. See Items Supplied.
- Output protection - Each output has over-voltage, over-current, and over-temperature protection. Over-voltage and over-current protection are programmable.
- Multiple-Quadrant operation - Available on Keysight N678xA SMU and N6783A power modules. 2-quadrant operation provides source and sink output capability. Keysight model N6784A offers 4-quadrant output operation.
- Electronic Load operation - Available on Keysight N679xA load modules. 100 W and 200 W input ratings are available.

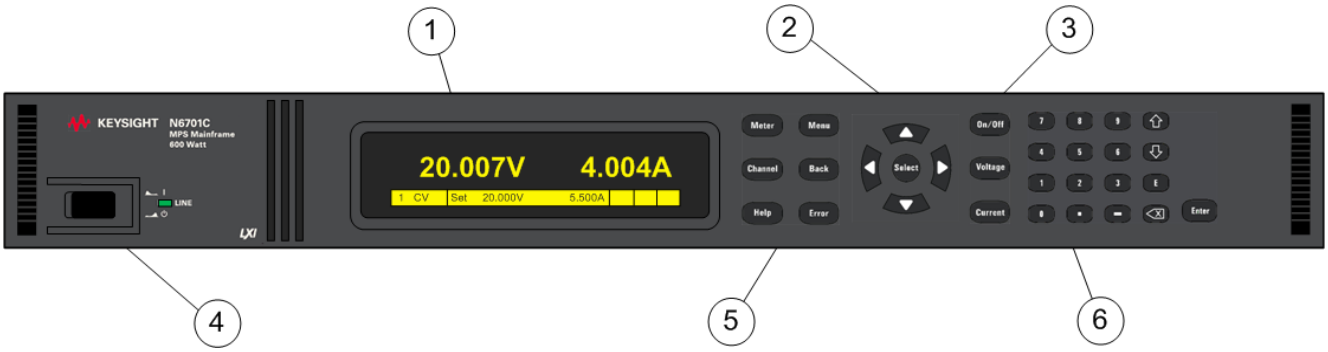
Measurement features

- Multiple-output/Single-output meter display - Switch between a 4-output summary view and a 1-output detailed view of power system information. All power modules display real-time output voltage and current measurements as well as status information.
- Seamless measurement autoranging - Available on Keysight N678xA SMU power modules. Output measurements seamlessly autorange between ranges – however, the 10 µA current range must be selected manually.
- Microampere current measurements - Available on Keysight N6761A, N6762A, and N678xA SMU power modules. Current measurement can be made as low as 1 µA in the 10 µA range.
- Fast Digitizing Available on Keysight N678xA SMU power modules. 5.12 µs/sample for one parameter; 10.24 µs/sample for two parameters.

System features

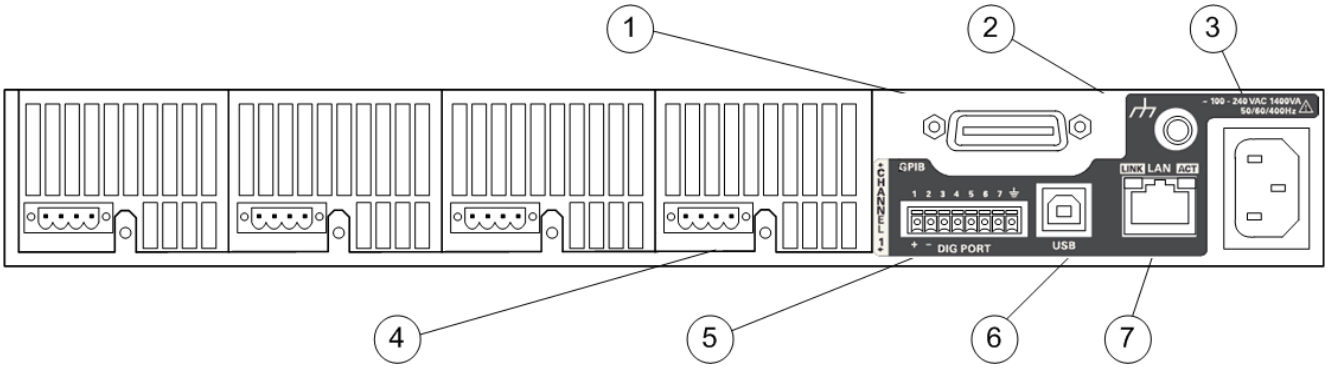
- Choice of three interfaces - GPIB (IEEE-488), LAN, and USB remote programming interfaces are built in.
- Built-in Web server - A built-in Web server lets you control the instrument directly from an internet browser on your computer.
- SCPI language - The instrument is compatible with the Standard Commands for Programmable Instruments (SCPI).
- Front panel I/O setup - Menus let you set up GPIB and LAN parameters from the front panel.
- Real-time status information - The front panel indicates the status of each output. It also indicates when a protection shut-down has occurred.
- Module identification - Each module has identifying data stored in non-volatile memory. Information includes model number, serial number, and options.
- Universal AC input - Mainframes have universal input voltage capability with active power factor correction.

Front Panel at a Glance



1. Display - Turns off after 1 hour of inactivity. Press any key to restore the display.
2. Navigation keys - Move the cursor to a menu item. Select the highlighted menu item.
3. Output keys - Turn the outputs on or off. Enter voltage or current.
4. On/Off switch and LED - LED indicates power is on. Green indicates normal operation. Amber indicates display is in screen-saver mode.
5. System keys - Toggle between single-channel and multiple-channel view. Access front panel command menu. Select an output channel to control.
6. Numeric Entry keys - Enter values. Arrow keys increment or decrement numeric settings.

Rear Panel at a Glance



1. GPIB - GPIB interface connector.
2. Ground - Chassis ground binding post.
3. IEC 320 connector - AC input connector. Power cord requires a ground conductor.
4. Output connector - Includes +/–output and +/– sense terminals.
5. Digital connector - Pin functions are user-configurable.
6. USB - USB interface connector.
7. LAN - 10/100/1000 Base-T Left LED indicates activity. Right LED indicates link integrity.

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.

Front Panel Display at a Glance

Voltage & Current View

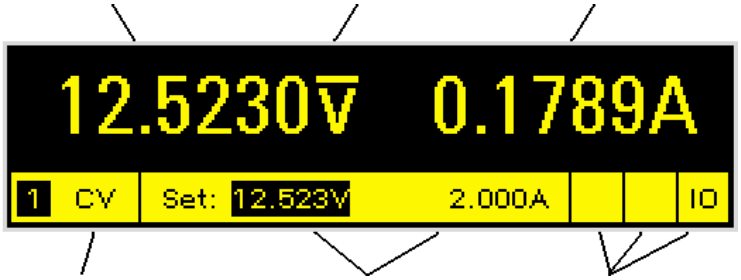
Voltage measurement

Bar indicates output polarity is reversed

Current measurement

Press **Meter**

to toggle between views



Operating status
(CV = constant voltage)

Voltage and current settings

Interface status
(IO = activity on interface)

Voltage, Current, & Power View

Voltage measurement

Current measurement and power measurement

Press **Meter**

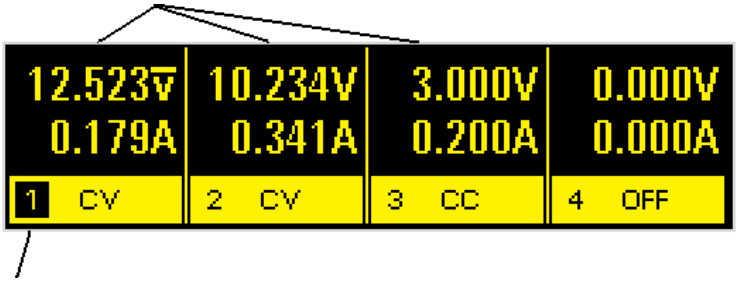
to toggle between views

4-Channel View

Voltage and Current measurements

Press **Meter**

to toggle between views

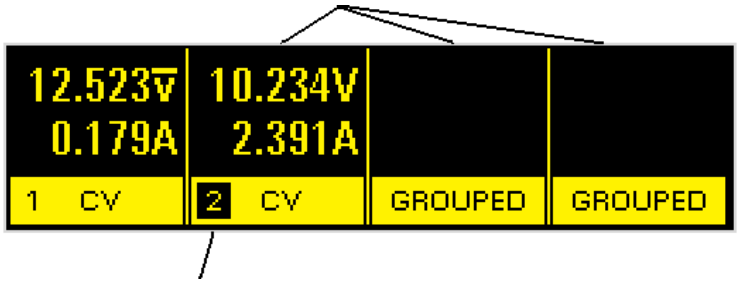


The highlighted channel is the active channel

Grouped-Channel View

Channels 2 through 4 are connected in parallel and have been configured or grouped to act as a single, higher-power channel

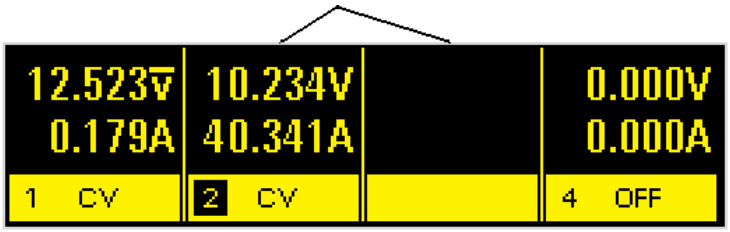
Refer to Output Groups for more information



Grouped channels are addressed using the channel number of the lowest channel in the group

Double-Wide View

Channel 2 is a double-wide power module that occupies two channel locations in the mainframe



Operating status indicators

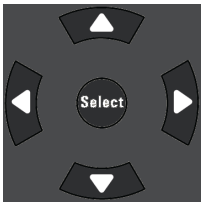
OFF = the output is off
CV = the output is in constant voltage mode
CC = the output is in constant current mode
CP+ = the output is limited (or disabled) by the positive power limit
CP– = the output is limited (or disabled) by the negative power limit
VL+/– = the output is in positive or negative voltage limit mode
CL+/– = the output is in positive or negative current limit mode
OV = the output is disabled by the over-voltage protection
OV– = the output is disabled by the negative over-voltage protection
OC = the output is disabled by the over-current protection
OT = the over-temperature protection has tripped
PF = the output is disabled by a power-fail condition
OSC = the output is disabled by the oscillation protection
INH = the output is disabled by an external inhibit signal
UNR = the output is unregulated
PROT = the output is disabled by a condition from a coupled channel
SH = the load input terminals are shorted (N679xA)
UVI = an under-voltage inhibit condition occurred (N679xA)

Interface status indicators

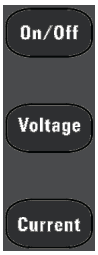
Err = an error has occurred (press Error key to display error message)
Lan = the LAN is connected and has been configured
IO = there is activity on one of the remote interfaces

Front Panel Keys at a Glance

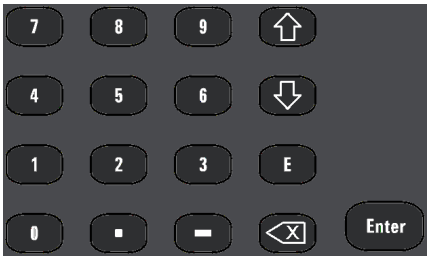
Meter returns the display to metering mode.
Menu accesses the command menu.
Channel selects or highlights a channel to control.
Back backs out of a menu without activating any changes.
Help accesses information about the displayed menu control.
Error displays any error messages in the error queue.



Arrows let you move around in the command menus.
Select lets you make a selection in the command menus. It also lets you enter edit mode for editing the numeric parameters.



On/Off controls the selected output (or all outputs when All is lit). This key is only active in Single- channel or Multiple-channel view.
Voltage lets you change the voltage setting.
Current lets you change the current setting.



The 0 through 9 keys enter numbers.
The (.) key is the decimal point.
The – key is used to enter a minus sign.
The ⬆⬇ arrow keys increment or decrement voltage or current settings. They also select letters in alphabetic entry fields.
The E key enters an exponent. Add the value to the right of the E.
The ⬅back arrow key deletes digits as it backspaces over them.
The Enter key enters a value. If you exit a field without pressing the Enter key, the value is ignored.

Front Panel Menu Reference

Press the **Menu** key to access the front panel menus. For a brief tutorial, refer to Use the Front Panel Menu. If a menu item is grayed-out, it is not available for the module that is being programmed.

1st Menu Level	2nd Level	3rd & 4th Levels	Description
Output	Settings	Voltage	Programs the voltage setting, limits, and ranges
		Current	Programs the current setting, limits, and ranges
		Power	Programs the power limit on models N679xA loads
		Resistance	Programs the resistance setting on N679xA loads Programs output resistance on N6781A, N6785A
	Mode		Selects voltage, current, resistance, or power priority modes on N678xA SMU, N679xA
	Sequence	Delay	Programs Turn-on /Turn-off delay
		Couple	Couples output channels for output on/off synchronization
	Short		Programs an input short on models N679xA loads
	Advanced	Slew Current	Programs current slew rate on models N678xA SMU, N679xA
		Voltage	Programs voltage slew rate
		Power	Programs power slew rate on models N679xA loads
		Resistance	Programs resistance slew rate on models N679xA loads
		Pol	Reverses the polarity of the output and sense terminals
		Bandwidth	Programs output bandwidth on N678xA SMU, N679xA
		UVI	Configures under-voltage inhibit on N679xA loads
		Tmode	Programs turn-on/turn-off impedance on N678xA SMU
Measure	Range		Selects voltage and current measurement range
	Sweep		Specifies measurement points, time interval, trigger offset
	Window		Selects measurement window: Rectangular, Hanning
	Input		Selects Auxiliary voltage input on N6781A, N6785A
	Control		Lets you abort a measurement in progress
Transient	Mode		Selects voltage, current, resistance, or power transient modes
	Step		Specifies the triggered step values
	List	Pace	Specifies Dwell or Trigger paced list

1st Menu Level	2nd Level	3rd & 4th Levels		Description
		Repeat		Specifies number of list repetitions or continuous list
		Terminate		Specifies list settings when the list terminates
		Config		Configures voltage, current, resistance, or power list settings
		Reset		Aborts the list and resets all list parameters
	Arb	Repeat		Specifies the number of times the Arb repeats
		Terminate		Specifies the settings when the Arb terminates
		Function		Selects the Arb type and shape
		Config	Step	Specifies the Step level and time
			Ramp	Specifies the Ramp level and time
			Stair	Specifies the Staircase level and time
			Sine	Specifies the Sine parameters
			Pulse	Specifies the Pulse level and time
			Trap	Specifies the Trapezoid level and time
			Exp	Specifies the Exponent parameters
			CD	Specifies the Constant-Dwell parameters
	TrigSource			Specifies the transient and Arb trigger sources
	Control			Initiates, Triggers, or Aborts triggers; displays trigger state
Protect	OVP			Configures over-voltage protection function
	OCP			Configures over-current protection function
	OPP			Configures over-power protection function
	OT			Returns the over-temperature protection margin
	Inh			Configures the external inhibit signal
	Coupling			Disables ALL output channels for a protection fault
	Wdog			Configures the output watchdog timer
	Osc			Enables/disables oscillation protection on N678xA SMU
	Clear			Clears protection conditions and displays output status
States	Reset			Resets all instrument settings to the reset (*RST) state
	SaveRecall			Saves and recalls instrument settings
	PowerOn			Selects the power-on instrument state

1st Menu Level	2nd & 3rd Levels	4th & 5th Levels	Description
System	IO LAN	Settings	Displays the LAN settings that are presently active
		Modify IP	Configures the IP addressing of the instrument
		Name	Configures the hostname of the instrument
		DNS	Configures the DNS server
		mDNS	Configures the mDNS service name
		Services	Selects the LAN services to enable or disable
		Apply	Applies the configuration changes and restarts
		Cancel	Cancels the configuration changes
		Reset	Performs an LXI LCI reset of LAN settings and restarts
		Defaults	Resets the network to the as-shipped defaults and restarts
	USB		Displays the USB identification string
	GPIB		Selects the GPIB address
	DigPort	Pins	Programs the digital pin's function and polarity
		Data	Sends/reads data from the digital I/O port
	Groups		Defines output channels that are grouped (paralleled)
	Preferences	Display Contrast	Configures the display contrast from 0 to 100%
		Saver	Configures the screen saver and wake-on I/O timer
		View	Specifies the channel-view at turn-on
		Keys	Enables/disables key clicks and configures the On/Off key
		Lock	Locks front panel keys using a password
		IDN	Change manufacturer and model for backward compatibility
	Admin	Login/Logout	Enter a password to access the Admin functions
	Cal	Volt Vprog	Configures High and Low voltage ranges
		Vlim	Calibrates voltage limit High and Low ranges
		Vmeas	Calibrates High, Low, Aux voltage measurement ranges
		Curr Iprog	Calibrates High and Low current ranges
		Ilim	Calibrates current limit
		Imeas	Calibrates High and Low current measurement ranges
		Misc CMRR	Calibrates common mode rejection ratio

1st Menu Level	2nd & 3rd Levels	4th & 5th Levels	Description
		Dprog	Calibrates the downprogrammer
		Ipeak	Calibrates I peak
		Resistance	Calibrates output resistance - all ranges
		Count	Returns the calibration count
		Date	Saves the calibration date for each channel
		Save	Saves the calibration data
	IO		Enables/disables the GPIB, USB, and LAN services
	Sanitize		Performs NISPOM secure erase of all user data
	Update		Password protect firmware updates
	Password		Changes the password for the admin functions
	About	Frame	Displays model, output ratings, serial number, firmware
		Module	Displays model, serial number, options, output ratings

Command Quick Reference

Some [optional] commands have been included for clarity. All settings commands have a corresponding query. See the Syntax Conventions for SCPI.

ABORt	(ACQuire and ELOG commands only on N676xA, N678xA SMU, Option 054)
:ACQuire (@chanlist)	Cancels any triggered measurements.
:ELOG (@chanlist)	Stops external data logging.
:TRANsient (@chanlist)	Cancels any triggered actions.

CALibrate	
:COUNt?	Returns the number of times the unit has been calibrated.
:CURRent	
[:LEVel] <*value*>, (@channel)	Calibrates the current programming.
:LIMit	
:NEGative <*value*>, (@channel)	Calibrates the negative current limit. (N678xA SMU, N6783A-BAT)
:POSitive <*value*>, (@channel)	Calibrates the positive current limit. (N678xA SMU, N6783A, N679xA)
:MEASure <*value*>, (@channel)	Calibrates the current measurement.
:PEAK (@channel)	Calibrates the peak current limit. N675xA, N676xA)
:DATA <*value*>	Enters the calibration value read by the external meter.
:DATE <*"date"*>, (@channel)	Stores the calibration date in nonvolatile memory.
:DPRog (@channel)	Calibrates the current downprogrammer.
:LEVel P1|P2|P3	Advances to the next level in the calibration.
:PASSword <*value*>	Sets a numeric password to prevent unauthorized calibration.
:RESistance 20|6, (@channel)	Calibrates the output resistance. (N6781A, N6785A)
:SAVE	Saves the calibration constants in non-volatile memory.
:STATe 0|OFF|1|ON	Enables/disables calibration mode.
:VOLTage	
[:LEVel] <*value*>, (@channel)	Calibrates the voltage programming.
:CMRR, (@channel)	Calibrates the voltage common mode rejection ratio. (N675xA, N676xA)
:LIMit	
:POSitive <*value*>, (@channel)	Calibrates the positive current limit. (N678xA SMU)
:MEASure <*value*>, (@channel)	Calibrates the voltage measurement.
:AUXiliary, (@channel)	Calibrates the auxiliary voltage measurement. (N6781A, N6785A)

DISPlay	
[:WINDow]	
[:STATe] 0|OFF|1|ON	Turns the front panel display on or off.
:CHANnel <channel>	Selects the channel in 1-channel view.
:VIEW METER1|METER4|METER_VIP	Selects 1-channel, 4-channel, or 1 channel with power view.

FETCh

(FETCh commands only on N676xA, N678xA SMU, Option 054)

[:SCALar]	
:CURRent	
[:DC]? (@chanlist)	Returns the averaged measurement.
:ACDC? (@chanlist)	Returns the RMS measurement (AC + DC).
:HIGH? (@chanlist)	Returns the High level of a pulse waveform.
:LOW? (@chanlist)	Returns the Low level of a pulse waveform.
:MAXimum? (@chanlist)	Returns the maximum value.
:MINimum? (@chanlist)	Returns the minimum value.
:POWer	
[:DC]? (@chanlist)	Returns the averaged measurement. (N676xA, N678xA SMU)
:MAXimum? (@chanlist)	Returns the maximum value.
:MINimum? (@chanlist)	Returns the minimum value.
:VOLTage	
[:DC]? (@chanlist)	Returns the averaged measurement.
:ACDC? (@chanlist)	Returns the RMS measurement (AC + DC).
:HIGH? (@chanlist)	Returns the High level of a pulse waveform.
:LOW? (@chanlist)	Returns the Low level of a pulse waveform.
:MAXimum? (@chanlist)	Returns the maximum value.
:MINimum? (@chanlist)	Returns the minimum value.
:ARRay	
:CURRent	
[:DC]? (@chanlist)	Returns an array with the instantaneous measurement.
:POWer	
[:DC]? (@chanlist)	Returns an array with the instantaneous measurement. (N676xA, N678xA SMU)
:VOLTage	
[:DC]? (@chanlist)	Returns an array with the instantaneous measurement.
:ELOG? <*value* (@chanlist)	Returns the most recent external datalog records.

FORMat

[:DATA] ASCII | REAL	Specifies the format of the returned data.
:BORDer NORMal | SWAPped	Specifies how binary data is transferred.

HCOPy

:SDUMp	
:DATA?	Returns an image of the front panel display.
:DATA	
:FORMat BMP|GIF|PNG	Specifies the format for front panel images returned.

IEEE 488.2 Common Commands

*CLS	Clears status.
*ESE <*value*>	Sets standard event status enable.

*ESR?	Returns event status register.
*IDN?	Returns instrument identification.
*LRN?	Returns a sequence of SCPI commands.
*OPC	Enables "operation complete" bit in ESR.
*OPC?	Returns a 1 when all pending operations complete.
*OPT?	Returns option number.
*RCL <*value*>	Recalls a saved instrument state.
*RDT?	Returns output channel descriptions.
*RST	Resets the instrument.
*SAV <*value*>	Saves an instrument state.
*SRE <*value*>	Sets service request enable register.
*STB?	Returns the status byte.
*TRG	Generates a trigger.
*TST?	Performs a self-test, then returns results.
*WAI	Pauses command processing until all device commands are done.

INITiate (ACQuire and ELOG commands only on N676xA, N678xA SMU, Option 054)

[:IMMediate]	
:ACQuire (@chanlist)	Initiates the measurement trigger system.
:ELOG (@chanlist)	Initiates external data logging.
:TRANsient (@chanlist)	Initiates the transient trigger system.
:CONTinuous	
:TRANsient 0|OFF|1|ON, (@chanlist)	Continuously initiates the transient trigger system.

LXI

:IDENtify	
[:STATe] 0|OFF|1|ON	Turns the front panel LXI identify indicator on or off.
:MDNS	
[:STATe] 0|OFF|1|ON	Controls the state of the mDNS server.

MEASure

[:SCALar]	
:CURRent	
[:DC]? (@chanlist)	Takes a measurement; returns the averaged current.
:ACDC? (@chanlist)	Takes a measurement; returns the RMS current (AC + DC).
:HIGH? (@chanlist)	Takes a measurement; returns the High level of a current pulse.
:LOW? (@chanlist)	Takes a measurement; returns the Low level of a current pulse.
:MAXimum? (@chanlist)	Takes a measurement; returns the maximum current.
:MINimum? (@chanlist)	Takes a measurement; returns the minimum current.
:POWer	
[:DC]? (@chanlist)	Takes a measurement; returns the averaged power. (N676xA, N678xA SMU)
:MAXimum? (@chanlist)	Takes a measurement; returns the maximum power.
:MINimum? (@chanlist)	Takes a measurement; returns the minimum power.

:VOLTage	
[:DC]? (@chanlist)	Takes a measurement; returns the averaged voltage.
:ACDC? (@chanlist)	Takes a measurement; returns the RMS voltage (AC + DC).
:HIGH? (@chanlist)	Takes a measurement; returns the High level of a voltage pulse.
:LOW? (@chanlist)	Takes a measurement; returns the Low level of a voltage pulse.
:MAXimum? (@chanlist)	Takes a measurement; returns the maximum voltage.
:MINimum? (@chanlist)	Takes a measurement; returns the minimum voltage.
:ARRay	(ARRay commands only on N676xA, N678xA SMU and Option 054)
:CURRent	
[:DC]? (@chanlist)	Takes a measurement; returns the instantaneous current.
:POWer	
[:DC]? (@chanlist)	Takes a measurement; returns the instantaneous power. (N676xA, N678xA SMU)
:VOLTage	
[:DC]? (@chanlist)	Takes a measurement; returns the instantaneous voltage.

OUTPut

[:STATe] 0|OFF|1|ON [,NORelay], (@chanlist)	Enables/disables the output.
:COUPle	
[:STATe] 0|OFF|1|ON	Enables/disables output coupling.
:CHANnel [<*value*>, {<*value*>}]	Selects which channels are coupled.
:DOFFset <*value*>	Sets a delay offset to synchronize coupled output state changes.
:MODE AUTO|MANual	Specifies the output delay offset coupling mode.
:MAX	
:DOFFset?	Returns the delay offset required for this instrument.
:DELay	
:FALL <*value*>, (@chanlist)	Sets the output turn-off sequence delay.
:RISE <*value*>, (@chanlist)	Sets the output turn-on sequence delay.
:PMODE VOLTage|CURRent, (@chanlist)	Sets the mode for turn-on/off transitions. (N6761A, N6762A)
:TMODE HIGHz|LOWZ, (@chanlist)	Specifies the turn-on/turn-off impedance. (N678xA SMU)
:INHibit	
:MODE LATChing|LIVE|OFF	Sets the operating mode of the remote inhibit digital pin.
:PON	
:STATe RST|RCL0	Set the output power-on state.
:PROTection	
:CLEar (@chanlist)	Resets the latched protection.
:COUPle0|OFF|1|ON	Enables/disables channel coupling for protection faults.
:DELay <*value*>, (@chanlist)	Sets the over-current protection programming delay.
:OSCillation0|OFF|1|ON, (@chanlist)	Enables/disables output oscillation protection. (N678xA SMU)
:TEMPerature	
:MARGin? (@chanlist)	Returns the margin remaining before the over-temperature trips.
:WDOG	
[:STATe] 0|OFF|1|ON	Enables/disables the I/O watchdog timer.
:DELay <*value*>	Sets the watchdog delay time.

:RELay	
:POLarity NORMal|REVerse, (@chanlist)	Sets the polarity of the output relays. (Option 760)
:SHORt	
[:STATe] 0|OFF|1|ON	Simulates a short circuit on the input of the load. (N679xA)

SENSe

:CURRent	
:CCOMpensate 0|OFF|1|ON, (@chanlist)	Enables/disables the capacitive current compensation. (not on N678xA SMU, N679xA)
[:DC]	
:RANGe	
[:UPPer] <*value*>, (@chanlist)	Selects a DC current measurement range.
:AUTO 0|OFF|1|ON, (@chanlist)	Enables/disables seamless measurement autoranging. (N678xA SMU)
:ELOG	(ELOG commands only on N676xA, N678xA SMU, Option 054)
:CURRent	
[:DC]	
:RANge	
[:UPPer] <*value*>, (@chanlist)	Selects the Elog current measurement range.
:AUTO 0|OFF|1|ON, (@chanlist)	Enables/disables seamless measurement autoranging. (N678xA SMU)
:FUNCtion	
:CURRent 0|OFF|1|ON, (@chanlist)	Enables/disables current data logging.
:MINMax 0|OFF|1|ON, (@chanlist)	Enables/disables min/max current data logging.
:VOLTage 0|OFF|1|ON, (@chanlist)	Enables/disables voltage data logging.
:MINMax 0|OFF|1|ON, (@chanlist)	Enables/disables min/max voltage data logging.
:PERiod <*value*>, (@chanlist)	Sets the integration time of an Elog measurement.
:VOLTage	
[:DC]	
:RANge	
[:UPPer] <*value*>, (@chanlist)	Selects the Elog voltage measurement range.
:AUTO 0|OFF|1|ON, (@chanlist)	Enables/disables seamless measurement autoranging. (N678xA SMU)
:FUNCtion <*"function"*>, (@chanlist)	Selects the measurement function (for backward compatibility)
:CURRent 0|OFF|1|ON, (@chanlist)	Enables/disables current measurements (replaces FUNCtion)
:VOLTage 0|OFF|1|ON, (@chanlist)	Enables/disables voltage measurements (replaces FUNCtion)
:INPut MAIN|AUXiliary, (@chanlist)	Selects the voltage measurement input. (N6781A, N6785A)
:SWEep	(SWEep commands only on N676xA, N678xA SMU, Option 054)
:OFFSet	
:POINts <*value*>, (@chanlist)	Defines the offset in a data sweep for triggered measurements.
:POINts <*value*>, (@chanlist)	Defines the number of points in a measurement.
:TINTerval <*value*>, (@chanlist)	Defines the time period between measurement samples.
:RESolution RES20|RES40	Sets the measurement resolution.
:VOLTage	
[:DC]	
:RANGe	
[:UPPer] <*value*>, (@chanlist)	Selects a DC voltage measurement range.

:AUTO 0|OFF|1|ON, (@chanlist)	Enables/disables seamless measurement autoranging. (N678xA SMU)
:WINDow	(WINDow command only on N676xA, N678xA SMU, Option 054)
[:TYPE] HANNing|RECTangular, (@chanlist)	Selects the measurement window.

[SOURce:]

ARB	(ARB commands only on N676xA, N678xA SMU, Option 054)
:COUNt?	Sets the ARB repeat count.
:CURRent | :VOLTage | :POWer | :RESISTANCE	Sets the Arb type (POWer and RESISTANCE only on N679xA)
:CDWell	
[:LEVel] <*value*>, {<*value*>}, (@chanlist)	Sets the list of the constant dwell Arb
:DWELl <*value*>, (@chanlist)	Sets the dwell time for the constant dwell Arb
:POINts? (@chanlist)	Returns the number of constant-dwell Arb points
:CONVert (@chanlist)	Converts the selected Arb to a user-defined list
:EXPonential	
:END	
[:LEVel] <*value*>, (@chanlist)	Sets the end level of the exponential Arb
:STARt	
[:LEVel] <*value*>, (@chanlist)	Sets the initial level of the exponential Arb
:TIMe <*value*>, (@chanlist)	Sets the length of the start time or delay
:TCONstant <*value*>, (@chanlist)	Sets the time constant of the exponential Arb
:TIMe <*value*>, (@chanlist)	Sets the time of the exponential Arb
:PULSe	
:END	
:TIMe <*value*>, (@chanlist)	Sets the length of the end time
:STARt	
[:LEVel] <*value*>, (@chanlist)	Sets the initial level of the pulse
:TIMe <*value*>, (@chanlist)	Sets the length of the start time or delay
:TOP	
[:LEVel] <*value*>, (@chanlist)	Sets the top level of the pulse
:TIMe <*value*>, (@chanlist)	Sets the length of the pulse
:RAMP	
:END	
[:LEVel] <*value*>, (@chanlist)	Sets the end level of the ramp
:TIMe <*value*>, (@chanlist)	Sets the length of the end time
:RTIMe <*value*>, (@chanlist)	Sets the rise time of the ramp
:STARt	
[:LEVel] <*value*>, (@chanlist)	Sets the initial level of the ramp
:TIMe <*value*>, (@chanlist)	Sets the length of the start time or delay
:SINusoid	
:AMPLitude <*value*>, (@chanlist)	Sets the amplitude of the sine wave
:FREQuency <*value*>, (@chanlist)	Sets the frequency of the sine wave
:OFFSet <*value*>, (@chanlist)	Sets the DC offset of the sine wave
:STAIRcase	

:END	
[:LEVel] <*value*>, (@chanlist)	Sets the end level of the staircase
:TIMe <*value*>, (@chanlist)	Sets the length of the end time
:NSTeps <*value*>, (@chanlist)	Sets the number of steps in the staircase
:STARt	
[:LEVel] <*value*>, (@chanlist)	Sets the initial level of the staircase
:TIMe <*value*>, (@chanlist)	Sets the length of the start time or delay
:TIMe <*value*>, (@chanlist)	Sets the length of the staircase
:STEP	
:END	
:TIMe <*value*>, (@chanlist)	Sets the end level of the step
:STARt	
[:LEVel] <*value*>, (@chanlist)	Sets the initial level of the step
:TIMe <*value*>, (@chanlist)	Sets the length of the start time or delay
: TRAPezoid	
:END	
:TIMe <*value*>, (@chanlist)	Sets the length of the end time
:FTIMe <*value*>, (@chanlist)	Sets the length of the fall time
:RTIMe <*value*>, (@chanlist)	Sets the length of the rise time
:STARt	
[:LEVel] <*value*>, (@chanlist)	Sets the initial level of the trapezoid
:TIMe <*value*>, (@chanlist)	Sets the length of the start time or delay
:TOP	
[:LEVel] <*value*>, (@chanlist)	Sets the top level of the trapezoid
:TIMe <*value*>, (@chanlist)	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 <*value*>, {<*value*>}, (@chanlist)	Sets the user-defined dwell values
:POINts? (@chanlist)	Returns the number of dwell points
:LEVel <*value*>, {<*value*>}, (@chanlist)	Sets the user-defined level values
:POINts? (@chanlist)	Returns the number of points
:FUNCtion <function>, (@chanlist)	Selects the Arb function (for backward compatibility)
:SHAPe <shape>, (@chanlist)	Selects the Arb function (replaces ARB:FUNCtion)
:TYPE CURRent|VOLTage|RESISTANCE, (@chanlist)	Selects the Arb type (replaces ARB:FUNCtion)
:SEQuence	
:COUNt <*value*>|INFinity, (@chanlist)	Sets the number of times the sequence is repeated
:LENGth? (@chanlist)	Returns the number of steps in the sequence
:QUALity? (@chanlist)	Returns the quality of the waveforms in the sequence
:RESet (@chanlist)	Resets the sequence to its power-on default setting
:STEP	
:COUNt <*value*>|INFinity, <step#> (@chanlist)	Sets the number of times the sequence step is repeated
:CURRent <function>, <step#> (@chanlist)	Programs the steps in a current sequence

:FUNCtion	
:SHAPe <function>, <step#>, (@chanlist)	Creates a new sequence step
:PACing DWELl|TRIGger, <step#> (@chanlist)	Specifies the type of pacing for the step
:RESISTANCE <function>, <step#> (@chanlist)	Programs the steps in a resistance sequence
:VOLTage <function>, <step#> (@chanlist)	Programs the steps in a voltage sequence
:TERMinate	
:LAST 0|OFF|1|ON, (@chanlist)	Sets the sequence termination mode
:TERMinate	
:LAST 0|OFF|1|ON, (@chanlist)	Sets the Arb termination mode

[SOURce:]

CURRent

[:LEVel]	
[:IMMediate]	
[:AMPLitude] <*value*>, (@chanlist)	Sets the output current.
:TRIGgered	
[:AMPLitude] <*value*>, (@chanlist)	Sets the triggered output current
:LIMit	
[:POSitive]	
[:IMMediate]	
[:AMPLitude] <*value*>, (@chanlist)	Sets the positive current limit. (N678xA SMU, N6783A, N679xA)
:COUPle 0|OFF|1|ON, (@chanlist)	Sets the current limit tracking state. (N678xA SMU)
:NEGative	
[:IMMediate]	
[:AMPLitude] <*value*>, (@chanlist)	Sets the negative current limit. (N678xA SMU, N6783A-BAT)
:MODE FIXed|STEP|LIST|ARB, (@chanlist)	Sets the transient mode.
:PROTection	
:DELay	
[:TIME] <*value*>, (@chanlist)	Sets the over-current protection delay.
:STARt SCHange|CCTRans, (@chanlist)	Specifies what starts the over-current protection delay timer.
:STATe 0|OFF|1|ON, (@chanlist)	Enables/disables the over-current protection.
:RANGe <*value*>, (@chanlist)	Sets the output current range.
:SLEW	
[:POSitive]	
[:IMMediate] <*value*>|INFinity, (@chanlist)	Sets the current slew rate. (N678xA SMU, N679xA)
:MAXimum 0|OFF|1|ON, (@chanlist)	Enables/disables the maximum slew rate override. (N678xA SMU, N679xA)
:COUPle 0|OFF|1|ON, (@chanlist)	Sets the current slew tracking state. (N679xA)
:NEGative	
[:IMMediate] <*value*>|INFinity, (@chanlist)	Sets the negative current slew rate. (N679xA)
:MAXimum 0|OFF|1|ON, (@chanlist)	Enables/disables the maximum slew rate override. (N679xA)

[SOURce:]	
DIGital	
:INPut	
:DATA?	Reads the state of the digital control port.
:OUTPut	
:DATA <*value*>	Sets the state of the digital control port.
:PIN<1-7>	
:FUNCtion <*function*>	Sets the function of the pins. DIO |DINPut |FAULt |INHibit |ONCouple |OFFCouple |TOUTput |TINPut
:POLarity POSitive|NEGative	Sets the polarity of the pins.
:TOUTput	
:BUS	
[:ENABle] 0|OFF|1|ON	Enables/disables BUS triggers on digital port pins.

[SOURce:]	
FUNCtion CURRent|VOLTage|RESistance|POWer, (@chanlist)	Sets the output priority mode). (N678xA SMU, N679xA)

[SOURce:]	
LIST	(LIST commands only on N676xA, N678xA SMU and Option 054)
:COUNt <*value*>|INFinity, (@chanlist)	Sets the list repeat count.
:CURRent	
[:LEVel] <*value*>{,<*value*>}, (@chanlist)	Specifies the setting for each list step.
:POINts? (@chanlist)	Returns the number of list points (same as steps).
:DWELl <*value*>{,<*value*>}, (@chanlist)	Specifies the dwell time for each list step.
:POINts? (@chanlist)	Returns the number of list points (same as steps).
:POWer	
[:LEVel] <*value*>{,<*value*>}, (@chanlist)	Specifies the setting for each list step. (N679xA)
:POINts? (@chanlist)	Returns the number of list points (same as steps).(N679xA)
:RESistance	
[:LEVel] <*value*>{,<*value*>}, (@chanlist)	Specifies the setting for each list step. (N679xA)
:POINts? (@chanlist)	Returns the number of list points (same as steps).(N679xA)
:STEP ONCE|AUTO, (@chanlist)	Specifies how the list responds to triggers.
:TERMinate	
:LAST 0|OFF|1|ON, (@chanlist)	Determines the output value when the list terminates.
:TOUTput	
:BOSTep	
[:DATA] <*Bool*>{,<*Bool*>}, (@chanlist)	Generates a trigger out at the Beginning Of STep
:POINts? (@chanlist)	Returns the number of list points (same as steps).
:EOSTep	
[:DATA] <*Bool*>{,<*Bool*>}, (@chanlist)	Generates a trigger out at the End Of STep
:POINts? (@chanlist)	Returns the number of list points (same as steps).
:VOLTage	
[:LEVel] <*value*>{,<*value*>}, (@chanlist)	Specifies the setting for each list step.
:POINts? (@chanlist)	Returns the number of list points (same as steps).

[SOURce:]	
POWer	
[:LEVel]	
[:IMMediate]	
[:AMPLitude] <*value*>, (@chanlist)	Sets the input power level. (N679xA)
:TRIGgered	
[:AMPLitude] <*value*>, (@chanlist)	Sets the triggered input power. (N679xA)
:LIMit <*value*>, (@chanlist)	Sets the power limit on output channels. (not on N678xA)
:MODE FIXed|STEP|LIST|ARB, (@chanlist)	Sets the power transient mode. (N679xA)
:PROTection	
:DELay	
[:TIME] <*value*>, (@chanlist)	Sets the power protection delay. (N679xA)
:STATe 0|OFF|1|ON, (@chanlist)	Enables/disables the power protection. (N679xA)
:RANGe <*value*>, (@chanlist)	Sets the power range. (N679xA)
:SLEW	
[:POSitive]	
[:IMMediate] <*value*>|INFinity, (@chanlist)	Sets the power slew rate. (N679xA)
:MAXimum 0|OFF|1|ON, (@chanlist)	Enables/disables the maximum slew rate override. (N679xA)
:COUPle 0|OFF|1|ON, (@chanlist)	Sets the power slew tracking state. (N679xA)
:NEGative	
[:IMMediate] <*value*>|INFinity, (@chanlist)	Sets the negative power slew rate. (N679xA)
:MAXimum 0|OFF|1|ON, (@chanlist)	Enables/disables the maximum slew rate override. (N679xA)

[SOURce:]	
RESistance	
[:LEVel]	
[:IMMediate]	
[:AMPLitude] <*value*>, (@chanlist)	Sets the output resistance level. (N6781A, N6785A, N679xA)
:TRIGgered	
[:AMPLitude] <*value*>, (@chanlist)	Sets the triggered resistance. (N679xA)
:MODE FIXed|STEP|LIST|ARB, (@chanlist)	Sets the resistance transient mode. (N679xA)
:RANGe <*value*>, (@chanlist)	Sets the resistance range. (N679xA)
:SLEW	
[:POSitive]	
[:IMMediate] <*value*>|INFinity, (@chanlist)	Sets the resistance slew rate. (N679xA)
:MAXimum 0|OFF|1|ON, (@chanlist)	Enables/disables the maximum slew rate override. (N679xA)
:COUPle 0|OFF|1|ON, (@chanlist)	Sets the resistance slew tracking state. (N679xA)
:NEGative	
[:IMMediate] <*value*>|INFinity, (@chanlist)	Sets the negative resistance slew rate. (N679xA)
:MAXimum 0|OFF|1|ON, (@chanlist)	Enables/disables the maximum slew rate override. (N679xA)
:STATe 0|OFF|1|ON, (@chanlist)	Enables/disables output resistance programming. (N6781A, N6785A)

[SOURce:]
STEP
:TOUTput 0|OFF|1|ON, (@chanlist) Specifies whether a trigger is generated when a step occurs.

[SOURce:]
VOLTage
[:LEVel]
[:IMMediate]
[:AMPLitude] <*value*>, (@chanlist) Sets the output voltage.
:TRIGgered
[:AMPLitude] <*value*>, (@chanlist) Sets the triggered output voltage.
:BWIDth
[:RANGe] LOW|HIGH1|2|3, (@chanlist) Sets the voltage bandwidth. (N678xA SMU)
:LEVel LOW|HIGH1|2|3, <frequency>, (@chanlist) Sets the bandwidth frequency. (N678xA SMU)
:INHibit
:VON
[:LEVel] <*value*>, (@chanlist) Current will sink if voltage is > voltage-on level. (N679xA)
:MODE LATChing|LIVE|OFF Sets the under-voltage inhibit mode. (N679xA)
:LIMit
[:POSitive]
[:IMMediate]
[:AMPLitude] <*value*>, (@chanlist) Sets the positive voltage limit. (N678xA SMU)
:COUPle 0|OFF|1|ON, (@chanlist) Sets the voltage limit tracking state. (N6784A)
:NEGative
[:IMMediate]
[:AMPLitude] <*value*>, (@chanlist) Sets the negative voltage limit. (N6784A)
:MODE FIXed|STEP|LIST|ARB, (@chanlist) Sets the transient mode.
:PROTection
[:LOCal]
[:LEVel] <*value*>, (@chanlist) Sets the over-voltage protection level.
:DELay
[:TIME] <*value*>, (@chanlist) Sets the over-voltage protection delay. (N678xA SMU, N6783A)
:REMote
[:POSitive]
[:LEVel] <*value*>, (@chanlist) Sets the positive remote OV protection. (N678xA SMU, N679xA)
:NEGative
[:LEVel] <*value*>, (@chanlist) Sets the negative remote OV protection. (N6784A)
:REVerse
:STATe 0|OFF|1|ON, (@chanlist) Specifies the input state when a reverse voltage is detected. (N679xA)
:TRACking
[:STATe] 0|OFF|1|ON, (@chanlist) Enables/disables tracking over-voltage protection. (Option J01)
:OFFSet <*value*>, (@chanlist) Sets the tracking OVP offset. (Option J01)
:RANGe <*value*>, (@chanlist) Sets the output voltage range.

:RESistance	
[:LEVel]	
[:IMMediate]	
[:AMPLitude] <*value*>, (@chanlist)	Sets the voltage priority resistance level. (N6781A, N6785A)
:STATe 0|OFF|1|ON, (@chanlist)	Enables/disables the voltage priority resistance. (N6781A, N6785A)
:SLEW	
[:POSitive]	
[:IMMediate] <*value*>|INFinity, (@chanlist)	Sets the voltage slew rate.
:MAXimum 0|OFF|1|ON, (@chanlist)	Enables/disables the maximum slew rate override.
:COUPle 0|OFF|1|ON, (@chanlist)	Sets the current slew tracking state. (N679xA)
:NEGative	
[:IMMediate] <*value*>|INFinity, (@chanlist)	Sets the negative current slew rate. (N679xA)
:MAXimum 0|OFF|1|ON, (@chanlist)	Enables/disables the maximum slew rate override. (N679xA)

STATus

:OPERation	
[:EVENt]? (@chanlist)	Queries the operation event register.
:CONDition? (@chanlist)	Queries the operation condition register.
:ENABle <*value*>, (@chanlist)	Sets the operation enable register.
:NTRansiton <*value*>, (@chanlist)	Sets the negative transition filter.
:PTRansiton <*value*>, (@chanlist)	Sets the positive transition filter.
:PRESet	Presets all Enable, PTR, and NTR registers.
:QUEStionable	
[:EVENt]? (@chanlist)	Queries the questionable event register.
:CONDition? (@chanlist)	Queries the questionable condition register.
:ENABle <*value*>, (@chanlist)	Sets the questionable enable register.
:NTRansiton <*value*>, (@chanlist)	Sets the negative transition filter.
:PTRansiton <*value*>, (@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	
:LAN|TCPip:CONTrol?	Returns the initial socket control connection port number.
:RLSTate LOCal|REMote|RWLock	Configures the remote/local state of the instrument.
:ERRor?	Reads and clears one error from the error queue.
:GROup?	(GROup commands do NOT apply to models N678xA SMU)
:CATalog?	Returns the groups that have been defined.
:DEFine (@chanlist)	Group multiple channels to create a single channel.

:DELete (@channel)	Remove the specified channel from the group.
:ALL	Ungroups all channels.
:PASSword	
:FPANel	
:RESet	Resets the front panel lockout password to zero.
:PERSona	
:MANufacturer "<manufacturer>"	Changes the manufacturer identity.
:DEFault	Sets the manufacturer identity to the factory default.
:MODel "<model number>"	Changes the model number.
:DEFault	Sets the model number to the factory default.
:REBoot	Reboots the instrument to its power-on state.
:SECurity	
:IMMediate	Clears all user memory and reboots the instrument.
:VERSion?	Returns the SCPI version that the instrument complies with.

TRIGger (ACQuire and ELOG commands only on N676xA, N678xA SMU, Option 054)

:ACQuire	
[:IMMediate] (@chanlist)	Generates an immediate measurement trigger.
:CURRent	
[:LEVel] <*value*>, (@chanlist)	Sets the triggered level of the output.
:SLOPe POSitive|NEGative, (@chanlist)	Sets the slope of the signal.
:SOURce <*source*>, (@chanlist)	Selects the trigger source for the acquisition system: BUS |CURRent<1-4> |EXTernal |PIN<1-7> |TRANsient<1-4> |VOLTage<1-4>
:TOUTput	
[:ENABle] 0|OFF|1|ON, (@chanlist)	Enables measurement triggers to be sent to a digital port pin.
:VOLTage	
[:LEVel] <*value*>, (@chanlist)	Sets the triggered level of the output.
:SLOPe POSitive|NEGative, (@chanlist)	Sets the slope of the signal.
:ARB	
:SOURce <*source*>	Selects the trigger source for the arbitrary waveform generator: BUS |EXTernal |IMMediate
:ELOG	
[:IMMediate] (@chanlist)	Generates an immediate trigger for external data logging.
:SOURce <*source*>, (@chanlist)	Selects the trigger source for external data logging: BUS |EXTernal |IMMediate| PIN<1-7>
:MEASure	
:TALign	
:CORRection	
[:STATe] 0|OFF|1|ON	Improves the alignment of measurement triggers with measurement data.
:TRANsient	
[:IMMediate] (@chanlist)	Generates an immediate output transient trigger.
:SOURce <*source*>, (@chanlist)	Selects the trigger source for the transient system: BUS |EXTernal IMMediate |PIN<1-7> |TRANsient<1-4>

Models and Options

Model Descriptions

Model Differences

Options

Model Descriptions

Model	Description
N6700C / N6701C / N6702C	400 W / 600 W / 1200W MPS Mainframe - without power modules
N6710B / N6711A / N6712A	Build-to-order Modular Power System – mainframe with installed power modules
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, N6777A	50 W / 100 W / 300 W 100 V DC Power Module
N6751A / N6752A	50 W / 100 W High-Performance Autoranging DC Power Module
N6753A, N6754A / N6755A, N6756A	300 W / 500 W High-Performance Autoranging DC Power Module
N6761A / N6762A	50 W / 100 W Precision DC Power Module
N6763A, N6764A / N6765A, N6766A	300 W / 500 W Precision DC Power Module
N6781A, N6782A, N6784A	20 W Source/Measure Unit (SMU)
N6785A, N6786A	80 W Source/Measure Unit (SMU)
N6783A-BAT / N6783A-MFG	18 W / 24 W Application-Specific DC Power Module
N6791A, N6792A	100 W/ 200 W Electronic Load Module

Model Differences

Feature	DC Power	High-Performance	Precision
(● = available)	N673xB, N674xB, N67'7xA	N675xA	N676xA
50 W output rating	N6731B – N6736B	N6751A	N6761A
100 W output rating	N6741B – N6746B	N6752A	N6762A
300 W output rating	N6773A – N6777A	N6753A, N6754A	N6763A, N6764A
500 W output rating		N6755A, N6756A	N6765A, N6766A
Output disconnect relays	Option 761	Option 761	Option 761
Output disconnect/polarity reversal relays [1]	Option 760	Option 760	Option 760
Arbitrary waveform generation	Option 054	Option 054	●
Autoranging output capability		●	●
Voltage or current turn-on preferred mode			N6761A, N6762A
Precision voltage and current measurements			●
Low voltage and low current output range			N6761A, N6762A
Low voltage and low current measurement range			●
200 microampere measurement range [2]			Option 2UA
Simultaneous voltage and current measurements			●
SCPI command output list capability [3]	Option 054	Option 054	●
SCPI command array readback [3]	Option 054	Option 054	●
SCPI command programmable sample rate [3]	Option 054	Option 054	●
SCPI command external data logging [3]	Option 054	Option 054	●
Double-wide (occupies 2 channel locations)		N6753A - N6756A	N6763A - N6766A

Note 1 Output current is limited to 10A max. on Models N6742B and N6773A with Option 760.
Option 760 is not available on Models N6741B, N6751A, N6752A, N6761A, and N6762A.
Note 2 Option 2UA.is only available on Models N6761A and N6762A. It includes Option 761.
Note 3 Only available when using the remote interfaces; not from the front panel.

Feature	Source/Measure Units (SMU)					Application-Specific	
(● = available)	N6781A	N6782A	N6784A	N6785A	N6786A	N6783A -BAT	N6783A -MFG
Output rating	20 W	20 W	20 W	80 W	80 W	24 W	18 W
2-quadrant operation	●	●		●	●	●	●
4-quadrant operation			●				
Auxiliary voltage input	●			●			
Output disconnect relays	●	●	●	●	●	Opt. 761	Opt. 761
Arbitrary waveform generation [1]	●	●	●	●	●	●	●
Negative voltage protection	●	●	●	●	●	●	●
Voltage or current priority	●	●	●	●	●		
Programmable resistance	●			●			
Number of voltage output ranges	3	3	3	4	4	1	1
Number of current output ranges	3	3	4	4	4	1	1
Number of voltage measurement ranges	3	3	3	1	1	1	1
Number of current measurement ranges	4	4	4	3	3	2	2
Simultaneous voltage and current measurements	●	●	●	●	●		
Seamless measurement autoranging	●	●	Opt. SMR	●	●		
SCPI output list capability [1, 2]	●	●	●	●	●	●	●
SCPI array readback [2]	●	●	●	●	●	●	●
SCPI programmable sample rate [2]	●	●	●	●	●	●	●
SCPI external data logging [2]	●	●	●	●	●	●	●
Double-wide (occupies two channel locations)				●	●		

Note 1 Arbitrary waveforms and List capability is not available on the negative current output on Model N6783A
Note 2 Only available when using the remote interfaces; not from the front panel.

Feature	Load Modules	
(● = available)	N6791A	N6792A
Input rating [1]	100 W	200 W
Input terminal short capability	●	●
Arbitrary waveform generation	●	●
Under-voltage inhibit	●	●
Voltage, current, resistance, and power priority	●	●
Number of resistance input ranges	3	3
Number of current input ranges [2]	2	2
Number of voltage input ranges [2]	1	1
Number of power input ranges	2	2
Simultaneous voltage and current measurements	●	●
SCPI command output list capability [3]	●	●
SCPI command array readback [3]	●	●
SCPI command programmable sample rate [3]	●	●
SCPI command external data logging [3]	●	●
Double-wide (occupies 2 channel locations)		●

Note 1 The load module's input is referred to by the term "Output" throughout this document.
Note 2 The input and measurement ranges re coupled.
Note 3 Only available when using the remote interfaces; not from the front panel.

Options

Mainframe Options	Description
908	Rack Mount Kit. For mounting in a 19-inch EIA rack cabinet. Also available as Model N6709C.
FLR	Filler module. For mainframes with less than four power modules. Also available as Model N6708A.

Power Module Options	Description
054	High-Speed Test Extensions. Includes digitized output measurements and output list capability. Available for Models N673xB,- 4xB,-5xA, -7xA. Included with Models N676xA, N678xA SMU, and N6783A.
760 [1]	Output disconnect/polarity reversal. Disconnects the + and – output and sense terminals. Switches the + and – output and sense polarities. Not available on N6741B, N6751A, N6752A, N676xA, N678xA.SMU, or N679xA.
761 [1]	Output disconnect. Disconnects + and – output and sense terminals. Standard on N678xA SMU. Not available on N679xA.
UK6	Commercial calibration with test results data
1A7	ISO 17025 calibration certificate
2UA	200 microampere measurement range with output disconnect relays. Only on Models N6761A, N6762A.
J01	Tracking overvoltage protection function. Only available on Models N6752A, N6754A, and N6762A when installed in an N6700B, N6701A, N6702A, N6700C, N6701C, or N6702C mainframe.
SMR	Seamless measurement autoranging for Model N6784A. Included with Models N6781A, N6782A, N6785A, and N6786A.

Note 1 A small AC network is always present across the output terminals.

Specifications

Supplemental Characteristics

Dimension Diagrams

This section lists the supplemental characteristics of the Keysight N6700C Modular Power System. Supplemental characteristics are not warranted but are descriptions of performance determined by design or by type testing. All supplemental characteristics are typical unless otherwise noted.

Specifications and characteristics are subject to change without notice.

NOTE

Complete specifications and supplemental characteristics information for all power modules are included in the Keysight N6700 Modular Power System Family Specifications Guide.

Supplemental Characteristics N6700C, N6701C, N6702C

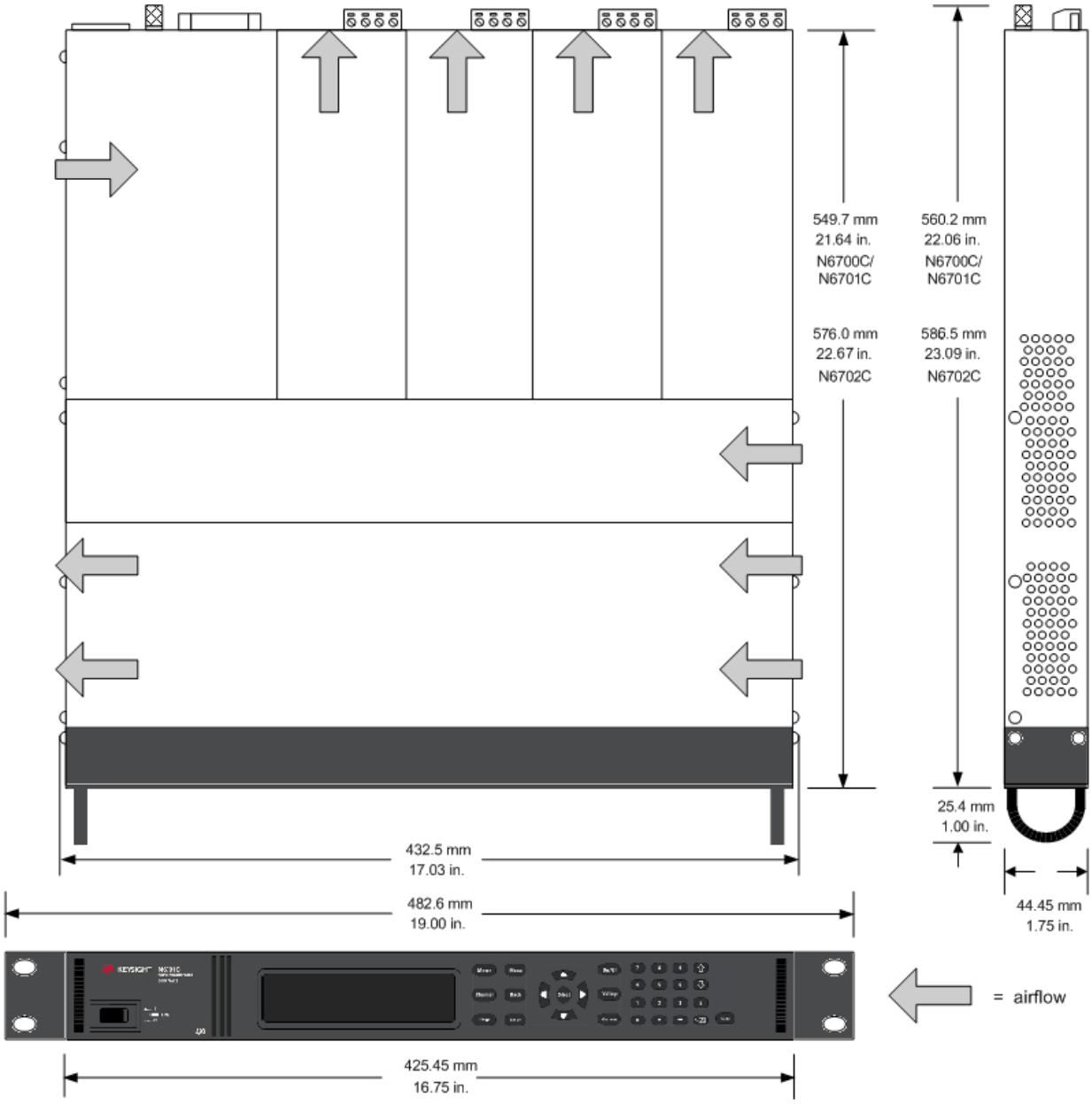
Characteristic	Keysight N6700C, N6701C, N6702C
Maximum Total Power Available for Power Modules:	400 W (for N6700C mainframes) 600 W (for N6701C mainframes) 1200 W (for N6702C mainframes)
Internal Flash memory:	8 Mbytes
Protection Response INH Input: Fault on coupled output:	 5 µs from receipt of inhibit to start of shutdown < 10 µs from receipt of fault to start of shutdown
Command Processing Time:	≤ 1 ms from receipt of command to start of output change
Digital Control 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

Characteristic	Keysight N6700C, N6701C, N6702C
Interface Capabilities	
LXI Core 2011:	10/100/1000 Base-T Ethernet (Sockets, VXI-11 protocol, Web interface)
USB 2.0 (USB-TMC488):	Requires Keysight IO Library version M.01.01 or 14.0 and up
10/100/1000 LAN:	Requires Keysight IO Library version L.01.01 or 14.0 and up
Web server:	Requires a Web browser
GPIB:	SCPI - 1993, IEEE 488.2 compliant interface
Regulatory Compliance:	
EMC:	Complies with European EMC Directive for test and measurement products: IEC/EN 61326-1; CISPR 11, Group 1, class A; AS/NZS CISPR 11; ICES/NMB-001 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
Safety:	Complies with European Low Voltage Directive and carries the CE-marking. Conforms to US and Canadian safety regulations.
Environmental	
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
Relative humidity:	Up to 95% (non-condensing)
Altitude:	Up to 2000 meters
Storage temperature:	-30°C to 70°C
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 (Typ-prüfung).
Output Terminal Isolation:	No output terminal may be more than 240 VDC from any other terminal or chassis ground. N6781A/N6785A Note: When using the AUX measurement input terminals on Models N6781A and N6785A, no output or input terminal may be more than ±60 VDC from any other terminal or chassis ground.
AC Input	
Input ratings:	~ 100 VAC – 240 VAC; 50/60/400Hz
Input ranges:	86–264 VAC; 47–63Hz; 380–420 Hz
Power Consumption:	1000 VA (N6700C) 1440 VA (N6701C) 1440 VA (N6702C @ < 180 VAC input) 2200 VA (N6702C @ > 180 VAC input)
Power Factor (Note 1):	0.99 @ nominal input and rated power
Fuse:	Internal fuse - not customer accessible N6702C Note: AC mains circuits rated at 100-180 VAC **cannot** supply enough current to power the N6702A mainframe when operated at its full rated power. When connected to a 100-180 VAC mains, internal circuits will limit the power available to modules to 600 W maximum.

Characteristic	Keysight N6700C, N6701C, N6702C
Net Weight	
N6700C with 4 modules:	12.73 kg / 28 lbs.
N6701C with 4 modules:	11.82 kg / 26 lbs.
N6702C with 4 modules:	14.09 kg / 31 lbs.
Single-wide module (typical):	1.23 kg / 2.71 lbs
Dimensions:	Refer to the dimension diagrams in the following section.

Note 1 Under full load at 400 Hz, power factor drops from 0.99 @ 120 VAC to as low as 0.76 @ 265 VAC. Power factor degrades further under no load conditions.

Dimension Diagrams



2 Installation

Preliminary Information

Installing the Mainframe

Connecting the Power Cord

Connecting the Outputs

Remote Sense Connections

Parallel and Series Connections

Auxiliary Measurement Connections

Interface Connections

Preliminary Information

Check for Items Supplied

Inspect the Unit

Review Safety Information

Observe Environmental Conditions

Check for Items Supplied

Before getting started, check the following list and verify that you have received these items with your unit. If anything is missing, please contact your nearest Keysight Sales and Support Office.

Mainframe Items	Description	Part Number
Power Cord	A power cord suitable for your location.	Call Keysight Sales & Support Office
Ferrite Core for N6700B	Installs on power cord to reduce common mode currents	Keysight 9170-2131
Digital Connector plug	8-pin connector for connecting signal lines to the digital port.	Keysight 1253-6408 Phoenix Contact MC 1,5/8-ST-3,5
Automation-Ready CD	Contains Keysight IO Libraries Suite.	Keysight E2094N
Quick Reference Guide	Contains quick reference information.	Keysight 5969-2950
T-10 Torx tool	Tool for installing or removing power modules.	Keysight 8710-2416
DC Power Module Items	**Description**	**Part Number**
8 A Output Connector plug	One 8 A, 8-pin connector plug for connecting power and sense leads. Only used in N678xA SMU.	Keysight 1253-6408 Phoenix Contact MC 1,5/8-ST-3,5
12 A Output Connector plug	One 12 A, 4-pin connector plug for connecting power and sense leads. Used in all except N6731B, N6741B, N6753A-N6756A, N6763A-N6766A, N6773A, N678xA SMU, N6791A, N6792A.	Keysight 1253-5826 Phoenix Contact MSTB 2,5/4-STF
20 A Output Connector plug	One 20 A, 4-pin connector plug for connecting power and sense leads. Only used in N6731B, N6741B, N6754A, N6756A, N6764A, N6766A, N6773A, N6791A.	Keysight 1253-6211 Phoenix Contact PC 4/4-ST-7,62
50 A Output Connector plug	One 50 A, 2-pin connector plug for connecting power leads. Only used in N6753A, N6755A, N6763A, N6765A, N6792A.	Keysight 1253-7187 Molex 39422-0002
AUX Measurement connector plug	A 2-pin connector plug for connecting the auxiliary measurement inputs. Only used in N6781A and N6785A.	Keysight 1253-8485 Phoenix Contact FMC 1,5/2-ST-3,5
Small Sense Jumpers	Two small jumpers for local sensing at the output connector. Used in all except N6731B, N6741B, N6753A-N6756A, N6763A-N6766A, N6773A, N678xA SMU, N6791A, N6792A.	Keysight 8120-8821 Phoenix Contact EPB 2-5(1733169)

DC Power Module Items	Description	Part Number
Large Sense Jumpers	Two large jumpers for local sensing at the output connector. Only used in N6731B, N6741B, N6754A, N6756A, N6764A, N6766A, N6773A, N6791A.	Keysight 0360-2935 Phoenix Contact 3118151
Sense Connector	A 4-pin connector for connecting sense leads. Wires (p/n 5185-8847) are used for local sensing. Only used in N6753A, N6755A, N6763A, N6765A, N6792A.	Keysight 1253-5830 Phoenix Contact MC 1,5/4-ST-3,5
Calibration Certificate	A certificate of calibration referenced to the serial number.	N/A

Inspect the Unit

When you receive your power system, inspect it for any obvious damage that may have occurred during shipment. If there is damage, notify the shipping carrier and nearest Keysight Sales and Support Office immediately. Refer to www.keysight.com/find/assist.

Until you have turned on and checked out the power system, save the shipping carton and packing materials in case the unit has to be returned.

Review Safety Information

This power system 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 power system and review this guide for safety warnings and instructions. Safety warnings for specific procedures are located at appropriate places throughout this Guide.

WARNING Some power modules generate voltages exceeding 60 VDC
Ensure that instrument connections, load wiring, and load connections are either insulated or covered so that no accidental contact with lethal output voltages can occur.

Observe Environmental Conditions

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

The environmental conditions of the power system are documented under Environmental Characteristics. Basically, the unit should only be operated indoors in a controlled environment.

The dimensions of your instrument as well as an outline diagram are also documented under Specifications. A fan cools the power system by drawing air through the sides and exhausting it out the 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.

Installing the Mainframe

Module Installation

Rack Mounting

Bench Installation

Redundant Ground for 400 Hz Operation

Module Installation

NOTE The information in this section applies if you have purchased an N6700 mainframe without the modules installed, or if you are adding a module to the mainframe.

CAUTION Equipment Damage Turn the mainframe off and disconnect the power cord before installing or removing modules. Observe all standard electrostatic discharge precautions before handling electronic components.

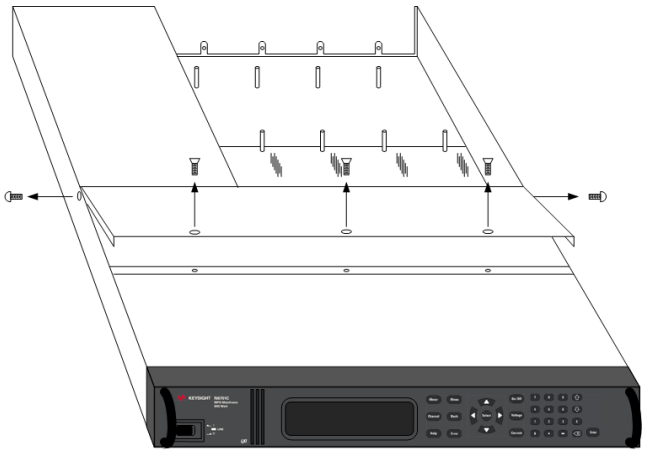
Modules must be installed next to one another, starting with slot 1. Do not leave any empty slots between modules, otherwise the power system will not operate.

Any remaining unused slots must have a filler module (N6708A) installed to ensure proper cooling. Do not install filler modules between modules.

Tools required: T10 Torx driver; Small flat-blade screwdriver

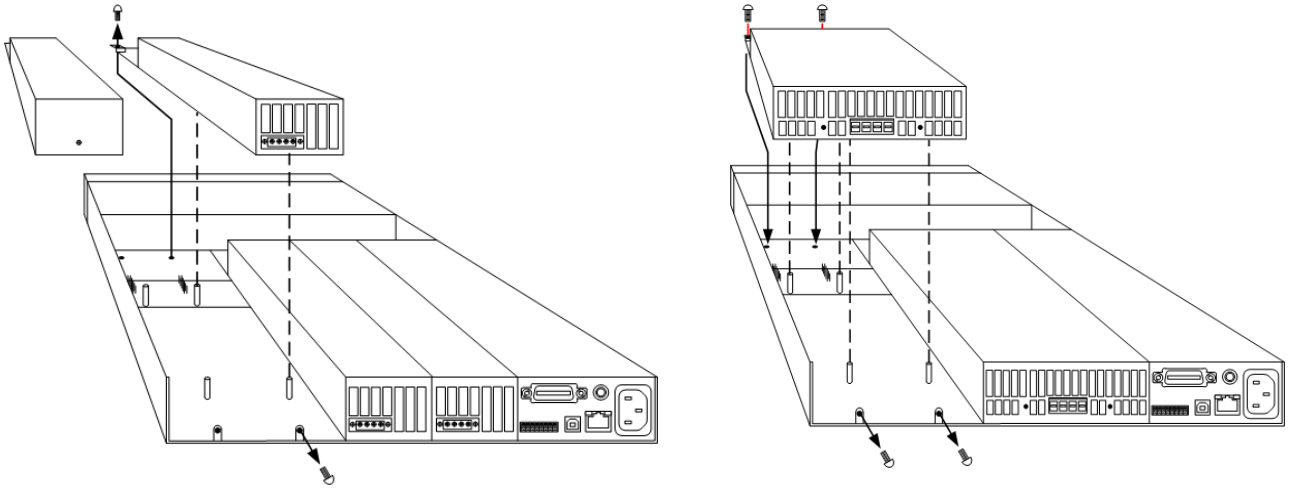
Step 1. Remove the blower cover.

Remove the screws from the top and sides of the blower cover. Tilt the cover up and slide it out.



Step 2. Install the power module.

Align the module over the pins and push it down onto the mainframe connector. Install a filler module in any unused slots.

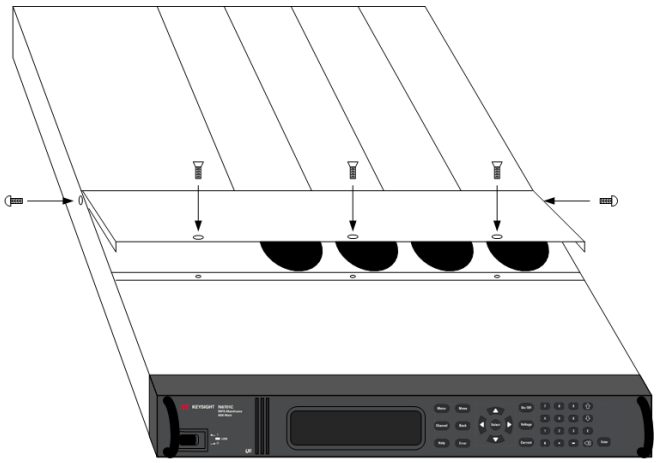


Step 3. Install the screws at each end of the module.

Use a T10 Torx driver to tighten the screws. Because the RFI strips apply upward pressure, continue pushing down on the module until the screws are tight.

Step 4. Replace the blower cover when finished.

Carefully fit the spring clips under the lip of the modules.



Power Module Channel Assignment

The slot location of a module in the mainframe determines the channel assignment of the module. When viewed from the rear, the module next to the GPIB connector is always output channel one. Numbering continues sequentially to the left, from 1 up to 4.

Double-wide modules are assigned the number of the lowest numbered slot in which is installed. For example, if a double-wide module is installed in slots 3 and 4, it is assigned channel number 3.

Grouped modules, those that are connected in parallel and have been configured or grouped to act as a single higher-power channel, are assigned the channel number of the lowest numbered slot of the group. Refer to Output Groups for more information.

Rack Mounting

CAUTION

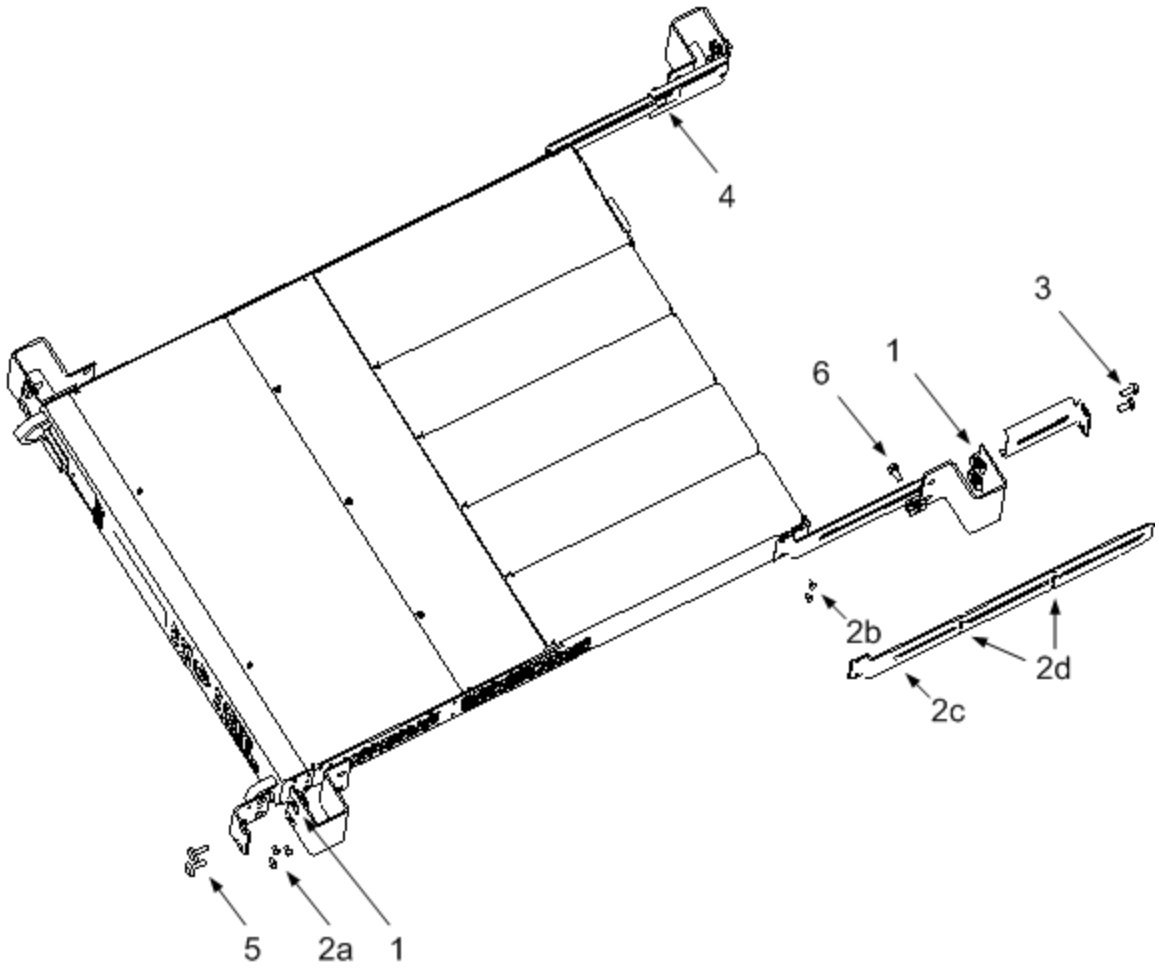
You cannot use support rails for rack mounting your instrument.
Support rails would block the airflow needed for cooling.
Use Rack Mount kit (Option 908) to rack mount your instrument.
The Rack Mount Kit is also available by ordering part number N6709C.

Keysight N6700 MPS mainframes can be mounted in a 19-inch EIA rack cabinet. They are designed to fit in one rack-unit (1U) of space. Do not block the air intake and exhaust at the sides of the unit, or the exhaust at the rear of the unit.

Tools required: Phillips driver, T22 Torx driver, T10 Torx driver

Step 1. Install eight clip-nuts on the rack frame (2 in each corner) where your instrument will be located.

The following figure references the installation steps.



Step 2. Install the two front ears and the two rear extender supports on the instrument as shown in the figure.

Use six M3 x 8mm screws (a) for the front ears and four M3 x 6mm screws (b) for the extender supports. If the standard extender supports are either too short or too long, use the longer supports (c). Cut the supports if required (d).

Step 3. Install the two rear ears on the back of the instrument rack as shown in the figure.

Use four plain 10-32 screws to install the rear ears.

Step 4. Slide the instrument into the rack, making sure that the rear extender supports are aligned inside the rear ears.

Step 5. Attach the front ears to the front of the instrument rack using the four dress 10-32 screws provided.

Step 6. This is optional. Insert a plain 10-32 screw through the slot of the rear ear and extender support and attach it using a clip nut.

This will prevent the unit from being slid out of the front of the rack.

Bench Installation

CAUTION Do not block the air intake and exhaust at the sides, or the exhaust at the rear of the unit. Refer to the dimension diagram in the Specifications section.

Minimum clearances for bench operation are 2 inches (51 mm) along the sides and back.

Redundant Ground for 400 Hz Operation

At 400 Hz AC input operation, the leakage current of the unit exceeds 3.5 mA. This requires the installation of a permanent, redundant ground from the instrument chassis to earth ground. This ensures that ground will always be connected and that any leakage current will be diverted to ground.

Refer to the Specifications section for power factor statistics at 400 Hz operation.

Refer to Redundant Ground for installation instructions.

Connecting the Power 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 Keysight 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.

Keysight N6702C Mainframe Note: Standard AC mains circuits rated at nominal 100-120 VAC cannot supply enough current to power the N6702A mainframe when it is operated at its full rated power. Nevertheless, the N6702A can be connected to an AC mains circuit rated at nominal 100-120 VAC. In this case, internal circuits will limit the power available to modules to 600 W. As a result of this power limiting, the current drawn from the AC mains will be < 15 A, so that standard 100-120 VAC mains circuits will not be overloaded.

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.

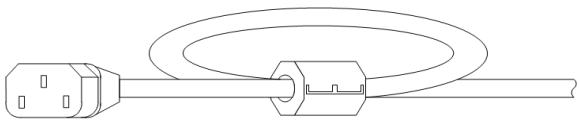
Snap-on Ferrite core for N6700C

Installing the supplied ferrite core is only necessary if you are connecting highly sensitive loads to the output of the N6700C. The purpose of the ferrite core is to reduce the possibility of common mode current spikes appearing at the output of the power system when AC power is switched on or off. Note that N6701C and N6702C mainframes have built-in ferrite cores.

Additional measures to protect sensitive loads from common mode currents are discussed under Protecting Sensitive Loads from AC Power Switching Transients.

To install the core:

1. Locate the core anywhere along the cord.
2. Pass the power cord through the core twice.
3. Close the core.



Connecting the Outputs

Output Wiring

Wire Sizing

Keysight N678xA SMU Wiring

Multiple Load Wiring

Positive and Negative Voltages

Load Capacitor Response Times

Ferrite Core Installation - for Keysight N6792A only

Protecting Sensitive Loads

NOTE Keysight N679xA Load Module input terminals are referred to as "Outputs" throughout this document N679xA.

Output Wiring

WARNING SHOCK HAZARD Turn off AC power before making rear panel connections. All wires and straps must be properly connected with the terminal block screws securely tightened.

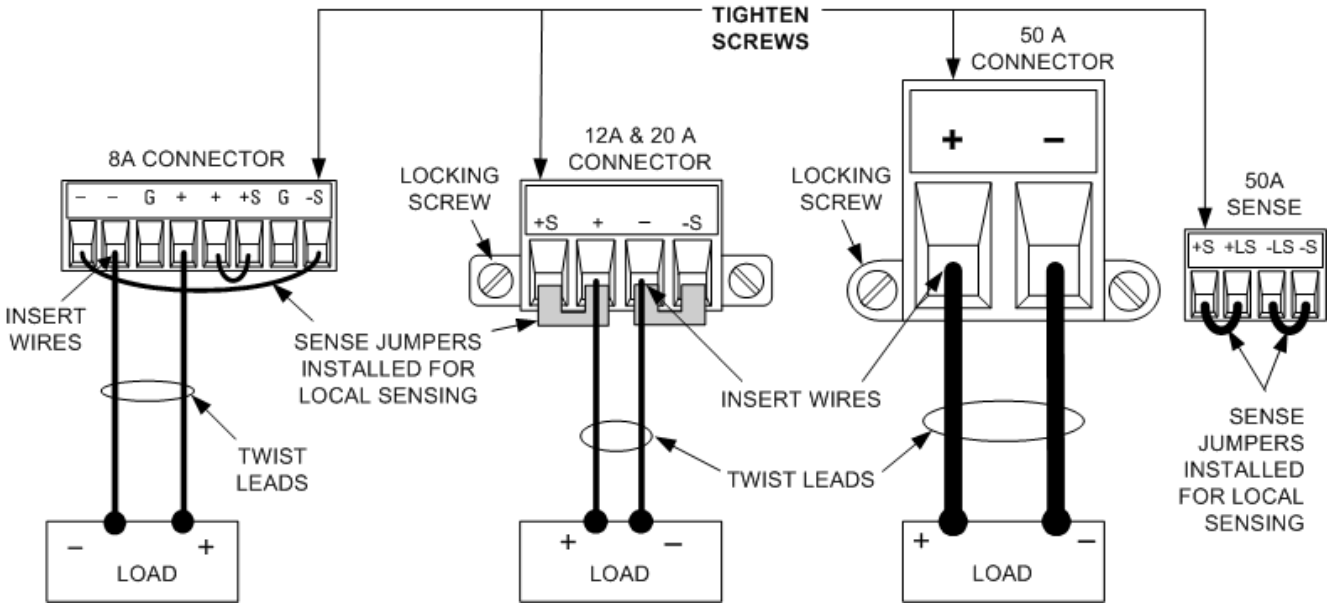
Some power modules generate voltages in excess of 60 VDC. Ensure that instrument connections, load wiring, and load connections are either insulated or covered so that no accidental contact with lethal output voltages can occur.

Disconnect the connector plug to make your wire connections. The 8A connector plug accepts wires sizes from AWG 14 to AWG 30. The 12A connector plug accepts wires sizes from AWG 12 to AWG 30. The 20A connector plug accepts wires sizes from AWG 10 to AWG 24. The 50A connector plug accepts wires sizes from AWG 6 to AWG 20. Wire sizes smaller than AWG 20 are not recommended. Connect the load wires to the + and - terminals. Connect the sense wires to the +s and -s terminals. Sense jumpers are provided for local sensing.

Securely fasten all wires by tightening the screw terminals. Insert the connector plug into the back of the unit. Secure the 12 A and 50 A connector by tightening the locking screws. A chassis ground binding post is located next to the AC input connector for ground connections.

Part number information for all connector plugs is provided under Items Supplied.

CAUTION On power modules with the 50A sense connector, the +LS and –LS terminals are ONLY used for local sense connections as illustrated. Do not connect the +LS and –LS terminals in any other way.



Wire Sizing

WARNING FIRE HAZARD Select a wire size large enough to carry short-circuit current without overheating (refer to the following table). To satisfy safety requirements, load wires must be heavy enough not to overheat while carrying the short-circuit output current of the unit. Keysight Model N678xA SMU wiring requirements are described in the following section.

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	Metric size (Note1)		Resistance	Max length to limit voltage to 1 V/lead			
				for 5 A	for 10 A	for 20 A	for 50 A
AWG	2 wires bundled	4 wires bundled	Ω per foot	Wire length in feext			
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 mm^2	2 wires bundled	4 wires bundled	Ω per 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. Maximum ambient temperature: 55°C. Maximum wire temperature: 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 (15.24 meters) in length per lead.
6. For models N679xA when reverse protection is activated, because of wire inductance considerations, wire lengths should be twisted, tie wrapped, or bundled together and less than 100 feet (30.48 meters) in length per lead. The goal is to prevent large voltage spikes by keeping the wire inductance below 1mH.

Keysight N678xA SMU Wiring

NOTE Because of the effect of wire inductance, the wire length information given in the previous table does not apply to Models N678xA SMU.

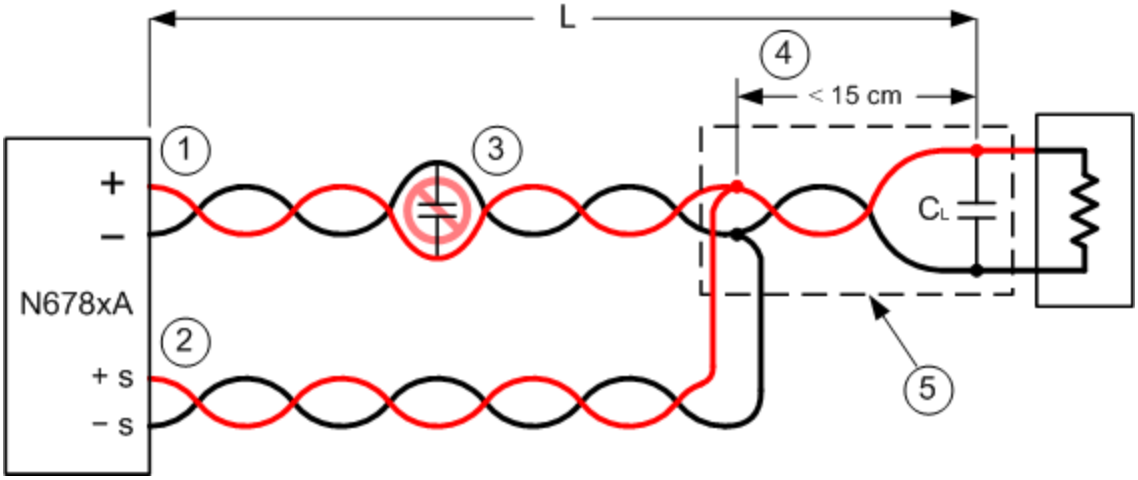
To minimize the effect of wire inductance, the following table describes the allowable load lead and wire length for several common output wire types. Using longer (or shorter) wire lengths than those indicated in the table may cause output oscillation.

Cable Type	To module connector	
	Length in feet	Length in meters
Twisted pair (AWG 14 or smaller)	1 to 4.25 feet	0.3 to 1.3 meters
50 ohm coaxial (RG-58)	2 to 10 feet	0.6 to 3 meters
10 ohm coaxial (inductance per cable foot ≤ 32 nH)	8.5 to 33 feet	2 to 10 meters

High Bandwidth Modes with Remote Sensing

The following wiring requirements apply when using Keysight Models N678xA SMU in the High bandwidth modes with remote sensing.

Refer to Output Bandwidth for more information about the bandwidth settings.



1. Load wires must be twisted-pair or coax and must not be twisted along with the sense wires. Refer to the above table for length (L).

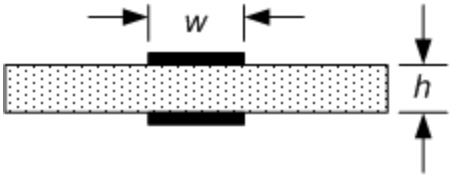
2. Sense wires must be twisted-pair or coax and must not be twisted with the load wires.

3. No capacitors are allowed within the sense-compensated load path.

4. If the load capacitor (CL) is not located at the sense point, the distance from the sense point to the load capacitor cannot exceed 15 cm and must be twisted-pair, coax, or pc traces.

5. If the test fixture consists of pc traces, the positive and negative traces should be directly facing on adjacent layers.

To minimize inductance, the width (w) of the traces should be at least as great as the thickness of the dielectric (h). It is better to make the traces much wider than this minimum requirement in order to minimize the DC resistance.



Low Bandwidth Mode with Remote or Local Sensing

All previously stated wiring requirements still apply in Low bandwidth mode except for the following.

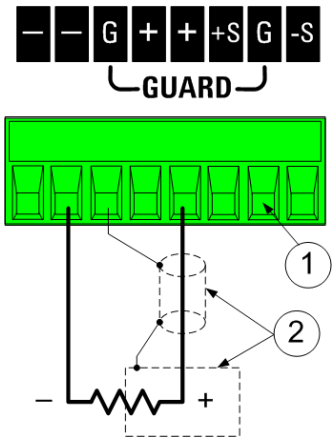
The 15 cm maximum limit between the sense point and the load capacitor (see #4) does not apply when using Low bandwidth mode.

Guard Connections

The purpose of a cable guard is to eliminate the effects of leakage current that can exist in the current path of the external test circuit. The cable guard can be used when the test fixture requires guarding and the power system is sourcing or measuring DC currents under 1 µA. Without a guard, leakage currents in the test circuit could affect the accuracy of the micro-amp measurements. Guarding is generally not required when measuring currents 1 µA and greater.

As shown below, cable guards are available at the output connector of Keysight Models N678xA SMU. The guard is typically used to drive the shields of cables and test fixtures. It provides a buffered voltage that is at the same potential as the + output terminals of the module connector. The guard current is limited to about 300 µA.

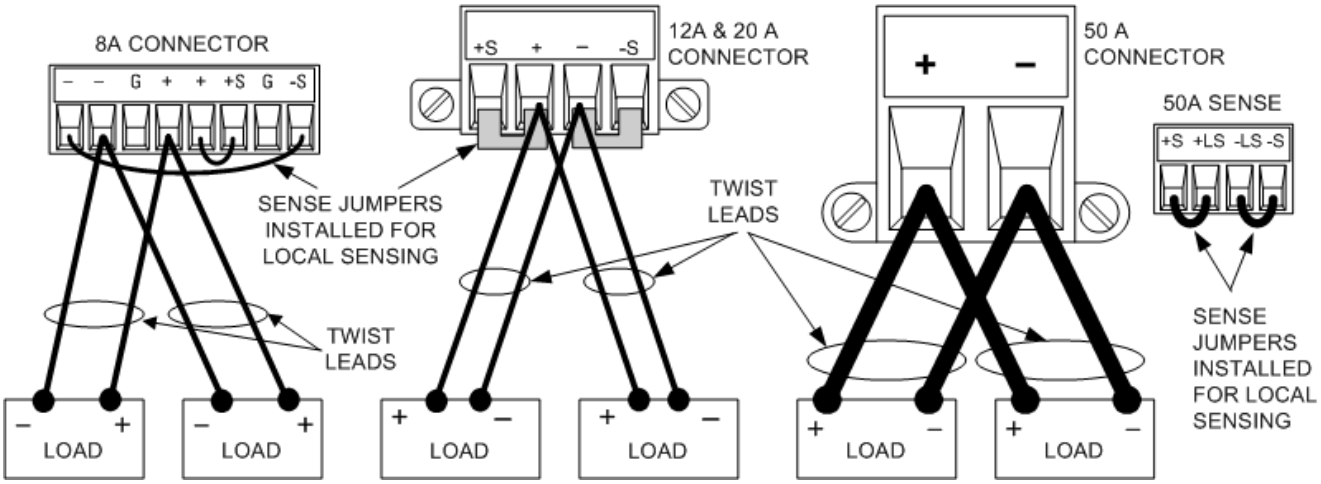
1. N678xA SMU connector
2. Guard shield (can be the shield of a coaxial cable)



Multiple Load Wiring

If you are using local sensing and are connecting multiple loads to one output, connect each load to the output terminals using separate load wires as shown in the following figure. This minimizes mutual coupling effects and takes full advantage of the power module's low output impedance. Keep each wire-pair as short as possible and twist or bundle the wires to reduce lead inductance and noise pickup. The goal is to always minimize the loop area or physical space between the + and - load wires from the power system to the load.

Note that Keysight Models N678xA SMU have additional wiring restrictions as previously discussed under Keysight N678xA SMU Wiring.



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. Remote voltage sensing is recommended under these circumstances. Sense either at the remote distribution terminals or, if one load is more sensitive than the others, directly at the critical load.

Positive and Negative Voltages

Either positive or negative voltages with respect to ground 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.

NOTE Keysight Models N678xA SMU are optimized for grounding the negative output terminal. Grounding the positive terminal may result in increased current measurement noise and a reduction in current measurement accuracy.

Load Capacitor Response Times

When programming with an external capacitor, voltage response time may be longer than that for purely resistive loads. Use the following formula to estimate the additional up-programming response time:

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

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

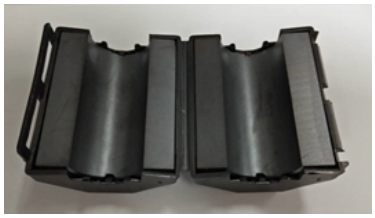
Ferrite Core Installation - for Keysight N6792A only

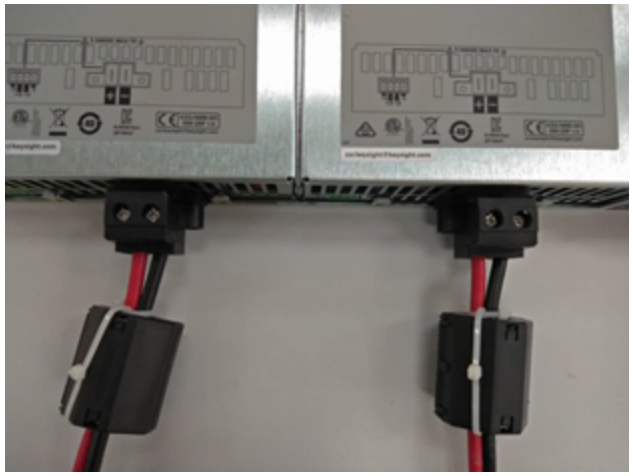
NOTE Compliance to radio frequency interference (RFI) standards requires a ferrite core to be installed on the load leads of the load module. The core is supplied with the module and does not affect the functionality of the module.

1. Locate the core along the length of the cables and pass the load cables through the core once

2. Clip the ferrite core onto the load cables as close as possible to the output connector. The recommended distance from the connector to the core is 4 cm or less.

3. Attach the tywrap to the load wires to prevent the core from sliding away from the connector.





Protecting Sensitive Loads from AC Power Switching Transients

NOTE This only applies if you are connecting loads that are highly sensitive to voltage or current transients to the output of the power system. If your load is connected directly to the output of the power system 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 of the power system.

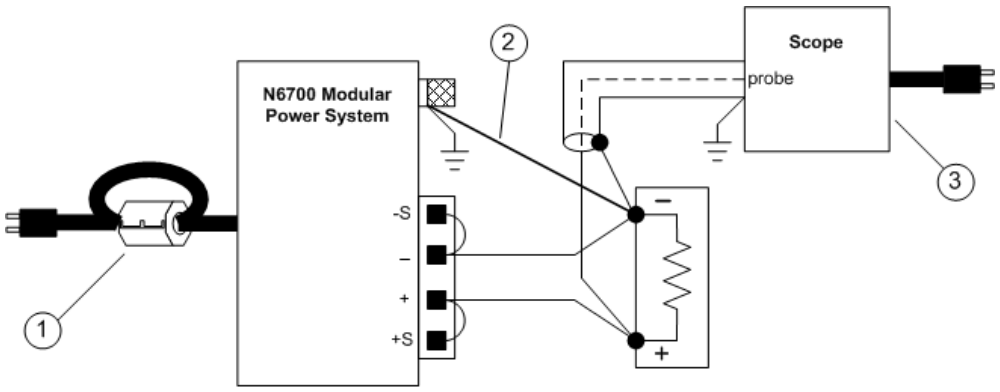
Operating the AC line switch can inject common mode current spikes into the DC output leads, resulting in voltage spikes that may damage loads that are highly sensitive to voltage or current transients. Note that any electronic device meeting international standards for EMI compliance is likely to generate similar current spikes. This situation arises from the presence of EMI filters at both the AC input and the DC output. These filters typically include common mode capacitors connected to the chassis of the power system. 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 figure illustrates a typical situation where a load that might otherwise be floating becomes grounded, thereby providing a return path for any injected currents. In this case, the return path is created by the low side of the scope probe, which is connected to the load circuit common and also to the scope's chassis. For this and similar cases, the following steps by order of preference, will help mitigate common mode current spikes appearing at the output when the power system is turned on or off by the AC line switch:

1. Install a ferrite core (Keysight p/n 9170-2131) on the power cord to insert additional impedance in the current path. This ferrite core is now installed inside N6701C and N6702C mainframes.

2. Install a separate bonding wire from the load's common point, to the ground terminal of the power system. This provides a lower impedance path that helps direct injected currents away from the DC output leads (and the sensitive load).

3. Break the return path through the external equipment. For example, instead of the single-ended scope shown in the figure, you can use a differential scope with a floating input or you can connect an isolated measuring instrument to the load.



NOTE Disconnecting the load from the output before switching the power system on or off will **always** protect the load from common mode currents.

Remote Sense Connections

Wiring

Open Sense Leads

Over-Voltage Protection Considerations

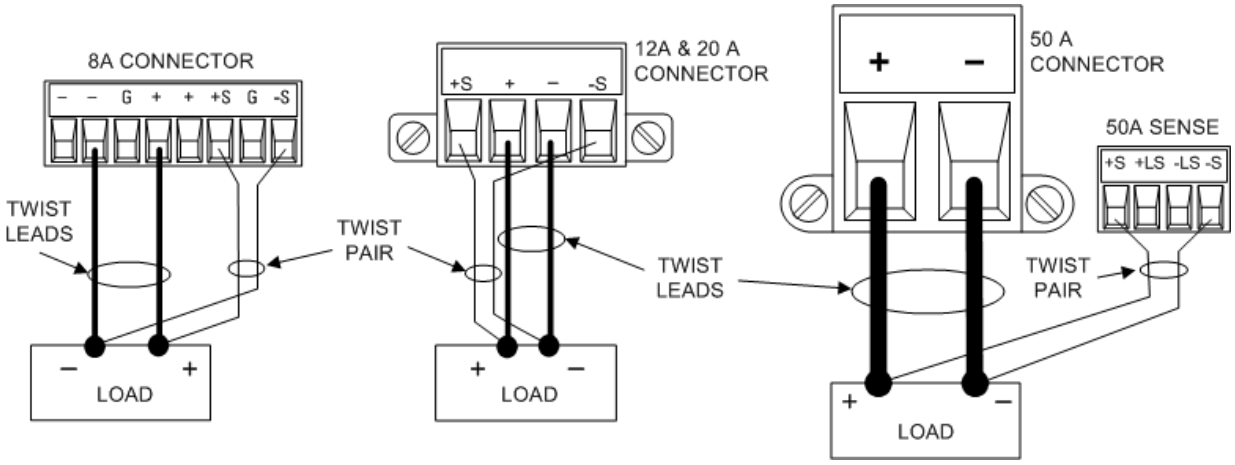
Output Noise Considerations

Wiring

WARNING SHOCK HAZARD Turn off AC power before making rear panel connections.

Remote sensing improves the voltage regulation at the load by monitoring the voltage there instead of at the output terminals. This allows the power system to automatically compensate for the voltage drop in the load leads. Remote sensing is especially useful for CV operation with load impedances that vary or have significant lead resistance. It has no effect during CC operation. Because sensing is independent of other power system functions, remote sensing can be used regardless of how the power system is programmed.

Connect the unit for remote sensing by first disconnecting the straps between sense and load terminals. Make your connections as shown in the following figure. Connect the load to the output terminals using separate connecting wires. Keep the wire-pair as short as possible and twist or bundle it to reduce lead inductance and noise pickup. Keep load leads under 14.7 meters (50 feet) per lead because of inductance effects.



Connect the sense leads as close to the load as possible. Do NOT bundle the sense wire-pair together with the load leads; keep the load wires and sense wires separate. 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. Keep the sense lead resistance less than about 0.5 Ω per lead (this requires 20 AWG or heavier for a 50 foot length).

Note that Keysight Models N678xA SMU require remote sensing when using any of the High output bandwidth modes discussed under Set the Output Bandwidth. Also, these models have additional wiring restrictions as discussed under Keysight N678xA SMU Wiring Requirements.

CAUTION When remote sensing on power modules with the 50 A sense connector, do not connect the +LS and –LS terminals. These are dedicated for local sensing only.

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 become open circuited. The power system includes protection resistors that reduce the effect of open sense leads during remote-sensing operation. If the sense leads open during operation, the power system returns to the 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.

OVP for Keysight N678xA SMU (local OVP)

For Keysight Models N678xA SMU only, the OVP circuit senses at the 4-wire sense terminals rather than at the output terminals. This allows for more precise overvoltage monitoring directly at the load. Since incorrect sense terminal wiring could defeat this feature, there is also a local OVP function.

The Local OVP function tracks the programmed OVP setting and trips if the voltage at the + and - output terminals rises more than 1.5 V above the programmed OVP setting. The local OVP also trips if the voltage at the output terminals exceeds 7.5 V on the 6 V range and 21.5 V on the 20 V range.

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 or use a ribbon cable 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 power system end only; do not use the shield as one of the sensing conductors.

The noise specifications documented in the Keysight N6700 Modular Power System Family Specifications Guide 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 and Series Connections

Parallel Connections

Series Connections

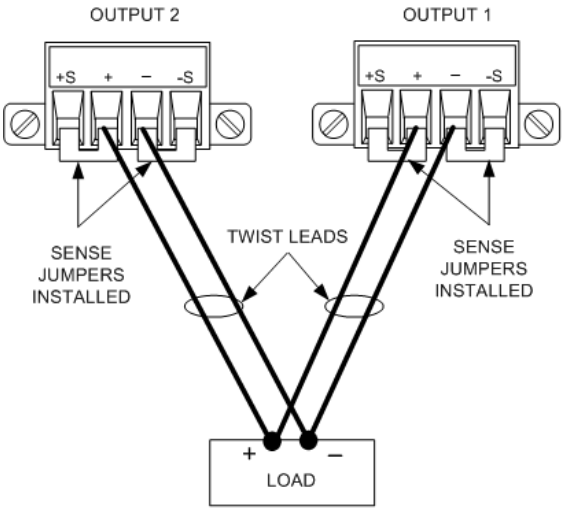
Parallel Connections

CAUTION

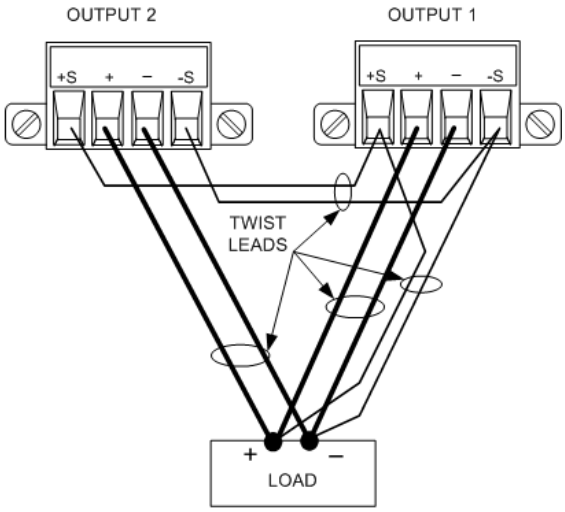
Equipment Damage Only connect power supplies that have identical voltage and current ratings in parallel. Keysight Models N678xA SMU may be paralleled, but ONLY when operated in Current Priority mode. Voltage Priority operation is not allowed.

Connecting power supplies in parallel provides a greater current capability than can be obtained from a single unit.

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. Note that in both cases, the remote sense terminals must be connected.

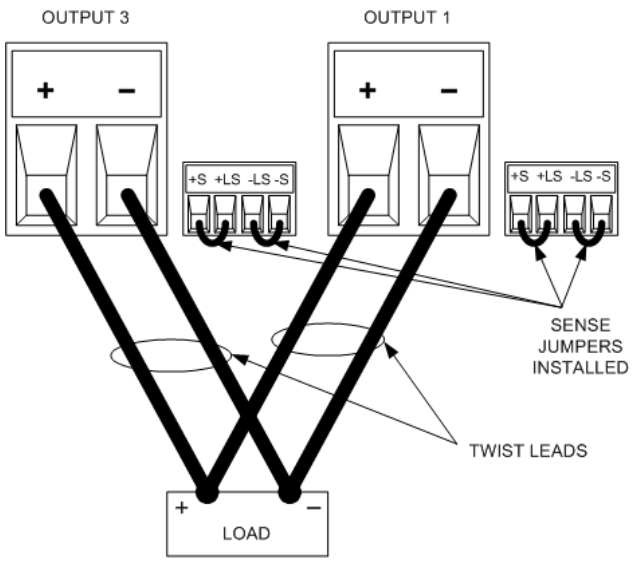


WITH LOCAL SENSING

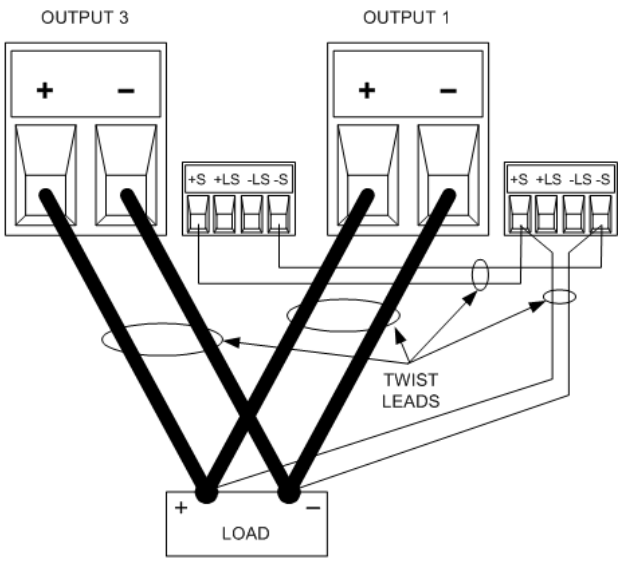


WITH REMOTE SENSING

The following figure shows the connections for 50A power modules.

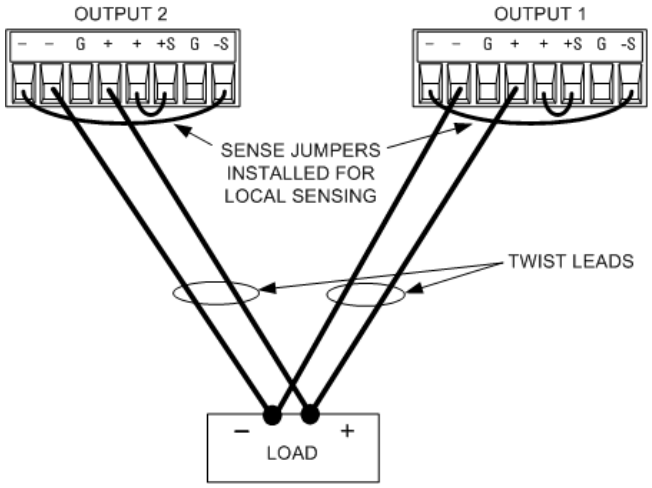


WITH LOCAL SENSING



WITH REMOTE SENSING

The following figure shows the paralleled connections for N678xA SMU power modules. Note that remote sensing is not normally used in Current Priority mode.



Grouping the Outputs

NOTE The output grouping function is not available for N678xA SMU power modules.

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

If you are not grouping output channels, first program both outputs to the desired output voltage. Then program the current limit of each output. In Current Priority mode, program the output current of each

output to one half of the total desired output current. Set the voltage limit to a value higher than the expected output voltage.

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.

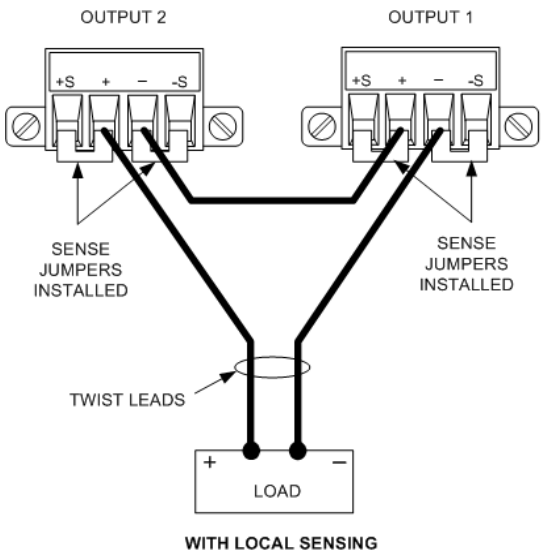
Keysight Models N678xA SMU, N6783A, and N679xA Loads cannot be connected in series.

.To prevent currents from damaging the power system when the load is connected, always turn series-connected outputs on and off together.

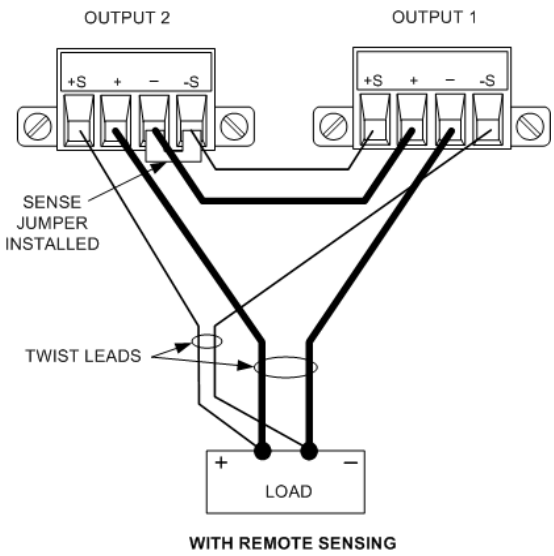
Do not leave one output on while the other is off.

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. Note that the +sense lead of output 1 must remain connected to the -sense terminal of output 2.

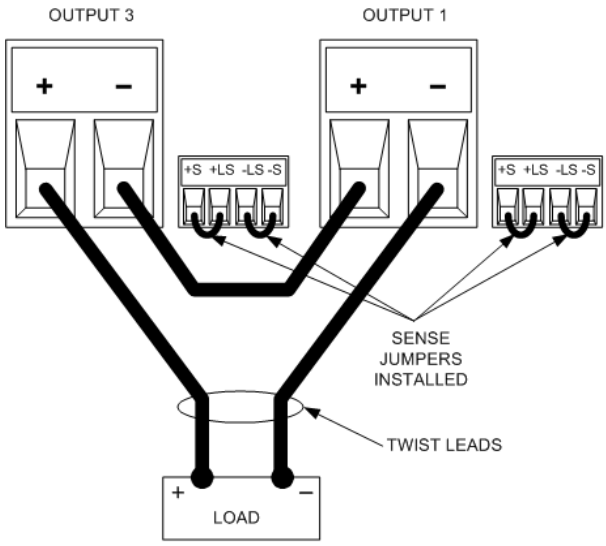


WITH LOCAL SENSING

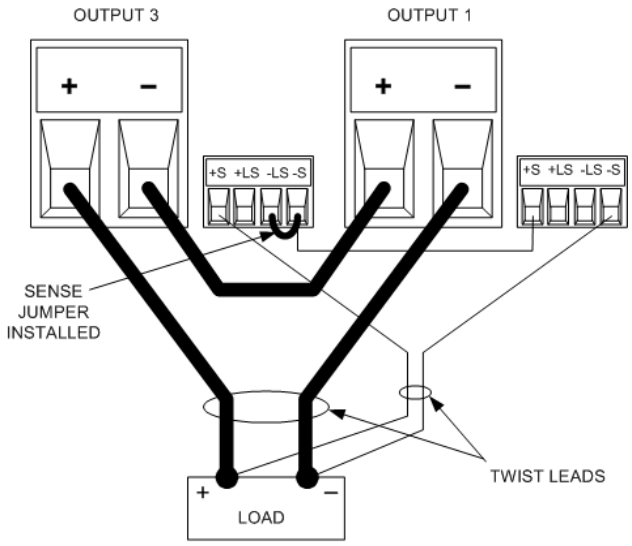


WITH REMOTE SENSING

The following figure shows the connections for 50A power modules.



WITH LOCAL SENSING



WITH REMOTE SENSING

Setting the Outputs

Outputs connected together in series cannot be grouped.

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 front panel status indicator 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.

Auxiliary Measurement Connections

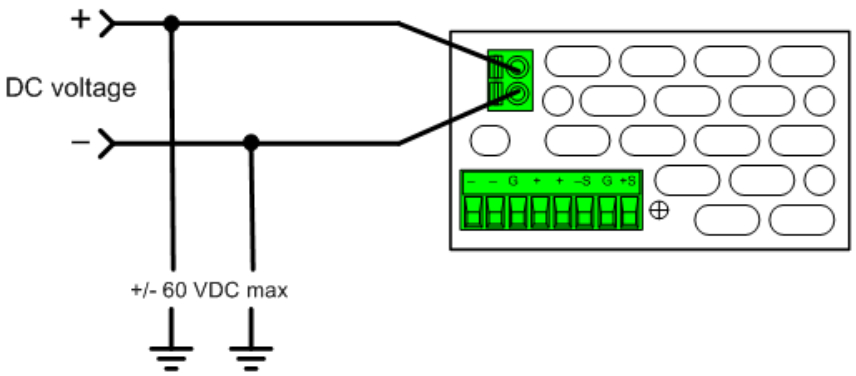
NOTE This information only applies to Keysight Models N6781A and N6785A.

The auxiliary voltage measurement input is located on the rear panel of the Keysight N6781A and N6785A. It is primarily used for battery voltage rundown measurements, but it is also suitable for general purpose DC measurements.

The auxiliary voltage measurement input is isolated from other commons. It has a bandwidth of about 2 kHz. It has one input range: –20 to +20 VDC.

As shown in the following figure, auxiliary voltage measurements cannot be made on test points that are at a greater potential than ±60 VDC from ground. Refer to Auxiliary Voltage Measurements for more information.

CAUTION When using the auxiliary voltage measurement input, no output terminal or measurement input terminal may be more than ± 60 VDC from any other terminal and chassis ground.



Interface Connections

GPIB Connections

USB Connections

LAN Connections - site and private

Digital Port Connections

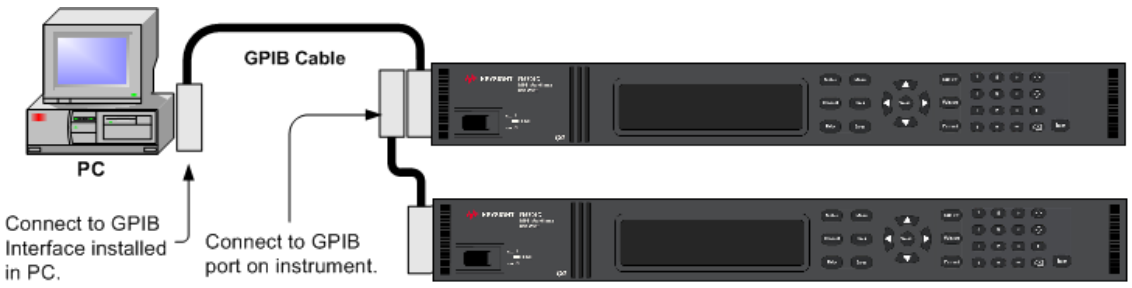
This section describes how to connect to the various communication interfaces on your power system. For further information about configuring the remote interfaces, refer to Remote Interface Configuration.

NOTE

If you have not already done so, install the Keysight IO Libraries Suite, which can be found at www.keysight.com/find/iolib. For detailed information about interface connections, refer to the Keysight Technologies USB/LAN/GPIB Interfaces Connectivity Guide included with the Keysight IO Libraries Suite.

GPIB Connections

The following figure illustrates a typical GPIB interface system.



1. If you do not have a GPIB interface card installed on your computer, turn off your computer and install the GPIB card

2. Connect your instrument to the GPIB interface card using a GPIB interface cable.

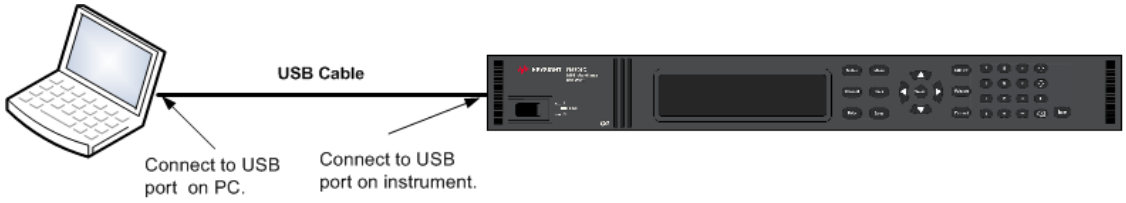
3. Use the Connection Expert utility of the Keysight IO Libraries Suite to configure the GPIB card's parameters.

4. The power system is shipped with its GPIB address set to 5. Use the front panel menu if you need to change the GPIB address.

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.

USB Connections

The following figure illustrates a typical USB interface system.



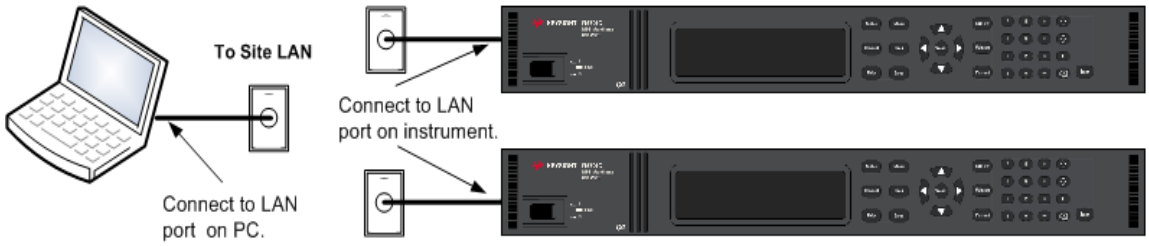
1. Connect your instrument to the USB port on your computer using a USB cable.

2. With the Connection Expert utility of the Keysight 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 view the instrument's USB connect string from the front panel menu.

3. 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 Connections - site and private

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. The following figure illustrates a typical site LAN system.



1. Connect the instrument to the site LAN or to your computer using a LAN cable. The as-shipped instrument LAN settings are configured to automatically obtain an IP address from the network using a DHCP server (DHCP is set On). 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

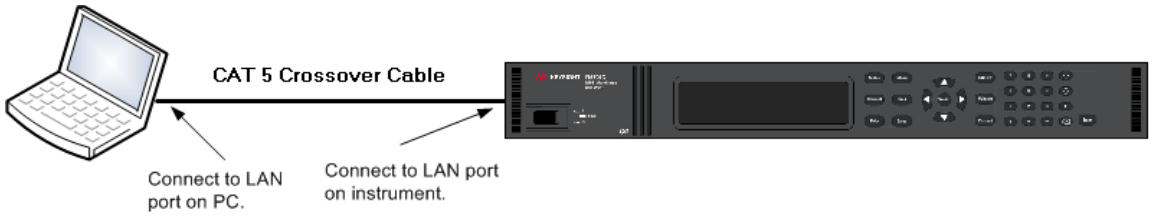
If you need to manually configure any instrument LAN settings, refer to Remote Interface Configuration for information about configuring the LAN settings from the front panel of the instrument.

2. Use the Connection Expert utility of the Keysight IO Libraries Suite to add the power system 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 its hostname or IP address.

NOTE If this does not work, refer to “Troubleshooting Guidelines” in the Keysight Technologies USB/LAN/GPIB Interfaces Connectivity Guide included with the Keysight IO Libraries Suite.

3. 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 communicate with the instrument as described under Using the Web Interface.

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. The following figure illustrates a typical private LAN system.



1. 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.

2. The factory-shipped instrument LAN settings are configured to automatically obtain an IP address from a site network using a DHCP server. You can leave these settings as they are. Most Keysight products and most computers will automatically choose an IP address using auto-IP if a DHCP server is not present. Each assigns itself 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.

NOTE Turning off DHCP reduces the time required to fully configure a network connection when the power system is turned on. To manually configure the instrument LAN settings, refer to Remote Interface Configuration for information about configuring the LAN settings from the front panel of the instrument.

3. Use the Connection Expert utility of the Keysight IO Libraries Suite to add the power system 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 its hostname or IP address.

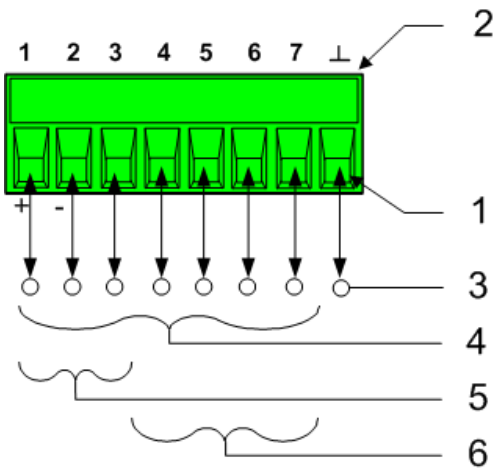
NOTE If this does not work, refer to “Troubleshooting Guidelines” in the Keysight Technologies USB/LAN/GPIB Interfaces Connectivity Guide included with the Keysight IO Libraries Suite.

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 communicate with the instrument as described under Using the Web Interface.

Digital Port Connections

An 8-pin connector and a quick-disconnect connector plug are provided on each instrument for accessing the five digital control port functions. The digital control connector accepts wires sizes from AWG 14 to AWG 30. Note that 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 IO signals
5. FLT/INH signals
6. Output couple controls



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.

Pin Functions

The following chart describes the possible pin configuration for the digital port functions. For a complete description of the electrical characteristics of the digital I/O port, refer to the product Specifications.

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 State	Pins 4 through 7
Common	Pin 8

In addition to the configurable pin functions, the active signal polarity for each pin is also configurable. 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.

For information on configuring the digital port functions, Refer to Using the Digital Control Port.

3
Getting Started

Using the Front Panel

Remote Interface Configuration

KEYSIGHT TECHNOLOGIES

Using the Front Panel

Turn the Unit On

Set the Output Voltage

Set the Output Current

Enable the Output

Use the Front Panel Menu

Set the Over-Voltage Protection

This section describes how to get started using your power system. It discusses turning the unit on, using the front panel controls, and navigating the front panel command menu. A map of the front panel menu structure is found in under Front Panel Menu Reference.

This section also contains information on how to configure the three remote interfaces that are provided on the back of the instrument.

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

Turn the Unit On

NOTE It may take 20 seconds or so for the power system to initialize before it is ready for use.

After you have connected the line cord, turn the unit on with the front panel power switch. The front panel display will light up after a few seconds.

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 **Err** indicator comes on. Press the Error key to display the list of errors on the front panel. Refer to Error Messages for more information.

When the front panel display appears, you can use the front panel controls to enter voltage and current values.

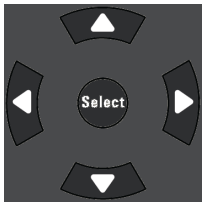
Select an Output Channel

Press Channel to select the output channel that you wish to program.

Set the Output Voltage

Method 1 – Use the Navigation and Arrow Keys

Navigation keys



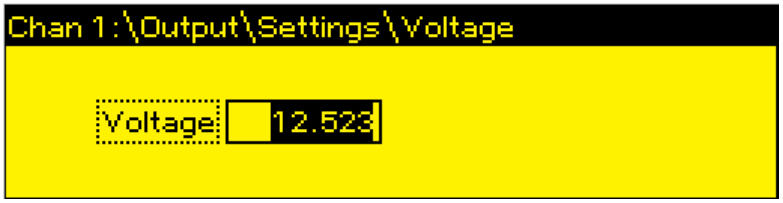
Use the left and right navigation keys to navigate to the setting that you wish to change. In the display below, channel 1's voltage setting is selected. Enter a value using the numeric keypad. Then press Enter.

Arrow keys ⬆⬇

You can also use the numeric arrow keys to adjust the value up or down, and switch between + and − limits on Model N6784A. When the output is on and the unit is operating in CV mode, the output voltage changes immediately. Otherwise, the value will become effective when the output is turned on.

Method 2 - Use the Voltage key to enter a value

Press Voltage to select the voltage entry field. In the display below, channel 1's voltage setting is selected. Enter the desired setting using the numeric keypad. Then press Enter.



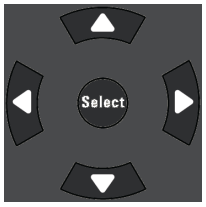
NOTE

If you make a mistake, either use the ⬅ backspace key to delete the number, press Back to back out of the menu, or press Meter to return to meter mode.

Set the Output Current

Method 1 – Use the Navigation and Arrow Keys

Navigation keys



Use the left and right navigation keys to navigate to the setting that you wish to change. In the display below, channel 1's current setting is selected. Enter a value using the numeric keypad. Then press Enter.

Arrow keys ⬆⬇ You can also use the arrow keys to adjust the value up or down and switch between + and − limits on Models N678xA SMU. When the output is on and the unit is operating in CC mode, the output current changes immediately. Otherwise, the value will become effective when the output is turned on

Method 2 - Use the Current key to enter a value

Current

Press Current to select the current entry field. In the display below, channel 1's current setting is selected. Enter the desired setting using the numeric keypad. Then press Enter.

NOTE If you make a mistake, either use the ⬅ backspace key to delete the number, press Back to back out of the menu, or press Meter to return to meter mode.

Enable the Output

Use the On/Off key to enable the output

On/Off

If a load is connected to the output, the front panel display will indicate that it is drawing current. Otherwise, the current reading will be zero. The status indicator next to the channel number indicates the output's status. In this case, the output channel is in constant voltage mode.

NOTE For a description of the status indicators, refer to Front Panel Display – At a Glance.

Use the Front Panel Menu

The front panel command menu lets you access most of the power system's functions. The actual function controls are located at the lowest menu level. Briefly:

- Press the Menu key to access the command menu.
- Press the left and right (◀, ▶) navigation keys to move across the menu commands.
- Press the center Select key to select a command and move down to the next level in the menu.

- Press the Help key at the lowest menu level to display help information about the function controls.

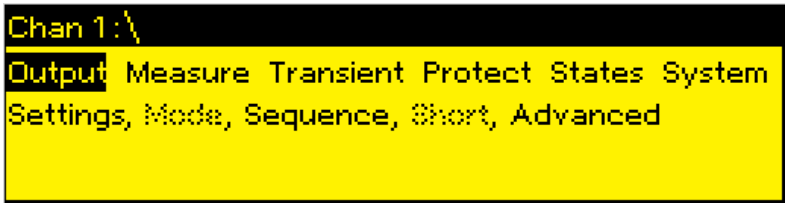
For a map of the front panel menu commands, refer to Front Panel Menu Reference. The following example shows you how to navigate the front panel command menu to program the over-voltage protection function.

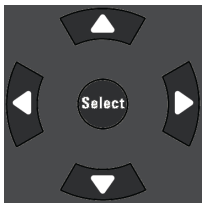
Menu example - setting over-voltage protection

Press Menu to access the front panel command menu. The first line identifies the output channel that is being controlled followed by the menu path. Since the top level is displayed, the path is empty.

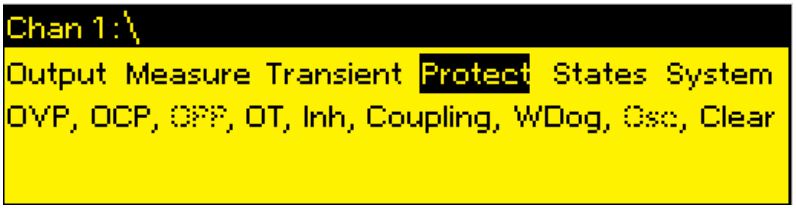
The second line indicates the commands that are available at the present menu level. In this case, the top-level menu commands are shown, with the Output command highlighted.

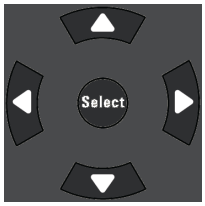
The third line indicates which commands are available under the Output command. Selecting the highlighted command accesses this lower level.



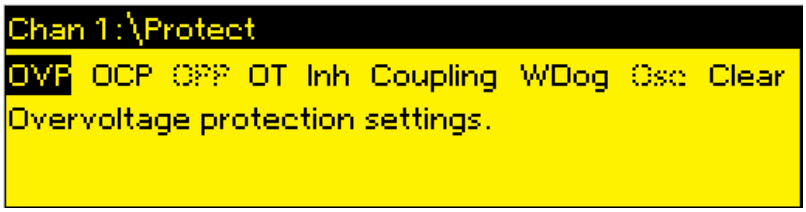


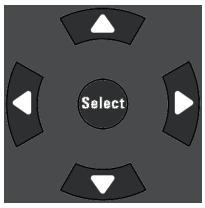
Press the right navigation ▶ key to traverse the menu until the Protect command is highlighted. Press Select to select the Protect command.





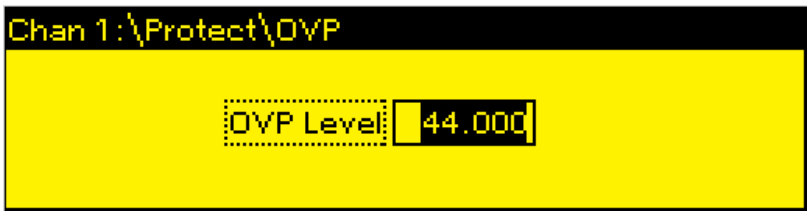
The menu path now lets you select from the available Protect commands on the second line. The OVP command is highlighted. The third line has a brief description of the OVP command. Press Select to select the OVP command.





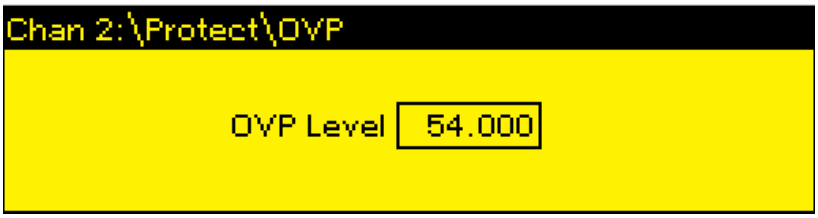
4, 4, Enter

The command menu is now at the function control level. This is the lowest level in this path. Use the navigation keys to highlight the OVP Level control as shown below. Enter the desired over-voltage protection level using the numeric keypad. Then press Enter.



Channel

Press **Channel** at any time to select a different output channel. This can save time because you can directly access the OVP control of each channel without having to navigate through the menu levels.



NOTE

If you program an over-voltage protection level that is lower than the present output voltage, the over-voltage protection circuit will trip and turn the output off. The front panel status indicator will show OV.

Exit the Command Menu

There are two ways to exit the command menu

Meter

Press **Meter** to immediately return to the metering screen. This is the quickest way to return to metering mode.

Back

Press **Back** to back up one level at a time in the command menu. This method may be more convenient if there are other menu commands to be given.

In Case of Trouble

Press the Help key to obtain additional help about any function control menu level. Press the Back key to exit the Help menu.

The front panel Err indicator comes on if self-test fails or if other operating problems occur with your instrument. Press the Error key to display the list of errors. Refer to the Service and Maintenance section for further information.

Remote Interface Configuration

USB Configuration

GPIB Configuration

LAN Configuration

Modifying the LAN Settings

Using the Web Interface

Using Telnet

Using Sockets

Securing the Interfaces

This Keysight N6700 MPS supports remote interface communication over three interfaces: GPIB, USB, and LAN. All three interfaces are live at power on. For information on connecting the interfaces, refer to Interface Connections.

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

Power system mainframes provide 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.

USB Configuration

There are no configurable USB parameters. You can retrieve the USB connect string using the front panel menu:

Front Panel Menu Reference	SCPI Command
Select System\IO\USB The dialog displays the USB connect string.	Not available

GPIB Configuration

Each device on the GPIB (IEEE-488) interface must have a unique whole number address between 0 and 30. The instrument ships with the address set to 5. Your computer's GPIB interface card address must not conflict with any instrument on the interface bus. This setting is non-volatile; it will not be changed by power cycling or *RST. Use the front panel menu to change the GPIB address:

Front Panel Menu Reference	SCPI Command
Select System\IO\GPIB	Not available
Use the numeric keys to enter a new value from 0 to 30. Then press Enter.	

LAN Configuration

The following sections describe the primary LAN configuration functions on the front-panel menus. Note that there are no SCPI commands to configure the LAN parameters. All LAN configuration must be done from the front panel.

NOTE

After changing the LAN settings, you must Save the changes. Select: System\IO\LAN\Apply. Selecting Apply cycles power to the instrument and activates the settings. LAN settings are nonvolatile, they will not be changed by power cycling or *RST. If you do not want to save your changes select: System\IO\LAN\Cancel. Selecting Cancel cancels all changes.

When shipped, DHCP is on, which may enable communication over LAN. The letters DHCP stands for Dynamic Host Configuration Protocol, a protocol for assigning dynamic IP addresses to devices on a network. With dynamic addressing, a device can have a different IP address every time it connects to the network.

Viewing Active Settings

To view the currently active LAN settings:

Front Panel Menu Reference	SCPI Command
Select System\IO\LAN\Settings	Not available
Displays the active LAN settings. Use the up and down arrow key to scroll through the list.	

The currently active settings for the IP Address, Subnet Mask, and Default Gateway may be different from the front panel configuration menu settings - depending on the configuration of the network. If the settings are different, it is because the network has automatically assigned its own settings.

Resetting the LAN

You can perform an LXI LCI reset if the LAN settings. This resets DHCP, DNS server address configuration, mDNS state, mDNS service name and web password. These settings are optimized for connecting your instrument to a site network. They should also work well for other network configurations.

You can also reset the LAN to the as-shipped settings. This returns ALL LAN settings to the as-shipped values and restarts networking. All default LAN settings are listed under Non-volatile Settings.

Front Panel Menu Reference	SCPI Command
Select **System\IO\LAN\Reset**	Not available
Select **System\IO\LAN\Defaults**	
Select **Reset**. This activates the selected LAN settings and restarts networking.	

Modifying the LAN Settings

As shipped from the factory, the power system's pre-configured settings should work in most LAN environments. If you need to manually configure these settings, press the Menu key, then use the navigation keys to select the LAN Modify menu. In the Modify menu you can then access the following items: IP, Name, DNS, WINS, mDNS, and Services.

Refer to Non-Volatile Settings for information on the factory-shipped LAN settings.

IP Address

Front Panel Menu Reference	SCPI Command
Select **System\IO\LAN\Modify\IP**	Not available
Select Auto or Manual. See below for a full description.	

- Auto - This parameter automatically configures the addressing of the instrument. When selected, 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 addresses on networks that do not have a DHCP server. (The letters DHCP stands for Dynamic Host Configuration Protocol, a protocol for assigning dynamic IP addresses to devices on a network. With dynamic addressing, a device can have a different IP address every time it connects to the network.)
- Manual - This parameter allows you to manually configure the addressing of the instrument by entering values in the following three fields. These fields only appear when Manual is selected.
- 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 with no leading zeros (for example, 169.254.2.20).
- Subnet Mask - This value is used to enable the instrument to determine if a client IP address is on the same local subnet. The same numbering notation applies as for the IP Address. When a client IP address is on a different subnet, all packets must be sent to the Default Gateway.
- DEF 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. The same numbering notation applies as for the IP Address. A value of 0.0.0.0 indicates that no default gateway is defined.

Dot-notation addresses ("nnn.nnn.nnn.nnn" where "nnn" is a byte value from 0 to 255) must be expressed with care, as most PC web software interprets byte values with leading zeros as octal (base 8) numbers. For example, "192.168.020.011" is actually equivalent to decimal "192.168.16.9" because ".020" is interpreted as "16" expressed in octal, and ".011" as "9". To avoid confusion, use only decimal values from 0 to 255, with no leading zeros.

Host Name

A hostname is the host portion of the domain name, which is translated into an IP address. To configure the hostname of the instrument:

Front Panel Menu Reference	SCPI Command
Select System\IO\LAN\Modify\Name You can enter any value from the numeric keypad. For additional characters, use the up/down navigation keys to enter an alpha character by scrolling through the selection list that appears when you press the keys. Use the left/right navigation keys to traverse the text field. Use the backspace key to delete a value. Press Enter when you are finished.	Not available

- 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.

  Each power system is shipped with a default hostname with the format: Keysight-modelnumber-serialnumber, where modelnumber is the mainframe's 6-character model number (e.g. N6700C), 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).

DNS Server and WINS Server

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. Normally, DHCP discovers the DNS address information; you only need to change this if DHCP is unused or not functional.

WINS configures the Windows service of the instrument. This is similar to the DNS service that translates domain names into IP addresses.

To manually configure the DNS and WINS services:

Front Panel Menu Reference	SCPI Command
Select System\IO\LAN\Modify\DNS Select System\IO\LAN\Modify\WINS Select Primary Address or Secondary Address. See below for a full description.	Not available

- Primary Address - This field enters the primary address of the server. Contact your LAN administrator for server details. The same numbering notation applies as for the IP Address. A value of 0.0.0.0 indicates that no default server is defined.
- Secondary Address - This field enters the secondary address of the server. Contact your LAN administrator for server details. The same numbering notation applies as for the IP Address. A value of 0.0.0.0 indicates that no default server is defined.

Dot-notation addresses ("nnn.nnn.nnn.nnn" where "nnn" is a byte value from 0 to 255) must be expressed with care, as most PC web software interprets byte values with leading zeros as octal (base 8) numbers. For example, "192.168.020.011" is actually equivalent to decimal "192.168.16.9" because ".020" is interpreted as "16" expressed in octal, and ".011" as "9". To avoid confusion, use only decimal values from 0 to 255, with no leading zeros.

mDNS Service Name

The mDNS service name is registered with the selected naming service. To configure the mDNS service name of the instrument:

Front Panel Menu Reference	SCPI Command
Select System\IO\LAN\Modify\Name You can enter any value from the numeric keypad. For additional characters, use the up/down navigation keys to enter an alpha character by scrolling through the selection list that appears when you press the keys. Use the left/right navigation keys to traverse the text field. Use the backspace key to delete a value. Press Enter when you are finished.	Not available

- mDNS Service Name - This field registers the service name with the selected naming service. If the field is left blank, no name is registered. A service name may contain upper and lower case letters, numbers and dashes(-).

  Each power system is shipped with a default service name with the format: Keysight-modelnumber-serialnumber, where modelnumber is the mainframe's 6-character model number (e.g. N6700C), 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).

Services

This selects the LAN services to enable or disable.

Front Panel Menu Reference	SCPI Command
Select System\IO\LAN\Modify\Services Check or uncheck the services that you wish to enable or disable	Not available

- The configurable services include: VXI-11, Telnet, Web control, Sockets, mDNS, and HiSLIP.
- You must enable Web control if you wish to remotely control your instrument using its built-in Web interface.

Using the Web Interface

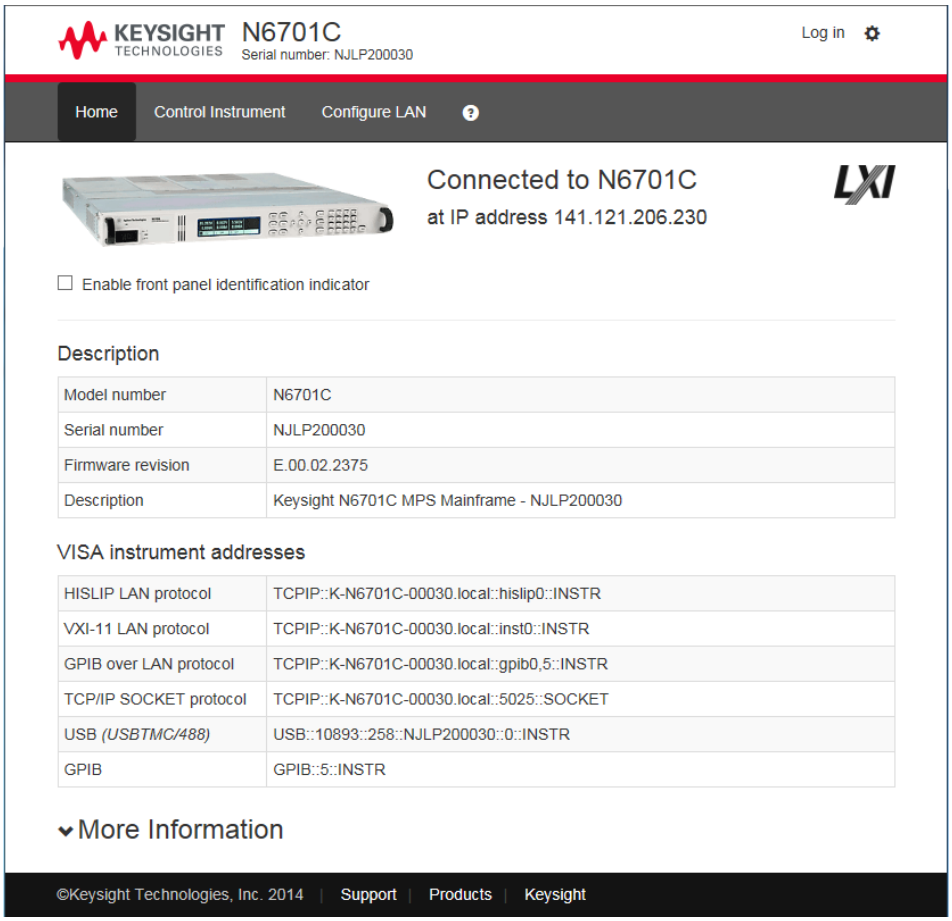
Your power system has a built-in Web interface that lets you control it directly from the Web browser on your computer. With the Web interface, you can access the front panel control functions including the LAN configuration parameters. Up to six simultaneous connections are allowed. With multiple connections, performance will be reduced.

NOTE The built-in Web interface only operates over the LAN. It requires a Web browser. For series N6700A and N6700B you also need the Java Plug-in version 7+. This is included in the Java Runtime Environment.

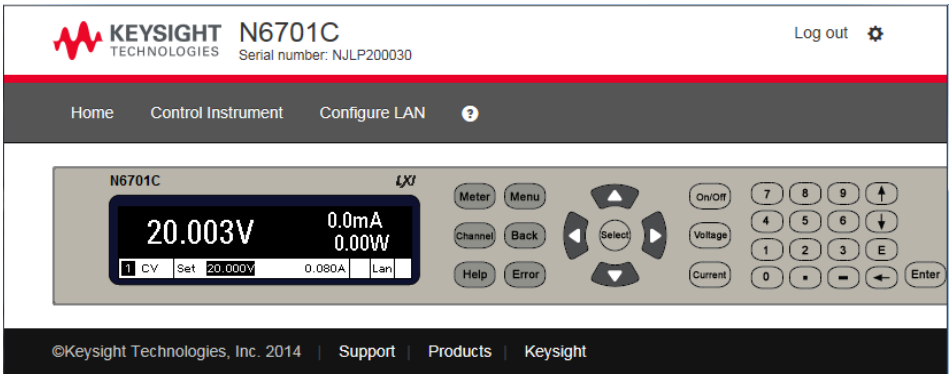
The Web interface is enabled when shipped. To launch the Web interface:

1. Open the Web browser on your computer.
2. Enter the instrument's hostname or IP address into the browser's Address field. The following home page will appear.
3. Click on the Control Instrument tab on the top of the page to begin controlling your instrument.
4. For additional help about any of the pages, click on the ? icon on the top of the page.

If desired, you can control access to the Web interface using password protection. As shipped, no password is set. To set a password, click Log In on the top of the page. Refer to the on-line help for additional information about setting a password.



When you click the Control Instrument tab, a representation of the front panel appears on the display. Use your mouse to control the front panel buttons in the same way that you would control the actual front panel of the instrument.



Using Telnet

In an MS-DOS Command Prompt box type: telnet hostname 5024 where hostname is the instrument's 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 power system. Type the SCPI commands at the prompt.

Using Sockets

NOTE Power supplies allow any combination of up to four simultaneous data socket, control socket, and telnet connections to be made.

Keysight 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 power system 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.

Securing the Interfaces

The USB interface, GPIB interface, and LAN interface are enabled when shipped. To enable or disable the interfaces from the front panel:

Front Panel Menu Reference	SCPI Command
Select **System\Admin\IO**	Not available
Enable or disable the interfaces by checking or unchecking the following items:	
Enable GPIB, Enable USB, and Enable LAN services	
Then press **Select**.	

If you cannot access the Admin menu, it may be password protected. Refer to Password Protection for more information.

NOTE The LAN must be enabled in order to enable the Web server.

4 Operating the Power System

Programming the Output

Stepping the Output

Synchronizing Output Turn-On

Programming Output Lists

Generating Arbitrary Waveforms

Making Measurements

Using the Digitizer

External Data Logging

Using the Digital Control Port

Using the Protection Functions

System-Related Operations

Mainframe Power Allocation

Operating Mode Tutorial

Programming the Output

Select a Channel View

Select an Output Channel

Set the Output Voltage

Set the Output Current

Set the Output Resistance

Set the Output Power

Set the Output Mode

Set the Slew Rate

Enable the Output

Sequence Multiple Outputs

Program the Output Relays

Set the Output Bandwidth

Set the Output Turn-Off Mode

Programming an Input Short

Enable Under-Voltage Inhibit

NOTE

When the power system is first turned on, it may take about 20 seconds or so to initialize the instrument before it is ready for use.

If a menu item is grayed-out, it is not available for the module, or not available in the mode that is presently selected.

Keysight N679xA Load Module input terminals are referred to as "Outputs" throughout this document N679xA.

Select a Channel View

Front Panel Menu Reference	SCPI Command
Press the Meter key to toggle between single-channel and multiple-channel view.	To select single-channel view: DISP:VIEW METER1 To select multiple-channel view: DISP:VIEW METER4

Select an Output Channel

Front Panel Menu Reference	SCPI Command
Press the Channel key to select an output channel.	Enter the selected channel(s) in the command's parameter list. OUTP:STAT? (@1,2)

Set the Output Voltage

Front Panel Menu Reference	SCPI Command
Press the Voltage key. Enter a voltage value. Then press **Select**.	To set output 1 to 5 V: VOLT 5,(@1) To set all outputs to 10 V: VOLT 10,(@1:4)

For models with multiple ranges, you can select a lower range if you need better output resolution.

Front Panel Menu Reference	SCPI Command
Press the Voltage key. Select a lower range. Then press **Select**.	To select the lower range, program a value that falls within the range: VOLT:RANG 5,(@1)

For Keysight Models N678xA SMU N678xA SMU operating in current priority mode, you can specify a Voltage limit, which limits the output voltage at the specified value. In current priority mode, the output current remains at its programmed setting as long as the output voltage is within the positive or negative limit. Check Tracking to let the negative voltage limit track the positive voltage limit.

Front Panel Menu Reference	SCPI Command
Press the Voltage key. Specify a + Voltage limit and or a – Voltage limit. Then press **Select**. Check the Tracking box if you want the – limit to track the + limit.	To select the voltage limit: VOLT:LIM 5,(@1) To select the negative voltage limit: VOLT:LIM:NEG 3,(@1) To enable voltage limit tracking: VOLT:LIM:COUP ON,(@1)

Set the Output Current

Front Panel Menu Reference	SCPI Command
Press the Current key. Enter a current value. Then press **Select**.	To set output 1 to 1 A: CURR 1,(@1) To set all outputs to 2 A: CURR 2,(@1:4)

For models with multiple ranges, you can select a lower range if you need better output resolution.

Front Panel Menu Reference	SCPI Command
Press the Current key. Select a lower range. Then press **Select**.	To select the lower range, program a value that falls within the range: CURR:RANG 1,(@1)

For Keysight Models N678xA SMU, N6783A, and N679xA N678xA SMU N6783A N679xA operating in voltage priority mode, you can specify a positive and negative current limit, which limits the output current at the specified value. In voltage priority mode, the output voltage remains at its programmed setting as long as the load current is within the positive or negative limit.

For Models N678xA SMU, check Tracking to let the negative current limit track the positive current limit. The negative current limit of Model N6783A-MFG is not programmable, but is fixed at -2A.

Front Panel Menu Reference	SCPI Command
Press the Current key. Specify a + Current limit and or a – Current limit. Then press **Select**. On N678xA SMU, check Tracking if you want the – limit to track the + limit.	To select the current limit: CURR:LIM 5,(@1) To select the negative current limit: CURR:LIM:NEG 3,(@1) To enable current limit tracking: CURR:LIM:COUP ON,(@1)

Set the Output Resistance

For Keysight Models N6781A and N6785A N6781A, N6785A, output resistance programming is primarily used in battery testing applications, and only applies in Voltage priority mode. Values are programmed in Ohms, from –40 mΩ to +1 Ω.

Front Panel Menu Reference	SCPI Command
Select **Output\Settings\Resistance**. Check Enable to enable resistance programming. Enter a value. Then press **Select**.	To enable resistance programming: VOLT:RES:STAT ON, (@1) To set the output resistance to 0.5 Ω: VOLT:RES 0.5,(@1)

For Keysight Models N679xA N679xA, the following commands program the load resistance. Resistance may be programmed in any of three overlapping ranges. The load module selects the range that corresponds to the resistance value that you program.

NOTE The resistance selection must previously be selected under Output Mode.

Front Panel Menu Reference	SCPI Command
Select **Output\Settings\Resistance**. Enter a resistance value. Then press **Select**.	To set the output resistance to 60 Ω: RES 60,(@1)

You can manually select a lower resistance range if you need better output resolution. The following ranges can be selected:

	N6791A	N6792A
High resistance range	from 30 Ω to 8 kΩ	from 15 Ω to 8 kΩ
Medium resistance range	from 2 Ω to 100 Ω	from 2 Ω to 100 Ω
Low resistance range	from 0.08 Ω to 3 Ω	from 0.04 Ω to 3 Ω

Front Panel Menu Reference	SCPI Command
Select **Output\Settings\Resistance**. Select a lower range. Then press **Select**.	To select the lower range, program a value that falls within the range: RES:RANG 1,(@1)

NOTE When changing ranges, the load input will be turned off, then back on again.

Set the Output Power

For Keysight N679xA load modules N679xA, the following commands program the input power limit. The maximum programmable output power is either 100 W or 200 W, depending on which load module is being programmed.

NOTE The power selection must previously be selected under Output Mode.

Front Panel Menu Reference	SCPI Command
Select **Output\Settings\Power**. Enter a Power Limit value. Then press **Select**.	To set the inout power to 50 W: POW 50,(@1)

You can also select a lower power range if you need better output resolution. The following ranges can be selected:

	N6791A	N6792A
High power range	from 0.3 W to 100 W	from 0.5 W to 200 W
Low power range	from 0.04 W to 10 W	from 0.1 W to 20 W

Front Panel Menu Reference	SCPI Command
Select **Output\Settings\Power**. Select a Range from the dropdown. Then press **Select**.	To select the lower range, program a value that falls within the range: POW:RANG 5,(@1)

NOTE When changing ranges, the load input will be turned off, then back on again.

Set the Output Mode

NOTE This information applies to Keysight Models N678xA SMU and N679xA only.
N678xA SMU N679xA

For Keysight Models N678xA SMU and N679xA, you can select either Voltage priority or Current priority mode. Power and Resistance priority modes are only available for N679xA load modules.

Voltage priority mode applies to Keysight Models N678xA SMU and N679xA. In this mode, the output is controlled by a bi-polar constant voltage feedback loop, which maintains the voltage at its positive or negative programmed setting. The voltage will remain at its programmed setting as long as the load current remains within the current limit.

Current priority mode applies to Keysight Models N678xA SMU and N679xA. In this mode, the output is controlled by a bi-polar constant current feedback loop, which maintains the current at its programmed setting. The current will remain at its programmed setting as long as the load voltage remains within the voltage limit.

Power priority mode applies to Keysight Models N679xA. In this mode, the load module will maintain the output power at the specified programmed power level.

Resistance priority mode applies to Keysight Models N679xA. In this mode, the load module will sink a current linearly proportional to the input voltage in accordance with the programmed resistance.

Front Panel Menu Reference	SCPI Command
Select **Output\Mode**. Select either Current, Voltage, Power, or Resistance priority. Then press **Select**.	To set output 1 to current priority: FUNC CURR,(@1)

NOTE When switching between Current, Voltage, Power, or Resistance priority, the output is turned off and the output settings revert to their power-on or *RST values. Refer to Operating Mode Tutorial for information about priority mode operation.

Set the Slew Rate

The voltage slew rate determines the rate at which the voltage changes to a new programmed setting.

The current slew rate is only available on Keysight Models N678xA SMU and N679xA N678xA SMU N679xA. It determines the rate at which the current changes to a new programmed setting.

Power and resistance slew rates ars only available on Keysight Models N679xA N679xA. They determines the rate at which the power or resistance changes to a new programmed setting.

Front Panel Menu Reference	SCPI Command
Select **Output\Advanced\Slew** Then select Voltage, Current, Power, or Resistance Enter the slew rate in the Slew Rate field. Then press **Select**. Check the Max slew rate box if you want to program the fastest slew rate.	To set the voltage slew rate to 5 V/s VOLT:SLEW 5,(@1) To set the current slew rate to 1 A/s CURR:SLEW 1,(@1) To set the power slew rate to 10 W/s POW:SLEW 10,(@1) To set the resistance slew rate to 6 Ω/s RES:SLEW 6,(@1) To set the fastest voltage slew rate: VOLT:SLEW MAX,(@1)

There are separate slew rates for positive and negative going transitions. The slew rate settings are absolute values. There is also a tracking mode setting to have the negative slew track the positive setting.

When set to MAXimum, INFinity, or to a very large value, the slew rate will be limited by the analog performance of the control circuit. The slowest or minimum slew rate is model-dependent and is a function of the full scale range. For other ranges the minimum slew rate is proportional to the full scale range.

Enable the Output

Front Panel Menu Reference	SCPI Command
Press the On/Off key. To enable/disable ALL outputs using the On/Off key, select **System\Preferences\Keys.** Check On/Off key affects all channels. Then press **Select**.	To enable only output 1: OUTP ON,(@1) To enable outputs 1-4: OUTP ON,(@1:4)

Because of internal circuit start-up procedures and any installed relay options, output on may take between 35 and 50 milliseconds to complete its function. Conversely, output off may take between 20 and 25 milliseconds to complete its function.

To mitigate these built-in delays, you can program the output to zero volts rather than using the output on/off function.

Sequence Multiple Outputs

Turn-on and turn-off delays control the power-up and power-down sequencing of the output channels in relation to each other.

Front Panel Menu Reference	SCPI Command
Press the Channel key to select an output. Then select **Output\Sequence\Delay**. Select either Turn-on delay or Turn-off delay. Enter a delay in seconds. Then press **Select**. Select **System\Preferences\Keys**. Check On/Off key affects all channels. Then press **Select**.	To program a 50 ms turn-on delay for output 1 and a 100 ms turn-on delay for output 2: OUTP:DEL:RISE 0.05,(@1) OUTP:DEL:RISE 0.1,(@2) To program a 200 ms turn-off delay for outputs 3 and 4: OUTP:DEL:FALL 0.2,(@3,4)

Output turn-on characteristics vary across the power module types - DC Power, Autoranging, Precision, and Source/Measure. When output channels of the same module type are programmed off-to-on, output sequencing is determined by the programmed turn-on delays.

When outputs of different module types are sequenced, there may be additional offsets of a few milliseconds from one output to another that must be accounted for. Specifying a common delay offset assures that the programmed turn-on delays will be synchronized to start at the completion of the common delay offset. Select the delay offset of the slowest power module in the mainframe and use that as the common delay offset. (See Synchronizing Output Turn-On for more information.)

Front Panel Menu Reference	SCPI Command
In the front panel menu, select **Output\Sequence\Couple**. **Max delay offset for this frame** displays the delay offset of the slowest power module in the frame. Enter this value into the **Delay offset** field in milliseconds. Then press **Select**.	To query the delay offset of the slowest power module in the mainframe (the maximum delay offset): OUTP:COUP:MAX:DOFF? To specify the common delay offset for the mainframe: OUTP:COUP:DOFF 0.051

Program the Output Relays

Output relay availability and options are described under Options. Option 761 provides double-pole, double-throw relays that disconnect both the output and sense terminals. Option 760 is the same as option 761 but adds output reversal relays. Note that a small AC network is always present across the output terminals.

Front Panel Menu Reference	SCPI Command
Not Available	To keep the relays closed when output 1 is turned off: OUTP OFF,NOR,(@1) To keep the relays closed when output 1 is turned on: OUTP ON,NOR,(@1)

If you have Option 761 installed, the normal operating mode of the relay is to open and close as the output is turned on or off. The relays are only opened or closed when the output is at a safe state (zero voltage; zero current). Note however, that you can program the output state on or off while leaving the relay state unchanged.

If you have Option 760 installed, you can also reverse the polarity of the output and sense terminals. Note that this command briefly turns the output off while the output and sense terminal polarities are switched. Also note that if this option is installed in Model N6742B, the maximum output current will be limited to 10A.

Front Panel Menu Reference	SCPI Command
Select **Output\Advanced\Pol**. Check the Reverse box. Uncheck the Reverse box to return the polarity to normal. Then press **Select**.	To switch the output and sense terminal polarities of output 1: OUTP:REL:POL REV,(@1) To return the polarities back to normal: OUTP:REL:POL NORM,(@1)

NOTE When the output polarity has been reversed, the voltage meter on the front panel display will show a bar over the voltage reading: $10.001\overline{V}$

Set the Output Bandwidth

NOTE This information applies to Keysight Models N678xA SMU only. N678xA SMU

Keysight Models N678xA SMU have several voltage bandwidth settings that let you optimize output response time with capacitive loads.

The Low bandwidth setting provides stability with a wide range of capacitive loads. Additional settings provide faster output response when the load capacitance is restricted to smaller values.

If capacitive loads cause the output to oscillate on the Low bandwidth or any other bandwidth setting, a protection function will detect the oscillation and latch the output off. This condition is annunciated by the OSC status bit. Oscillation usually occurs with load capacitances that fall outside the indicated ranges. At power-on the oscillation protection function is enabled.

Select a bandwidth according to the following load capacitances and load lead lengths:

Setting	Load Capacitance	Sensing	Maximum distance from sense point to capacitor	ESR @100 kHz	Minimum frequency
Low	0–150 µF	Local or Remote	Full lead length [1]	50 to 200 mΩ	1440 Hz
High1	0–1 µF	Remote only	6 inches (155 mm)	50 to 200 mΩ	33,000 Hz
High2	0–7 µF	Remote only	6 inches (155 mm)	50 to 200 mΩ	20,500 Hz
High3	7–150 µF	Remote only	6 inches (155 mm)	50 to 200 mΩ	8300 Hz

Note 1 Refer to Keysight N678xA SMU Wiring for additional information on allowable load lead lengths.

The frequency parameter sets the pole frequency associated with a voltage bandwidth range. The power-on default for each range is the minimum frequency. This is optimized for no overshoot with the worst-case load capacitance for that range. If the load capacitance is not worst-case, or if some output overshoot is acceptable, the output voltage transition times can be reduced by increasing the frequency limit.

Front Panel Menu Reference	SCPI Command
Select **Output\Advanced\Bandwidth**. Select a bandwidth from the ranges listed. Then press **Select**. Optionally, enter a different frequency limit for the specified range. Then press **Select**.	To select a voltage bandwidth: VOLT:BWID HIGH1,(@1) To select a different frequency limit, use: VOLT:BWID:LEV HIGH1, <frequency>, (@1)

Set the Output Turn-Off Mode

NOTE This information applies to Keysight Models N678xA SMU only. N678xA SMU

This lets you specify high impedance or low impedance mode at output turn-on and turn-off.

Low impedance - At turn-on the output relays are closed after which the output is programmed to the set value. At turn-off the output is first programmed to zero, after which the output relays are opened.

High impedance – At turn-on the output is programmed to the set value after which the output relays are closed. At turn-off the output relays are opened while the output remains at its set value. This reduces current pulses that may be undesirable in some applications.

Front Panel Menu Reference	SCPI Command
Select **Output\Advanced\Tmode**. Select either High or Low impedance. Then press **Select**.	To set output 1 to a high impedance mode: OUTP:TMOD HIGHZ,(@1)

Programming an Input Short

NOTE This information applies to Keysight Models N679xA only. N679xA

This simulates a short circuit on the input of the N679xA load module. It works in all priority modes - it temporarily overrides input and slew settings. Note that the output on/off and the output protection functions take precedence over an input short. An input-short condition is annunciated by the SH status bit.

Front Panel Menu Reference	SCPI Command
Select **Output\Short**. Check Enable short to short the input. Uncheck to open the short. Then press **Select**.	To short output 1: OUTP:SHOR ON,(@1)

Enable Under-Voltage Inhibit

NOTE This information applies to Keysight Models N679xA only. N679xA

When the under-voltage inhibit function is enabled, the N679xA load modules are prevented from sinking current until the voltage-on level is exceeded. This condition is annunciated by the UVI status bit. The following modes can be specified:

Off - turns the under-voltage inhibit function off.

Live - turns the input off whenever the voltage drops below the voltage-on setting. Turns the input back on when the voltage reaches the voltage-on setting.

Latched - lets the load sink current when the voltage subsequently drops below the voltage-on setting. An under-voltage inhibit condition is annunciated by the UVI status bit.

Note that under-voltage inhibit is not available when load modules are grouped or when the unit is operating in CV mode.

Front Panel Menu Reference	SCPI Command
Select **Output\Advanced\UVI** Enter a voltage value in the Voltage On box. Select either Live or Latched mode to enable. Then press **Select**.	To set the voltage-on value to 3 V VOLT:INH:VON 3, (@1) To enable and set the under-voltage inhibit function: VOLT:INH:VON:MODE LATC|LIVE, (@1)

Stepping the Output

Enable the output to respond to trigger commands

Program the step trigger levels

Selects the transient trigger source

Initiate the transient trigger system

Trigger the output step

Generating Trigger-Out Signals

The transient system lets you step the output voltage, current, resistance, or power up or down in response to triggered events. This section describes the procedure to generate triggered output steps.

Enable the output to respond to trigger commands

First, you must enable the output to respond to Step triggers. Unless an output is enabled to respond to triggers, nothing will happen even if you have programmed a trigger level and generated a trigger for the output. Resistance and Power step triggers apply to N679xA. The parameters apply to the selected Arb type (Voltage, Current, Power, or Resistance).

Use the following commands to enable an output to respond to step triggers:

Front Panel Menu Reference	SCPI Command
Select **Transient\Mode**. Set dropdown of the the specified function to Step. Then press **Select**.	To enable the specified function to respond to step triggers, use: VOLT:MODE STEP,(@1) CURR:MODE STEP,(@1) RES:MODE STEP,(@1) POW:MODE STEP,(@1)

NOTE In Step mode, the triggered value becomes the immediate value when the trigger is received. In Fixed mode, trigger signals are ignored; the immediate values remain in effect when a trigger is received.

Program the step trigger levels

Next, use the following commands to program a triggered level. The output will go to this level when the trigger is received. Resistance and Power trigger levels apply to N679xA.

If you have a model that has multiple ranges, the selected triggered settings must be within the same range that the output channel is presently operating in

Front Panel Menu Reference	SCPI Command
Select **Transient\Step**. Enter a value. Then press **Select**.	To set a trigger level for output 1 use: VOLT:TRIG 15,(@1) CURR:TRIG 1,(@1) RES:TRIG 50,(@1) POW:TRIG 75,(@1)

Selects the transient trigger source

Select a trigger source from the following:

Bus Selects GPIB device trigger, *TRG, or <GET> (Group Execute Trigger).

Imm An immediate trigger command either from the front panel or over the bus will generate an immediate trigger.

Ext Selects all digital port pins that have been configured as trigger inputs.

Pin<n>Selects a specific pin that is configured as a Trigger Input on the digital port.<n> specifies the pin number. The selected pin must be configured as a Trigger Input in order to be used as a trigger source (refer to Trigger Input).

Transient<n> Selects the output channel's transient system as the trigger source. <n> specifies the channel. When you select a channel, you must also set up that channel's transient system to generate a trigger out signal. Refer to Generate Trigger Out Signals.

Use the following commands to select a trigger source:

Front Panel Menu Reference	SCPI Command
To select Bus triggers, select **Transient\TrigSource**. Under Transient trigger source, select Bus.	To select Bus triggers for output 1: TRIG:TRAN:SOUR BUS,(@1)
To select Digital pin triggers, select **Transient\TrigSource**. Then select one of the digital port pins. (Ext selects all pins that have been configured as trigger inputs.)	To select Immediate triggers for output 1: TRIG:TRAN:SOUR IMM,(@1)
To select Transient output triggers, select **Transient\TrigSource**. Then select one of the output channels. Then press **Select**.	To select Digital pin triggers: TRIG:TRAN:SOUR PIN<n>,(@1) where n is the pin number. To select Transient output triggers: TRIG:TRAN:SOUR TRAN<n>,(@1) where n is the output channel that will generate the trigger signal

Initiate the transient trigger system

When the power system is turned on, the trigger system is in the idle state. In this state, the trigger system is disabled, ignoring all triggers. Initiating the trigger system moves it from the idle state to the initiated state, which enables the power system to receive triggers. To initiate the trigger system, use:.

Front Panel Menu Reference	SCPI Command
Select **Transient\Control**. Navigate to Initiate. Then press **Select**.	To initiate the transient trigger system: INIT:TRAN (@1)

It takes a few milliseconds for the instrument to be ready to receive a trigger signal after receiving the INITiate:TRANsient command.

If a trigger occurs before the trigger system is ready for it, the trigger will be ignored. You can test the WTG_tran bit in the operation status register to know when the instrument is ready to receive a trigger.

Front Panel Menu Reference	SCPI Command
Not Available	To query the WTG_tran bit (bit 4): STAT:OPER:COND? (@1)

If a bit value of 16 is returned in the query, the WTG_tran bit is true, and the instrument is ready to receive the trigger signal. Refer to Status Tutorial for more information.

NOTE Unless INITiate:CONTinuous:TRANsient is programmed, it will be necessary to initiate the transient trigger system each time a triggered action is desired

Trigger the output step

The trigger system is waiting for a trigger signal in the initiated state. You can immediately trigger the output as follows:

Front Panel Menu Reference	SCPI Command
Select **Transient\Control**. Navigate to Trigger. This generates an immediate trigger signal regardless of the trigger source setting. Then press **Select**.	To generate a transient trigger: TRIG:TRAN (@1) Alternatively, you can also program a *TRG or an IEEE-488 <get> command.

As previously discussed, a trigger can also be generated by another output channel or by a trigger signal applied to an input pin on the digital port connector. If any of these systems are configured as the trigger source, the instrument will wait indefinitely for the trigger signal. If the trigger does not occur, you must manually return the trigger system to the idle state.

The following commands return the trigger system to the idle state:

Front Panel Menu Reference	SCPI Command
Select **Transient\Control**. Navigate to Abort. Then press **Select**.	ABOR:TRAN (@1)

When a trigger is received, the triggered functions are set to their programmed trigger levels. When the triggered actions are completed, the trigger system returns to the idle state.

You can test the TRAN_active bit in the Operation Status register to know when the transient trigger system has returned to the idle state.

Front Panel Menu Reference	SCPI Command
Not Available	To query the TRAN_active bit (bit 6): STAT:OPER:COND?

If a bit value of 64 is returned in the query, the TRAN_active bit is true, and the transient action is NOT complete. When the TRAN_active bit is false, the transient action is complete. Refer to Status Tutorial for more information.

Generating Trigger-Out Signals

Each output channel can generate trigger signals that can be used by other output channels, or routed to a pin on the digital port that has been configured as a trigger output (TOUT). Use the following commands to program transient trigger signals that are generated when an output Step occurs.

Front Panel Menu Reference	SCPI Command
Use the Channel key to select the channel that is the trigger source. Select **Transient\Step**. Check Enable Trig out. Then press **Select**.	To program channel 3's step function to generate a trigger signal, use STEP:TOUT ON,(@3)

Synchronizing Output Turn-On

Synchronizing Output Turn-On Delays

Synchronizing Multiple Mainframes

Synchronization Operation

This function lets you accurately synchronize output turn-on sequences by letting you specify a common delay offset, which serves as a reference point for the user-programmed turn-on delays. This same reference point also makes it possible to connect multiple Keysight N6700C-series mainframes together and program accurate turn-on sequences across multiple mainframes.

Note that there is no delay offset when outputs turn off. Outputs start executing their programmed turn-off delays as soon as an output Off command is received.

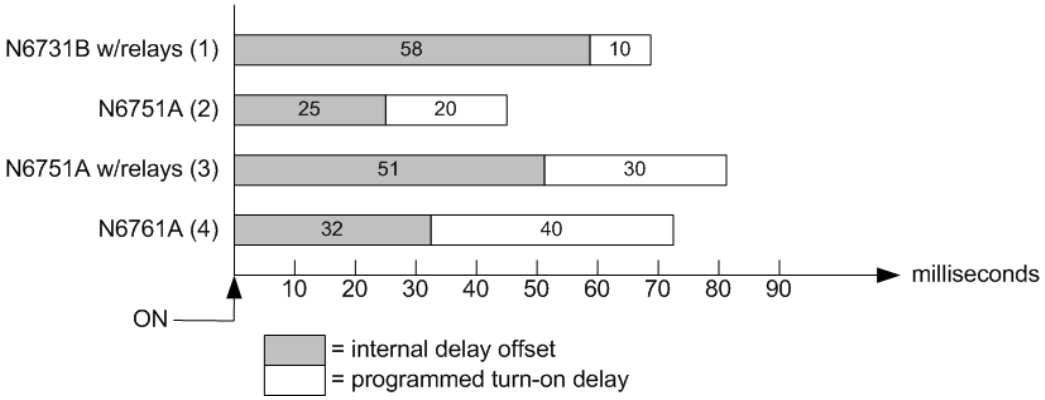
Synchronizing Output Turn-On Delays

All N6700 series power modules that are installed in Keysight N6700C mainframes 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. If you specify a user-programmed turn-on delay, this delay will be added to the minimum delay offset, resulting in a turn-on delay that is actually longer than the one you programmed. The minimum delay offset is shown as follows:

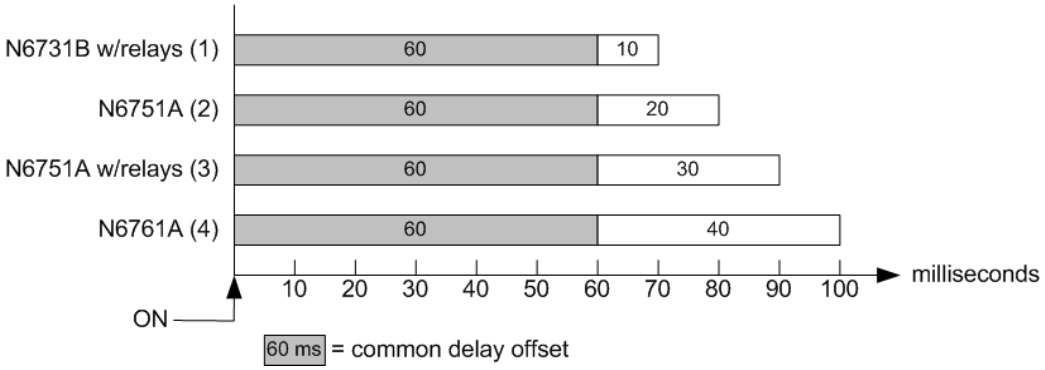
Power Modules	Options and Mode	Delay Offset
N673xB, N674xB, N677xA	Without relays With relay option 760, 761	32 ms 58 ms
N6751A, N6752A	Without relays With relay option 761	25 ms 51 ms
N6753A, N6754A	Without relays With relay option 760, 761	18 ms 44 ms
N6761A, N6762A	Constant Voltage - without relays Constant Voltage - with relay option 761 Constant Current - without relays Constant Current - with relay option 761	32 ms 58 ms 23 ms 45 ms
N6781A, N6782A, N6784A With relays programmed closed	Voltage Priority - Low Z mode; or Current Priority Voltage Priority - High Z mode Voltage Priority - Low Z mode; or Current Priority Voltage Priority - High Z mode	25.6 ms 24.8 ms 5.2 ms 7.3 ms
N6785A, N6786A With relays programmed closed	Voltage Priority - Low Z mode; or Current Priority Voltage Priority - High Z mode Voltage Priority - Low Z mode; or Current Priority Voltage Priority - High Z mode	35.9 ms 34.9 ms 5.2 ms 7.3 ms

To determine which power modules are installed in your mainframe, select System\About\Module from the front panel. For models N676xA, send OUTPut:PMODe? to query the preferred turn-on mode. For models N678xA, send FUNCtion? to query the priority mode that has been set.

To determine the actual turn-on delay between the "on" event (such as pressing the Output On key or sending an Output On command), you must add the programmed turn-on delay to the minimum delay offset as shown in the following example. In this example, if you program delay values of 10 ms, 20 ms, 30 ms, and 40 ms for output channels 1 through 4 respectively, the actual output delays will be 68 ms, 45 ms, 81 ms, and 72 ms for output channels 1 through 4.



To synchronize power modules with different minimum delay offsets as shown above, you can specify a common delay offset parameter. By setting the common delay offset to be greater than or equal to the largest minimum delay offset, you can synchronize the programmed turn-on delays as shown in the following example.



Since there will be an additional delay due to the common delay offset, you will need to account for the additional delay time. As shown in the previous example, if you program a common delay of 60 ms and user-programmed delays of 10 ms, 20 ms, 30 ms, and 40 ms for output channels 1 through 4, the actual output delays from the "on" event will be 70 ms, 80 ms, 90 ms, and 100 ms respectively.

Even though this 60 ms delay offset will be seen on all outputs, the additional delay time will not affect most applications because the relative delay times between output module turn-on will still be 10 ms, 20, ms, 30 ms, and 40 ms – the exact values originally specified.

Step 1. Enable the Synchronization Function

Output turn-on synchronization must be enabled on the mainframe as follows:

Front Panel Menu Reference	SCPI Command
In the front panel menu, select **Output\Sequence\Couple**. Check the Enable box. Then press **Select**. To disable, uncheck the box.	To enable, send: OUTP:COUP ON To disable, send: OUTP:COUP OFF

Step 2. Specify which Output Channels will be Synchronized

Select the output channels that will be synchronized:

Front Panel Menu Reference	SCPI Command
In the front panel menu, select **Output\Sequence\Couple**. Check which channels will be coupled. Then press **Select**. To remove a channel, uncheck the box.	To specify a channel or channels: OUTP:COUP:CHAN 1,2,3,4

Step 3. Specify the Turn-On Delays for each Output Channel

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

Front Panel Menu Reference	SCPI Command
For channels 1, 2, 3, and 4, select **Output\Sequence\Delay**. Specify the Turn-on delay for each channel in seconds. Then press **Select**.	Program a turn-on delays for channels 1 through 4: OUTP:DEL:RISE .01,(@1) OUTP:DEL:RISe .02,(@2) OUTP:DEL:RISE .03,(@3) OUTP:DEL:RISE .04,(@4)

Step 4. Specify Common Delay Offset

This step is required if you have power modules with **different** minimum delay offsets. Specifying a common delay offset assures that the user-programmed turn-on delays will be synchronized to start at the completion of the common delay offset. Select the delay offset of the slowest power module in the mainframe and use that as the common delay offset:

Front Panel Menu Reference	SCPI Command
In the front panel menu, select **Output\Sequence\Couple**. The **Max delay offset for this frame** field displays the delay offset of the slowest power module in the frame. Enter the delay offset value of the slowest power module in the **Delay offset** field in milliseconds. Then press **Select**.	To query the delay offset of the slowest power module in the mainframe (the maximum delay offset) in seconds: OUTP:COUP:MAX:DOFF? To specify the common delay offset for the mainframe in seconds: OUTP:COUP:DOFF .051

Note that you can 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 power modules with longer delay offsets. However, if you program a value that is shorter than the maximum delay offset, you may experience improper synchronization across all outputs.

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.

Synchronizing Multiple Mainframes

The output turn-on synchronization function can be used across multiple mainframes that have coupled output channels. Each mainframe that will be synchronized must have at least one coupled channel. Note that cross-frame synchronization must be enabled for any mainframe that contains synchronized output channels.

Step 1. Configure the output channels on each mainframe (refer to previous steps 1- 3)

Step 2. Specify a common delay offset for all of the synchronized output channels

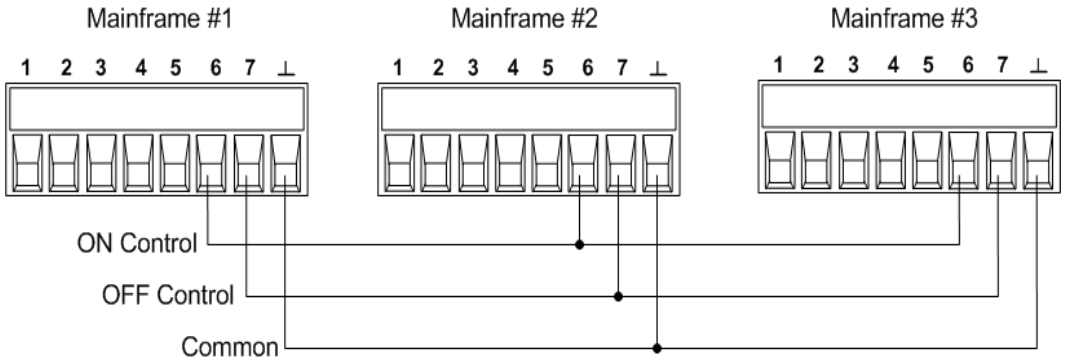
This step is required if you have power modules with *different* minimum delay offsets. The delay value must be the largest delay offset of all synchronized output channels regardless of the mainframe in which they are installed. This same value must be specified as the common delay offset for each mainframe.

Front Panel Menu Reference	SCPI Command
In the front panel menu of each mainframe, select **Output\Sequence\Couple**. In the Delay offset field, enter the delay offset value of the slowest power module of all the mainframes in milliseconds. Then press **Select**. The **Max delay offset for this frame** field displays the delay offset of the slowest power module in this frame.	To specify the common delay offset for each mainframe in seconds: OUTP:COUP:DOFF .051 To return the delay offset of the slowest power module in each mainframe (the maximum delay offset) in seconds: OUTP:COUP:MAX:DOFF?.

Step 3. Connect and configure the digital connector pins of the synchronized 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.

The digital connector pins of the synchronized mainframes that contain coupled channels 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 "ONCouple" and "OFFCouple" 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.

Front Panel Menu Reference	SCPI Command
For mainframe #1, select **System\IO\DigPort\Pins**. Select pin 6, then Function, then On Couple. Select **Pins**., select pin 7, then Function, then Off Couple. Repeat these steps for mainframes #2 and #3.	To configure pin 6 of mainframe #1 as the ON control: DIG:PIN6:FUNC ONC To configure pin 7 of mainframe #1 as the OFF control: DIG:PIN7:FUNC OFFC Repeat these commands for mainframes #2 and #3.

Synchronization Operation

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

If a mainframe has its ON/OFF key coupled (located in the **System\Preferences\Keys** menu), turning the output on or off on any coupled channel will cause all coupled channels as well as non-coupled channels on *that mainframe* to turn on or off.

Programming Output Lists

Output Lists

Program an Output Pulse or Pulse Train

Program an Arbitrary List

NOTE The output List function requires Option 054 to be installed on models N673xA. N674xA, N675xA, and N677xA.

Output Lists

Output current, voltage, power, and resistance may be list-controlled. For Models N678xA SMU, only the parameters associated with one of the priority modes may be list controlled. Power and Resistance lists only apply to Models N679xA loads. List mode lets you generate complex sequences of output changes with rapid, precise timing, which may be synchronized with internal or external signals. Lists can contain up to 512 individually programmed steps, and can be programmed to repeat themselves.

The current, voltage, power, and resistance lists are paced by a separate list that defines the duration or dwell of each step. Each of the up to 512 steps can have an individual dwell time associated with it, which specifies the time in seconds that the list will remain at that step before moving on to the next step. Dwell times can be programmed from 0 to 262.144 seconds. The default dwell time is 0.001 seconds.

If you need an output list to closely follow external events, then a trigger-paced list is more appropriate. In a trigger-paced list, the list advances one step for each trigger received. As previously discussed, a number of trigger sources can be selected to generate triggers. With a trigger-paced list, you do not need to program a dwell time for each step. If you do program a dwell time, triggers that are received during the dwell period are ignored.

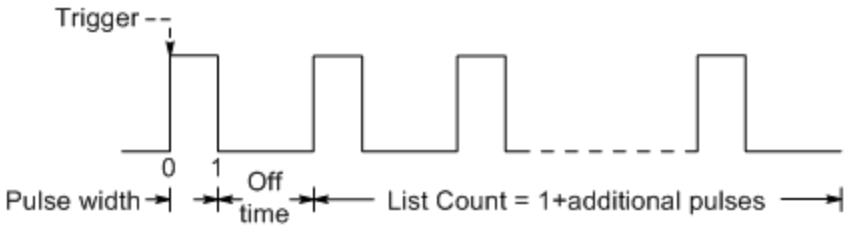
Lists can also be configured to generate trigger signals at specified steps. This is accomplished by two additional lists: a beginning-of-step (BOST) and an end-of-step (EOST) list. These lists define which steps will generate a trigger signal and if the trigger occurs at the beginning or end of the step. These trigger signals can be used to synchronize other events with the list.

When either a voltage, current, power, or resistance list is programmed, the associated dwell, BOST, and EOST lists must all be set to the same number of steps, otherwise an error will occur when the list is run. For convenience, a list may be programmed with only one step or value. In this case, a single-step list is treated as if it had the same number of steps as the other lists, with all values being equal to the one value.

NOTE List data is not stored in non-volatile memory. This means that list data that is sent to the instrument either from the front panel or over the bus will be lost when the power system is turned off. However, list data can be saved as part of a saved instrument state. Refer to Instrument State Storage .

Program an Output Pulse or Pulse Train

The following procedure shows how to generate an output pulse train using the List function as illustrated in the following figure.



Step 1. Set the voltage, current, power, or resistance function for which you want to generate a pulse to List mode. This example programs a voltage pulse. Resistance and Power modes apply to N679xA. The parameters apply to the selected Arb type (Voltage, Current, Power, or Resistance).

Front Panel Menu Reference	SCPI Command
Select **Transient\Mode**. Set the voltage mode to List. Then press **Select**.	To program output 1, use VOLT:MODE LIST,(@1)

Step 2. Set the amplitude and width of the pulse. For example, to generate a pulse with an amplitude of 15 V and a pulse width of 1 second, use:

Front Panel Menu Reference	SCPI Command
Select **Transient\List\Config**. Select List Step 0 and enter a voltage value of 15. Then press **Select**. Enter a dwell value of 1 for List Step 0. Then press **Select**.	To program output 1, use LIST:VOLT 15,(@1) LIST:DWEL 1,(@1)

Step 3. Set the list pacing to Auto, so that as each dwell time elapses, the next step is immediately output.

Front Panel Menu Reference	SCPI Command
Select **Transient\List\Pace**. Select Dwell paced. Then press **Select**.	LIST:STEP AUTO,(@1)

NOTE If you only wish to program a single pulse, skip steps 4 and 5 and go to step 6.

Step 4. If you want to generate a pulse train, you must specify the off time between pulses. To do this you must program another step. For a voltage list, you must specify an amplitude and an off time. For example, to program an off time of 2 seconds with an amplitude of 0 V between pulses, use:

Front Panel Menu Reference	SCPI Command
Select **Transient\List\Config**. Select List Step 1 and enter a voltage value of 0. Then press **Select**. Enter a dwell value of 2 for List Step 1. Then press **Select**.	To program output 1, use LIST:VOLT 15,0,@1) LIST:DWEL 1,2,(@1)

Step 5. To generate a pulse train, you can simply repeat the pulse as needed. For example, to program a pulse train of 50 pulses, use:

Front Panel Menu Reference	SCPI Command
Select **Transient\List\Repeat**. Enter the number of list repetitions (50). Then press **Select**.	To program output 1, use LIST:COUN 50,(@1)

Step 6. Specify if you want the output pulse to generate a trigger signal that can be used to trigger actions on other output channels or on any external equipment connected to the digital port. For example, to generate a trigger signal at the end of the pulse, use:

Front Panel Menu Reference	SCPI Command
Select **Transient\List\Config**. Select List Step 0 and enter a value of 1 in the Tout end step field. Then press **Select**.	To program a trigger at the End of the pulse for output 1, use LIST:TOUT:EOST 1,0(@1) You must program a value of 0 (no trigger) for step 1 as a placeholder.

Step 7. Specify the output state after the pulse has completed. For example, to return the output to the state it was in before the pulse, use:

Front Panel Menu Reference	SCPI Command
Select **Transient\List\Terminate**. Select Return to start settings. Then press **Select**.	To program output 1, use LIST:TERM:LAST 0, (@1)

Step 8. Select the trigger source that will generate the pulse or pulse train.

Select a trigger source from the following:

- **Bus** Selects GPIB device trigger, *TRG, or <GET> (Group Execute Trigger).
- **Imm** An immediate trigger command either from the front panel or over the bus will generate an immediate trigger.
- **Ext** Selects all digital port pins that have been configured as trigger inputs.

- Pin<n>Selects a specific pin that is configured as a Trigger Input on the digital port.<n> specifies the pin number. The selected pin must be configured as a Trigger Input in order to be used as a trigger source (refer to Trigger Input).
- Transient<n> Selects the output channel's transient system as the trigger source. <n> specifies the channel. When you select a channel, you must also set up that channel's transient system to generate a trigger out signal. Refer to Generate Trigger Out Signals.

For example, to select Bus triggers as the trigger source, use:

Front Panel Menu Reference	SCPI Command
Select **Transient\TrigSource**. Under Transient trigger source, select Bus. Then press **Select**.	To program output 1, use: TRIG:TRAN:SOUR BUS,(@1)

Step 9. Initiate the transient trigger system. To enable the trigger system for one transient event or trigger use:

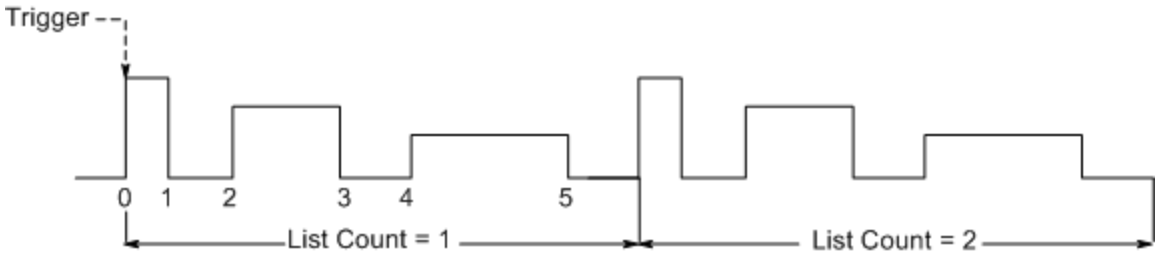
Front Panel Menu Reference	SCPI Command
Select **Transient\Control**. Navigate to Initiate. Then press **Select**.	To program output 1, use: INIT:TRAN (@1)

Step 10. Trigger the output pulse or pulse train.

Front Panel Menu Reference	SCPI Command
Select **Transient\Control**. Navigate to Trigger. Then press **Select**.	*TRG

Program an Arbitrary List

The following procedure shows how to generate the list of voltage changes as illustrated in the following figure.



Step 1. Set the voltage, current, power, or resistance function for which you want to generate a list to List mode. This example programs a voltage list. Resistance and Power modes apply to N679xA

Front Panel Menu Reference	SCPI Command
Select **Transient\Mode**. Set the voltage mode to List. Then press **Select**.	To program output 1, use VOLT:MODE LIST,(@1)

Step 2. Program the list of values for the List function. The order in which the values are entered determines the order in which the values will be output. To generate the voltage list shown in the figure, a list may include the following values: 9, 0, 6, 0, 3, 0

Front Panel Menu Reference	SCPI Command
Select **Transient\List\Config**. Select the List Step number and enter a voltage value. Then press **Select**. Repeat this for each step. Use the ⬆⬇ keys to select the next step.	To program output 1, use LIST:VOLT 9,0,6,0,3,0,(@1)

Step 3. Determine the time interval, in seconds, that the output remains at each step in the list before it advances to the next step. To specify the six dwell intervals in the figure, a list may include the following values: 2, 3, 5, 3, 7, 3

Front Panel Menu Reference	SCPI Command
Select **Transient\List\Config**. Select the List Step number and enter a voltage value. Then press **Select**. Repeat this for each step. Use the ⬆⬇ keys to select the next step.	To program output 1, use LIST:DWEL 2,3,5,3,7,3,(@1)

NOTE The number of dwell steps must equal the number of voltage steps. If a dwell list has only one value, that value will be applied to all steps in the list.

Step 4. Determine how the list is paced. To pace the list by dwell time, set the list pacing to Dwell-paced on the front panel menu. (Set the LIST:STEP command to AUTO.) As each dwell time elapses, the next step is immediately output.

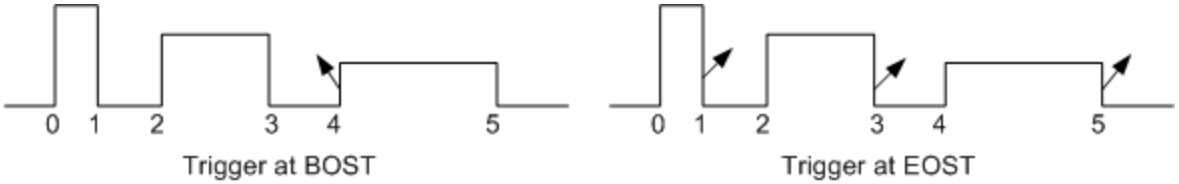
Front Panel Menu Reference	SCPI Command
Select **Transient\List\Pace**. Select Dwell paced. Then press **Select**.	LIST:STEP AUTO,(@1)

In a trigger-paced list, the list advances one step for each trigger received. To enable trigger-paced lists, select Trigger-paced on the front panel menu. (Set the LIST:STEP command to ONCE.)

The dwell time associated with each step determines the minimum time that the output remains at the step. If a trigger is received before the dwell time completes, the trigger is ignored. To ensure that no triggers are lost in a trigger-paced list, set the dwell time to zero.

Step 5. Specify if you want the list to generate trigger signals that can be used to trigger actions on other output channels or on external equipment connected to the digital port.

Front Panel Menu Reference	SCPI Command
Select **Transient\List\Config**. Select the List Step number. To generate a trigger, enter a 1 in the Tout begin step or Tout end step field. If a zero is entered, no trigger is generated for the step. Repeat this for each step. Use the ⬆⬇ keys to select the next step.	To program a trigger at the start of step 4 for output 1, use LIST:TOUT:BOST 0,0,0,0,1,0,@(1) To program a trigger at the end of step 0, 2, and 4 for output 1, use LIST:TOUT:EOST 1,0,1,0,1,0,(@1)



Step 6. Specify how you want the list to terminate. For example, if you want the list to remain at the values of the last list step when finished, use:

Front Panel Menu Reference	SCPI Command
Select **Transient\List\Terminate**. Select Stop at last step settings. Then press **Select**.	To program output 1, use LIST:TERM:LAST 1,(@1)

Step 7. If applicable, specify how many times you want the list to repeat. Sending the INFinity parameter in the SCPI command makes the list repeat indefinitely. At reset, the list count is set to 1.

Front Panel Menu Reference	SCPI Command
Select **Transient\List\Repeat**. Enter the number of List repetitions (2). Then press **Select**.	To program the output 1 list to repeat 2 times, use LIST:COUN 2,(@1)

Step 8. Select a trigger source, then initiate, and trigger the list. This is previously described under Program an Output Pulse or Pulse Train.

Generating Arbitrary Waveforms

Arbitrary Waveform Description

Configuring Step Arbs

Configuring Pulse Arbs

Configuring Ramp Arbs

Configuring Trapezoid Arbs

Configuring Staircase Arbs

Configuring Exponential Arbs

Configuring Sinusiod Arbs

Configuring Constant-Dwell Arbs

Configuring an Arb Sequence

Configuring User-Defined Arbs

Configuring Steps Common to all Arbs

Running the Arb

NOTE The Arbitrary waveform function requires Option 054 to be installed on models N673xA. N674xA, N675xA, and N677xA.

Arbitrary Waveform Description

Each output on the power system can be modulated by the built-in arbitrary waveform generator function. This allows the output to act as a DC bias transient generator or an arbitrary waveform generator. The maximum bandwidth is based on the type of power module that is installed. This is documented in the Keysight N6700 Modular Power System Family Specifications Guide.

The arbitrary waveform generator has a variable dwell period, where each point in the waveform is defined by the current, voltage, power, or resistance setting along with the dwell time or duration to stay at that setting. Waveforms can be generated by specifying only a small number of points. For example, a pulse would only take three points to define it. However, sine, ramp, trapezoid, and exponential waveforms have 100 points assigned to the portion of their waveform that continuously changes. Constant-dwell waveforms can have up to 65,535 points assigned to them.

Each waveform can be set to repeat continuously or repeat a specific number of times. For example, to generate a pulse train of 10 identical pulses, you can program the parameters for one pulse and then specify that you want it to repeat 10 times.

For the user-defined waveforms, you can specify up to 511 step-points for each waveform. You can specify a different dwell time for each of the step-points. The output will step through the user-defined values, staying at each point for the programmed dwell time, and then moving on to the next point.

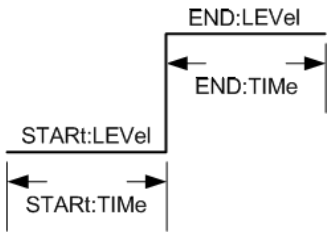
You can combine a number of individual arbitrary waveforms into an Arb sequence, as long as the total number of points of all waveforms does not exceed 511 points.

Configuring Step Arbs

Step 1. Select the Arb Type and Shape. Power and Resistance types apply to N679xA.

Front Panel Menu Reference	SCPI Command
Select **Transient\Arb\Function**. Select a Voltage, Current, Power, or Resistance Arb Type. Then select the Step Shape. Then press **Select**.	To select a current, voltage, power, or resistance step Arb, use: ARB:FUNC:TYPE CURR|VOLT|POW|RES,(@1) ARB:FUNC:SHAP STEP,(@1)

Step 2. Configure the step parameters. The parameters apply to the selected Arb type (Voltage, Current, Power, or Resistance).



Enter the values for the level before and after the step.

Enter the time before the step.

Front Panel Menu Reference	SCPI Command
Select **Transient\Arb\Config\Step\Level**. Enter the Start and End level in volts. Then press **Select**. Select **Transient\Arb\Config\Step\Time**. Enter the Start and End time in seconds. Then press **Select**.	To configure a voltage step Arb, use: ARB:VOLT:STEP:STAR 0, (@1) ARB:VOLT:STEP:END 10, (@1) ARB:VOLT:STEP:STAR:TIM 0.25,(@1)

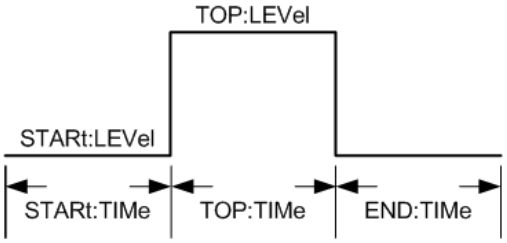
Step 3. Configure the final steps common to all Arbs. Refer to Configuring Steps Common to all Arbs at the end of this section.

Configuring Pulse Arbs

Step 1. Select the Arb Type and Shape. Power and Resistance types apply to N679xA.

Front Panel Menu Reference	SCPI Command
Select **Transient\Arb\Function**. Select a Voltage, Current, Power, or Resistance Arb Type. Then select the Pulse Shape. Then press **Select**.	To select a current, voltage, power, or resistance pulse Arb, use: ARB:FUNC:TYPE VOLT|CURR|POW|RES,(@1) ARB:FUNC:SHAP PULS,(@1)

Step 2. Configure the pulse parameters. The parameters apply to the selected Arb type (Voltage, Current, Power, or Resistance).



Enter the values for the level before and during the top of the pulse.

Enter the time before the pulse, the time of the pulse, the time after the pulse. A pulse frequency can only be specified directly using SCPI commands. The pulse frequency can also be specified using the Time parameters.

Front Panel Menu Reference	SCPI Command
Select **Transient\Arb\Config\Pulse\Level**. Enter the Start and Top level in volts. Then press **Select**. Select **Transient\Arb\Config\Pulse\Time**. Enter the Start, Top, and End times in seconds. Then press **Select**.	To configure a voltage pulse Arb, use: ARB:VOLT:PULS:STAR 0,(@1) ARB:VOLT:PULS:TOP 10,(@1) ARB:VOLT:PULS:STAR:TIM 0.25,(@1) ARB:VOLT:PULS:TOP:TIM 0.5,(@1) ARB:VOLT:PULS:END:TIM 0.25,(@1) ARB:VOLT:PULS:FREQ 1,(@1)

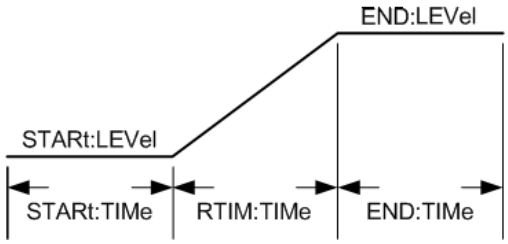
Step 3. Configure the final steps common to all Arbs. Refer to Configuring Steps Common to all Arbs at the end of this section.

Configuring Ramp Arbs

Step 1. Select the Arb Type and Shape. Power and Resistance types apply to N679xA.

Front Panel Menu Reference	SCPI Command
Select **Transient\Arb\Function**. Select a Voltage, Current, Power, or Resistance Arb Type. Then select the Ramp Shape. Then press **Select**.	To select a current, voltage, power, or resistance ramp Arb, use: ARB:FUNC:TYPE VOLT|CURR|POW|RES,(@1) ARB:FUNC:SHAP RAMP,(@1)

Step 2. Configure the ramp parameters. The parameters apply to the selected Arb type (Voltage, Current, Power, or Resistance).



Enter the values for the level before and after the ramp.

Enter the time before the ramp, the rise-time of the ramp, and the time after the ramp.

Front Panel Menu Reference	SCPI Command
Select **Transient\Arb\Config\Ramp\Level**. Enter the Start and End level in volts. Then press **Select**. Select **Transient\Arb\Config\Ramp\Time**. Enter the Start, Rise, and End times in seconds. Then press **Select**.	To configure a voltage ramp Arb, use: ARB:VOLT:RAMP:STAR 0, (@1) ARB:VOLT:RAMP:END 10, (@1) ARB:VOLT:RAMP:STAR:TIM 0.25,(@1) ARB:VOLT:RAMP:RTIM:TIM 0.5,(@1) ARB:VOLT:RAMP:END:TIM 0.25,(@1)

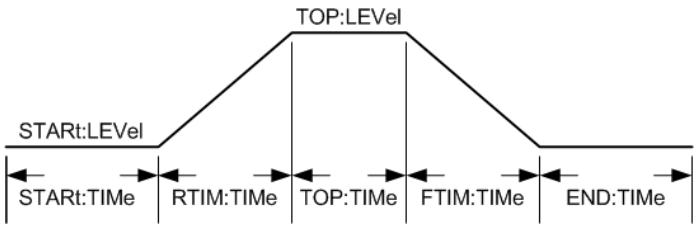
Step 3. Configure the final steps common to all Arbs. Refer to Configuring Steps Common to all Arbs at the end of this section.

Configuring Trapezoid Arbs

Step 1. Select the Arb Type and Shape. Power and Resistance types apply to N679xA.

Front Panel Menu Reference	SCPI Command
Select **Transient\Arb\Function**. Select a Voltage, Current, Power, or Resistance Arb Type. Then select the Trapezoid Shape. Then press **Select**..	To select a current, voltage, power, or resistance trapezoid Arb, use: ARB:FUNC:TYPE VOLT|CURR|POW|RES,(@1) ARB:FUNC:SHAP TRAP,(@1)

Step 2. Configure the trapezoid parameters. The parameters apply to the selected Arb type (Voltage, Current, Power, or Resistance).



Enter the values for the level before and during the top of the trapezoid.

Enter the time before the trapezoid, the rise-time, top-time, fall-time, and the time after the trapezoid.

Front Panel Menu Reference	SCPI Command
Select **Transient\Arb\Config\Trap\Level**. Enter the Start and Top level in volts. Then press **Select**. Select **Transient\Arb\Config\Trap\Time**. Enter the Start, Rise, Top, Fall, and End times in seconds.. Then press **Select**.	To configure a voltage trapezoid Arb, use: ARB:VOLT:TRAP:STAR 0, (@1) ARB:VOLT:TRAP:TOP 10,(@1) ARB:VOLT:TRAP:STAR:TIM 0.25,(@1) ARB:VOLT:TRAP:RTIM:TIM 0.5,(@1) ARB:VOLT:TRAP:TOP:TIM 0.5,(@1) ARB:VOLT:TRAP:FTIM:TIM 0.5,(@1) ARB:VOLT:TRAP:END:TIM 0.25,(@1)

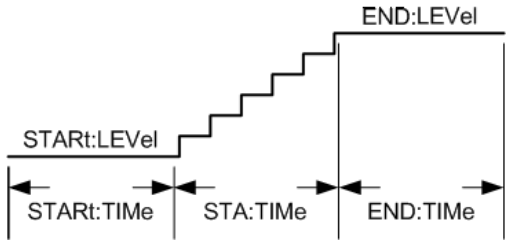
Step 3. Configure the final steps common to all Arbs. Refer to Configuring Steps Common to all Arbs at the end of this section.

Configuring Staircase Arbs

Step 1. Select the Arb Type and Shape. Power and Resistance types apply to N679xA.

Front Panel Menu Reference	SCPI Command
Select **Transient\Arb\Function**. Select a Voltage, Current, Power, or Resistance Arb Type. Then select the Staircase Shape. Then press **Select**.	To select a current, voltage, power, or resistance staircase Arb, use: ARB:FUNC:TYPE VOLT|CURR|POW|RES,(@1) ARB:FUNC:SHAP STAIR,(@1)

Step 2. Configure the staircase parameters. The parameters apply to the selected Arb type (Voltage, Current, Power, or Resistance).



Enter the values for the level before and after the staircase.

Enter the time before the staircase, the stair-time of the ramp, and the time after the staircase.

Then enter the total number of steps.

Front Panel Menu Reference	SCPI Command
Select **Transient\Arb\Config\Stair\Level**. Enter the Start and End level in volts. Then press **Select**. Select **Transient\Arb\Config\Stair\Time**. Enter the Start, Stair, and End times in seconds. Enter the number of steps. Then press **Select**.	To configure a voltage staircase Arb, use: ARB:VOLT:STA:STAR 0,(@1) ARB:VOLT:STA:END 10,(@1) ARB:VOLT:STA:STAR:TIM 0.25,(@1) ARB:VOLT:STA:TIM 0.5,(@1) ARB:VOLT:STA:END:TIM 0.25,(@1) ARB:VOLT:STA:NST 6,(@1)

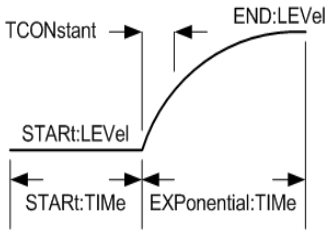
Step 3. Configure the final steps common to all Arbs. Refer to Configuring Steps Common to all Arbs at the end of this section.

Configuring Exponential Arbs

Step 1. Select the Arb Type and Shape. Power and Resistance types apply to N679xA.

Front Panel Menu Reference	SCPI Command
Select **Transient\Arb\Function**. Select a Voltage, Current, Power, or Resistance Arb Type. Then select the Exponential Shape. Then press **Select**.	To select a current, voltage, power, or resistance exponential Arb, use: ARB:FUNC:TYPE VOLT|CURR|POW|RES,(@1) ARB:FUNC:SHAP EXP,(@1)

Step 2. Configure the exponential parameters. The parameters apply to the selected Arb type (Voltage, Current, Power, or Resistance).



Enter the values for the level before and after the exponential.

Enter the time before the exponential, the exponential time, and the time constant of the exponential.

Front Panel Menu Reference	SCPI Command
Select **Transient\Arb\Config\Exp\Level**. Enter the Start and End level in volts. Then press **Select**. Select **Transient\Arb\Config\Exp\Time**. Enter the Start, Time, and Time Constant (TC) in seconds. Then press **Select**.	To configure a voltage step Arb, use: ARB:VOLT:EXP:STAR 0, (@1) ARB:VOLT:EXP:END 10, (@1) ARB:VOLT:EXP:STAR:TIM 0.25,(@1) ARB:VOLT:EXP:TIM 0.5,(@1) ARB:VOLT:EXP:TCON 0.25,(@1)

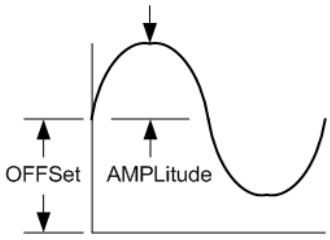
Step 3. Configure the final steps common to all Arbs. Refer to Configuring Steps Common to all Arbs at the end of this section.

Configuring Sinusoid Arbs

Step 1. Select the Arb Type and Shape. Power and Resistance types apply to N679xA.

Front Panel Menu Reference	SCPI Command
Select **Transient\Arb\Function**. Select a Voltage, Current, Power, or Resistance Arb Type. Then select the Sine Shape. Then press **Select**.	To select a current, voltage, power, or resistance sinusoid Arb, use: ARB:FUNC:TYPE VOLT|CURR|POW|RES,(@1) ARB:FUNC:SHAP SIN,(@1)

Step 2. Configure the sinusoid parameters. The parameters apply to the selected Arb type (Voltage, Current, Power, or Resistance).



Enter the amplitude, offset, and frequency of the sinusoid Arb.

Front Panel Menu Reference	SCPI Command
Select **Transient\Arb\Config\Sine**. Enter the Amplitude and Offset in volts. Enter the Frequency in Hertz. Then press **Select**.	To configure a voltage sinusoid Arb, use: ARB:VOLT:SIN:AMPL 10, (@1) ARB:VOLT:SIN:OFFS 5, (@1) ARB:VOLT:SIN:FREQ 10,(@1)

Step 3. Configure the final steps common to all Arbs. Refer to Configuring Steps Common to all Arbs at the end of this section.

Configuring Constant-Dwell Arbs

Constant-Dwell (CD)Arbs are a unique type of Arb that have some useful differences from other types. CD Arbs are not limited to 511 points, they can contain up to 65,535 points. Unlike other Arbs, they do not have separate dwell values associated with each point; a single dwell value applies to every point in the CD Arb. Also, the minimum dwell time of a CD Arb is 10 .24 microseconds, instead of the 1 microsecond resolution of the other Arbs.

A CD Arb can run along with other Arbs on other outputs. If multiple outputs run a CD Arb, all CD Arbs must have the same dwell time. If a repeat count is specified, all CD Arbs must have the same length and repeat count.

Step 1. Select the Arb Type and Shape. Power and Resistance types apply to N679xA.

Front Panel Menu Reference	SCPI Command
Select **Transient\Arb\Function**. Select a Voltage, Current, Power, or Resistance Arb Type. Then select the CD Shape. Then press **Select**.	To select a current, voltage, power, or resistance CD Arb, use: ARB:FUNC:TYPE VOLT|CURR|POW|RES,(@1) ARB:FUNC:SHAP CD,(@1)

Step 2. Configure the CD parameters. The parameters apply to the selected Arb type (Voltage, Current, Power, or Resistance).

Enter the dwell time that will be used for each point in the CD Arb.

Program the number of points in the CD Arb. Assign a value for each point.

Front Panel Menu Reference	SCPI Command
Select **Transient\Arb\Config\CD**. Enter a Dwell time in seconds. Select a point number and enter a value for that point. Then press **Select**.	To configure a voltage CD Arb of 10 points, use: ARB:VOLT:CDW:DWEL 0.01,(@1) ARB:VOLT:CDW 1,2,3,4,5,6,7,8,9,10,(@1)

Step 3. Configure the final steps common to all Arbs. Refer to Configuring Steps Common to all Arbs at the end of this section.

Configuring an Arb Sequence

NOTE

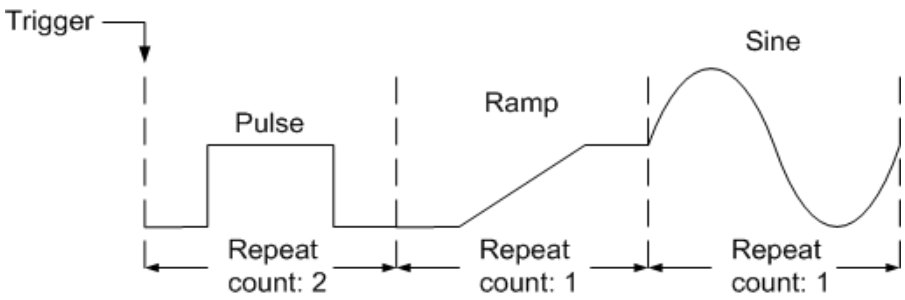
Arb Sequences can only be programmed using SCPI commands. However, individual Arbs within the sequence can be programed from the front panel and with SCPI commands as previously discussed.

The Arb Sequence allows multiple and different Arbs to run one after another is succession. Any of the standard Arb types, except for constant-dwell Arbs, can be included in the Arb sequence. All Arbs in the sequence must be of the same type; either voltage, current, resistance, or power.

As with single Arbs, each Arb in the sequence has its own repeat count, can be set for dwell or trigger pacing, and can be set to repeat continuously. Note also that a repeat count can be set for the entire sequence, and it can also be set to repeat continuously.

Sequence steps must be specified sequentially. The last value in the parameter list is the sequence step number. When a step is added, all Arb parameters must be entered.

The following figure illustrates a sequence comprised of a pulse Arb, a ramp Arb, and a sine Arb. The repeat count value indicates how many times each Arb repeats before moving to the next type.



Front Panel Menu Reference	SCPI Command
Not available	To set up output 1 to program a sequence of voltage waveforms, use: ARB:FUNC:TYPE VOLT,(@1) ARB:FUNC:SHAP SEQ,(@1) ARB:SEQ:RESet (@1) To program step 0 as a voltage pulse: ARB:SEQ:STEP:FUNC:SHAP PULS,0,(@1) ARB:SEQ:STEP:VOLT:PULS:TOP 10,0,(@1) ARB:SEQ:STEP:VOLT:PULS:STAR:TIM 0.25,0,(@1) ARB:SEQ:STEP:VOLT:PULS:TOP:TIM 0.5,0,(@1) ARB:SEQ:STEP:VOLT:PULS:END:TIM 0.25,0,(@1) To program step 1 as a voltage ramp: ARB:SEQ:STEP:FUNC:SHAP RAMP,1,(@1) ARB:SEQ:STEP:VOLT:RAMP:END 10,1,(@1) ARB:SEQ:STEP:VOLT:RAMP:STAR:TIM 0.25,1,(@1) ARB:SEQ:STEP:VOLT:RAMP:RTIM:TIM 0.5,1,(@1) ARB:SEQ:STEP:VOLT:RAMP:END:TIM 0.25,1,(@1) To program step 2 as a voltage sine wave: ARB:SEQ:STEP:FUNC:SHAP SIN,2,(@1) ARB:SEQ:STEP:VOLT:SIN:AMPL 10.0,2,(@1) ARB:SEQ:STEP:VOLT:SIN:OFFS 20.0,2,(@1) ARB:SEQ:STEP:VOLT:SIN:FREQ 0.067,2,(@1) To repeat step 0 twice: ARB:SEQ:STEP:COUN 2,0,(@1) Specify if the next step will start when the dwell time has elapsed or when an external trigger is received. To set the pacing for step 2 to triggered: ARB:SEQ:STEP:PAC TRIG,2,(@1) To select the trigger source for step 2: TRIG:ARB:SOUR BUS,2,(@1) To end the sequence at the last Arb value: ARB:SEQ:TERM:LAST ON,(@1) Set a repeat count for the entire sequence. To make the entire sequence repeat twice: ARB:SEQ:COUN 3,(@1) To set up the transient trigger system and trigger the sequence: VOLT:MODE ARB,(@1) INIT:TRAN (@1) *TRG

Configuring User-Defined Arbs

NOTE

User-Defined Arbs can only be programed using SCPI commands. Refer to User-Defined commands .
Resistance and Powerntypes apply to N679xA. The parameters apply to the selected Arb type (Voltage, Current, Power, or Resistance).

Front Panel Menu Reference	SCPI Command
Not available	To set up the Arb type (current, voltage, power, or resistance) and shape, use: ARB:FUNC:TYPE VOLT|CURR|POW|RES,(@1) ARB:FUNC:SHAP UDEF,(@1) To specify the voltage value of five steps: ARB:VOLT:UDEF:LEV 1,2,3,4,5,(@1) To specify the time that the output stays at the voltage steps: ARB:VOLT:UDEF:DWEL 1,2,3,2,1,(@1) To generate an external trigger signal at the start of a voltage step (the trigger is generated at the start of step #3): ARB:VOLT:UDEF:BOST 0,0,1,0,0,(@1)

Configuring Steps Common to all Arbs

Step 4. Specify what happens when the Arb completes.

Select whether the output returns to the DC value that was in effect before the Arb started, or whether the output should remain at the last Arb value.

Front Panel Menu Reference	SCPI Command
Select **Transient\Arb\Terminate**. Specify Return to start setting or Stop at last Arb setting. Then press **Select**.	To specify a setting when the Arb ends, use: ARB:TERM:LAST OFF,(@1)

Step 5. Specify the repeat count of the Arb.

Specify if the Arb should repeat, either continuously (INFinity), or only for a specified repeat count. A repeat count of 1 runs the Arb once.

Front Panel Menu Reference	SCPI Command
Select **Transient\Arb\Repeat**. Specify a repeat count, or run the Arb continuously. Then press **Select**.	To specify an Arb count, use: ARB:COUN 1,(@1)

Running the Arb

Step 6. Enable the Arb function to respond to output triggers.

Front Panel Menu Reference	SCPI Command
Select **Transient\Mode**. For voltage, current, power, or resistance Arb triggering, set the mode to Arb. Then press **Select**.	To enable the Arb to respond to triggers, use: VOLT:MODE ARB,(@1) CURR:MODE ARB,(@1) POW:MODE ARB,(@1) RES:MODE ARB,(@1)

Step 7. Select the Arb trigger source.

Select a trigger source from the following:

- **Bus** Selects GPIB device trigger, *TRG, or <GET> (Group Execute Trigger).
- **Imm** An immediate trigger command either from the front panel or over the bus will generate an immediate trigger.
- **Ext** Selects all digital port pins that have been configured as trigger inputs.
- **Pin<n>**Selects a specific pin that is configured as a Trigger Input on the digital port.<n> specifies the pin number. The selected pin must be configured as a Trigger Input in order to be used as a trigger source (refer to Trigger Input).

Use the following commands to select a trigger source:

Front Panel Menu Reference	SCPI Command
Select **Transient\TrigSource**. Under Arb trigger source, select Bus. To select Digital pin triggers, select **Transient\TrigSource**. Then select one of the digital port pins. (Ext selects all pins that have been configured as trigger inputs.) Then press **Select**.	To select Bus triggers for Arbs, use: TRIG:ARB:SOUR BUS,(@1) To select Immediate triggers for output 1: TRIG:ARB:SOUR IMM,(@1) To select Digital pin triggers: TRIG:ARB:SOUR PIN<n>,(@1) where n is the pin number.

Step 8. Initiate and Trigger the Arb.

Front Panel Menu Reference	SCPI Command
Select **Transient\Control**. Select Initiate. Wait a second, then select Trigger to generate an immediate trigger signal regardless of the trigger source setting.	To initiate the transient trigger system and generate a trigger: INIT:TRAN (@1) TRIG:TRAN (@1) Alternatively, you can also program a *TRG or an IEEE-488 <get> command.

NOTE It takes a few milliseconds for the instrument to be ready to receive a trigger signal after receiving the INIT:TRAN command. If a trigger occurs before the trigger system is ready for it, the trigger will be ignored. You can test the WTG_tran bit (bit 4) in the operation status register to know when the instrument is ready to receive a trigger after being initiated.

Making Measurements

Basic DC Measurements

Measurement Ranges

Seamless Measurements

Simultaneous Measurements

Auxiliary Voltage Measurements

Basic DC Measurements

Each output channel has its own measurement capability. The output voltage and current is measured by acquiring a number of samples at the selected time interval, applying a window function to the samples, and averaging the samples.

The default time interval and number of samples yield a measurement time of 21 milliseconds per reading (1024 data samples at 20.48 microsecond intervals). The windowing function is Rectangular.

Use the following commands to make a simple measurement. Models that have simultaneous voltage and current measurement capability let you measure power (refer to Model Differences).

Front Panel Menu Reference	SCPI Command
Select the **Meter** key.	MEAS:VOLT? (@1) MEAS:CURR? (@1) MEAS:POW? (@1)

Measurement Ranges

Some models have multiple voltage and current measurement ranges (refer to Model Differences). Selecting a lower measurement range provides greater measurement accuracy, provided the measurement does not exceed the range.

Front Panel Menu Reference	SCPI Command
Select **Measure\Range**. Select the lower measurement range from the voltage or current dropdown menu. Then press **Select**.	To set the 5 V measurement range: SENS:VOLT:RANG 5,(@1) To set the 1 A measurement range: SENS:CURR:RANG 1,(@1)

The maximum measurable current is the maximum rating of the range. If the measurement exceeds the range, an "Overload" error will occur. Examples of programming measurement ranges are:

3.06 A range To select, program values > 0.1 A and ≤ 3.06 A.
0.10 A range To select, program values > 200 µA and ≤ 0.1 A.
200 µA range (option 2UA) To select, program values ≤ 200 µA.

Seamless Measurements

NOTE Seamless measurement autoranging for both voltage and current measurements is available on models N678xA SMU and with Option SMR. N678xA SMU Option SMR

Seamless measurement autoranging enables a wide dynamic measurement range with no data lost when transitioning across ranges. Seamless autoranging does not include the 10 µA range, which must be selected manually.

Front Panel Menu Reference	SCPI Command
Select **Measure\Range**. Select Auto from the voltage or current dropdown menu. Then press **Select**.	To enable seamless voltage or current autoranging on channel 1: SENS:VOLT:RANG:AUTO ON,(@1) SENS:CURR:RANG:AUTO ON, (@1)

Simultaneous Measurements

Some models have simultaneous voltage and current measurement capability (refer to Model Differences). In this case BOTH voltage and current can be acquired on any measurement.

Front Panel Menu Reference	SCPI Command
Not available	Select the measurement function: SENS:FUNC:VOLT ON,(@1) SENS:FUNC:CURR ON,(@1) Initiate and trigger the measurement system: INIT:ACQ (@1) TRIG:ACQ (@1) Fetch the voltage, current, or power measurement: FETC:VOLT? (@1) FETC:CURR? (@1) FETC:POW? (@1)

Auxiliary Voltage Measurements

NOTE This information applies to models N6781A and N6785A only. N6781A, N6785A

Keysight Models N6781A and N6785A have an auxiliary voltage measurement input, whose primary use is for battery voltage rundown measurements. It may also be suitable for other applications including general purpose DC voltage measurements between +/-20 VDC. The auxiliary voltage measurement input is isolated from other commons. It has a bandwidth of about 2 kHz. It has one input range: –20 to +20 VDC.

Auxiliary voltage measurements cannot be made along with output voltage measurements. When the auxiliary voltage measurement input is selected, the voltage measurement input will be switched to the Aux Voltage inputs instead of the normal + and – sense terminals.

To enable auxiliary voltage measurements:

Front Panel Menu Reference	SCPI Command
Select **Measure\Input**. Select Auxiliary. Then press **Select**. Select Main to reconnect the voltage measurement input to the output terminals.	To enable auxiliary measurements: SENS:FUNC:VOLT:INP AUX,(@1) Take the auxiliary voltage measurement: MEAS:VOLT? (@1)

NOTE When the auxiliary voltage measurement terminals are left unconnected, the front panel meter will indicate a voltage reading of approximately 1.6V. This is a normal indication which does not affect the voltage measurement once the auxiliary measurement terminals are connected.

Using the Digitizer

Measurement Types

Programming the Digitizer

Synchronizing Digitizer Measurements

NOTE

The Digitizer function requires Option 054 to be installed on models N673xA. N674xA, N675xA, and N677xA.

When a remote interface measurement is in progress, the front panel display may indicate "-- -- -- -- --". Front panel measurements resume when the remote measurement completes.

Measurement Types

In addition to the DC (or average) measurements discussed under Making Measurements, the following digitized measurements are also available. These can only be measured using the corresponding SCPI command.

ACDC – is a calculation that returns the total RMS measurement (AC + DC).

HIGH – is a calculation that generates a histogram of the waveform using 16 bins between the maximum and minimum data points. The bin containing the most data points above the 50% point is the high bin. The average of all the data points in the high bin is returned as the High level. If no high bin contains more than 1.25% of the total number of acquired points, then the maximum data point is returned.

LOW – is a calculation that generates a histogram of the waveform using 16 bins between the maximum and minimum data points. The bin containing the most data points below the 50% point is the low bin. The average of all the data points in the low bin is returned as the Low level. If no low bin contains more than 1.25% of the total number of acquired points, then the minimum data point is returned.

MAX – is the maximum value of the digitized measurement.

MIN – is the minimum value of the digitized measurement.

Array queries are also available to return ALL values in the voltage and current measurement buffer. No averaging is applied, only raw data is returned from the buffer.

Programming the Digitizer

The digitizer function lets you access the enhanced voltage and current measurement capabilities of the N6700C power system. You can:

Select a measurement function and range.

Adjust the measurement sample rate.

Specify a measurement window that can attenuate AC noise.

Trigger the measurement

Retrieve the measurement array data.

Select a Measurement Function and Range

The following commands select a measurement function. To enable the measurement function, use:

Front Panel Menu Reference	SCPI Command
Not available	To enable voltage or current measurements: SENS:FUNC:VOLT ON, (@1) SENS:FUNC:CURR ON, (@2)

If a power module has simultaneous measurements (refer to Model Differences), you can enable BOTH voltage and current measurements on the same output channel.

Some power modules also have multiple measurement ranges. Selecting a lower measurement range provides greater measurement accuracy, provided that the measurement does not exceed the range. To select lower measurement ranges, use:

Front Panel Menu Reference	SCPI Command
Select **Measure\Range**. Select the lower measurement range from the voltage or current dropdown menu. Then press **Select**.	To set the 5 V measurement range: SENS:VOLT:RANG 5, (@1) To set the 1 A measurement range: SENS:CURR:RANG 1, (@1)

Seamless Measurements

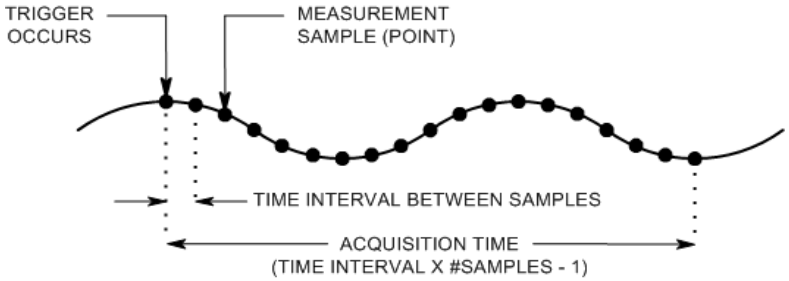
NOTE Seamless measurement autoranging for both voltage and current measurements is available on models N678xA SMU and with Option SMR. N678xA SMU Option SMR

Seamless measurement autoranging enables a wide dynamic measurement range with no data lost when transitioning across ranges. Seamless autoranging does not include the 10 µA range, which must be selected manually.

Front Panel Menu Reference	SCPI Command
Select **Measure\Range**. Select Auto from the voltage or current dropdown menu. Then press **Select**.	To enable seamless voltage or current autoranging: SENS:VOLT:RANG:AUTO ON, (@1) SENS:CURR:RANG:AUTO ON, (@1)

Adjust the Measurement Sample Rate

The following figure illustrates the relationship between measurement samples (or points), and the time interval between samples in a typical measurement. You can fine tune the measurement by specifying the number of points in the measurement as well as the time interval between points.



You can vary the measurement data sampling rate as follows:

Front Panel Menu Reference	SCPI Command
Select **Measure\Sweep**. Enter the number of points. Then press **Select**. Enter the time interval. Then press **Select**.	To set the time interval to 60µs with 4096 samples, use: SENS:SWE:TINT 60E-6, (@1) SENS:SWE:POIN 4096, (@1)

The maximum number of sample points that are available for all measurements is 512 K points (K = 1024). If you specify a voltage measurement with 500 K points on channel 1 for example, you will only have 12 K points available for all other measurements.

Time interval values can range from 5.12 microseconds (for one parameter on Models N678xA SMU) to 40,000 seconds. Note that the shortest time interval (fastest speed) that can be specified depends on the number of parameters that are being measured, the model that is doing the measuring, and the time interval resolution. You can only measure up to 4 parameters with the time interval resolution set to 20 microseconds.

1 parameter (models N678xA SMU only)	5.12 µs
1 or 2 parameters (all models)	10.24 µs
3 or 4 parameters (all models), with 20 µs programmed resolution	20.48 µs
5 to 8 parameters (all models), with 40 µs programmed resolution	40.96 µs

Time interval values from 10.24 up to 20.48 microseconds are rounded to the nearest 10.24-microsecond increment. Values above 20.48 microseconds are rounded to the nearest 20.48-microsecond increment when the resolution is set to RES20. Values above 40.96 microseconds are rounded to the nearest 40.96-microsecond increment when the resolution is set to RES40.

You can change the time interval resolution as follows:

Front Panel Menu Reference	SCPI Command
Not available	To set the resolution to 20 or 40 microseconds: SENS:SWE:TINT:RES RES20 SENS:SWE:TINT:RES RES40

Specify a Window Function

Windowing is a signal conditioning process that reduces the error in average measurements made in the presence of periodic signals and noise. Two window functions are available: Rectangular and Hanning. At power-on, the measurement window is Rectangular.

The Rectangular window calculates average measurements without any signal conditioning. However, in the presence of periodic signals such AC line ripple, a Rectangular window can introduce errors when calculating average measurements. This can occur when a non-integral number of cycles of data has been acquired due to the last partial cycle of acquired data.

One way of dealing with AC line ripple is to use a Hanning window. The Hanning window applies a cos4 weighting function to the data when calculating average measurements. This attenuates the AC noise in the measurement window. The best attenuation is achieved when at least three or more waveform cycles are in the measurement.

Front Panel Menu Reference	SCPI Command
Select **Measure\Window**. Select Auto from the voltage or current dropdown menu. Then press **Select**.	To select the Hanning window function: SENS:WIND HANN,(@1)

Trigger the Measurement

The following commands trigger and return measurement data:

Front Panel Menu Reference	SCPI Command
Select the **Meter** key. Front panel meters can only measure average voltage and current.	To measure average voltage & current: MEAS:VOLT? (@1) MEAS:CURR? (@1) To measure RMS voltage & current: MEAS:VOLT:ACDC? (@1) MEAS:CURR:ACDC? (@1) To measure the high or low level of a pulse: MEAS:VOLT:HIGH? (@1) MEAS:CURR:HIGH? (@1) MEAS:VOLT:LOW? (@1) MEAS:CURR:LOW? (@1) To measure the maximum or minimum value: MEAS:VOLT:MAX? (@1) MEAS:CURR:MAX? (@1) MEAS:VOLT:MIN? (@1) MEAS:CURR:MIN? (@1) To measure power: MEAS:POW? (@1)

Power measurements require simultaneous measurement capability (refer to Model Differences).

Array queries return all values in the voltage and current measurement buffer. No averaging is applied, only raw data is returned from the buffer.

Front Panel Menu Reference	SCPI Command
Not available	MEAS:ARR:VOLT? (@1) MEAS:ARR:POW? (@1) MEAS:ARR:CURR? (@1)

Retrieving the Measurement Array Data

Once a measurement finishes, you may wish to retrieve the array data without initiating a new measurement. Use FETCh queries to return the array data from the last measurement. Fetch queries do not alter the data in the measurement buffer. The commands are:

Front Panel Menu Reference	SCPI Command
Not available	FETC:ARR:VOLT? (@1) FEAS:ARR:POW? (@1) FETC:ARR:CURR? (@1)

Power measurements require simultaneous measurement capability (refer to Model Differences).

If a FETCh query is sent before the measurement is started or before it is finished, the response will be delayed until the measurement trigger occurs and the acquisition completes. This may tie up the computer if the measurement trigger does not occur immediately. You can test the MEAS_active bit in the operation status register to know when the measurement has completed as explained in the following section.

Synchronizing Digitizer Measurements

Use the measurement trigger system to synchronize the acquisition of measurements with a Bus, Transient, or an external trigger. Then use FETCh commands to return voltage or current information from the acquired data. Briefly, to make a triggered measurement:

Select the measurement function

Capture pre-trigger data (optional)

Select the measurement trigger source

Initiate the measurement trigger system

Trigger the measurement

Fetch the measurement

Select the Measurement Function

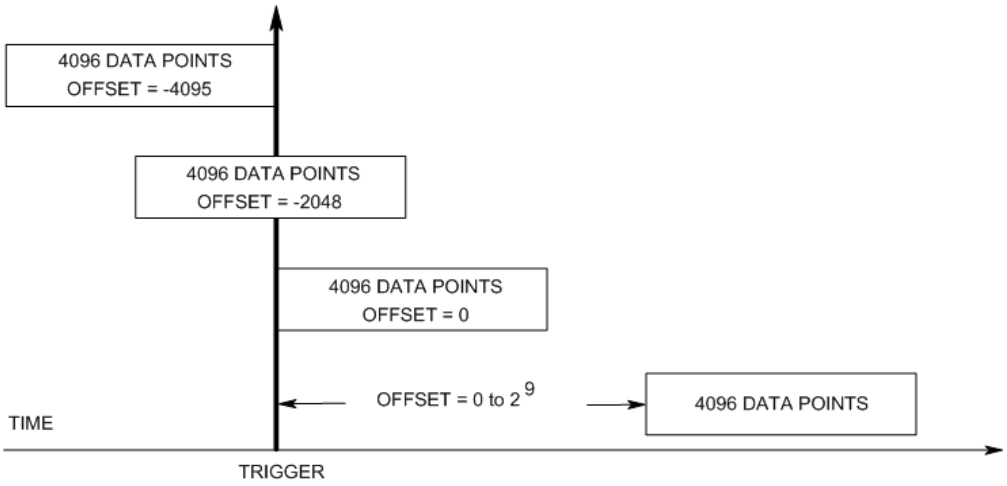
The following commands select a measurement function:

Front Panel Menu Reference	SCPI Command
Not available	To enable voltage measurements: SENS:FUNC:VOLT ON, (@1) To enable current measurements: SENS:FUNC:CURR ON, (@2)

Some power modules have two measurement converters, which allow simultaneous voltage and current measurements (refer to Model Differences). In that case, BOTH voltage and current measurements can be enabled. If a power module has only one converter, the parameter that it measures (either voltage or current) must be specified.

Capture Pre-Trigger Data (optional)

The measurement system lets you capture data before, after, or at the trigger signal. As shown in the following figure, you can move the block of data being read into the acquisition buffer with reference to the trigger. This allows pre- or post-trigger data sampling.



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

Front Panel Menu Reference	SCPI Command
Select **Measure\Sweep**. Enter an Offset value. Then press **Select**.	To offset the measurement by 100 points: SENS:SWE:OFFS:POIN 100, (@1)

When the value is 0, all measurement samples are taken after the trigger. Positive values represent the delay after the trigger occurs but before the samples are acquired. This can be used to exclude measurement samples that occur during the delay time. (Delay time = offset x sample period). Negative values represent data samples taken prior to the trigger. This lets you acquire measurement samples prior to the trigger.

NOTE If, during a pre-trigger data acquisition, a trigger occurs before the pre-trigger data count is completed, the measurement system ignores this trigger. This will prevent the completion of the measurement if another trigger is not generated.

Select the Measurement Trigger Source

NOTE A TRIGger:ACQuire[:IMMediate] command over the bus will always generate an immediate measurement trigger, regardless of the selected trigger source.

Unless you are using TRIGger:ACQuire[:IMMediate], select a trigger source from the following:

Bus - Selects GPIB device trigger, *TRG, or <GET> (Group Execute Trigger).

External - Selects all digital port pins that have been configured as trigger inputs.

Pin<n> - Selects a specific pin that is configured as a Trigger Input on the digital port. <n> specifies the pin number. The selected pin must be configured as a Trigger Input in order to be used as a trigger source (see Using the Digital Port).

Transient<n> - Selects the output channel's transient system as the trigger source. <n> specifies the channel. When you select a channel, you must also set up that channel's transient system to generate a trigger out signal. See Generate Trigger Out Signals and Program an Arbitrary List.

Use the following commands to select a trigger source:

Front Panel Menu Reference	SCPI Command
Not available	To select Bus triggers for output 1: TRIG:ACQ:SOUR BUS, (@1) To select a Digital pin as the trigger: TRIG:ACQ:SOUR PIN<n>, (@1) To select a Transient output as trigger: TRIG:ACQ:SOUR TRAN<n>, (@1) where n is the output channel that will generate the trigger signal.

Initiate the Measurement Trigger System

Next, you must initiate or enable the measurement trigger system.

When the power system is turned on, the trigger system is in the idle state. In this state, the trigger system is disabled, ignoring all triggers. The INITiate commands enable the trigger system to receive triggers. To initiate the trigger system, use:

Front Panel Menu Reference	SCPI Command
Not available	To initiate the measurement trigger system: INIT:ACQ (@1)

It takes a few milliseconds for the instrument to be ready to receive a trigger signal after receiving the INITiate:ACQuire command, and it can take longer for Keysight Models N678xA SMU.

If a trigger occurs before the trigger system is ready for it, the trigger will be ignored. You can test the WTG_meas bit in the operation status register to know when the instrument is ready to receive a trigger after being initiated.

Front Panel Menu Reference	SCPI Command
Not available	To query the WTG_meas bit (bit 3): STAT:OPER:COND?(@1)

If a bit value of 8 is returned in the query, the WTG_meas bit is true, and the instrument is ready to receive the trigger signal. Refer to Status Tutorial for more information.

NOTE

It will be necessary to initiate the measurement trigger system each time a triggered measurement is desired.

Trigger the Measurement

The trigger system is waiting for a trigger signal in the initiated state. You can immediately trigger the measurement as follows:

Front Panel Menu Reference	SCPI Command
Not available	To generate a measurement trigger: TRIG:ACQ (@1) Alternatively, if the trigger source is BUS, you can also program a *TRG or an IEEE-488 <get> command.

As previously discussed, a trigger can also be generated by another output channel or an input pin on the digital port connector. If any of these systems are configured as the trigger source, the instrument will wait indefinitely for the trigger signal. If the trigger does not occur, you must manually return the trigger system to the idle state.

The following commands return the trigger system to the idle state:

Front Panel Menu Reference	SCPI Command
Select **Measure\Control**. Then select the Abort control.	ABOR:ACQ (@1)

Fetch the Measurement

After a trigger is received and the measurement completes, the trigger system will return to the idle state. When this occurs, you can use FETCh queries to return the measurement data.

Front Panel Menu Reference	SCPI Command
Not available	To return average voltage & current: FETC:VOLT? (@1) FETC:CURR? (@1) To return RMS voltage & current: FETC:VOLT:ACDC? (@1) FETC:CURR:ACDC? (@1) To return the high or low level of a pulse: FETC:VOLT:HIGH? (@1) FETC:CURR:HIGH? (@1) FETC:VOLT:LOW? (@1) FETC:CURR:LOW? (@1) To return the maximum or minimum value: FETC:VOLT:MAX? (@1) FETC:CURR:MAX? (@1) FETC:VOLT:MIN? (@1) FETC:CURR:MIN? (@1) To return power: FETC:POW? (@1)

Power measurements require simultaneous measurement capability (refer to Model Differences).

If a FETCh query is sent before the measurement is finished, the response will be delayed until the measurement trigger occurs and the acquisition completes. You can test the MEAS_active bit in the operation status register to know when the measurement trigger system has returned to the idle state.

Front Panel Menu Reference	SCPI Command
Not available	To query the MEAS_active bit (bit 5): STAT:OPER:COND? (@1)

If a bit value of 32 is returned in the query, the MEAS_active bit is true, and the measurement is NOT complete. When the MEAS_active bit is false, you can retrieve the measurement. Refer to Status Tutorial for more information.

External Data Logging

Data Logging Functions

Select the Measurement Function and Range

Specify the Integration Period

Select the Elog Trigger Source

Initiate and Trigger the Elog

Periodically Retrieve the Data

Terminate the Elog

Data Logging Functions

NOTE The external data logging function can only be programmed using SCPI commands.

The Keysight N6700C models have an "external" data logging function (Elog) that lets you continuously log voltage and current measurements. Data logging is external to the instrument because it can only be implemented using SCPI commands. Voltage and current measurement data is temporarily stored in a FIFO (first-in, first-out) buffer located in the instrument. However, this buffer is only large enough to hold about 20 seconds of accumulated measurements. This means that you must periodically empty the internal buffer to an external storage device; otherwise the data in the buffer will be overwritten.

The following table details the various data logging functions.

Function	Description
Data Storage	Buffers measurements for about 20 seconds and requires that the computer periodically reads measurements to prevent the internal buffer from overflowing. The computer needs to provide the external data storage.
Measurement Resources	Run independently on each output. Some outputs can be running an external data log, while the remaining outputs can be used in front panel control or used for other SCPI functions.
Measurement Functions	If a power module has only one measurement converter, then either voltage or current, but not both, can be logged.
Integration Period	Minimum integration period is 102.4 microseconds for one parameter with data format set to REAL. During the specified integration period, the samples are averaged, and min and max values are tracked.
Data viewing	No front panel view or control. Data must be collected and viewed externally.

Select the Measurement Function and Range

The following commands select a measurement function:

Front Panel Menu Reference	SCPI Command
Not available	To enable voltage or current measurements: SENS:ELOG:FUNC:VOLT ON, (@1) SENS:ELOG:FUNC:CURR ON, (@1) To enable min/max measurements: SENS:ELOG:FUNC:VOLT:MINM ON, (@1) SENS:ELOG:FUNC:CURR:MINM ON, (@1)

If a power module has simultaneous measurements (refer to Model Differences), you can enable BOTH voltage and current measurements on the same output channel. Power modules that do not have simultaneous measurement capability cannot externally log both voltage and current.

Some power modules also have multiple measurement ranges. Selecting a lower measurement range provides greater measurement accuracy, provided that the measurement does not exceed the range. To select lower measurement ranges, use:

Front Panel Menu Reference	SCPI Command
Not available	To set the 5 V measurement range: SENS:ELOG:VOLT:RANG 5, (@1) To set the 1 A measurement range: SENS:ELOG:CURR:RANG 1, (@1)

Seamless Measurements

NOTE

Seamless measurement autoranging for both voltage and current measurements is available on models N678xA SMU and with Option SMR. N678xA SMU Option SMR

Seamless measurement autoranging enables a wide dynamic measurement range with no data lost when transitioning across ranges. Seamless autoranging does not include the 10 µA range, which must be selected manually.

Front Panel Menu Reference	SCPI Command
Not available	To enable seamless elog autoranging: SENS:ELOG:VOLT:RANG:AUTO ON, (@1) SENS:ELOG:CURR:RANG:AUTO ON, (@1)

Specify the Integration Period

The integration period can be set from a minimum of 102.4 microseconds to a maximum of 60 seconds.

Front Panel Menu Reference	SCPI Command
Not available	To set an integration period of 600 microseconds: SENS:ELOG:PER 0.0006, (@1)

During the integration period, Elog samples are averaged, and the minimum and maximum values are tracked. At the end of each integration period the average, minimum, and maximum values are added to the internal FIFO buffer. You can specify up to six measurement parameters per channel: Voltage+Vmax+Vmin, and Current+Imax+Imin.

Although the absolute minimum integration period is 102.4 microseconds, the actual minimum depends on the number of measurement parameters that are being logged. The actual minimum is 102.4 microseconds times the number of parameters being logged at each interval. Note that you can measure up to 4 parameters with the time interval resolution set to 20 microseconds, and up to 24 parameters with the resolution set to 40 microseconds. When the instrument sets an integration period, the value sent is rounded to the nearest integer multiple of the chosen resolution, either 20.48 microseconds or 40.96 microseconds.

1 parameter (Voltage or Current), with 20 µs resolution	102.4 µs
2 parameters (Voltage and Current), with 20 µs resolution	204.8 µs
4 parameters (Voltage+Vmin+Vmax+Current), with 20 µs resolution	409.6 µs
8 parameters with 40 µs resolution	819.2 µs
16 parameters with 40 µs resolution	1638.4 µs
24 parameters with 40 µs resolution	2457.6 µs

You can change the time interval resolution as follows:

Front Panel Menu Reference	SCPI Command
Not available	To set the resolution: SENS:SWE:TINT:RES RES20 SENS:SWE:TINT:RES RES40

If the specified integration period is at or near the minimum logging intervals, the data format must be specified as binary. If the REAL format is not specified, the data will be in ASCII format and the minimum logging intervals will typically be up to five times longer than what can be achieved with binary format.

Front Panel Menu Reference	SCPI Command
Not available	To set the data format to REAL: FORM REAL

Select the Elog Trigger Source

The TRIGger:ELOG command generates an immediate trigger regardless of the trigger source. Unless you are using this command, select a trigger source from the following:

Bus – Selects GPIB device trigger, *TRG, or <GET> (Group Execute Trigger).

External – Selects all digital port pins that have been configured as trigger inputs.

Immediate – Selects the immediate trigger source. This triggers the data logger immediately when initiated

Pin<n> – Selects a specific pin that is configured as a Trigger Input on the digital port. <n> specifies the pin. The selected pin must be configured as a Trigger Input in order to be used as a trigger source (see Using the Digital Port).

Use the following commands to select one of the available trigger sources:

Front Panel Menu Reference	SCPI Command
Not available	To select Bus triggers: TRIG:TRAN:SOUR BUS, (@1) To select any digital pin as the trigger source: TRIG:TRAN:SOUR EXT, (@1) To select an immediate trigger: TRIG:TRAN:SOUR IMM, (@1) To select digital pin 5 as the trigger: TRIG:ACQ:SOUR PIN5, (@1)

Initiate and Trigger the Elog

When the power system is turned on, the trigger system is in the Idle state. In this state, the trigger system is disabled, ignoring all triggers. The INITiate command enables the measurement system to receive triggers. To initiate and trigger the Elog:

Front Panel Menu Reference	SCPI Command
Not available	To initiate and trigger the Elog: INIT:ELOG, (@1) TRIG:ELOG, (@1) Alternatively, if the trigger source is BUS, you can also program a *TRG or an IEEE-488 <get> command.

When triggered, the Elog starts placing data in the internal measurement buffer. Because the buffer is only large enough to hold 20 seconds of accumulated measurement your PC application must periodically retrieve (or fetch) the data from this buffer.

Periodically Retrieve the Data

Each FETCh command returns number of requested records of the data in the buffer and removes them, making room available for more data. The Elog continues until it is aborted.

An Elog record is one set of voltage and current readings for one time interval. The exact format of a record depends on which functions have been enabled for Elog sensing. If all functions are enabled, then one record will contain the following data in the specified order:
Current average
Current minimum
Current maximum
Voltage average

Voltage minimum
Voltage maximum

Front Panel Menu Reference	SCPI Command
Not available	To retrieve a maximum of 1000 records: FETC:ELOG? 1000, (@1)

ASCII data (the default) is returned as comma-separated ASCII numeric data sets of average, min, or max values terminated by a newline. ASCII queries can only fetch data from one channel at a time.

Binary data is returned as a comma-separated list of data for each channel requested. The data is a definite length binary block, with the byte order specified by the FORMat:BORDer command.

Terminate the Elog

Front Panel Menu Reference	SCPI Command
Not available	ABOR:ELOG, (@1)

Using the Digital Control Port

Bi-directional Digital IO

Digital Input

Fault Output

Inhibit Input

Fault/Inhibit System Protection

Output State

A Digital Control Port consisting of seven I/O pins is provided to access various control functions. Each pin is user-configurable. The following control functions are available for the I/O pins:

Bi-directional Digital IO

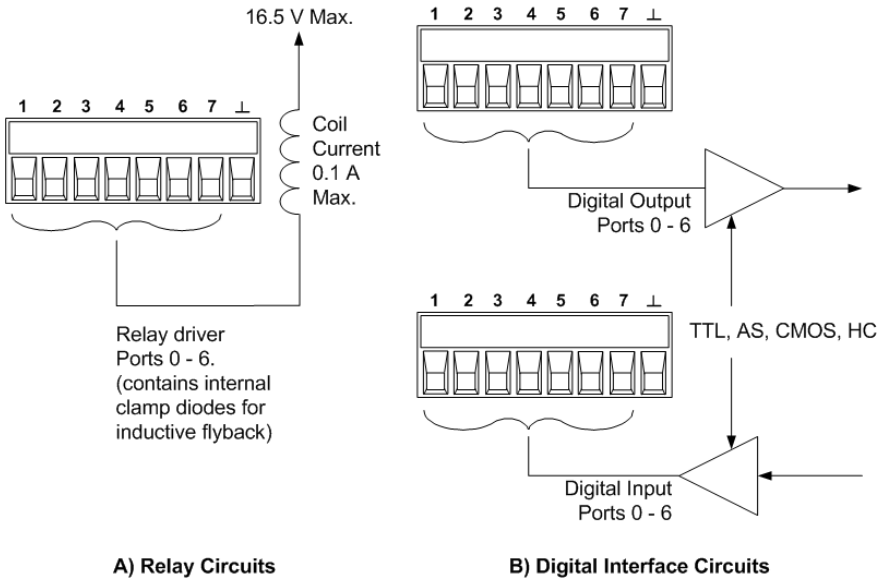
Each of the seven pins can be configured as general purpose bi-directional digital inputs and outputs. The polarity of the pins can also be configured. Pin 8 is the signal common for the digital I/O pins. Data is programmed according to the following bit assignments:

Pins	7	6	5	4	3	2	1
Bit weight	6 (msb)	5	4	3	2	1	0 (lsb)

To configure the pins for digital IO:

Front Panel Menu Reference	SCPI Command
Select System\IO\DigPort\Pins. Select a pin in the pin field. In the Function field, select Dig I/O. In the Polarity field, select Positive or Negative. To send data to the pins, select System\IO\DigPort\Data. Select the Data Out field and enter the binary word.	To configure the pin function: DIG:PIN1:FUNC DIO To select the pin polarity: DIG:PIN1:POL POS DIG:PIN1:POL NEG To send data to the pins: DIG:OUTP:DATA <data>

The digital I/O pin can be used to control both relay circuits as well as digital interface circuits. The following figure illustrates typical relay circuits as well as digital interface circuit connections using the digital I/O functions.



Digital Input

Each of the seven pins can be configured as digital input only. The polarity of the pins can also be configured. Pin 8 is the signal common for the digital input pins. The pin status reflects the true condition of the external signal that is applied to the pin. The pin state is not affected by the value of the binary output word.

To configure the pins for digital input only:

Front Panel Menu Reference	SCPI Command
Select System\IO\DigPort\Pins. Select a pin in the pin field. In the Function field, select Dig In. In the Polarity field, select Positive or Negative. To read the data from the pins, select System\IO\DigPort\Data. The input data is displayed as a binary number in the Data In field.	To configure the pin function: DIG:PIN1:FUNC DINP To select the pin polarity: DIG:PIN1:POL POS DIG:PIN1:POL NEG To read the pin data: DIG:INP:DATA?

External Trigger I/O

Each of the seven pins can be configured as trigger inputs or trigger outputs. The polarity of the pins can also be configured. When you program trigger polarity, POSitive means a rising edge and NEGative means a falling edge. Pin 8 is the signal common for the trigger pins.

When configured as a trigger input, 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 4

microseconds for positive-going signals, and 10 microseconds for negative-going signals. The pin's polarity setting determines which edge generates a trigger-in event.

When configured as a trigger output, the designated trigger pin will generate a 10 microsecond-wide pulse when a Trigger Out occurs. Depending on the polarity setting, it can be either positive-going (rising edge) or negative-going (falling-edge) when referenced to common.

Front Panel Menu Reference	SCPI Command
Select **System\IO\DigPort\Pins**. Select a pin in the Pin field. In the Function field, select either the Trig In or Trig Out function. In the Polarity field, select Positive or Negative.	To select the trigger output function for pin 1: DIG:PIN1:FUNC TOUT To select the trigger input function for pin 2: DIG:PIN2:FUNC TINP To select the pin polarity: DIG:PIN1:POL POS DIG:PIN2:POL NEG

Fault Output

Pins 1 and 2 can be configured as a fault-output pair. The Fault Output function enables a fault condition on any channel to generate a protection fault signal on the digital port. Refer to Protection Functions for a list of protection signals that will generate a fault.

Both pins 1 and 2 are dedicated to this function. Pin 1 is the Fault output; pin 2 is the common for pin 1. This provides for an optically-isolated output. The polarity of pin 1 can also be configured. Note that the Fault output signal remains latched until the fault condition is removed and the protection circuit is cleared. as explained under Clearing Protection Functions.

NOTE Pin 2's selected function is ignored. Pin 2 should be connected to the ground of the external circuit.

Front Panel Menu Reference	SCPI Command
Select **System\IO\DigPort\Pins**. Select pin 1. In the Function field, select Fault Out. In the Polarity field, select Positive or Negative.	To configure the Fault function: DIG:PIN1:FUNC FAUL To select the pin polarity: DIG:PIN1:POL POS DIG:PIN1:POL NEG

Inhibit Input

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

The following non-volatile inhibit input modes can be programmed:

LATChing - causes a logic-true transition on the Inhibit input to disable the output. The output will remain disabled after the inhibit signal is received.

LIVE - allows the enabled output to follow the state of the Inhibit input. When the Inhibit input is true, the output is disabled. When the Inhibit input is false, the output is re-enabled.

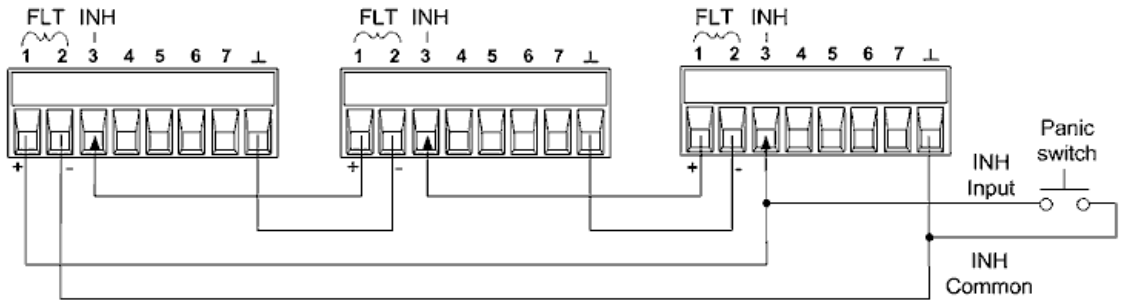
OFF - The Inhibit input is ignored.

To configure the Inhibit Input function:

Front Panel Menu Reference	SCPI Command
Select **System\IO\DigPort\Pins**. Select pin 3. In the Function field, select Inhibit In. In the Polarity field, select Positive or Negative. Select **Protect\Inhibit**. Select either Latching or Live. To disable the Inhibit signal, select Off.	To select the Inhibit function: DIG:PIN3:FUNC INH To select the pin polarity: DIG:PIN3:POL POS DIG:PIN3:POL NEG To set Inhibit mode to Latching: OUTP:INH:MODE LATC To set Inhibit mode to Live: OUTP:INH:MODE LIVE To disable the Inhibit signal: OUTP:INH:MODE OFF

Fault/Inhibit System Protection

The following figure illustrates some ways that you can connect the Fault/Inhibit pins of the connector.



As shown in the figure, when the Fault outputs and Inhibit inputs of several instruments are daisy-chained, an internal fault condition in one of the units will disable all outputs 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.

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 outputs. 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 (which is sourced by the Inhibit signal).

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

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 unit as explained under Clearing Protection Functions. If the operating mode of the Inhibit input is Latched, turn off the Inhibit input on ALL units individually. To re-enable the chain, re-program the Inhibit input on each unit to Latched mode.

Output State

Only pins 4 through 7 can be configured to control the output state. This function lets you connect multiple Keysight N6700 mainframes together and synchronize the output on/off sequence across mainframes. Refer to Synchronizing Output Turn-On for detailed information.

Using the Protection Functions

Set the Over-Voltage Protection

Set the Over-Current Protection

Couple Output Protection

Set the Over-Power Protection

Query the Over-Temperature Margin

Set the Oscillation Protection

Watchdog Timer Protection

Clear Output Protection

Protection Functions

Each output has independent protection functions. A front panel status indicator will turn on when a protection function has been set. Protection functions are latching, which means that they must be cleared once they have been set. As explained under Couple Output Protection you can configure the instrument so that when a protection fault occurs on one output, ALL outputs will be turned off. Of the following protection functions, only OV, OV-, OC, OSC, PROT, and INH are user- programmable.

OV - Over-voltage protection is a hardware OVP whose trip level is a programmable value. The OVP is always enabled.

OV– - Negative voltage protection is a hardware OVP. Applies to Keysight N6783A/84A, and N679xA.

OC - Over-current protection is a programmable function that can be enabled or disabled. When enabled, the output will be disabled when the output current teaches the current limit setting.

OT - Over-temperature protection monitors the temperature of each output and shuts down the output if any temperature exceeds the maximum factory-defined limits (see OUTPut:PROTection:TEMPerature:MARGin?).

OSC - Oscillation protection shuts down the output if an oscillation is detected on the output. Applies to Keysight N678xA SMU.

PF - PF indicates that a power fail condition on the AC mains has disabled the output.

CP+ - CP+ indicates that a positive power limit condition has disabled the output. This protection function does not apply to all power modules. Refer to Power Limit Operation for further information.

CP– - CP– indicates that a negative power limit condition has disabled the output. This protection function does not apply to all power modules. Refer to Power Limit Operation for further information.

PROT - Prot indicates that the output is disabled, either because of a coupled protection signal from another output, or because the programmed watchdog time has expired.

INH - The Inhibit input (pin 3) on the rear panel digital connector can be programmed to act as an external shutdown signal. Refer to Inhibit Input for further information.

Set the Over-Voltage Protection

Over-voltage protection disables the output if the output voltage reaches the programmed OVP level. The OVP circuit monitors the voltage at the + and – output terminals.

For models N678xA SMU N678xA SMU, the voltage is monitored at the + and – sense terminals rather than at the output terminals. This allows for more precise over-voltage monitoring directly at the load. Refer to Over-Voltage Protection Considerations for details. These models also have a back-up local OVP function. Refer to Local OVP for a description of the feature. Additionally, for model N6784A, you can program a negative over-voltage value. Enter the value in the **-OVP** field.

For models N678xA SMU and N6783A N678xA SMU N6783A, you can specify a delay to prevent momentary over-voltage excursions from tripping the over-voltage protection. Enter the value in the over-voltage Delay field. These models also have negative voltage protection, which disables the output if negative voltages are detected. Negative voltage protection is indicated by the OV- annunciator.

On models with Option J01 Option J01, the voltage is also monitored at the + and – sense terminals. This option also has tracking OVP in addition to the standard overvoltage protection. This lets you set an overvoltage protection limit that is offset from the programmed voltage. The tracking OVP threshold automatically tracks the real time programmed settings.

For models N69xA N679xA the over-voltage protection level is not programmable and is fixed at 110% of the rated input voltage. These models also have reverse voltage protection. You can specify if reverse voltages will disable the input. Reverse voltage protection is indicated by the OV- annunciator.

Front Panel Menu Reference	SCPI Command
Select **Protect\OVP** Enter a value in the OVP level box and press Select. For J01 units, enter a value in the Tracking OVP Offset box and check the Enable box. Then press **Select**.	To set an OVP of 10 V for output 1: VOLT:PROT 10, (@1) To set remote OVP for Models N678xA SMU: VOLT:PROT:REM 10, (@1) To enable tracking OVP for output 1: VOLT:PROT:TRAC ON, (@1) To set the tracking offset to 2V: VOLT:PROT:TRAC:OFFS 2, (@1) To enable reverse voltage protection on the input terminals for Models N679xA: VOLT:PROT:REV:STAT ON, (@1)

Set the Over-Current Protection

When over-current protection is enabled, the power system turns off the output if the output current reaches the current limit setting and transitions from CV to CC operation.

Front Panel Menu Reference	SCPI Command
Select **Protect\OCP** Check Enable to enable OCP. Then press **Select**.	To enable OCP: CURR:PROT:STAT ON, (@1)

You can also specify an OCP delay to prevent momentary output settings, load, and status changes from tripping the over-current protection. In most cases these momentary conditions would not be considered an over-current protection fault, and having an OCP condition disable the output when they occur would be a nuisance. Specifying an OCP delay lets the OCP circuit ignore these momentary changes during the specified delay period. Once the OCP delay time has expired and the over-current condition persists, the output will shut down.

The delay can be programmed from 0 to 0.255 seconds. You can specify if the OCP delay timer is started by any transition of the output into CC operation, or only at the end of a settings change in voltage, current, or output state.

Front Panel Menu Reference	SCPI Command
Select **Protect\OCP** Enter an OCP delay value. Then press **Select**. Under Delay Start, select "CC Transition" to start the delay timer by ANY output transition into CC mode. Otherwise, the delay timer will only be started by a Settings Change in voltage, current, or output state.	To specify a 10 millisecond delay: CURR:PROT:DEL 0.01, (@1) To start the delay timer by ANY output transition into CC operation: CURR:PROT:DEL:STAR CCTR, (@1) To start the delay timer by a settings change in voltage current or output: CURR:PROT:DEL:STAR SCH, (@1)

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

Note that the time it takes the output to go into CC operation varies - depending on the magnitude of the over-current condition compared to the current limit setting. For example, if the over-current is only slightly greater than the current limit setting, it may take several tens of milliseconds for the output to set the CC status bit. If the over-current is significantly greater than the current limit setting, it may only take a few hundred microseconds or less for the output to set the CC status bit. To determine when the output will shut down, you must add the time it takes for the CC status bit to the over-current protection delay time. If the over-current persists beyond the sum of these two time intervals, the output will shut down.

Models N679xA N679xA have an additional fixed over-current protection that is always enabled. This protection will turn the output off whenever the input current exceeds 105% of the high ranges and approximately 110% of the low current ranges.

Set the Over-Power Protection

For models N679xA N679xA only, the over-power protection will turn the output off if the input power exceeds 110% of the module's power rating. You can program an over-power protection delay to prevent the over-power protection function from being triggered during the delay time. This prevents momentary input power spikes from triggering the over-power protection. The delay can be programmed from 0 to 0.255 seconds.

Front Panel Menu Reference	SCPI Command
Select **Protect\OPP** Check Enable to enable OPP. Enter a delay value. Then press **Select**.	To enable over-power protection: POW:PROT:STAT ON, (@1) To specify a 10 millisecond delay: POW:PROT:DEL 0.01, (@1)

Couple Output Protection

Protection coupling lets you disable all output channels when a protection condition occurs on a single output channel. To couple output protection:

Front Panel Menu Reference	SCPI Command
Select **Protect\Coupling** Check Enable Coupling. Then press **Select**.	To enable output protection coupling: OUTP:PROT:COUP ON

Query the Over-Temperature Margin

You can query the margin remaining before the over-temperature trips and shuts down the output. The temperature margin is the minimum difference between the internal temperature sensors and the fixed over-temperature trip level. The margin is returned in degrees Celsius.

Front Panel Menu Reference	SCPI Command
Select **Protect\OT** Displays over-temperature margin. Press **Select**.	To query the over-temperature margin: OUTP:PROT:TEMP:MARG? (@1)

Set the Oscillation Protection

NOTE This information applies to Keysight Models N678xA SMU only. N678xA SMU

If open sense leads or capacitive loads outside the allowable range cause the output to oscillate, the oscillation protection function detects the oscillation and latches the output off. The condition is annunciated on the front panel by the OSC status annunciator.

Front Panel Menu Reference	SCPI Command
Select **Protect\OSC** Check the OSC box. Then press **Select**.	To enable oscillation protection for output 1 and 2: OUTP:PROT:OSC ON, (@1,2)

Watchdog Timer Protection

The watchdog timer, when enabled, causes all outputs to go into protection mode if there is no SCPI I/O activity on the remote interfaces (USB, LAN, GPIB) within the user-specified time period. Note that the watchdog timer function is NOT reset by activity on the front panel or when using the Web server – the outputs will still shut down after the time period has elapsed..

After the time period has expired, the outputs will be disabled, but the programmed output state is not changed. The PROT bit in the status questionable register as well as the PROT indicator on the front panel will be set.

The watchdog delay can be programmed from 1 to 3600 seconds in 1 second increments. As shipped from the factory, the watchdog timer is set to disable the outputs 60 seconds after all IO activity has ceased.

The watchdog state and delay settings are volatile, but can be saved and recalled as part of the instrument state. A watchdog protect can be cleared as described under Clear Output Protection.

Front Panel Menu Reference	SCPI Command
Select **Protect\Wdog** Check Enable Watchdog to enable the watchdog timer. Enter a value in the Watchdog Delay box. Then press **Select**.	To enable the watchdog timer: OUTP:PROT:WDOG ON To set the watchdog timer to 600 seconds: OUTP:PROT:WDOG:DEL 600

Clear Output Protection

If an over-voltage, over-current, over-temperature, power-fail condition, power-limit condition, protection condition, or inhibit signal occurs, the power system turns off the affected output channel. The appropriate operating status indicator on the front panel will be on. To clear the protection function and restore normal operation, first remove that condition that caused the protection fault. Then, clear the protection function as follows:

Front Panel Menu Reference	SCPI Command
Select **Protect\Clear** Select Clear.	To clear a protection fault: OUTP:PROT:CLE (@1)

System-Related Operations

Self-test

Instrument Identification

Instrument State Storage

Output Groups

Front Panel Display

Front Panel Keys

Password Protection

Self-test

A power-on self-test occurs automatically when you turn on the power system. This test assures you that the instrument is operational. If the self-test is successful, the power system will continue to operate normally. If the self-test fails, the front panel Err indicator comes on. Press the Error key to display the list of errors on the front panel. Refer to Preliminary Checkout for further Information.

Front Panel Menu Reference	SCPI Command
Cycle AC power.	*TST?

Instrument Identification

Keysight N6700C MPS mainframes are identified by the serial number located on the interface cover. Power module serial numbers are located on their top covers.

The serial number consists of a 10-character number (e.g. MY24D00013) located on the label on the top of the interface board. The first two characters indicate the country of manufacture, and the last five digits are a sequential number assigned to each mainframe.

For MPS mainframes, you can programmatically query the model number, serial number, firmware revision, backup and active firmware. For power modules, you can programmatically query the model number, serial number, installed options, voltage, current and power rating.

Front Panel Menu Reference	SCPI Command
Select System\About\Frame	For mainframe information: *IDN?
or Select System\About\Module	For information about the power module in channel 1: SYST:CHAN:MOD? (@1) SYST:CHAN:OPT? (@1) SYST:CHAN:SER? (@1)

Note that you have the ability to change the identity of the mainframe. This functionality is only intended for compatibility with previous "A" and "B" version mainframes.

Front Panel Menu Reference	SCPI Command
Select System\Preferences\IDN Check the box to identify the instrument as an Agilent product.	SYST:PERS:MAN "<manufacturer>" SYST:PERS:MOD "<model number>"

The IDN change and PERSona commands affects the following identification items:

- *IDN? command for vendor and model
- VISA programmatic access APIs for vendor and model
- LXI instrument web pages
- LXI XML
- LXI mDNS announcements

Instrument State Storage

The power system has ten storage locations in non-volatile memory to store instrument states. The locations are numbered 0 through 9. Any state previously stored in the same location will be overwritten.

Front Panel Menu Reference	SCPI Command
Select States\SaveRecall. In the SaveRecall field, enter a location from 0 to 9. Then press Select. Select Save to save the state or Recall to recall a state.	To save a state in location 1: *SAV 1 To recall a state from location 1: *RCL 1

Specifying a power-on state

When shipped from the factory, the power system is configured to automatically recall the reset (*RST) settings at power-on. However, you can configure the power system to recall the settings you have stored in memory location 0 (RCL0) at power-on.

Front Panel Menu Reference	SCPI Command
Select States\PowerOn. Select Recall State 0. Then press Select.	OUTP:PON:STAT RCL0

Output Groups

NOTE Output grouping does not apply to Keysight Models N678xA SMU.

Output channels can be configured or “grouped” to create a single output with higher current and power capability. Almost all instrument functionality is supported by grouped channels, including

voltage and current programming, measurements, status, step and list transients. The following conditions apply:

- Up to four output channels can be grouped per mainframe.
- Output channels that are grouped must also be connected in parallel as described under Parallel Connections.
- Grouped channels do not have to be adjacent, but they must have identical model numbers and options installed.
- The maximum output current is the sum of the maximum of each channel in the group.
- Low current measurement ranges should not be used with grouped channels, otherwise a measurement overload error will occur. Low current output ranges, however, can be used.
- Over-current protection delay has a slightly slower response time (~10 ms) and slightly less resolution than an ungrouped channel.
- When output channels have been grouped, they are addressed using the channel number of the lowest channel in the group.
- Power limiting should not be used when Keysight N673xB, N674xB, and N677xA power modules are grouped. Refer to Power Allocation.

Front Panel Menu Reference	SCPI Command
Select **System\Groups**. In the matrix that appears, select the channels you want to group. Each row defines a separate group.	To configure a group of channels: SYST:GRO:DEF (@2,3,4) This groups channels 2 through 4. To address the group, use channel 2.

To return grouped channels back to an ungrouped state, first remove the parallel connections between channels and proceed as follows:

Front Panel Menu Reference	SCPI Command
Select **System\Groups**. In the matrix, place each output channel in its own separate group.	To ungroup all channels: SYST:GRO:DEL:ALL

Reboot the unit for the changes to take effect.

Front Panel Menu Reference	SCPI Command
Cycle AC power.	SYST:REB

Front Panel Display

View

You can specify how the output channels are displayed at turn on.

Front Panel Menu Reference	SCPI Command
Select **System\Preferences\Display\View** Check Voltage, Current to display one channel. Check Volt, Curr, Power to display voltage, current and power in one-channel view. Check 4-channel to display all channels.	To display one channel: DISP:VIEW METER1 To display voltage, current and power in one-channel view: DISP:VIEW METER_VIP To display all channels: DISP:VIEW METER4

Contrast

You can set the contrast of the front panel display to compensate for ambient lighting conditions. The contrast can be set from 0% to 100% in increments of 1%. As-shipped, the contrast is set to 80%.

Front Panel Menu Reference	SCPI Command
Select **System\Preferences\Display\Contrast** Enter a contrast value in the Contrast box. Then press **Select**.	Not available

Screen Saver

The power system has a front panel screen saver that significantly increases the life of the LED display by turning it off during periods of inactivity. The delay can be set from 30 to 999 minutes in 1 minute increments. 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. The first action of the key turns the display on. Subsequently, the key will revert to its normal function.

If the Wake on I/O function is selected, the display is restored whenever there is activity on the remote interface. This also resets the timer on the screen saver. As shipped, Wake on I/O is active.

Front Panel Menu Reference	SCPI Command
Select **System\Preferences\Display\Saver** Enable or disable the screen saver by checking or unchecking the Screen Saver checkbox. Then press **Select**. Enter a value in minutes in the Saver Delay 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.	Not available

Front Panel Keys

Lockout

You can lock the front panel keys to prevent unwanted control of the instrument from the front panel. This is the most secure way of locking the front panel keys because you need a password to unlock the front panel. The lockout setting is saved in non-volatile memory so that the front panel remains locked even after AC power is cycled.

Front Panel Menu Reference	SCPI Command
Select **System\Preferences\Lock** Enter the password to unlock the front panel. Then select Lock. The menu to unlock the front panel appears every time a key is pressed. Enter the password to unlock the front panel.	Not available

NOTE

If the password is lost, the SYSTem:PASSword:FPANel:RESet command can reset the front panel lockout password.

The SYSTem:COMMunicate:RLSTate RWLock command can also lock and unlock the front panel. This command is completely independent of the front panel lockout function. If you use this command to lock the front panel, the front panel will be unlocked when AC power is cycled.

Keys

You can enable or disable the front panel key clicks.

Front Panel Menu Reference	SCPI Command
Select **System\Preferences\Keys** Check Enable key clicks to enable key clicks. Press **Select**. Uncheck to disable key clicks.	Not available

You can configure the On/Off key to enable or disable ALL outputs.

Front Panel Menu Reference	SCPI Command
Select **System\Preferences\Keys** Check On/Off key affects all channels. Press **Select**. The ON/Off key will now be active on ALL channels.	Not available

Password Protection

You can password-protect all functions located in the Admin menu. These include instrument calibration, interface access, non-volatile memory reset, firmware update, and password updates.

As shipped from the factory, the Admin menu password is 0 (zero). This means that you do not have to enter a password to access the Admin menu. Simply select System\Admin\Login and press Enter. To password-protect the Admin menu:

Front Panel Menu Reference	SCPI Command
Select System\Admin\Password Enter the password. The password must be numeric, and up to 15 digits long. Then press Select. Log out of the Admin menu to activate the password. You can now only enter the Admin menu by providing the right password. Enter the password in the Password field.	Enter calibration mode using the original password: CAL:STAT ON, <password> To change the password: CAL:PASS <password> To exit calibration mode and activate the password: CAL:STAT OFF

If the password is lost, access 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 Calibration Switches for more information.

Mainframe Power Allocation

Mainframe Power Ratings

Mainframe Power Limit

Module Power Limit

Power Limit Allocation

Mainframe Power Ratings

For the majority of Keysight N6700C MPS configurations, full power is available from all installed power modules. However, it is possible to configure a power system in which the combined ratings of the power modules exceed the power rating of the mainframe. The power system will continue to operate normally as long as the combined module output power is within the power rating of the mainframe. The power rating of Keysight N6700C mainframes is as follows:

Keysight N6700C : 400 W
Keysight N6701C : 600 W
Keysight N6702C @ nominal 100 - 120 VAC: 600 W
Keysight N6702C @ nominal 200 - 240 VAC: 1200 W

Mainframe Power Limit

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

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

NOTE

For N6702C mainframes operating at 100-120 VAC nominal, the sum of the channel power limit settings cannot exceed 600W due to a restriction on the AC line current. There is no restriction when operating at 200-240 VAC nominal.

Module Power Limit

When the power limit has been set to a value less than the maximum rating on a power module, 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. If the power limit is left at the maximum rating, then the power module will not enable its power limit function.

For Keysight N673xB, N674xB, and N677xA power modules, the power limit function will turn 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 explained under Clear Output Protection. Note that on these models, it may be preferable for some applications to use the current or voltage setting to limit the output power so as to avoid turning the output off.

NOTE

Power limiting should not be used when Keysight N673xB, N674xB, and N677xA power modules are grouped. When these power modules are grouped, you must reset the power limit to its maximum rated value.

For Keysight N675xA, and N676xA power modules, the power limit function will limit 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 automatically returns to normal operation - either constant voltage or constant current mode.

For Keysight Models N678xA SMU, N6783A-BAT/MFG, and N679xA Loads, the power limit function does not apply.

Power Limit Allocation

The following commands program the module power limit function:

Front Panel Menu Reference	SCPI Command
Select **Output\Advanced\Power**. Enter a power limit for each output. Press **Select**.	To set a power limit on output 1: POW:LIM 100, (@1)

To query the power limits that are set, send:

Front Panel Menu Reference	SCPI Command
Select **Output\Advanced\Power**. The power allocation for all output channels is displayed in the dialog boxes.	POW:LIM? (@1:4)

To return all output channels to their default settings, you can either cycle AC power or send the following commands:

Front Panel Menu Reference	SCPI Command
Select **States\Reset**.	*RST or POW:LIM MAX, (@1:4)

NOTE

When an output channel is set to MAX, it returns to its maximum rated value, and the power limit function will not activate.

Operating Mode Tutorial

Single-Quadrant Operation

Multi-Quadrant Operation

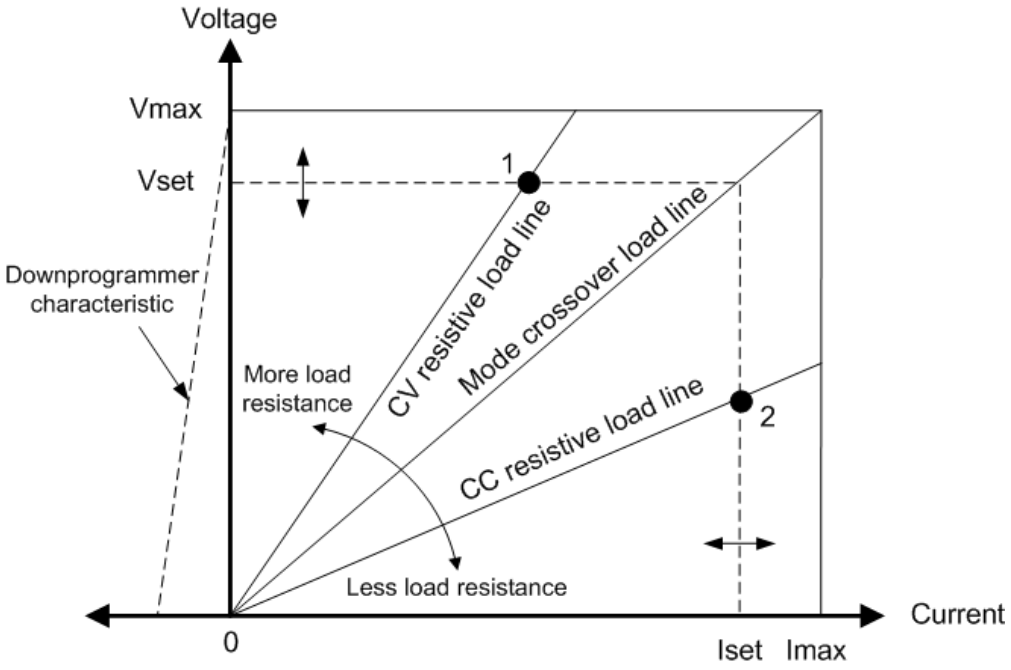
Keysight N679xA Load Module Operation

Single-Quadrant Operation

The Keysight N6700C Modular Power System 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.

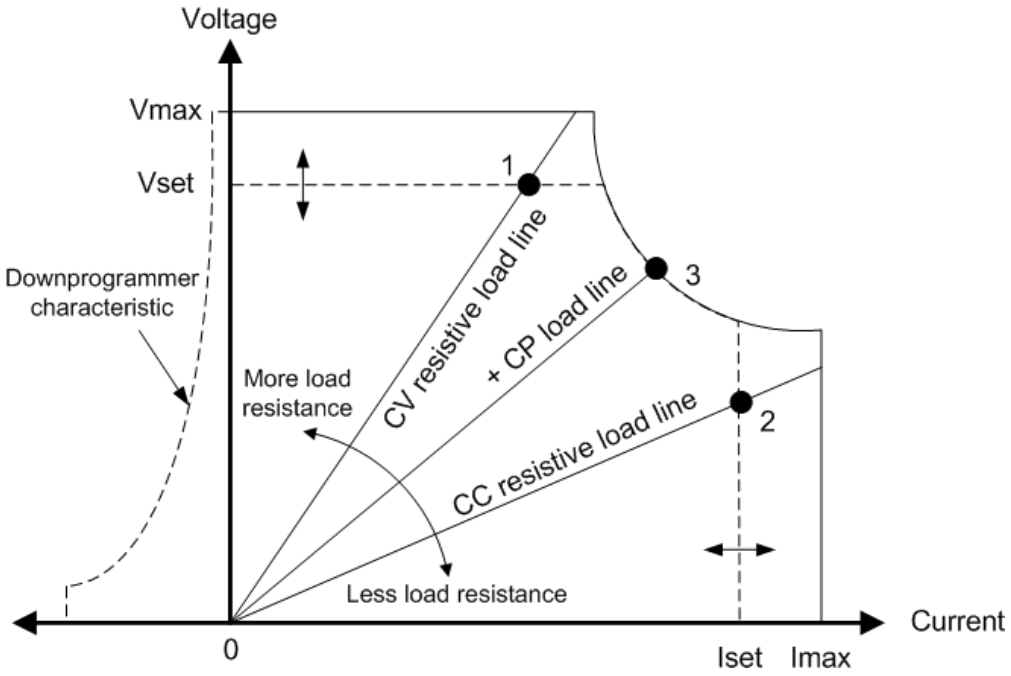
Constant current mode is defined as an operating mode in which the dc source maintains its output current at the programmed current limit in spite of changes in load, line, or temperature. Thus, when the load resistance changes, the output current remains constant while the output voltage changes to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

All DC power modules, except for Keysight Models N678xA SMU, are designed as constant voltage sources. This means that the specifications and operating characteristics are optimized for constant voltage mode operation. Note that these power modules cannot be programmed to operate in a specific mode. At turn-on, the operating mode 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.



AutoRanging N675xA, N676xA

The following figure illustrates the autoranging output characteristic of the Keysight N675xA and N676xA power modules. Point 3 shows a situation in which the voltage and current settings are such that the operating locus is limited by the maximum output power boundary of the output. 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.



Downprogrammming

As shown by the dashed line on the left in the figures, the power system 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. The negative current is not programmable.

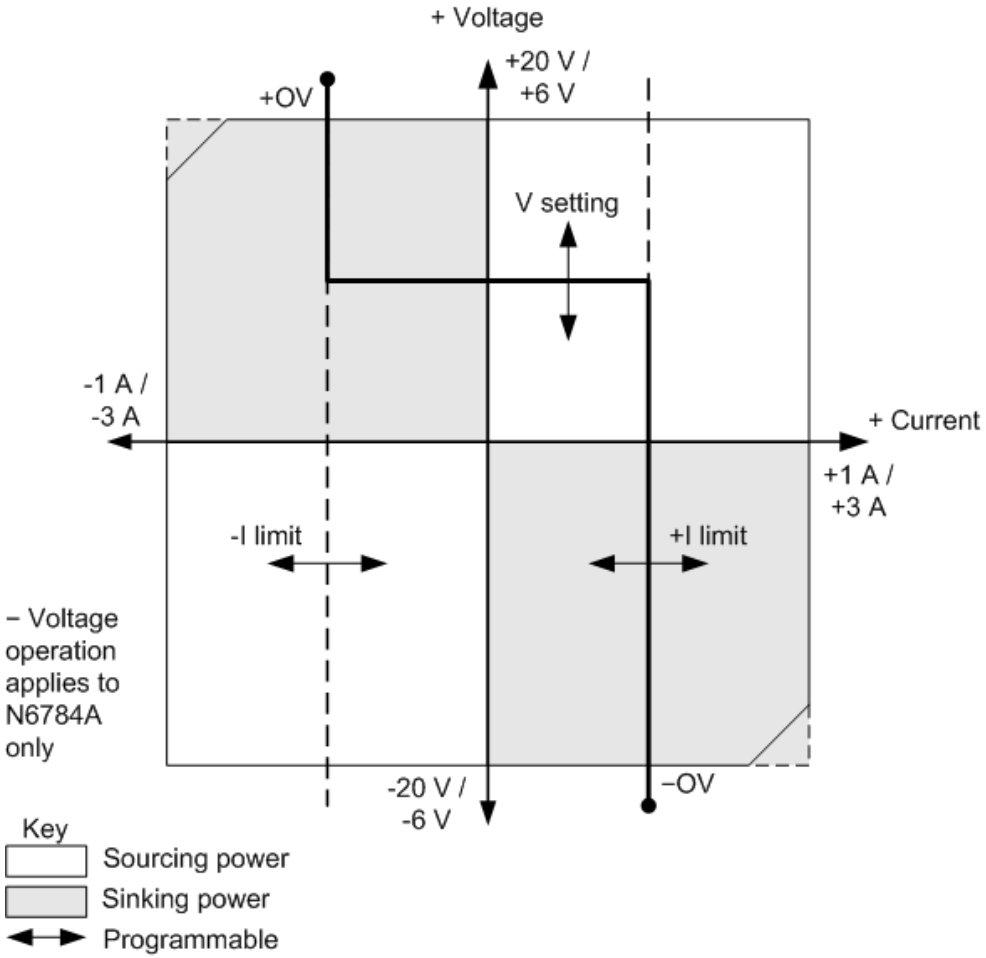
Multi-Quadrant Operation

Keysight Models N678xA SMU N678xA SMU can be operated in either voltage or current priority mode. They can source as well as sink output power. Note that Keysight Models N6781A, N6782A, N6785A, and N6786A operate only in the + Voltage quadrants.

Voltage Priority Mode

In voltage priority mode, the output voltage should be programmed to the desired positive or negative value. A positive current limit value should also be set. The current limit should always be set higher than the actual output current requirement of the external load. With tracking enabled, the negative current limit tracks the positive current limit setting. With tracking disabled, you can set different values for the positive and negative current limits.

The following figure shows the voltage priority operating locus of the power modules. The area in the white quadrants shows the output as a source (sourcing power). The area in the shaded quadrants shows the output as a load (sinking power.



The heavy solid line illustrates the locus of possible operating points as a function of the output load. As shown by the horizontal portion of the line, the output voltage remains regulated at its programmed setting as long as the load current remains within the positive or negative current limit setting. A CV (constant voltage) status flag indicates that the output current is within the limit settings.

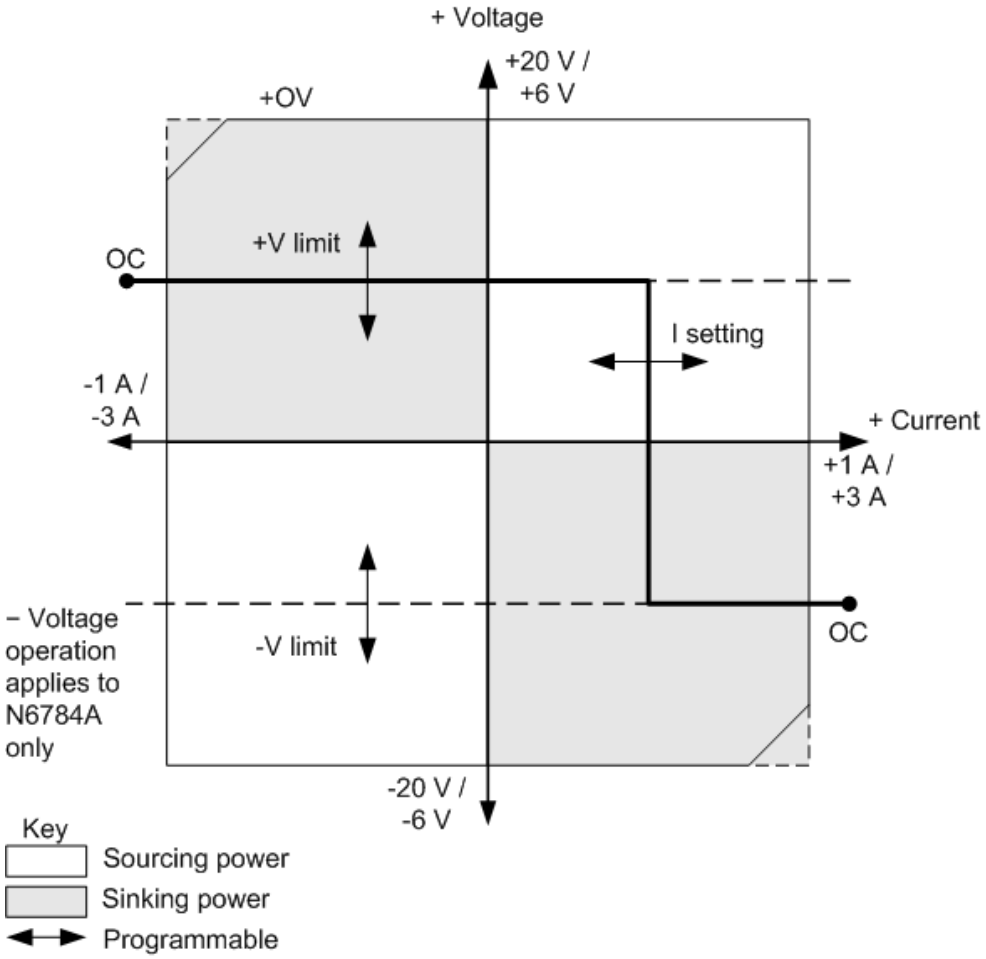
When the output current reaches either the positive or negative current limit, the unit no longer operates in constant voltage mode and the output voltage is no longer held constant. Instead, the power system will now regulate the output current at its current limit setting. Either a LIM+ (positive current limit), or LIM- (negative current limit) status flag is set to indicate that a current limit has been reached.

As shown by the vertical portions of the load line, when the unit is sinking power, the output voltage may continue to increase in the positive or negative direction as more current is forced into the unit. When the output voltage exceeds either the positive or negative over-voltage setting, the output will shut down, the output relays will open, and either the OV or OV- and the PROT status bits will be set. Either the user-defined over-voltage setting or the local over-voltage function can trip the over-voltage protection.

Current Priority Mode

In current priority mode, the output current should be programmed to the desired positive or negative value. A positive voltage limit value should also be set. The voltage limit should always be set higher than the actual output voltage requirement of the external load. With tracking enabled, the negative voltage limit tracks the positive voltage limit setting. With tracking disabled, you can set different values for the positive and negative voltage limits.

The following figure shows the current priority operating locus of the power modules. The area in the white quadrants shows the output as a source (sourcing power). The area in the shaded quadrants shows the output as a load (sinking power).



The heavy solid line illustrates the locus of possible operating points as a function of the output load. As shown by the vertical portion of the line, the output current remains regulated at its programmed setting as long as the output voltage remains within the positive or negative voltage limit setting. A CC (constant current) status flag indicates when the output voltage is within the limit settings.

If the output voltage reaches either the positive or negative voltage limit, the unit no longer operates in constant current mode and the output current is no longer held constant. Instead, the power system will now regulate the output voltage at its voltage limit setting. Either a LIM+ (positive voltage limit) or LIM- (negative voltage limit) status flag is set to indicate that either the positive or negative voltage limit has been reached.

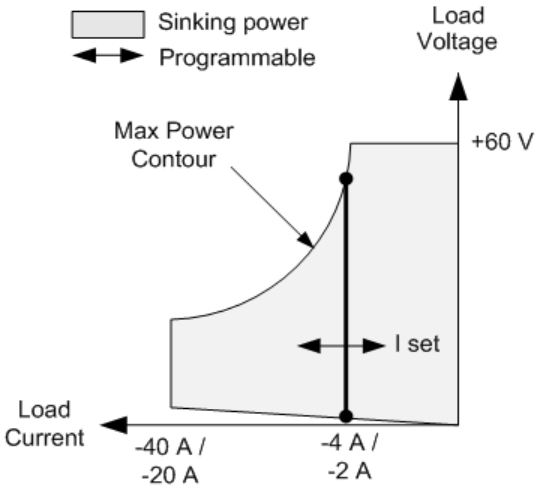
As shown by the horizontal portions of the load line, when the unit is sinking power, the output current may continue to increase in the positive or negative direction as more current is forced into the unit. Once the current is exceeds 112% of the rated current of the range, the output will shut down, the output relays will open, and the OC and PROT status bits will be set.

Keysight N679xA Load Module Operation

The operating modes of operation for Keysight N6791xA Load modules N679xA are: current priority, voltage priority, power priority, and resistance priority. When programmed to a mode, a module remains in that mode until the mode is changed or until a fault condition, such as an over=power or over-temperature occurs.

Current Priority Mode

In this mode, the load module will sink a current in accordance with the programmed value regardless of the input voltage.

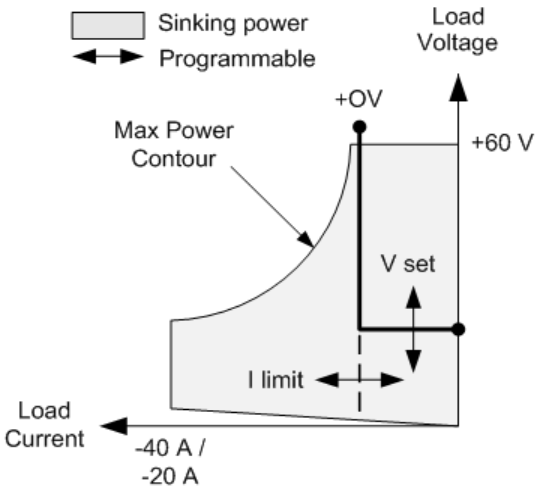


The heavy solid vertical line illustrates the locus of possible operating points as a function of the load current. A CC (constant current) status flag indicates that the load current is at the specified setting. A voltage limit is not programmable in current priority mode. Also, if the DUT imposes a voltage that is above 110% of the rated input voltage, the overvoltage protection will trip and the output will turn off.

Current may be programmed in one of two overlapping ranges, a Low range and a High range. The low range provides better programming and measurement resolution at low current settings.

Voltage Priority Mode

In this mode, the load module will attempt to sink enough current to maintain the input voltage at its programmed value.



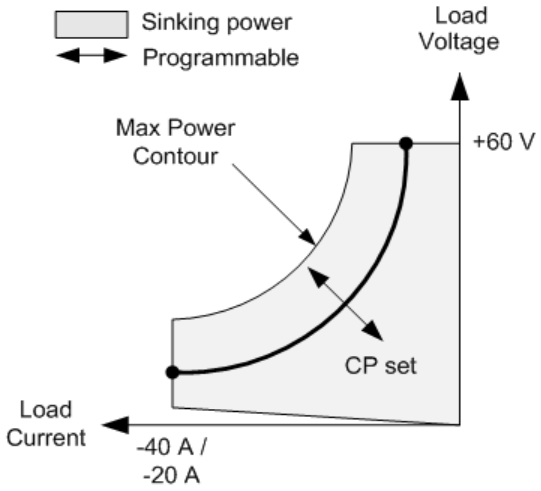
The heavy solid line illustrates the locus of possible operating points as a function of the load voltage.

Note that in voltage priority mode, a current limit can be imposed. As shown by the horizontal portion of the line, the input voltage remains regulated at its programmed setting as long as the input current remains within the current limit setting. A CV (constant voltage) status flag indicates that the input current is within the limit settings.

When the input current reaches the current limit, the unit is no longer in constant voltage operation and the input voltage is no longer held constant. Instead, the load module will now regulate the input current at its current limit setting. A CL (current limit) status flag is set to indicate that a current limit has been reached. If the input voltage increases until it exceeds 110% of the rated input voltage, the overvoltage protection will trip and the output will turn off.

Power Priority Mode

In this mode, the load module will regulate the power being drawn from the DUT according to the programmed constant power value.



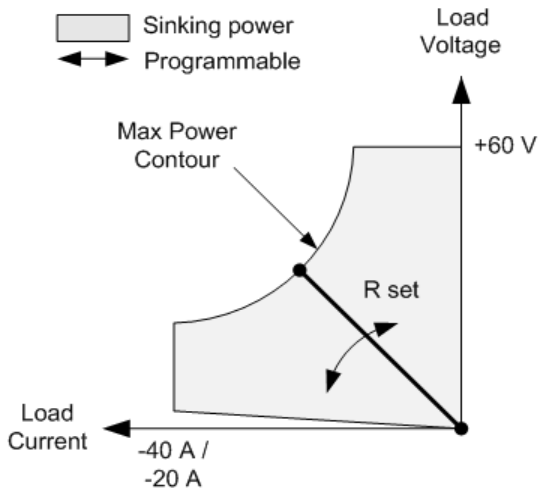
The load module regulates the input power by measuring the input voltage and current and adjusting the input power based on data streamed from the measurement ADCs.

Power may be programmed in one of two overlapping ranges, a Low range and a High range. The low range provides better programming and measurement resolution at low power settings.

The load modules have a built-in over-power protection function that will not let you exceed 110% of the power rating of the load module (the Max Power Contour).

Resistance Priority Mode

In this mode, the load module will sink current proportional to the input voltage in accordance with the programmed resistance.



The heavy solid line illustrates the locus of possible operating points as a function of the resistance.

Resistance may be programmed in one of three overlapping ranges - a Low, Medium, and a High resistance range. The lower ranges provide better programming and measurement resolution at lower resistance settings. The load module automatically selects the resistance range that best corresponds to the resistance value that you program. If the resistance value falls in a region where ranges overlap, the load selects the range with the highest resolution for the resistance value

5 SCPI Programming Reference

Related Information

Introduction to the SCPI Language

Commands by Subsystem

Status Tutorial

Reset and Non-Volatile Settings

SCPI Error Messages

Compatibility With A and B Version MPS

Related Information

IO Libraries and Instrument Drivers

The Keysight IO Libraries Suite software is provided on the Keysight Automation Ready CD-ROM provided with your instrument. Installation instructions are provided on the CD-ROM.

For detailed information about interface connections, refer to the Keysight Technologies USB/LAN/GPIB Interfaces Connectivity Guide included with the Keysight IO Libraries Suite. Or you can download the guide from the Web at www.keysight.com/find/connectivity.

You can also download the Keysight IO Libraries Suite software, along with IVI-COM and LabVIEW drivers from the Keysight Developer Network at www.keysight.com/find/adn.

N6700C Series Documentation

You can download the latest version of this document at www.keysight.com/find/n6700c.

Web Interface

The N6700C series provides a Web interface that is built into the instrument. You can use this interface over LAN for remote access and control of the instrument via a Web browser. See Using the Web Interface for details.

Introduction to the SCPI Language

Command Types

Keywords

Queries

Coupled Commands

Command Separators and Terminators

Syntax Conventions

Parameter Types

Device Clear

Command Types

This instrument complies with the rules and conventions of the present SCPI version (see SYSTem:VERSion?).

SCPI (Standard Commands for Programmable Instruments) is an ASCII-based instrument command language designed for test and measurement instruments. SCPI has two types of commands, common and subsystem.

IEEE 488.2 Common commands are defined by the IEEE 488.2 standard to perform common interface functions such as reset, status, and synchronization. All common commands consist of a three-letter mnemonic preceded by an asterisk: *RST *IDN? *SRE 8.

Subsystem commands perform specific instrument functions. They can be a single command or a group of commands. The groups are comprised of commands that extend one or more levels below the root. Subsystem commands are arranged alphabetically according to the function they perform. The following figure shows a portion of a subsystem command tree, from which you access the commands located along the various paths. Some [optional] commands have been included for clarity

```
OUTPut
      [:STATe] OFF|0|ON|1,(@1)
      :INHibit
            :MODE OFF
      :PROTection
            :CLEar (@1)
```

Keywords

Keywords, also referred to as headers, are instructions recognized by the instrument. Common commands are also keywords.

OUTPut is the root keyword, PROTection is a second-level keyword, CLEar is a third-level keyword. Colons (:) separate the keyword levels.

The command syntax shows most commands (and some parameters) as a mixture of upper- and lower-case letters. The upper-case letters indicate the abbreviated spelling for the command. For shorter program lines, you can send the abbreviated form. For better program readability, you can send the long form.

In the above examples, OUTP and OUTPUT are both acceptable forms. You can use upper- or lower-case letters. Therefore, OUTPUT, outp, and Outp are all acceptable. Other forms such as OUT, are not valid and will generate an error.

Queries

Following a keyword with a question mark (?) turns it into a query (Example: VOLTage?, VOLTage:TRIGgered?). If a query contains parameters, place the query indicator at the end of the last keyword, before the parameters. Insert a space between the query indicator and the first parameter.

You can query the programmed value of most parameters. For example, you can query the voltage setting by sending:

```
VOLTage? (@1)
```

You can also query the minimum or maximum allowable voltage settings as follows:

```
VOLTage? MIN,(@1)
VOLTage? MAX,(@1)
```

You must read back all the results of a query before sending another command to the instrument. Otherwise, a *Query Interrupted* error will occur and the unreturned data will be lost.

Coupled Commands

When commands are coupled it means that the value sent by one command is affected by the settings of another command. The following commands are coupled:

[SOURce:]CURRent and [SOURce:]CURRent:RANGe.

[SOURce:]VOLTage and [SOURce:]VOLTage:RANGe.

If a range command is sent that places an output on a range with a lower maximum setting than the present level, an error is generated. This also occurs if a level is programmed with a value too large for the present range.

These types of errors can be avoided by sending the both level and range commands as a set, in the same SCPI message. For example,

```
CURRent 10,(@1);CURRent:RANGe 10,(@1)<NL>
```

will always be correct because the commands are not executed until the message terminator is received. Because the range and setting information is received as a set, no range/setting conflict occurs.

Command Separators and Terminators

Separators

Colons (:) separate keyword levels. Blank spaces must be used to separate command parameters from their corresponding keyword. Note the space between STATe and the *RST parameter. If a command requires more than one parameter, use a comma to separate adjacent parameters. In the following example, the optional startindex and points parameters must be separated with a comma.

```
FETCh:CURRent? [<start_index>, <points>,] (@1)
```

Semicolons (;) separate commands within the same subsystem. This lets you send several subsystem commands within the same message string. For example, sending the following command string:

```
OUTPut:STATe ON,(@1);PON:STATe RST
```

is the same as sending the following commands:

```
OUTPut ON,(@1)
OUTPut:PON:STATe RST
```

Note that the semicolon follows the implied path of the hierarchical tree structure. In the above example, the optional :STATe keyword must follow the OUTput keyword to place the command parser at the second level in the hierarchy. This allows the use of the PON keyword after the semicolon, since PON is a second-level keyword.

You can also combine commands of different subsystems within the same message string. In this case, you must use a colon to return the command parser to the root level in order to access another subsystem. For example, you could clear the output protection and check the status of the Operation Condition register in one message by using a root specifier as follows:

```
OUTPut:PROTection:CLEar,(@1);:STATus:OPERation:CONDition? (@1)
```

Note the use of the colon *after* the semicolon in order to return the command parser to the root.

Terminators

A command string sent to the instrument must terminate with a new line (<NL>) character. The IEEE-488 EOI (End-Or-Identify) message is interpreted as a <NL> character and can be used to terminate a command string in place of an <NL>. A carriage return followed by a new line (<CR><NL>) is also accepted. Command string termination will always reset the current SCPI command path to the root level.

Syntax Conventions

- Triangle brackets (< >) indicate that you must specify a value for the enclosed parameter. For example, in the VOLTage <*value*> command syntax, the <*value*> parameter is enclosed in triangle brackets. The brackets are not sent with the command string. You must specify a value for the parameter (Example: "VOLTage 50V") unless you select another option shown in the syntax (Example: "VOLTage MAX").
- A vertical bar (|) separates multiple parameter choices for a given command string. For example, RST|RCL0 in the OUTPut:PON:STATe command indicates that you can specify "RST" or "RCL0". The bar is not sent with the command string.
- Square brackets (**[ ]**) enclose some syntax elements - nodes and parameters for example. This indicates that the element is optional and can be omitted. The brackets are not sent with the command string. Any keyword enclosed in brackets is optional and can be omitted. However, if you are combining several commands within the same message string as previously described, you must include the optional commands to place the command parser at the correct level in the hierarchy.
- Braces (**{ }**) indicate parameters that may be repeated zero or more times. It is used especially for showing arrays. The notation <A>{,<B>} shows that parameter "A" must be entered, while parameter "B" may be omitted or may be entered one or more times

Parameter Types

The SCPI language defines several data formats to be used in commands and queries.

Channel Parameter

The channel parameter <chanlist> is required to address one or more channels. It has the following syntax:

(@<channel> [,<channel>][,<channel>][,<channel>])

You can also specify a range of sequential channels as follows:

(@<start_channel>:<end_channel>)

For example, (@2) specifies channel 2 and (@1:3) specifies channels 1 through 3. The channel list, shown as <chanlist> throughout this document, must be preceded with the @ symbol and must be enclosed in parentheses (). A maximum of 4 channels may be specified through a combination of single channels and ranges. Query results are channel list order-sensitive. Results are returned in the order they are specified in the list.

NOTE When adding a channel list parameter to a query, you must include a space character between the query indicator (?) and the channel list parameter. Otherwise error –103, Invalid separator will occur.

Numeric Parameters

Commands that require numeric parameters will accept all commonly used decimal representations of numbers including optional signs, decimal points, and scientific notation. If a command accepts only certain specific values, the instrument will automatically round the input numeric parameters to the accepted values. The following command requires a numeric parameter for the voltage value:

```
[SOURce:]VOLTage 50V|MIN|MAX,(@1)
```

Note that special values for numeric parameters such as MINimum and MAXimum are also accepted. Instead of selecting a specific value for the voltage parameter, you can substitute MIN to set the voltage to its minimum allowable value, MAX to set it to its maximum allowable value.

You can also send engineering unit suffixes with numeric parameters (e.g., V for volts, A for amperes, W for Watts). All parameters values are in base units.

Discrete Parameters

Discrete parameters are used to program settings that have a limited number of values (like IMMediate, EXTernal, or BUS). They may have a short form and a long form just like command keywords. You can use upper- or lower-case letters. Query responses will always return the short form in all upper-case letters. The following command requires a discrete parameter for the display settings:

```
VOLTage:MODE FIXed|STEP,(@1)
```

Boolean Parameters

Boolean parameters represent a single binary condition that is either true or false. For a false condition, the instrument will accept "OFF" or "0". For a true condition, the instrument will accept "ON" or "1". When you query a Boolean setting, the instrument will always return "0" or "1". The following command requires a Boolean parameter:

```
OUTput OFF|0|ON|1,(@1)
```

ASCII String Parameters

String parameters can contain virtually any set of ASCII characters. A string must begin and end with matching quotes; either with a single quote or a double quote. You can include the quote delimiter as part of the string by typing it twice without any characters in between. The following command uses a string parameter:

```
CALibrate:DATE "12/12/12",(@1)
```

Device Clear

Device Clear is an IEEE-488 low-level bus message that you can use to return the instrument to a responsive state. Different programming languages and IEEE-488 interface cards provide access to

this capability through their own unique commands. The status registers, the error queue, and all configuration states are left unchanged when a Device Clear message is received.

Device Clear performs the following actions:

- If a measurement is in progress, it is aborted.
- The instrument returns to the trigger idle state.
- The instrument's input and output buffers are cleared.
- The instrument is prepared to accept a new command string.

NOTE The ABORt command is the recommended method to terminate an instrument operation.

Commands by Subsystem

Abort

ARB

Calibrate

Current

Digital

Display

Fetch

Format

Function

Hcopy

IEEE 488.2 Common

Initiate

List

LXI

Measure

Output

Power

Resistance

Sense

Status

Step

System

Trigger

Voltage

Abort Commands

Abort commands cancel any pending triggered actions. They return the specified trigger system back to the Idle state.

ABORt:ACQuire (@<chanlist>)
ABORt:ELOG (@<chanlist>)
ABORt:TRANsient (@<chanlist>)

NOTE ABORt:ACQuire and ABORt:ELOG commands require Option 054 to be installed on models N673xA. N674xA, N675xA, and N677xA.

ABORt:ACQuire - Cancels any triggered measurements. It also resets the WTG-meas bit in the Condition Status register.

ABORt:ELOG - Stops external data logging.

ABORt:TRANsient - Cancels any triggered actions. It also resets the WTG-tran bit in the Operation Condition Status register.

Parameter	Typical Return
(none)	(none)
Aborts the triggered action: ABOR:ACQ (@1) Stops the external data log: ABOR:ELOG (@1) Aborts the triggered action: ABOR:TRAN (@1)	

- ABORt:ACQuire and ABORt:TRANsient are also executed at power-on and upon execution of the *RST command.
- Abort:TRANsient does not turn off continuous triggers if INITiate:CONTinuous:TRANsient ON has been programmed. In this case, the trigger system will automatically re-initiate.

ARB Commands

ARB commands program the arbitrary waveform generator. They program pre-defined, user-defined, and sequenced waveforms.

NOTE ARB commands require Option 054 to be installed on models N673xA. N674xA, N675xA, and N677xA.

Constant-Dwell

Exponential

Pulse

Ramp

Sinusoid

Staircase

Step

Trapezoid

User-Defined

ARB Sequence

[SOURce:]ARB:COUNt <*value*>, (@<chanlist>)
[SOURce:]ARB:COUNt? [MIN|MAX,] (@<chanlist>)

Sets the number of times that the arbitrary waveform is repeated. The repeat count range is 1 through >16 million. For constant-dwell Arbs only, the maximum count is limited to 256.

Parameter	Typical Return
1 – 16,777,216 |MIN|MAX|INFinity, *RST 1	<Arb count>
Sets the Arb count to 10: ARB:COUN 10, (@1)	

- Use the INFinity parameter to repeat the arbitrary waveform continuously. If MAX, or a value greater than 16,777,216 is programmed, the Arb will also repeat continuously.
- Use ABORt:TRANsient to stop the Arb at any time. When the Arb is aborted, the output returns to the settings that were in effect before the Arb started.
- If a count of 9.9E37 is returned, it means that the Arb is set to repeat continuously.

[SOURce:]ARB:CURRent:CONVert (@<chanlist>)
[SOURce:]ARB:VOLTage:CONVert (@<chanlist>)
[SOURce:]ARB:POWer:CONVert (@<chanlist>) N679xA
[SOURce:]ARB:RESISTANCE:CONVert (@<chanlist>) N679xA

Converts the specified arbitrary waveform to a list of points in the user-defined current, voltage, power, or resistance Arb types. This makes it possible to modify/edit one of the "standard" arbitrary waveforms.

To use this command you must first specify an Arb shape and type using the ARB:FUNCtion:SHAPe and the ARB:FUNCtion:TYPE commands.

Parameter	Typical Return
(none)	(none)
The following commands convert the ARB previously specified on channel 1: ARB:CURR:CONV (@1) ARB:VOLT:CONV (@1) ARB:POW:CONV (@1) ARB:RESISTANCE:CONV (@1)	

- If the Arb function is set to User-Defined or None, the command is ignored.

[SOURce:]ARB:FUNCtion:SHAPe <shape>, (@<chanlist>)
[SOURce:]ARB:FUNCtion:SHAPe? (@<chanlist>)

NOTE This command replaces the previous ARB:FUNCtion command and should be used in new applications. ARB:FUNCtion is used for backward compatibility.

Sets the shape of the arbitrary waveform generator as follows:

STEP	Specifies a step
RAMP	Specifies a ramp
STAircase	Specifies a staircase
SINusoid	Specifies a sine wave
PULSe	Specifies a pulse
TRAPezoid	Specifies a trapezoid
EXPonential	Specifies a exponential waveform
UDEFined	Specifies a user-defined waveform
CDWell	Specifies a constant-dwell waveform
SEQuence	Specifies a sequence of arbitrary waveforms
NONE	Specifies no arbitrary waveform

Parameter	Typical Return
STEP | RAMP | STAircase | SINusoid | PULSe | TRAPezoid | EXPonential | UDEFined | CDWell | SEQuence |NONE, *RST NONE	STEP, RAMP, STA, SIN, PULS, TRAP, EXP, or UDEF.
Specify a step on channel 1: ARB:FUNC:SHAP STEP, (@1)	

- Select the CURRent:MODE Arb parameter to enable the instrument to generate arbitrary current waveforms when the transient system is initiated and triggered.
- Select the VOLTage:MODE Arb parameter to enable the instrument to generate arbitrary voltage waveforms when the transient system is initiated and triggered.
- Select the POWer:MODE Arb parameter to enable the instrument to generate arbitrary power waveforms when the transient system is initiated and triggered.
- Select the RESISTANCE:MODE Arb parameter to enable the instrument to generate arbitrary resistance waveforms when the transient system is initiated and triggered.

[SOURce:]ARB:FUNCtion:TYPE <type>, (@<chanlist>)
[SOURce:]ARB:FUNCtion:TYPE? (@<chanlist>)

NOTE This command replaces the previous ARB:FUNCtion command and should be used in new applications. ARB:FUNCtion is still available for backward compatibility..

Selects a current, voltage, power, or resistance Arb. Only one type of Arb may be output at a time.

Parameter	Typical Return
CURRent | VOLTage | POWer | RESISTANCE *RST VOLTage	<type>
Specify an Arb type on channel 1: ARB:FUNC:TYPE CURR, (@1)	

- Power and resistance Arb types apply to N679xA.

[SOURce:]ARB:TERMinate:LAST <Bool>, (@<chanlist>)
[SOURce:]ARB:TERMinate:LAST? (@<chanlist>)

Determines the output value when the Arb terminates. The state is either ON (1) or OFF (0).

When ON	The output remains at the last Arb sequence value. The last current, voltage, power, or resistance Arb value becomes the IMMediate value when the ARB completes.
When OFF	The output returns to the settings in effect before the Arb started. This also applies when the Arb is aborted,

Parameter	Typical Return
0|OFF|1|ON, *RST Off	0 or 1
Sets the ARB to terminate with the voltage, resistance, or current set at the last Arb value: ARB:TERM:LAST ON,(@1)	

- The query returns 0 if the output returns to the settings that were in effect before the Arb started, and 1 if the output remains at the last Arb value.

Constant-Dwell (CD)

Back to ARB Commands

[SOURce:]ARB:CURRent:CDWell[:LEVel] <*value*>{<,*value*>},(@<chanlist>)
[SOURce:]ARB:CURRent:CDWell[:LEVel]? (@<chanlist>)
[SOURce:]ARB:VOLTage:CDWell[:LEVel] <*value*>{<,*value*>},(@<chanlist>)
[SOURce:]ARB:VOLTage:CDWell[:LEVel]? (@<chanlist>)
[SOURce:]ARB:POWer:CDWell[:LEVel] <*value*>{<,*value*>},(@<chanlist>) N679xA
[SOURce:]ARB:POWer:CDWell[:LEVel]? (@<chanlist>)
[SOURce:]ARB:RESISTANCE:CDWell[:LEVel] <*value*>{<,*value*>},(@<chanlist>) N679xA
[SOURce:]ARB:RESISTANCE:CDWell[:LEVel]? (@<chanlist>)

Specifies the level of each current, voltage, power, or resistance point in a constant-dwell Arb.

You can only program one constant-dwell Arb type at a time, so setting the current CD Arb resets the voltage, power, and resistance Arbs to 1 point at the minimum value. A comma-delimited list of up to 65,535 points may be programmed.

Parameter	Typical Return
Current: 0 - maximum Voltage: 0 - maximum Power: 0 - maximum Resistance: 0 - maximum Values are range and module-rating dependent. *RST 1 point set to the minimum value.	<value> [,<value>] or <block> [,<block>]
Program five current points: ARB:CURR:CDW 5,4,3,2,1,(@1) Program five voltage points: ARB:VOLT:CDW 20,21,22,23,24,(@1) Program five power points: ARB:POW:CDW 10,20,30,40,50,(@1) Program five resistance points: ARB:RESISTANCE:CDW 50,100,500,100,50,(@1)	

- For better performance, the list of points can be sent as a definite length binary block instead of an ASCII list.
- The return format depends on the settings of the FORMat:BORDer and FORMat[:DATA] commands. When the data format is set to ASCII, returned values are comma separated. Only one channel can be queried when the format is ASCII. When the data format is set to REAL, data is returned as single precision floating point numbers in definite length arbitrary block response format. Each block contains all the records for one of the channels given in the <chanlist> parameter. If multiple channels are given, then each definite length arbitrary block of data is separated by a comma.

[SOURce:]ARB:CURRent:CDWell:DWELl <*value*>,(@<chanlist>)
[SOURce:]ARB:CURRent:CDWell:DWELl? (@<chanlist>)
[SOURce:]ARB:VOLTage:CDWell:DWELl <*value*>,(@<chanlist>)
[SOURce:]ARB:VOLTage:CDWell:DWELl? (@<chanlist>)
[SOURce:]ARB:POWer:CDWell:DWELl <*value*>,(@<chanlist>) N679xA
[SOURce:]ARB:POWer:CDWell:DWELl? (@<chanlist>)
[SOURce:]ARB:RESISTANCE:CDWell:DWELl <*value*>,(@<chanlist>) N679xA
[SOURce:]ARB:RESISTANCE:CDWell:DWELl? (@<chanlist>)

Specifies the dwell time in seconds for each current, voltage, power, or resistance point in a constant-dwell Arb

You can only program one constant-dwell Arb type at a time, so setting the current CD Arb resets the voltage, power, and resistance Arbs to 1 point at the minimum value. Programmed values can range from 10.24 microseconds to 0.30 seconds. Values are rounded to the nearest 10.24-microsecond increment.

Parameter	Typical Return
0.00001024 - 0.30, *RST 0.001	<dwell value>

Program a constant-dwell current time: `ARB:CURR:CDW:DWEL 0.2,(@1)`
Program a constant-dwell voltage time: `ARB:VOLT:CDW:DWEL 0.5,(@1)`
Program a constant-dwell power time: `ARB:POW:CDW:DWEL 5,(@1)`
Program a constant-dwell resistance time: `ARB:RESISTANCE:CDW:DWEL 2,(@1)`

- The maximum repeat count for CD Arbs is 256. See [SOURce:]ARB:COUNt.

[SOURce:]ARB:CURRent:CDWell:POINts? (@<chanlist>)
[SOURce:]ARB:VOLTage:CDWell:POINts? (@<chanlist>)
[SOURce:]ARB:POWer:CDWell:POINts? (@<chanlist>) N679xA
[SOURce:]ARB:RESISTANCE:CDWell:POINts? (@<chanlist>) N679xA

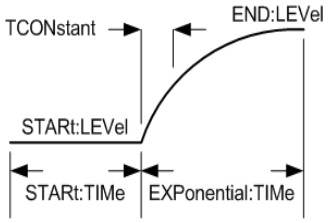
Returns the number of current, voltage, power, or resistance points in a constant-dwell Arb in the form +n.nnnnnnE+nn.

Parameter	Typical Return
(none)	<number of points>

Program a constant-dwell time of 0.2 seconds:
`ARB:CURR:CDW:DWEL 0.2,(@1)`
`ARB:VOLT:CDW:DWEL 0.2,(@1)`
`ARB:POW:CDW:DWEL 0.2,(@1)`
`ARB:RESISTANCE:CDW:DWEL 0.2,(@1)`

Exponential

Back to ARB Commands



[SOURce:]ARB:CURRent:EXPonential:END[:LEVel] <*value*>, (@<chanlist>)
[SOURce:]ARB:CURRent:EXPonential:END[:LEVel]? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:VOLTage:EXPonential:END[:LEVel] <*value*>, (@<chanlist>)
[SOURce:]ARB:VOLTage:EXPonential:END[:LEVel]? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:POWer:EXPonential:END[:LEVel] <*value*>, (@<chanlist>) N679xA
[SOURce:]ARB:POWer:EXPonential:END[:LEVel]? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:RESISTANCE:EXPonential:END[:LEVel] <*value*>, (@<chanlist>) N679xA
[SOURce:]ARB:RESISTANCE:EXPonential:END[:LEVel]? [MIN|MAX,] (@<chanlist>)

Specifies the ending current, voltage, power, or resistance level after the exponential waveform ends.

[SOURce:]ARB:SEQuence:STEP:CURRent:EXPonential:END[:LEVel] <*value*>, <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:CURRent:EXPonential:END[:LEVel]? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:VOLTage:EXPonential:END[:LEVel] <*value*>, <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:VOLTage:EXPonential:END[:LEVel]? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:POWer:EXPonential:END[:LEVel] <*value*>, <*step#*>, (@<chanlist>) N679xA
[SOURce:]ARB:SEQuence:STEP:POWer:EXPonential:END[:LEVel]? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:RESISTANCE:EXPonential:END[:LEVel] <*value*>, <*step#*>, (@<chanlist>) N679xA
[SOURce:]ARB:SEQuence:STEP:RESISTANCE:EXPonential:END[:LEVel]? [MIN|MAX,] <*step#*>, (@<chanlist>)

Specifies the ending current, voltage, power, or resistance level after the exponential waveform ends for Arb sequence steps.

Parameter	Typical Return
Current: 0 - maximum|MIN|MAX, *RST MIN Voltage: 0 - maximum|MIN|MAX, *RST MIN Power: 0 - maximum|MIN|MAX, *RST MIN Resistance: 0 - maximum|MIN|MAX, *RST MIN Values are range and module-rating dependent.	<end value>
Step 0 - 99, *RST 0	(none)
Programs an end level current: ARB:CURR:EXP:END 1,(@1) Programs an end level voltage: ARB:VOLT:EXP:END 20,(@1) Programs an end level power: ARB:POW:EXP:END 50,(@1) Programs an end level resistance: ARB:RESISTANCE:EXP:END 100,(@1) Programs an end current for step 0: ARB:SEQ:STEP:CURR:EXP:END 1, 0,(@1)	

[SOURce:]ARB:CURRent:EXPonential:STARt[:LEVel] <*value*>, (@<chanlist>)
[SOURce:]ARB:CURRent:EXPonential:STARt[:LEVel]? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:VOLTage:EXPonential:STARt[:LEVel] <*value*>, (@<chanlist>)
[SOURce:]ARB:VOLTage:EXPonential:STARt[:LEVel]? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:POWer:EXPonential:STARt[:LEVel] <*value*>, (@<chanlist>) N679xA
[SOURce:]ARB:POWer:EXPonential:STARt[:LEVel]? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:RESISTANCE:EXPonential:STARt[:LEVel] <*value*>, (@<chanlist>) N679xA
[SOURce:]ARB:RESISTANCE:EXPonential:STARt[:LEVel]? [MIN|MAX,] (@<chanlist>)

Specifies the initial current, voltage, power, or resistance level when the exponential waveform starts.

[SOURce:]ARB:SEQuence:STEP:CURRent:EXPonential:STARt[:LEVel] <*value*>, <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:CURRent:EXPonential:STARt[:LEVel]? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:VOLTage:EXPonential:STARt[:LEVel] <*value*>, <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:VOLTage:EXPonential:STARt[:LEVel]? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:POWer:EXPonential:STARt[:LEVel] <*value*>, <*step#*>, (@<chanlist>) N679xA
[SOURce:]ARB:SEQuence:STEP:POWer:EXPonential:STARt[:LEVel]? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:RESISTANCE:EXPonential:STARt[:LEVel] <*value*>, <*step#*>, (@<chanlist>)
N679xA
[SOURce:]ARB:SEQuence:STEP:RESISTANCE:EXPonential:STARt[:LEVel]? [MIN|MAX,] <*step#*>, (@<chanlist>)

Specifies the initial current, voltage, power, or resistance level after the exponential waveform ends for Arb sequence steps.

Parameter	Typical Return
Current: 0 - maximum|MIN|MAX, *RST MIN Voltage: 0 - maximum|MIN|MAX, *RST MIN Power: 0 - maximum|MIN|MAX, *RST MIN Resistance: 0 - maximum|MIN|MAX, *RST MIN Values are range and module-rating dependent.	<start value>
Step 0 - 99, *RST 0	(none)
Programs a start level current: ARB:CURR:EXP:STAR 0,(@1) Programs a start level voltage: ARB:VOLT:EXP:STAR 0,(@1) Programs a start level power: ARB:POW:EXP:STAR 0,(@1) Programs a start level resistance: ARB:RESISTANCE:EXP:END 50,(@1) Programs a start current for step 0: ARB:SEQ:STEP:CURR:EXP:STAR 0, 0,(@1)	

[SOURce:]ARB:CURRent:EXPonential:STARt:TIMe <*value*>, (@<chanlist>)
[SOURce:]ARB:CURRent:EXPonential:STARt:TIMe? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:VOLTage:EXPonential:STARt:TIMe<*value*>, (@<chanlist>)
[SOURce:]ARB:VOLTage:EXPonential:STARt:TIMe? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:POWer:EXPonential:STARt:TIMe<*value*>, (@<chanlist>) N679xA
[SOURce:]ARB:POWer:EXPonential:STARt:TIMe? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:RESISTANCE:EXPonential:STARt:TIMe<*value*>, (@<chanlist>) N679xA
[SOURce:]ARB:RESISTANCE:EXPonential:STARt:TIMe? [MIN|MAX,] (@<chanlist>)

Specifies the delay in seconds after the trigger is received, but before the exponential waveform occurs.

[SOURce:]ARB:SEQuence:STEP:CURRent:EXPonential:STARt:TIMe <*value*>, <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:CURRent:EXPonential:STARt:TIMe? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:VOLTage:EXPonential:STARt:TIMe<*value*>, <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:VOLTage:EXPonential:STARt:TIMe? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:POWer:EXPonential:STARt:TIMe<*value*>, <*step#*>, (@<chanlist>) N679xA
[SOURce:]ARB:SEQuence:STEP:POWer:EXPonential:STARt:TIMe? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:RESISTANCE:EXPonential:STARt:TIMe<*value*>, <*step#*>, (@<chanlist>) N679xA
[SOURce:]ARB:SEQuence:STEP:RESISTANCE:EXPonential:STARt:TIMe? [MIN|MAX,] <*step#*>, (@<chanlist>)

Specifies the delay in seconds after the trigger is received, but before the exponential waveform occurs for Arb sequence steps.

Parameter	Typical Return
0 – 262.144 | MIN | MAX, *RST 0	<start time>
Step 0 - 99, *RST 0	(none)
Programs a start time for the current Arb: ARB:CURR:EXP:STAR:TIM 1,(@1) Programs a start time for the voltage Arb: ARB:VOLT:EXP:STAR:TIM 1,(@1) Programs a start time for the power Arb: ARB:POW:EXP:STAR:TIM 1,(@1) Programs a start time for the resistance Arb: ARB:RESISTANCE:EXP:STAR:TIM 1,(@1) Programs a start time for step 0: ARB:SEQ:STEP:CURR:EXP:STAR:TIM 1, 0,(@1)	

[SOURce:]ARB:CURRent:EXPonential:TCONstant <*value*>, (@<chanlist>)
[SOURce:]ARB:CURRent:EXPonential:TCONstant? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:VOLTage:EXPonential:TCONstant <*value*>, (@<chanlist>)
[SOURce:]ARB:VOLTage:EXPonential:TCONstant? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:POWer:EXPonential:TCONstant <*value*>, (@<chanlist>) N679xA
[SOURce:]ARB:POWer:EXPonential:TCONstant? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:RESISTANCE:EXPonential:TCONstant <*value*>, (@<chanlist>) N679xA
[SOURce:]ARB:RESISTANCE:EXPonential:TCONstant? [MIN|MAX,] (@<chanlist>)

Specifies the time constant of the exponential curve.

[SOURce:]ARB:SEQuence:STEP:CURRent:EXPonential:TCONstant <*value*>, <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:CURRent:EXPonential:TCONstant ? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:VOLTage:EXPonential:TCONstant <*value*>, <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:VOLTage:EXPonential:TCONstant ? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:POWer:EXPonential:TCONstant <*value*>, <*step#*>, (@<chanlist>) N679xA
[SOURce:]ARB:SEQuence:STEP:POWer:EXPonential:TCONstant ? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:RESISTANCE:EXPonential:TCONstant <*value*>, <*step#*>, (@<chanlist>) N679xA
[SOURce:]ARB:SEQuence:STEP:RESISTANCE:EXPonential:TCONstant ? [MIN|MAX,] <*step#*>, (@<chanlist>)

Specifies the time constant of the exponential curve for Arb sequence steps.

Parameter	Typical Return
0 – 262.144 | MIN | MAX, *RST 1	<time constant>
Step 0 - 99, *RST 0	(none)

Parameter	Typical Return
Programs a time constant for the current Arb: ARB:CURR:EXP:TCON 5,(@1) Programs a time constant for the voltage Arb: ARB:VOLT:EXP:TCON 5,(@1) Programs a time constant for the power Arb: ARB:POW:EXP:TCON 5,(@1) Programs a time constant for the resistance Arb: ARB:RESISTANCE:EXP:TCON 5,(@1) Programs a time constant for step 0: ARB:SEQ:STEP:CURR:EXP:TCON 5, 0,(@1)	

[SOURce:]ARB:CURRent:EXPonential:TIMe <*value*>, (@<chanlist>)
[SOURce:]ARB:CURRent:EXPonential:TIMe? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:VOLTage:EXPonential:TIMe <*value*>, (@<chanlist>)
[SOURce:]ARB:VOLTage:EXPonential:TIMe? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:POWer:EXPonential:TIMe <*value*>, (@<chanlist>) N679xA
[SOURce:]ARB:POWer:EXPonential:TIMe? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:RESISTANCE:EXPonential:TIMe <*value*>, (@<chanlist>) N679xA
[SOURce:]ARB:RESISTANCE:EXPonential:TIMe? [MIN|MAX,] (@<chanlist>)

Specifies the total time for the current, voltage, power, or resistance to go from the starting level to the ending level in seconds.

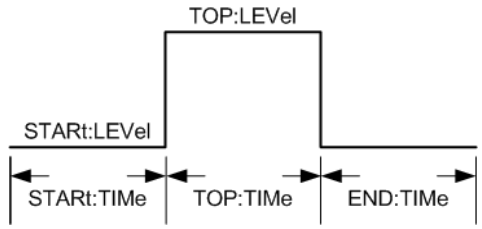
[SOURce:]ARB:SEQuence:STEP:CURRent:EXPonential:TIMe <*value*>, <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:CURRent:EXPonential:TIMe? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:VOLTage:EXPonential:TIMe<*value*>, <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:VOLTage:EXPonential:TIMe? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:POWer:EXPonential:TIMe<*value*>, <*step#*>, (@<chanlist>) N679xA
[SOURce:]ARB:SEQuence:STEP:POWer:EXPonential:TIMe? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:RESISTANCE:EXPonential:TIMe<*value*>, <*step#*>, (@<chanlist>) N679xA
[SOURce:]ARB:SEQuence:STEP:RESISTANCE:EXPonential:TIMe? [MIN|MAX,] <*step#*>, (@<chanlist>)

Specifies the total time for the current, voltage, power, or resistance to go from the starting level to the ending level in seconds for Arb sequence steps.

Parameter	Typical Return
0 – 262.144 | MIN | MAX, *RST 0	<total time>
Step 0 - 99, *RST 0	(none)
Programs the total time for the current Arb: ARB:CURR:EXP:TIM 10,(@1) Programs the total time for the voltage Arb: ARB:VOLT:EXP:TIM 10,(@1) Programs the total time for the power Arb: ARB:POW:EXP:TIM 10,(@1) Programs the total time for the resistance Arb: ARB:RESISTANCE:EXP:TIM 10,(@1) Programs the total time for step 0: ARB:SEQ:STEP:CURR:EXP:TIM 10, 0,(@1)	

Pulse

Back to ARB Commands



[SOURce:]ARB:CURRent:PULSe:END:TIMe <*value*>, (@<chanlist>)
[SOURce:]ARB:CURRent:PULSe:END:TIMe? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:VOLTage:PULSe:END:TIMe<*value*>, (@<chanlist>)
[SOURce:]ARB:VOLTage:PULSe:END:TIMe? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:POWer:PULSe:END:TIMe<*value*>, (@<chanlist>) N679xA
[SOURce:]ARB:POWer:PULSe:END:TIMe? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:RESISTANCE:PULSe:END:TIMe<*value*>, (@<chanlist>) N679xA
[SOURce:]ARB:RESISTANCE:PULSe:END:TIMe? [MIN|MAX,] (@<chanlist>)

Specifies the time in seconds, after the pulse completes, that the starting current, voltage, power, or resistance level persists.

[SOURce:]ARB:SEQuence:STEP:CURRent:PULSe:END:TIMe <*value*>, <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:CURRent:PULSe:END:TIMe? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:VOLTage:PULSe:END:TIMe<*value*>, <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:VOLTage:PULSe:END:TIMe? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:POWer:PULSe:END:TIMe<*value*>, <*step#*>, (@<chanlist>) N679xA
[SOURce:]ARB:SEQuence:STEP:POWer:PULSe:END:TIMe? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:RESISTANCE:PULSe:END:TIMe<*value*>, <*step#*>, (@<chanlist>) N679xA
[SOURce:]ARB:SEQuence:STEP:RESISTANCE:PULSe:END:TIMe? [MIN|MAX,] <*step#*>, (@<chanlist>)

Specifies the time in seconds, after the pulse completes, that the starting current, voltage, power, or resistance level persists for Arb sequence steps.

Parameter	Typical Return
0 – 262.144 | MIN | MAX, *RST 0	<end time>
Step 0 - 99, *RST 0	(none)
Programs an end time for the current pulse: ARB:CURR:PULS:END:TIM 2,(@1) Programs an end time for the voltage pulse:ARB:VOLT:PULS:END:TIM 2,(@1) Programs an end time for the power pulse:ARB:POW:PULS:END:TIM 2,(@1) Programs an end time for the resistance pulse:ARB:RESISTANCE:PULS:END:TIM 2,(@1) Programs an end time for step 0: ARB:SEQ:STEP:CURR:PULS:END:TIM 2, 0,(@1)	

[SOURce:]ARB:CURRent:PULSe:FREQuency<*value*>, (@<chanlist>)
[SOURce:]ARB:CURRent:PULSe:FREQuency? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:VOLTage:PULSe:FREQuency <*value*>, (@<chanlist>)
[SOURce:]ARB:VOLTage:PULSe:FREQuency? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:POWer:PULSe:FREQuency <*value*>, (@<chanlist>) N679xA
[SOURce:]ARB:POWer:PULSe:FREQuency? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:RESISTANCE:PULSe:FREQuency <*value*>, (@<chanlist>) N679xA
[SOURce:]ARB:RESISTANCE:PULSe:FREQuency? [MIN|MAX,] (@<chanlist>)

Specifies the frequency of the current, voltage, power, or resistance pulse in Hertz. The frequency commands are coupled with the pulse time commands.

[SOURce:]ARB:SEQuence:STEP:CURRent:PULSe:FREQuency<*value*>, <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:CURRent:PULSe:FREQuency? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:VOLTage:PULSe:FREQuency <*value*>, <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:VOLTage:PULSe:FREQuency? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:POWer:PULSe:FREQuency <*value*>, <*step#*>, (@<chanlist>) N679xA
[SOURce:]ARB:SEQuence:STEP:POWer:PULSe:FREQuency? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:RESISTANCE:PULSe:FREQuency <*value*>, <*step#*>, (@<chanlist>) N679xA
[SOURce:]ARB:SEQuence:STEP:RESISTANCE:PULSe:FREQuency? [MIN|MAX,] <*step#*>, (@<chanlist>)

Specifies the frequency of the current, voltage, power, or resistance pulse in Hertz for Arb sequence steps. The frequency commands are coupled with the pulse time commands.

Parameter	Typical Return
3.8147E-5 - 1.0E4 | MIN | MAX, *RST 1	<frequency>
Step 0 - 99, *RST 0	(none)
Programs a current frequency: ARB:CURR:PULS:FREQ 10,(@1) Programs a voltage frequency: ARB:VOLT:PULS:FREQ 10,(@1) Programs a power frequency: ARB:POW:PULS:FREQ 10,(@1) Programs a resistance frequency: ARB:RESISTANCE:PULS:FREQ 10,(@1) Programs a current frequency for step 0: ARB:SEQ:STEP:CURR:PULS:FREQ 10, 0,(@1)	

[SOURce:]ARB:CURRent:PULSe:STARt[:LEVel] <*value*>, (@<chanlist>)
[SOURce:]ARB:CURRent:PULSe:STARt[:LEVel]? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:VOLTage:PULSe:STARt[:LEVel] <*value*>, (@<chanlist>)
[SOURce:]ARB:VOLTage:PULSe:STARt[:LEVel]? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:POWer:PULSe:STARt[:LEVel] <*value*>, (@<chanlist>) N679xA
[SOURce:]ARB:POWer:PULSe:STARt[:LEVel]? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:RESISTANCE:PULSe:STARt[:LEVel] <*value*>, (@<chanlist>) N679xA
[SOURce:]ARB:RESISTANCE:PULSe:STARt[:LEVel]? [MIN|MAX,] (@<chanlist>)

Specifies the current, voltage, power, or resistance before and after the pulse occurs.

[SOURce:]ARB:SEQuence:STEP:CURRent:PULSe:STARt[:LEVel] <*value*>, <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:CURRent:PULSe:STARt[:LEVel]? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:VOLTage:PULSe:STARt[:LEVel] <*value*>, <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:VOLTage:PULSe:STARt[:LEVel]? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:POWer:PULSe:STARt[:LEVel] <*value*>, <*step#*>, (@<chanlist>) N679xA
[SOURce:]ARB:SEQuence:STEP:POWer:PULSe:STARt[:LEVel]? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:RESISTANCE:PULSe:STARt[:LEVel] <*value*>, <*step#*>, (@<chanlist>) N679xA
[SOURce:]ARB:SEQuence:STEP:RESISTANCE:PULSe:STARt[:LEVel]? [MIN|MAX,] <*step#*>, (@<chanlist>)

Specifies the current, voltage, power, or resistance before and after the pulse occurs for Arb sequence steps.

Parameter	Typical Return
Current: 0 - maximum|MIN|MAX, *RST MIN Voltage: 0 - maximum|MIN|MAX, *RST MIN Power: 0 - maximum|MIN|MAX, *RST MIN Resistance: 0 - maximum|MIN|MAX, *RST MIN Values are range and module-rating dependent.	<start value>
Step 0 - 99, *RST 0	(none)
Programs a start- and end-level current: ARB:CURR:PULS:STAR 1,(@1) Programs a start- and end-level voltage: ARB:VOLT:PULS:STAR 1,(@1) Programs a start- and end-level power: ARB:POW:PULS:STAR 1,(@1) Programs a start- and end-level resistance: ARB:RESISTANCE:PULS:STAR 1,(@1) Programs a start- and end-level for step 0: ARB:SEQ:STEP:CURR:PULS:STAR 1, 0,(@1)	

[SOURce:]ARB:CURRent:PULSe:STARt:TIMe <*value*>, (@<chanlist>)
[SOURce:]ARB:CURRent:PULSe:STARt:TIMe? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:VOLTage:PULSe:STARt:TIMe<*value*>, (@<chanlist>)
[SOURce:]ARB:VOLTage:PULSe:STARt:TIMe? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:POWer:PULSe:STARt:TIMe<*value*>, (@<chanlist>) N679xA
[SOURce:]ARB:POWer:PULSe:STARt:TIMe? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:RESISTANCE:PULSe:STARt:TIMe<*value*>, (@<chanlist>) N679xA
[SOURce:]ARB:RESISTANCE:PULSe:STARt:TIMe? [MIN|MAX,] (@<chanlist>)

Specifies the delay in seconds after the trigger is received, but before the pulse occurs.

[SOURce:]ARB:SEQuence:STEP:CURRent:PULSe:STARt:TIMe <*value*>, <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:CURRent:PULSe:STARt:TIMe? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:VOLTage:PULSe:STARt:TIMe <*value*>, <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:VOLTage:PULSe:STARt:TIMe? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:POWer:PULSe:STARt:TIMe <*value*>, <*step#*>, (@<chanlist>) N679xA
[SOURce:]ARB:SEQuence:STEP:POWer:PULSe:STARt:TIMe? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:RESISTANCE:PULSe:STARt:TIMe <*value*>, <*step#*>, (@<chanlist>) N679xA
[SOURce:]ARB:SEQuence:STEP:RESISTANCE:PULSe:STARt:TIMe? [MIN|MAX,] <*step#*>, (@<chanlist>)

Specifies the delay in seconds after the trigger is received, but before the pulse occurs for Arb sequence steps.

Parameter	Typical Return
0 – 262.144 | MIN | MAX, *RST 0	<start time>
Step 0 - 99, *RST 0	(none)
Programs a start time for the current pulse: ARB:CURR:PULS:STAR:TIM 1,(@1) Programs a start time for the voltage pulse: ARB:VOLT:PULS:STAR:TIM 1,(@1) Programs a start time for the power pulse: ARB:POW:PULS:STAR:TIM 1,(@1) Programs a start time for the resistance pulse: ARB:RESISTANCE:PULS:STAR:TIM 1,(@1) Programs a start time for step 0: ARB:SEQ:STEP:CURR:PULS:STAR:TIM 1, 0,(@1)	

[SOURce:]ARB:CURRent:PULSe:TOP[:LEVel] <*value*>, (@<chanlist>)
[SOURce:]ARB:CURRent:PULSe:TOP[:LEVel]? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:VOLTage:PULSe:TOP[:LEVel] <*value*>, (@<chanlist>)
[SOURce:]ARB:VOLTage:PULSe:TOP[:LEVel]? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:POWer:PULSe:TOP[:LEVel] <*value*>, (@<chanlist>) N679xA
[SOURce:]ARB:POWer:PULSe:TOP[:LEVel]? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:RESISTANCE:PULSe:TOP[:LEVel] <*value*>, (@<chanlist>) N679xA
[SOURce:]ARB:RESISTANCE:PULSe:TOP[:LEVel]? [MIN|MAX,] (@<chanlist>)

Specifies the top current, voltage, power, or resistance level of the pulse.

[SOURce:]ARB:SEQuence:STEP:CURRent:PULSe:TOP[:LEVel] <*value*>, <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:CURRent:PULSe:TOP[:LEVel]? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:VOLTage:PULSe:TOP[:LEVel] <*value*>, <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:VOLTage:PULSe:TOP[:LEVel]? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:POWer:PULSe:TOP[:LEVel] <*value*>, <*step#*>, (@<chanlist>) N679xA
[SOURce:]ARB:SEQuence:STEP:POWer:PULSe:TOP[:LEVel]? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:RESISTANCE:PULSe:TOP[:LEVel] <*value*>, <*step#*>, (@<chanlist>) N679xA
[SOURce:]ARB:SEQuence:STEP:RESISTANCE:PULSe:TOP[:LEVel]? [MIN|MAX,] <*step#*>, (@<chanlist>)

Specifies the top current, voltage, power, or resistance level of the pulse for Arb sequence steps.

Parameter	Typical Return
Current: 0 - maximum|MIN|MAX, *RST MIN Voltage: 0 - maximum|MIN|MAX, *RST MIN Power: 0 - maximum|MIN|MAX, *RST MIN Resistance: 0 - maximum|MIN|MAX, *RST MIN Values are range and module-rating dependent.	<top value>
Step 0 - 99, *RST 0	(none)
Programs the top level current: ARB:CURR:PULS:TOP 2,(@1) Programs the top level voltage: ARB:VOLT:PULS:TOP 20,(@1) Programs the top level power: ARB:POW:PULS:TOP 50,(@1) Programs the top level resistance: ARB:RESISTANCE:PULS:TOP 20,(@1) Programs the top level for step 0: ARB:SEQ:STEP:CURR:PULS:TOP 2, 0,(@1)	

[SOURce:]ARB:CURRent:PULSe:TOP:TIMe <*value*>, (@<chanlist>)
[SOURce:]ARB:CURRent:PULSe:TOP:TIMe? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:VOLTage:PULSe:TOP:TIMe<*value*>, (@<chanlist>)
[SOURce:]ARB:VOLTage:PULSe:TOP:TIMe? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:POWer:PULSe:TOP:TIMe<*value*>, (@<chanlist>) N679xA
[SOURce:]ARB:POWer:PULSe:TOP:TIMe? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:RESISTANCE:PULSe:TOP:TIMe<*value*>, (@<chanlist>) N679xA
[SOURce:]ARB:RESISTANCE:PULSe:TOP:TIMe? [MIN|MAX,] (@<chanlist>)

Specifies the time of the pulse in seconds.

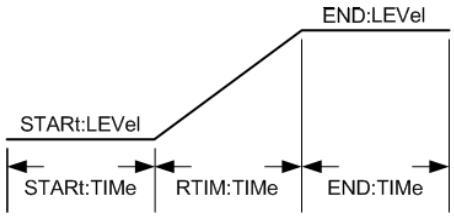
[SOURce:]ARB:SEQuence:STEP:CURRent:PULSe:TOP:TIMe <*value*>, <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:CURRent:PULSe:TOP:TIMe? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:VOLTage:PULSe:TOP:TIMe <*value*>, <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:VOLTage:PULSe:TOP:TIMe? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:POWer:PULSe:TOP:TIMe <*value*>, <*step#*>, (@<chanlist>) N679xA
[SOURce:]ARB:SEQuence:STEP:POWer:PULSe:TOP:TIMe? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:RESISTANCE:PULSe:TOP:TIMe <*value*>, <*step#*>, (@<chanlist>) N679xA
[SOURce:]ARB:SEQuence:STEP:RESISTANCE:PULSe:TOP:TIMe? [MIN|MAX,] <*step#*>, (@<chanlist>)

Specifies the time of the pulse in seconds for Arb sequence steps.

Parameter	Typical Return
0 – 262.144 | MIN | MAX, *RST 0	<end time>
Step 0 - 99, *RST 0	(none)
Programs a top time for the current pulse: ARB:CURR:PULS:TOP:TIM 2,(@1) Programs a top time for the voltage pulse: ARB:VOLT:PULS:TOP:TIM 2,(@1) Programs a top time for the power pulse: ARB:POW:PULS:TOP:TIM 2,(@1) Programs a top time for the resistance pulse: ARB:RESISTANCE:PULS:TOP:TIM 2,(@1) Programs a top time for step 0: ARB:SEQ:STEP:CURR:PULS:TOP:TIM 2, 0,(@1)	

Ramp

Back to ARB Commands



[SOURce:]ARB:CURRent:RAMP:END[:LEVel] <*value*>, (@<chanlist>)
[SOURce:]ARB:CURRent:RAMP:END[:LEVel]? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:VOLTage:RAMP:END[:LEVel] <*value*>, (@<chanlist>)
[SOURce:]ARB:VOLTage:RAMP:END[:LEVel]? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:POWer:RAMP:END[:LEVel] <*value*>, (@<chanlist>) N679xA
[SOURce:]ARB:POWer:RAMP:END[:LEVel]? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:RESISTANCE:RAMP:END[:LEVel] <*value*>, (@<chanlist>) N679xA
[SOURce:]ARB:RESISTANCE:RAMP:END[:LEVel]? [MIN|MAX,] (@<chanlist>)

Specifies the ending current, voltage, power, or resistance level after the ramp occurs.

[SOURce:]ARB:SEQuence:STEP:CURRent:RAMP:END[:LEVel] <*value*>, <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:CURRent:RAMP:END[:LEVel]? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:VOLTage:RAMP:END[:LEVel] <*value*>, <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:VOLTage:RAMP:END[:LEVel]? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:POWer:RAMP:END[:LEVel] <*value*>, <*step#*>, (@<chanlist>) N679xA
[SOURce:]ARB:SEQuence:STEP:POWer:RAMP:END[:LEVel]? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:RESISTANCE:RAMP:END[:LEVel] <*value*>, <*step#*>, (@<chanlist>) N679xA
[SOURce:]ARB:SEQuence:STEP:RESISTANCE:RAMP:END[:LEVel]? [MIN|MAX,] <*step#*>, (@<chanlist>)

Specifies the ending current, voltage, power, or resistance level level after the ramp occurs for Arb sequence steps.

Parameter	Typical Return
Current: 0 - maximum|MIN|MAX, *RST MIN Voltage: 0 - maximum|MIN|MAX, *RST MIN Power: 0 - maximum|MIN|MAX, *RST MIN Resistance: 0 - maximum|MIN|MAX, *RST MIN Values are range and module-rating dependent.	<end value>
Step 0 - 99, *RST 0	(none)
Programs an end level current: ARB:CURR:RAMP:END 2,(@1) Programs an end level voltage: ARB:VOLT:RAMP:END 20,(@1) Programs an end level power: ARB:POW:RAMP:END 20,(@1) Programs an end level resistance: ARB:RESISTANCE:RAMP:END 50,(@1) Programs an end level current for step 0: ARB:SEQ:STEP:CURR:RAMP:END 2, 0,(@1)	

[SOURce:]ARB:CURRent:RAMP:END:TIMe <*value*>, (@<chanlist>)
[SOURce:]ARB:CURRent:RAMP:END:TIMe? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:VOLTage:RAMP:END:TIMe<*value*>, (@<chanlist>)
[SOURce:]ARB:VOLTage:RAMP:END:TIMe? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:POWer:RAMP:END:TIMe<*value*>, (@<chanlist>) N679xA
[SOURce:]ARB:POWer:RAMP:END:TIMe? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:RESISTANCE:RAMP:END:TIMe<*value*>, (@<chanlist>) N679xA
[SOURce:]ARB:RESISTANCE:RAMP:END:TIMe? [MIN|MAX,] (@<chanlist>)

Specifies the time in seconds, after the ramp completes, that the ending current, voltage, power, or resistance level persists.

[SOURce:]ARB:SEQuence:STEP:CURRent:RAMP:END:TIMe <*value*>, <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:CURRent:RAMP:END:TIMe? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:VOLTage:RAMP:END:TIMe<*value*>, <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:VOLTage:RAMP:END:TIMe? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:POWer:RAMP:END:TIMe<*value*>, <*step#*>, (@<chanlist>) N679xA
[SOURce:]ARB:SEQuence:STEP:POWer:RAMP:END:TIMe? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:RESISTANCE:RAMP:END:TIMe<*value*>, <*step#*>, (@<chanlist>) N679xA
[SOURce:]ARB:SEQuence:STEP:RESISTANCE:RAMP:END:TIMe? [MIN|MAX,] <*step#*>, (@<chanlist>)

Specifies the time in seconds, after the ramp completes, that the ending current, voltage, power, or resistance level persists for Arb sequence steps.

Parameter	Typical Return
0 – 262.144 | MIN | MAX, *RST 0	<end time>
Step 0 - 99, *RST 0	(none)
Programs an end time for the current ramp: ARB:CURR:RAMP:END:TIM 2,(@1) Programs an end time for the voltage ramp:ARB:VOLT:RAMP:END:TIM 2,(@1) Programs an end time for the power ramp:ARB:POW:RAMP:END:TIM 2,(@1) Programs an end time for the resistance ramp: ARB:RESISTANCE:RAMP:END:TIM 2,(@1) Programs an end time for step 0: ARB:SEQ:STEP:CURR:RAMP:END:TIM 2, 0,(@1)	

[SOURce:]ARB:CURRent:RAMP:RTIMe <*value*>, (@<chanlist>)
[SOURce:]ARB:CURRent:RAMP:RTIMe? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:VOLTage:RAMP:RTIMe<*value*>, (@<chanlist>)
[SOURce:]ARB:VOLTage:RAMP:RTIMe? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:POWer:RAMP:RTIMe<*value*>, (@<chanlist>) N679xA
[SOURce:]ARB:POWer:RAMP:RTIMe? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:RESISTANCE:RAMP:RTIMe<*value*>, (@<chanlist>) N679xA
[SOURce:]ARB:RESISTANCE:RAMP:RTIMe? [MIN|MAX,] (@<chanlist>)

Specifies the rise time of the ramp in seconds.

[SOURce:]ARB:SEQuence:STEP:CURRent:RAMP:RTIMe <*value*>, <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:CURRent:RAMP:RTIMe? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:VOLTage:RAMP:RTIMe <*value*>, <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:VOLTage:RAMP:RTIMe? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:POWer:RAMP:RTIMe <*value*>, <*step#*>, (@<chanlist>) N679xA
[SOURce:]ARB:SEQuence:STEP:POWer:RAMP:RTIMe? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:RESISTANCE:RAMP:RTIMe <*value*>, <*step#*>, (@<chanlist>) N679xA
[SOURce:]ARB:SEQuence:STEP:RESISTANCE:RAMP:RTIMe? [MIN|MAX,] <*step#*>, (@<chanlist>)

Specifies the rise time of the ramp in seconds for Arb sequence steps.

Parameter	Typical Return
0 – 262.144 | MIN | MAX, *RST 1	<rise time>
Step 0 - 99, *RST 0	(none)
Programs a rise time for the current ramp: ARB:CURR:RAMP:RTIM 10,(@1) Programs a rise time for the voltage ramp: ARB:VOLT:RAMP:RTIM 10,(@1) Programs a rise time for the power ramp: ARB:POW:RAMP:RTIM 10,(@1) Programs a rise time for the resistance ramp: ARB:RESISTANCE:RAMP:RTIM 10,(@1) Programs a rise time for step 0: ARB:SEQ:STEP:CURR:RAMP:RTIM 10, 0,(@1)	

[SOURce:]ARB:CURRent:RAMP:STARt[:LEVel] <*value*>, (@<chanlist>)
[SOURce:]ARB:CURRent:RAMP:STARt[:LEVel]? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:VOLTage:RAMP:STARt[:LEVel] <*value*>, (@<chanlist>)
[SOURce:]ARB:VOLTage:RAMP:STARt[:LEVel]? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:POWer:RAMP:STARt[:LEVel] <*value*>, (@<chanlist>) N679xA
[SOURce:]ARB:POWer:RAMP:STARt[:LEVel]? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:RESISTANCE:RAMP:STARt[:LEVel] <*value*>, (@<chanlist>) N679xA
[SOURce:]ARB:RESISTANCE:RAMP:STARt[:LEVel]? [MIN|MAX,] (@<chanlist>)

Specifies the initial current, voltage, power, or resistance level before the ramp occurs.

[SOURce:]ARB:SEQuence:STEP:CURRent:RAMP:STARt[:LEVel] <*value*>, <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:CURRent:RAMP:STARt[:LEVel]? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:VOLTage:RAMP:STARt[:LEVel] <*value*>, <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:VOLTage:RAMP:STARt[:LEVel]? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:POWer:RAMP:STARt[:LEVel] <*value*>, <*step#*>, (@<chanlist>) N679xA
[SOURce:]ARB:SEQuence:STEP:POWer:RAMP:STARt[:LEVel]? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:RESISTANCE:RAMP:STARt[:LEVel] <*value*>, <*step#*>, (@<chanlist>) N679xA
[SOURce:]ARB:SEQuence:STEP:RESISTANCE:RAMP:STARt[:LEVel]? [MIN|MAX,] <*step#*>, (@<chanlist>)

Specifies the initial current, voltage, power, or resistance level before the ramp occurs for Arb sequence steps.

Parameter	Typical Return
Current: 0 - maximum|MIN|MAX, *RST MIN Voltage: 0 - maximum|MIN|MAX, *RST MIN Power: 0 - maximum|MIN|MAX, *RST MIN Resistance: 0 - maximum|MIN|MAX, *RST MIN Values are range and module-rating dependent.	<start value>
Step 0 - 99, *RST 0	(none)
Programs a start level current: ARB:CURR:RAMP:STAR 1,(@1) Programs a start level voltage: ARB:VOLT:RAMP:STAR 1,(@1) Programs a start level power: ARB:POW:RAMP:STAR 1,(@1) Programs a start level for the resistance: ARB:RESISTANCE:RAMP:STAR 1,(@1) Programs a start level for step 0: ARB:SEQ:STEP:CURR:RAMP:STAR 1, 0,(@1)	

[SOURce:]ARB:CURRent:RAMP:STARt:TIMe <*value*>, (@<chanlist>)
[SOURce:]ARB:CURRent:RAMP:STARt:TIMe? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:VOLTage:RAMP:STARt:TIMe<*value*>, (@<chanlist>)
[SOURce:]ARB:VOLTage:RAMP:STARt:TIMe? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:POWer:RAMP:STARt:TIMe<*value*>, (@<chanlist>) N679xA
[SOURce:]ARB:POWer:RAMP:STARt:TIMe? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:RESISTANCE:RAMP:STARt:TIMe<*value*>, (@<chanlist>) N679xA
[SOURce:]ARB:RESISTANCE:RAMP:STARt:TIMe? [MIN|MAX,] (@<chanlist>)

Specifies the delay in seconds after the trigger is received, but before the ramp occurs.

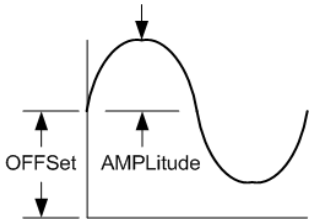
[SOURce:]ARB:SEQuence:STEP:CURRent:RAMP:STARt:TIMe <*value*>, <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:CURRent:RAMP:STARt:TIMe? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:VOLTage:RAMP:STARt:TIMe<*value*>, <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:VOLTage:RAMP:STARt:TIMe? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:POWer:RAMP:STARt:TIMe<*value*>, <*step#*>, (@<chanlist>) N679xA
[SOURce:]ARB:SEQuence:STEP:POWer:RAMP:STARt:TIMe? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:RESISTANCE:RAMP:STARt:TIMe<*value*>, <*step#*>, (@<chanlist>) N679xA
[SOURce:]ARB:SEQuence:STEP:RESISTANCE:RAMP:STARt:TIMe? [MIN|MAX,] <*step#*>, (@<chanlist>)

Specifies the delay in seconds after the trigger is received for Arb sequence steps.

Parameter	Typical Return
0 – 262.144 | MIN | MAX, *RST 0	<start time>
Step 0 - 99, *RST 0	(none)
Programs a start time for the current ramp: ARB:CURR:RAMP:STAR:TIM 1,(@1) Programs a start time for the voltage ramp: ARB:VOLT:RAMP:STAR:TIM 1,(@1) Programs a start time for the power ramp: ARB:POW:RAMP:STAR:TIM 1,(@1) Programs a start time for the resistance ramp: ARB:RESISTANCE:RAMP:STAR:TIM 1,(@1) Programs a start time for step 0: ARB:SEQ:STEP:CURR:RAMP:STAR:TIM 1, 0,(@1)	

Sinusoid

Back to ARB Commands



[SOURce:]ARB:CURRent:SINusoid:AMPLitude<*value*>, (@<chanlist>)
[SOURce:]ARB:CURRent:SINusoid:AMPLitude? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:VOLTage:SINusoid:AMPLitude <*value*>, (@<chanlist>)
[SOURce:]ARB:VOLTage:SINusoid:AMPLitude? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:POWer:SINusoid:AMPLitude <*value*>, (@<chanlist>) N679xA
[SOURce:]ARB:POWer:SINusoid:AMPLitude? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:RESISTANCE:SINusoid:AMPLitude <*value*>, (@<chanlist>) N679xA
[SOURce:]ARB:RESISTANCE:SINusoid:AMPLitude? [MIN|MAX,] (@<chanlist>)

Specifies the amplitude or peak value of the current, voltage, power, or resistance sine wave.

[SOURce:]ARB:SEQuence:STEP:CURRent:SINusoid:AMPLitude<*value*>, <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:CURRent:SINusoid:AMPLitude? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:VOLTage:SINusoid:AMPLitude <*value*>, <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:VOLTage:SINusoid:AMPLitude? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:POWer:SINusoid:AMPLitude <*value*>, <*step#*>, (@<chanlist>) N679xA
[SOURce:]ARB:SEQuence:STEP:POWer:SINusoid:AMPLitude? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:RESISTANCE:SINusoid:AMPLitude <*value*>, <*step#*>, (@<chanlist>) N679xA
[SOURce:]ARB:SEQuence:STEP:RESISTANCE:SINusoid:AMPLitude? [MIN|MAX,] <*step#*>, (@<chanlist>)

Specifies the amplitude or peak value of the current, voltage, power, or resistance sine wave for Arb sequence steps.

Parameter	Typical Return
Current: 0 - maximum|MIN|MAX, *RST MIN Voltage: 0 - maximum|MIN|MAX, *RST MIN Power: 0 - maximum|MIN|MAX, *RST MIN Resistance: 0 - maximum|MIN|MAX, *RST MIN Values are range and module-rating dependent.	<amplitude>
Step 0 - 99, *RST 0	(none)
Programs a current amplitude: ARB:CURR:SIN:AMPL 5,(@1) Programs a voltage amplitude: ARB:VOLT:SIN:AMPL 10,(@1) Programs a power amplitude: ARB:POW:SIN:AMPL 30,(@1) Programs a resistance amplitude: ARB:RESISTANCE:SIN:AMPL 50,(@1) Programs a current amplitude for step 0: ARB:SEQ:STEP:CURR:SIN:AMPL 5, 0,(@1)	

[SOURce:]ARB:CURRent:SINusoid:FREQuency<*value*>, (@<chanlist>)
[SOURce:]ARB:CURRent:SINusoid:FREQuency? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:VOLTage:SINusoid:FREQuency <*value*>, (@<chanlist>)
[SOURce:]ARB:VOLTage:SINusoid:FREQuency? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:POWer:SINusoid:FREQuency <*value*>, (@<chanlist>) N679xA
[SOURce:]ARB:POWer:SINusoid:FREQuency? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:RESISTANCE:SINusoid:FREQuency <*value*>, (@<chanlist>) N679xA
[SOURce:]ARB:RESISTANCE:SINusoid:FREQuency? [MIN|MAX,] (@<chanlist>)

Specifies the frequency of the current, voltage, power, or resistance sine wave in Hertz.

[SOURce:]ARB:SEQuence:STEP:CURRent:SINusoid:FREQuency<*value*>, <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:CURRent:SINusoid:FREQuency? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:VOLTage:SINusoid:FREQuency <*value*>, <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:VOLTage:SINusoid:FREQuency? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:POWer:SINusoid:FREQuency <*value*>, <*step#*>, (@<chanlist>) N679xA
[SOURce:]ARB:SEQuence:STEP:POWer:SINusoid:FREQuency? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:RESISTANCE:SINusoid:FREQuency <*value*>, <*step#*>, (@<chanlist>) N679xA
[SOURce:]ARB:SEQuence:STEP:RESISTANCE:SINusoid:FREQuency? [MIN|MAX,] <*step#*>, (@<chanlist>)

Specifies the frequency of the current, voltage, power, or resistance sine wave in Hertz for Arb sequence steps.

Parameter	Typical Return
3.8147E-5 - 1.0E4 | MIN | MAX, *RST 1	<frequency>
Step 0 - 99, *RST 0	(none)
Programs a current frequency: ARB:CURR:SIN:FREQ 10,(@1) Programs a voltage frequency: ARB:VOLT:SIN:FREQ 10,(@1) Programs a power frequency: ARB:POW:SIN:FREQ 10,(@1) Programs a resistance frequency: ARB:RESISTANCE:SIN:FREQ 10,(@1) Programs a current frequency for step 0: ARB:SEQ:STEP:CURR:SIN:FREQ 10, 0,(@1)	

[SOURce:]ARB:CURRent:SINusoid:OFFSet<*value*>, (@<chanlist>)
[SOURce:]ARB:CURRent:SINusoid:OFFSet? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:VOLTage:SINusoid:OFFSet <*value*>, (@<chanlist>)
[SOURce:]ARB:VOLTage:SINusoid:OFFSet? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:POWer:SINusoid:OFFSet <*value*>, (@<chanlist>) N679xA
[SOURce:]ARB:POWer:SINusoid:OFFSet? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:RESISTANCE:SINusoid:OFFSet <*value*>, (@<chanlist>) N679xA
[SOURce:]ARB:RESISTANCE:SINusoid:OFFSet? [MIN|MAX,] (@<chanlist>)

Specifies the offset of the current, voltage, power, or resistance sine wave from zero.

[SOURce:]ARB:SEQuence:STEP:CURRent:SINusoid:OFFSet<*value*>, <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:CURRent:SINusoid:OFFSet? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:VOLTage:SINusoid:OFFSet <*value*>, <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:VOLTage:SINusoid:OFFSet? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:POWer:SINusoid:OFFSet <*value*>, <*step#*>, (@<chanlist>) N679xA
[SOURce:]ARB:SEQuence:STEP:POWer:SINusoid:OFFSet? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:RESISTANCE:SINusoid:OFFSet <*value*>, <*step#*>, (@<chanlist>) N679xA
[SOURce:]ARB:SEQuence:STEP:RESISTANCE:SINusoid:OFFSet? [MIN|MAX,] <*step#*>, (@<chanlist>)

Specifies the offset of the current, voltage, power, or resistance sine wave from zero for Arb sequence steps.

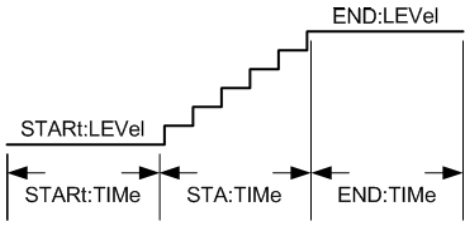
NOTE

Except for models N678xA SMU, the output cannot generate negative amplitudes. Therefore, the offset value cannot be less than the peak value of the sine wave.

Parameter	Typical Return
Current: 0 - maximum|MIN|MAX, *RST 0 Voltage: 0 - maximum|MIN|MAX, *RST 0 Power: 0 - maximum|MIN|MAX, *RST MIN Resistance: 0 - maximum|MIN|MAX, *RST MIN Values are range and module-rating dependent.	<offset value>
Step 0 - 99, *RST 0	(none)
Programs a current offset: ARB:CURR:SIN:OFFS 5,(@1) Programs a voltage offset: ARB:VOLT:SIN:OFFS 10,(@1) Programs a power offset: ARB:POW:SIN:OFFS 30,(@1) Programs a resistance offset: ARB:RESISTANCE:SIN:OFFS 50,(@1) Programs a current offset for step 0: ARB:SEQ:STEP:CURR:SIN:OFFS 5, 0,(@1)	

Staircase

Back to ARB Commands



[SOURce:]ARB:CURRent:STAircase:END[:LEVel] <*value*>, (@<chanlist>)
[SOURce:]ARB:CURRent:STAircase:END[:LEVel]? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:VOLTage:STAircase:END[:LEVel] <*value*>, (@<chanlist>)
[SOURce:]ARB:VOLTage:STAircase:END[:LEVel]? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:POWer:STAircase:END[:LEVel] <*value*>, (@<chanlist>) N679xA
[SOURce:]ARB:POWer:STAircase:END[:LEVel]? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:RESISTANCE:STAircase:END[:LEVel] <*value*>, (@<chanlist>) N679xA
[SOURce:]ARB:RESISTANCE:STAircase:END[:LEVel]? [MIN|MAX,] (@<chanlist>)

Specifies the ending current, voltage, power, or resistance level after the staircase occurs.

[SOURce:]ARB:SEQuence:STEP:CURRent:STAircase:END[:LEVel] <*value*>, <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:CURRent:STAircase:END[:LEVel]? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:VOLTage:STAircase:END[:LEVel] <*value*>, <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:VOLTage:STAircase:END[:LEVel]? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:POWer:STAircase:END[:LEVel] <*value*>, <*step#*>, (@<chanlist>) N679xA
[SOURce:]ARB:SEQuence:STEP:POWer:STAircase:END[:LEVel]? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:RESISTANCE:STAircase:END[:LEVel] <*value*>, <*step#*>, (@<chanlist>) N679xA
[SOURce:]ARB:SEQuence:STEP:RESISTANCE:STAircase:END[:LEVel]? [MIN|MAX,] <*step#*>, (@<chanlist>)

Specifies the ending current, voltage, power, or resistance level after the staircase occurs for Arb sequence steps.

NOTE The difference between the start level and the end level is divided equally among the number of steps.

Parameter	Typical Return
Current: 0 - maximum|MIN|MAX, *RST MIN Voltage: 0 - maximum|MIN|MAX, *RST MIN Power: 0 - maximum|MIN|MAX, *RST MIN Resistance: 0 - maximum|MIN|MAX, *RST MIN Values are range and module-rating dependent.	<end value>
Step 0 - 99, *RST 0	(none)
Programs an end level current: ARB:CURR:STA:END 2,(@1) Programs an end level voltage: ARB:VOLT:STA:END 20,(@1) Programs an end level power: ARB:POW:STA:END 20,(@1) Programs an end level resistance: ARB:RESISTANCE:STA:END 50,(@1) Programs an end level current for step 0: ARB:SEQ:STEP:CURR:STA:END 2, 0,(@1)	

[SOURce:]ARB:CURRent:STAircase:END:TIMe <*value*>, (@<chanlist>)
[SOURce:]ARB:CURRent:STAircase:END:TIMe? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:VOLTage:STAircase:END:TIMe<*value*>, (@<chanlist>)
[SOURce:]ARB:VOLTage:STAircase:END:TIMe? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:POWer:STAircase:END:TIMe<*value*>, (@<chanlist>) N679xA
[SOURce:]ARB:POWer:STAircase:END:TIMe? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:RESISTANCE:STAircase:END:TIMe<*value*>, (@<chanlist>) N679xA
[SOURce:]ARB:RESISTANCE:STAircase:END:TIMe? [MIN|MAX,] (@<chanlist>)

Specifies the time in seconds, after the staircase completes, that the ending current, voltage, power, or resistance level persists.

[SOURce:]ARB:SEQuence:STEP:CURRent:STAircase:END:TIMe <*value*>, <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:CURRent:STAircase:END:TIMe? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:VOLTage:STAircase:END:TIMe <*value*>, <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:VOLTage:STAircase:END:TIMe? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:POWer:STAircase:END:TIMe <*value*>, <*step#*>, (@<chanlist>) N679xA
[SOURce:]ARB:SEQuence:STEP:POWer:STAircase:END:TIMe? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:RESISTANCE:STAircase:END:TIMe <*value*>, <*step#*>, (@<chanlist>) N679xA
[SOURce:]ARB:SEQuence:STEP:RESISTANCE:STAircase:END:TIMe? [MIN|MAX,] <*step#*>, (@<chanlist>)

Specifies the time in seconds, after the staircase completes, that the ending current, voltage, power, or resistance level persists for Arb sequence steps.

Parameter	Typical Return
0 – 262.144 | MIN | MAX, *RST 0	<end time>
Step 0 - 99, *RST 0	(none)
Programs an end time after the current staircase:ARB:CURR:STA:END:TIM 2,(@1) Programs an end time after the voltage staircase:ARB:VOLT:STA:END:TIM 2,(@1) Programs an end time after the power staircase:ARB:POW:STA:END:TIM 2,(@1) Programs an end time after the resistance staircase: ARB:RESISTANCE:STA:END:TIM 2,(@1) Programs an end time for step 0:ARB:SEQ:STEP:CURR:STA:END:TIM 2, 0,(@1)	

[SOURce:]ARB:CURRent:STAircase:NSTeps <*value*>, (@<chanlist>)
[SOURce:]ARB:CURRent:STAircase:NSTeps? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:VOLTage:STAircase:NSTeps<*value*>, (@<chanlist>)
[SOURce:]ARB:VOLTage:STAircase:NSTeps? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:POWer:STAircase:NSTeps<*value*>, (@<chanlist>) N679xA
[SOURce:]ARB:POWer:STAircase:NSTeps? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:RESISTANCE:STAircase:NSTeps<*value*>, (@<chanlist>) N679xA
[SOURce:]ARB:RESISTANCE:STAircase:NSTeps? [MIN|MAX,] (@<chanlist>)

Specifies the number of steps in the staircase.

[SOURce:]ARB:SEQuence:STEP:CURRent:STAircase:NSTeps <*value*>, <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:CURRent:STAircase:NSTeps? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:VOLTage:STAircase:NSTeps <*value*>, <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:VOLTage:STAircase:NSTeps? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:POWer:STAircase:NSTeps <*value*>, <*step#*>, (@<chanlist>) N679xA
[SOURce:]ARB:SEQuence:STEP:POWer:STAircase:NSTeps? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:RESISTANCE:STAircase:NSTeps <*value*>, <*step#*>, (@<chanlist>) N679xA
[SOURce:]ARB:SEQuence:STEP:RESISTANCE:STAircase:NSTeps? [MIN|MAX,] <*step#*>, (@<chanlist>)

Specifies the number of steps in the staircase for Arb sequence steps.

Parameter	Typical Return
0 – 500 | MIN | MAX, *RST 10	<number of steps>
Step 0 - 99, *RST 0	(none)
Programs five steps for the current staircase: ARB:CURR:STA:NST 5,(@1) Programs five steps for the voltage staircase: ARB:VOLT:STA:NST 5,(@1) Programs five steps for the power staircase: ARB:POW:STA:NST 5,(@1) Programs five steps for the resistance staircase: ARB:RESISTANCE:STA:NST 5,(@1) Programs five steps for sequence step 0: ARB:SEQ:STEP::CURR:STA:NST 5, 0(@1)	

[SOURce:]ARB:CURRent:STAircase:STARt[:LEVel] <*value*>, (@<chanlist>)
[SOURce:]ARB:CURRent:STAircase:STARt[:LEVel]? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:VOLTage:STAircase:STARt[:LEVel] <*value*>, (@<chanlist>)
[SOURce:]ARB:VOLTage:STAircase:STARt[:LEVel]? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:POWer:STAircase:STARt[:LEVel] <*value*>, (@<chanlist>) N679xA
[SOURce:]ARB:POWer:STAircase:STARt[:LEVel]? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:RESISTANCE:STAircase:STARt[:LEVel] <*value*>, (@<chanlist>) N679xA
[SOURce:]ARB:RESISTANCE:STAircase:STARt[:LEVel]? [MIN|MAX,] (@<chanlist>)

Specifies the initial current, voltage, power, or resistance before the staircase occurs.

[SOURce:]ARB:SEQuence:STEP:CURRent:STAircase:STARt[:LEVel] <*value*>, <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:CURRent:STAircase:STARt[:LEVel]? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:VOLTage:STAircase:STARt[:LEVel] <*value*>, <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:VOLTage:STAircase:STARt[:LEVel]? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:POWer:STAircase:STARt[:LEVel] <*value*>, <*step#*>, (@<chanlist>) N679xA
[SOURce:]ARB:SEQuence:STEP:POWer:STAircase:STARt[:LEVel]? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:RESISTANCE:STAircase:STARt[:LEVel] <*value*>, <*step#*>, (@<chanlist>) N679xA
[SOURce:]ARB:SEQuence:STEP:RESISTANCE:STAircase:STARt[:LEVel]? [MIN|MAX,] <*step#*>, (@<chanlist>)

Specifies the initial current, voltage, power, or resistance before the staircase occurs for Arb sequence steps.

NOTE The difference between the start level and the end level is divided equally among the number of steps.

Parameter	Typical Return
Current: 0 - maximum|MIN|MAX, *RST MIN Voltage: 0 - maximum|MIN|MAX, *RST MIN Power: 0 - maximum|MIN|MAX, *RST MIN Resistance: 0 - maximum|MIN|MAX, *RST MIN Values are range and module-rating dependent.	<start value>
Step 0 - 99, *RST 0	(none)
Programs a start level current: ARB:CURR:STA:STAR 1,(@1) Programs a start level voltage: ARB:VOLT:STA:STAR 10,(@1) Programs a start level power: ARB:POW:STA:STAR 10,(@1) Programs a start level resistance: ARB:RESISTANCE:STA:STAR 100,(@1) Programs an start level for step 0:ARB:SEQ:STEP:CURR:STA:STAR 1, 0,(@1)	

[SOURce:]ARB:CURRent:STAircase:STARt:TIMe <*value*>, (@<chanlist>)
[SOURce:]ARB:CURRent:STAircase:STARt:TIMe? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:VOLTage:STAircase:STARt:TIMe<*value*>, (@<chanlist>)
[SOURce:]ARB:VOLTage:STAircase:STARt:TIMe? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:POWer:STAircase:STARt:TIMe<*value*>, (@<chanlist>) N679xA
[SOURce:]ARB:POWer:STAircase:STARt:TIMe? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:RESISTANCE:STAircase:STARt:TIMe<*value*>, (@<chanlist>) N679xA
[SOURce:]ARB:RESISTANCE:STAircase:STARt:TIMe? [MIN|MAX,] (@<chanlist>)

Specifies the delay in seconds after the trigger is received, but before the staircase occurs.

[SOURce:]ARB:SEQuence:STEP:CURRent:STAircase:STARt:TIMe <*value*>, <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:CURRent:STAircase:STARt:TIMe? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:VOLTage:STAircase:STARt:TIMe <*value*>, <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:VOLTage:STAircase:STARt:TIMe? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:POWer:STAircase:STARt:TIMe <*value*>, <*step#*>, (@<chanlist>) N679xA
[SOURce:]ARB:SEQuence:STEP:POWer:STAircase:STARt:TIMe? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:RESISTANCE:STAircase:STARt:TIMe <*value*>, <*step#*>, (@<chanlist>) N679xA
[SOURce:]ARB:SEQuence:STEP:RESISTANCE:STAircase:STARt:TIMe? [MIN|MAX,] <*step#*>, (@<chanlist>)

Specifies the delay in seconds after the trigger is received, but before the staircase occurs for Arb sequence steps.

Parameter	Typical Return
0 – 262.144 | MIN | MAX, *RST 0	<start time>
Step 0 - 99, *RST 0	(none)
Programs a start time for the current staircase:ARB:CURR:STA:STAR:TIM 1,(@1) Programs a start time for the voltage staircase:ARB:VOLT:STA:STAR:TIM 1,(@1) Programs a start time for the power staircase:ARB:POW:STA:STAR:TIM 1,(@1) Programs a start time for the resistance staircase: ARB:RESISTANCE:STA:STAR:TIM 1,(@1) Programs a start time for step 0:ARB:SEG:STEP:CURR:STA:STAR:TIM 1, 0,(@1)	

[SOURce:]ARB:CURRent:STAircase:TIMe <*value*>, (@<chanlist>)
[SOURce:]ARB:CURRent:STAircase:TIMe? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:VOLTage:STAircase:TIMe<*value*>, (@<chanlist>)
[SOURce:]ARB:VOLTage:STAircase:TIMe? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:POWer:STAircase:TIMe<*value*>, (@<chanlist>) N679xA
[SOURce:]ARB:POWer:STAircase:TIMe? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:RESISTANCE:STAircase:TIMe<*value*>, (@<chanlist>) N679xA
[SOURce:]ARB:RESISTANCE:STAircase:TIMe? [MIN|MAX,] (@<chanlist>)

Specifies the total time to complete all of the staircase steps in seconds. Each step is of equal time.

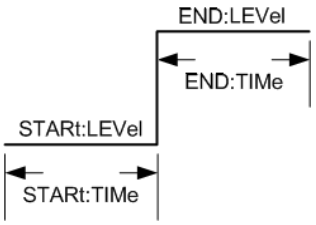
[SOURce:]ARB:SEQuence:STEP:CURRent:STAircase:TIMe <*value*>, <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:CURRent:STAircase:TIMe? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:VOLTage:STAircase:TIMe <*value*>, <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:VOLTage:STAircase:TIMe? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:POWer:STAircase:TIMe <*value*>, <*step#*>, (@<chanlist>) N679xA
[SOURce:]ARB:SEQuence:STEP:POWer:STAircase:TIMe? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:RESISTANCE:STAircase:TIMe <*value*>, <*step#*>, (@<chanlist>) N679xA
[SOURce:]ARB:SEQuence:STEP:RESISTANCE:STAircase:TIMe? [MIN|MAX,] <*step#*>, (@<chanlist>)

Specifies the total time to complete all of the staircase steps in seconds for Arb sequence steps. Each step is of equal time.

Parameter	Typical Return
0 – 262.144 | MIN | MAX, *RST 1	<staircase time>
Step 0 - 99, *RST 0	(none)
Programs a time for the current staircase: ARB:CURR:STA:TIM 10,(@1) Programs a time for the voltage staircase: ARB:VOLT:STA:TIM 10,(@1) Programs a time for the power staircase: ARB:POW:STA:TIM 10,(@1) Programs a time for the resistance staircase: ARB:RESISTANCE:STA:TIM 10,(@1) Programs a time for step 0:ARB:SEG:STEP:CURR:STA:TIM 10, 0,(@1)	

Step

Back to ARB Commands



[SOURce:]ARB:CURRent:STEP:END[:LEVel] <*value*>, (@<chanlist>)
[SOURce:]ARB:CURRent:STEP:END[:LEVel]? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:VOLTage:STEP:END[:LEVel] <*value*>, (@<chanlist>)
[SOURce:]ARB:VOLTage:STEP:END[:LEVel]? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:POWer:STEP:END[:LEVel] <*value*>, (@<chanlist>) N679xA
[SOURce:]ARB:POWer:STEP:END[:LEVel]? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:RESISTANCE:STEP:END[:LEVel] <*value*>, (@<chanlist>) N679xA
[SOURce:]ARB:RESISTANCE:STEP:END[:LEVel]? [MIN|MAX,] (@<chanlist>)

Specifies the step current, voltage, power, or resistance level.

[SOURce:]ARB:SEQuence:STEP:CURRent:STEP:END[:LEVel] <*value*>, <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:CURRent:STEP:END[:LEVel]? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:VOLTage:STEP:END[:LEVel] <*value*>, <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:VOLTage:STEP:END[:LEVel]? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:POWer:STEP:END[:LEVel] <*value*>, <*step#*>, (@<chanlist>) N679xA
[SOURce:]ARB:SEQuence:STEP:POWer:STEP:END[:LEVel]? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:RESISTANCE:STEP:END[:LEVel] <*value*>, <*step#*>, (@<chanlist>) N679xA
[SOURce:]ARB:SEQuence:STEP:RESISTANCE:STEP:END[:LEVel]? [MIN|MAX,] <*step#*>, (@<chanlist>)

Specifies the step current, voltage, power, or resistance level for Arb sequence steps.

Parameter	Typical Return
Current: 0 - maximum|MIN|MAX, *RST MIN Voltage: 0 - maximum|MIN|MAX, *RST MIN Power: 0 - maximum|MIN|MAX, *RST MIN Resistance: 0 - maximum|MIN|MAX, *RST MIN Values are range and module-rating dependent.	<end value>
Step 0 - 99, *RST 0	(none)
Programs the step level current: ARB:CURR:STEP:END 2,(@1) Programs the step level voltage: ARB:VOLT:STEP:END 20,(@1) Programs the step level power: ARB:POW:STEP:END 50,(@1) Programs the step level resistance: ARB:RESISTANCE:STEP:END 100,(@1) Programs a step level for step 0: ARB:SEQ:STEP:CURR:STEP:END 2, 0,(@1)	

[SOURce:]ARB:CURRent:STEP:STARt[:LEVel] <*value*>, (@<chanlist>)
[SOURce:]ARB:CURRent:STEP:STARt[:LEVel]? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:VOLTage:STEP:STARt[:LEVel] <*value*>, (@<chanlist>)
[SOURce:]ARB:VOLTage:STEP:STARt[:LEVel]? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:POWer:STEP:STARt[:LEVel] <*value*>, (@<chanlist>) N679xA
[SOURce:]ARB:POWer:STEP:STARt[:LEVel]? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:RESISTANCE:STEP:STARt[:LEVel] <*value*>, (@<chanlist>) N679xA
[SOURce:]ARB:RESISTANCE:STEP:STARt[:LEVel]? [MIN|MAX,] (@<chanlist>)

Specifies the initial current, voltage, power, or resistance level.

[SOURce:]ARB:SEQuence:STEP:CURRent:STEP:STARt[:LEVel] <*value*>, <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:CURRent:STEP:STARt[:LEVel]? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:VOLTage:STEP:STARt[:LEVel] <*value*>, <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:VOLTage:STEP:STARt[:LEVel]? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:POWer:STEP:STARt[:LEVel] <*value*>, <*step#*>, (@<chanlist>) N679xA
[SOURce:]ARB:SEQuence:STEP:POWer:STEP:STARt[:LEVel]? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:RESISTANCE:STEP:STARt[:LEVel] <*value*>, <*step#*>, (@<chanlist>) N679xA
[SOURce:]ARB:SEQuence:STEP:RESISTANCE:STEP:STARt[:LEVel]? [MIN|MAX,] <*step#*>, (@<chanlist>)

Specifies the initial current, voltage, power, or resistance level for Arb sequence steps.

Parameter	Typical Return
Current: 0 - maximum|MIN|MAX, *RST MIN Voltage: 0 - maximum|MIN|MAX, *RST MIN Power: 0 - maximum|MIN|MAX, *RST MIN Resistance: 0 - maximum|MIN|MAX, *RST MIN Values are range and module-rating dependent.	<start value>
Step 0 - 99, *RST 0	(none)
Programs a start level current: ARB:CURR:STEP:STAR 1,(@1) Programs a start level voltage: ARB:VOLT:STEP:STAR 1,(@1) Programs a start level power: ARB:POW:STEP:STAR 1,(@1) Programs a start level resistance: ARB:RESISTANCE:STEP:STAR 50,(@1) Programs a start level for step 0: ARB:SEQ:STEP:CURR:STEP:STAR 1, 0,(@1)	

[SOURce:]ARB:CURRent:STEP:STARt:TIMe <*value*>, (@<chanlist>)
[SOURce:]ARB:CURRent:STEP:STARt:TIMe? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:VOLTage:STEP:STARt:TIMe<*value*>, (@<chanlist>)
[SOURce:]ARB:VOLTage:STEP:STARt:TIMe? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:POWer:STEP:STARt:TIMe<*value*>, (@<chanlist>) N679xA
[SOURce:]ARB:POWer:STEP:STARt:TIMe? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:RESISTANCE:STEP:STARt:TIMe<*value*>, (@<chanlist>) N679xA
[SOURce:]ARB:RESISTANCE:STEP:STARt:TIMe? [MIN|MAX,] (@<chanlist>)

Specifies the delay in seconds after the trigger is received, but before the step occurs.

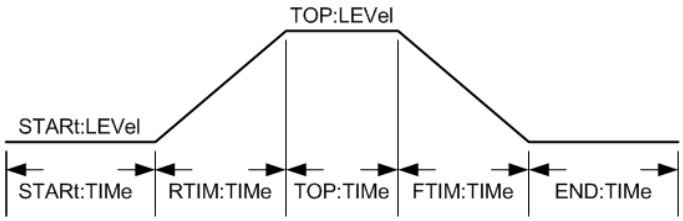
[SOURce:]ARB:SEQuence:STEP:CURRent:STEP:STARt:TIMe <*value*>, <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:CURRent:STEP:STARt:TIMe? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:VOLTage:STEP:STARt:TIMe <*value*>, <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:VOLTage:STEP:STARt:TIMe? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:POWer:STEP:STARt:TIMe <*value*>, <*step#*>, (@<chanlist>) N679xA
[SOURce:]ARB:SEQuence:STEP:POWer:STEP:STARt:TIMe? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:RESISTANCE:STEP:STARt:TIMe <*value*>, <*step#*>, (@<chanlist>) N679xA
[SOURce:]ARB:SEQuence:STEP:RESISTANCE:STEP:STARt:TIMe? [MIN|MAX,] <*step#*>, (@<chanlist>)

Specifies the delay in seconds after the trigger is received, but before the step occurs for Arb sequence steps.

Parameter	Typical Return
0 – 262.144 | MIN | MAX, *RST 0	<start time>
Step 0 - 99, *RST 0	(none)
Programs a start time for the current step: ARB:CURR:STEP:STAR:TIM 1,(@1) Programs a start time for the voltage step: ARB:VOLT:STEP:STAR:TIM 1,(@1) Programs a start time for the power step: ARB:POW:STEP:STAR:TIM 1,(@1) Programs a start time for the resistance step: ARB:RESISTANCE:STEP:STAR:TIM 1,(@1) Programs a start time for step 0: ARB:SEQ:STEP:CURR:STEP:STAR:TIM 1, 0,(@1)	

Trapezoid

Back to ARB Commands



[SOURce:]ARB:CURRent:TRAPezoid:END:TIMe <*value*>, (@<chanlist>)
[SOURce:]ARB:CURRent:TRAPezoid:END:TIMe? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:VOLTage:TRAPezoid:END:TIMe<*value*>, (@<chanlist>)
[SOURce:]ARB:VOLTage:TRAPezoid:END:TIMe? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:POWer:TRAPezoid:END:TIMe<*value*>, (@<chanlist>) N679xA
[SOURce:]ARB:POWer:TRAPezoid:END:TIMe? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:RESISTANCE:TRAPezoid:END:TIMe<*value*>, (@<chanlist>) N679xA
[SOURce:]ARB:RESISTANCE:TRAPezoid:END:TIMe? [MIN|MAX,] (@<chanlist>)

Specifies the time in seconds, after the trapezoid, that the starting current, voltage, or resistance level persists.

[SOURce:]ARB:SEQuence:STEP:CURRent:TRAPezoid:END:TIMe <*value*>, <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:CURRent:TRAPezoid:END:TIMe? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:VOLTage:TRAPezoid:END:TIMe <*value*>, <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:VOLTage:TRAPezoid:END:TIMe? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:POWer:TRAPezoid:END:TIMe <*value*>, <*step#*>, (@<chanlist>) N679xA
[SOURce:]ARB:SEQuence:STEP:POWer:TRAPezoid:END:TIMe? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:RESISTANCE:TRAPezoid:END:TIMe <*value*>, <*step#*>, (@<chanlist>) N679xA
[SOURce:]ARB:SEQuence:STEP:RESISTANCE:TRAPezoid:END:TIMe? [MIN|MAX,] <*step#*>, (@<chanlist>)

Specifies the time in seconds, after the trapezoid, that the starting current, voltage, power, or resistance level persists for Arb sequence steps.

Parameter	Typical Return
0 – 262.144 | MIN | MAX, *RST 0	<end time>
Step 0 - 99, *RST 0	(none)
Programs an end time after the current trapezoid: ARB:CURR:TRAP:END:TIM 2,(@1) Programs an end time after the voltage trapezoid: ARB:VOLT:TRAP:END:TIM 2,(@1) Programs an end time after the power trapezoid: ARB:POW:TRAP:END:TIM 2,(@1) Programs an end time after the resistance trapezoid: ARB:RESISTANCE:TRAP:END:TIM 2,(@1) Programs an end time for step 0:ARB:SEQ:STEP:CURR:TRAP:END:TIM 2, 0,(@1)	

[SOURce:]ARB:CURRent:TRAPezoid:FTIMe <*value*>, (@<chanlist>)
[SOURce:]ARB:CURRent:TRAPezoid:FTIMe? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:VOLTage:TRAPezoid:FTIMe<*value*>, (@<chanlist>)
[SOURce:]ARB:VOLTage:TRAPezoid:FTIMe? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:POWer:TRAPezoid:FTIMe<*value*>, (@<chanlist>) N679xA
[SOURce:]ARB:POWer:TRAPezoid:FTIMe? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:RESISTANCE:TRAPezoid:FTIMe<*value*>, (@<chanlist>) N679xA
[SOURce:]ARB:RESISTANCE:TRAPezoid:FTIMe? [MIN|MAX,] (@<chanlist>)

Specifies the fall time of the trapezoid in seconds.

[SOURce:]ARB:SEQuence:STEP:CURRent:TRAPezoid:FTIMe <*value*>, <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:CURRent:TRAPezoid:FTIMe? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:VOLTage:TRAPezoid:FTIMe <*value*>, <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:VOLTage:TRAPezoid:FTIMe? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:POWer:TRAPezoid:FTIMe <*value*>, <*step#*>, (@<chanlist>) N679xA
[SOURce:]ARB:SEQuence:STEP:POWer:TRAPezoid:FTIMe? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:RESISTANCE:TRAPezoid:FTIMe <*value*>, <*step#*>, (@<chanlist>) N679xA
[SOURce:]ARB:SEQuence:STEP:RESISTANCE:TRAPezoid:FTIMe? [MIN|MAX,] <*step#*>, (@<chanlist>)

Specifies the fall time of the trapezoid in seconds for Arb sequence steps.

Parameter	Typical Return
0 – 262.144 | MIN | MAX, *RST 1	<fall time>
Step 0 - 99, *RST 0	(none)
Programs a fall time for the current trapezoid: ARB:CURR:TRAP:FTIM 10,(@1) Programs a fall time for the voltage trapezoid: ARB:VOLT:TRAP:FTIM 10,(@1) Programs a fall time for the power trapezoid: ARB:POW:TRAP:FTIM 10,(@1) Programs a fall time for the resistance trapezoid: ARB:RESISTANCE:TRAP:FTIM 10,(@1) Programs a fall time for step 0:ARB:SEQ:STEP:CURR:TRAP:FTIM 10, 0,(@1)	

[SOURce:]ARB:CURRent:TRAPezoid:RTIMe <*value*>, (@<chanlist>)
[SOURce:]ARB:CURRent:TRAPezoid:RTIMe? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:VOLTage:TRAPezoid:RTIMe<*value*>, (@<chanlist>)
[SOURce:]ARB:VOLTage:TRAPezoid:RTIMe? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:POWer:TRAPezoid:RTIMe<*value*>, (@<chanlist>) N679xA
[SOURce:]ARB:POWer:TRAPezoid:RTIMe? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:RESISTANCE:TRAPezoid:RTIMe<*value*>, (@<chanlist>) N679xA
[SOURce:]ARB:RESISTANCE:TRAPezoid:RTIMe? [MIN|MAX,] (@<chanlist>)

Specifies the rise time of the trapezoid in seconds.

[SOURce:]ARB:SEQuence:STEP:CURRent:TRAPezoid:RTIMe <*value*>, <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:CURRent:TRAPezoid:RTIMe? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:VOLTage:TRAPezoid:RTIMe <*value*>, <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:VOLTage:TRAPezoid:RTIMe? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:POWer:TRAPezoid:RTIMe <*value*>, <*step#*>, (@<chanlist>) N679xA
[SOURce:]ARB:SEQuence:STEP:POWer:TRAPezoid:RTIMe? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:RESISTANCE:TRAPezoid:RTIMe <*value*>, <*step#*>, (@<chanlist>) N679xA
[SOURce:]ARB:SEQuence:STEP:RESISTANCE:TRAPezoid:RTIMe? [MIN|MAX,] <*step#*>, (@<chanlist>)

Specifies the rise time of the trapezoid in seconds for Arb sequence steps.

Parameter	Typical Return
0 – 262.144 | MIN | MAX, *RST 1	<rise time>
Step 0 - 99, *RST 0	(none)
Programs a rise time for the current trapezoid: ARB:CURR:TRAP:RTIM 10,(@1) Programs a rise time for the voltage trapezoid: ARB:VOLT:TRAP:RTIM 10,(@1) Programs a rise time for the power trapezoid: ARB:POW:TRAP:RTIM 10,(@1) Programs a rise time for the resistance trapezoid: ARB:RESISTANCE:TRAP:RTIM 10,(@1) Programs a rise time for step 0:ARB:SEQ:STEP:CURR:TRAP:RTIM 10, 0,(@1)	

[SOURce:]ARB:CURRent:TRAPezoid:STARt[:LEVel] <*value*>, (@<chanlist>)
[SOURce:]ARB:CURRent:TRAPezoid:STARt[:LEVel]? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:VOLTage:TRAPezoid:STARt[:LEVel] <*value*>, (@<chanlist>)
[SOURce:]ARB:VOLTage:TRAPezoid:STARt[:LEVel]? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:POWer:TRAPezoid:STARt[:LEVel] <*value*>, (@<chanlist>) N679xA
[SOURce:]ARB:POWer:TRAPezoid:STARt[:LEVel]? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:RESISTANCE:TRAPezoid:STARt[:LEVel] <*value*>, (@<chanlist>) N679xA
[SOURce:]ARB:RESISTANCE:TRAPezoid:STARt[:LEVel]? [MIN|MAX,] (@<chanlist>)

Specifies the initial and final current, voltage, power, or resistance level of the trapezoid.

[SOURce:]ARB:SEQuence:STEP:CURRent:TRAPezoid:STARt[:LEVel] <*value*>, <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:CURRent:TRAPezoid:STARt[:LEVel]? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:VOLTage:TRAPezoid:STARt[:LEVel] <*value*>, <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:VOLTage:TRAPezoid:STARt[:LEVel]? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:POWer:TRAPezoid:STARt[:LEVel] <*value*>, <*step#*>, (@<chanlist>) N679xA
[SOURce:]ARB:SEQuence:STEP:POWer:TRAPezoid:STARt[:LEVel]? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:RESISTANCE:TRAPezoid:STARt[:LEVel] <*value*>, <*step#*>, (@<chanlist>) N679xA
[SOURce:]ARB:SEQuence:STEP:RESISTANCE:TRAPezoid:STARt[:LEVel]? [MIN|MAX,] <*step#*>, (@<chanlist>)

Specifies the initial and final current, voltage, power, or resistance level of the trapezoid for Arb sequence steps.

Parameter	Typical Return
Current: 0 - maximum|MIN|MAX, *RST MIN Voltage: 0 - maximum|MIN|MAX, *RST MIN Power: 0 - maximum|MIN|MAX, *RST MIN Resistance: 0 - maximum|MIN|MAX, *RST MIN Values are range and module-rating dependent.	<start value>
Step 0 - 99, *RST 0	(none)
Programs a start- and end-level current: ARB:CURR:TRAP:STAR 1,(@1) Programs a start- and end- level voltage: ARB:VOLT:TRAP:STAR 1,(@1) Programs a start- and end- level power: ARB:POW:TRAP:STAR 1,(@1) Programs a start- and end-level resistance: ARB:RESISTANCE:TRAP:STAR 10,(@1) Programs a start- and end-level for step 0: ARB:SEQ:STEP:CURR:TRAP:STAR 1, 0,(@1)	

[SOURce:]ARB:CURRent:TRAPezoid:STARt:TIMe <*value*>, (@<chanlist>)
[SOURce:]ARB:CURRent:TRAPezoid:STARt:TIMe? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:VOLTage:TRAPezoid:STARt:TIMe<*value*>, (@<chanlist>)
[SOURce:]ARB:VOLTage:TRAPezoid:STARt:TIMe? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:POWer:TRAPezoid:STARt:TIMe<*value*>, (@<chanlist>) N679xA
[SOURce:]ARB:POWer:TRAPezoid:STARt:TIMe? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:RESISTANCE:TRAPezoid:STARt:TIMe<*value*>, (@<chanlist>) N679xA
[SOURce:]ARB:RESISTANCE:TRAPezoid:STARt:TIMe? [MIN|MAX,] (@<chanlist>)

Specifies the delay in seconds after the trigger is received, but before the rising ramp occurs.

[SOURce:]ARB:SEQuence:STEP:CURRent:TRAPezoid:STARt:TIMe <*value*>, <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:CURRent:TRAPezoid:STARt:TIMe? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:VOLTage:TRAPezoid:STARt:TIMe <*value*>, <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:VOLTage:TRAPezoid:STARt:TIMe? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:POWer:TRAPezoid:STARt:TIMe <*value*>, <*step#*>, (@<chanlist>) N679xA
[SOURce:]ARB:SEQuence:STEP:POWer:TRAPezoid:STARt:TIMe? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:RESISTANCE:TRAPezoid:STARt:TIMe <*value*>, <*step#*>, (@<chanlist>) N679xA
[SOURce:]ARB:SEQuence:STEP:RESISTANCE:TRAPezoid:STARt:TIMe? [MIN|MAX,] <*step#*>, (@<chanlist>)

Specifies the delay in seconds after the trigger is received, but before the rising ramp occurs for Arb Sequence steps.

Parameter	Typical Return
0 – 262.144 | MIN | MAX, *RST 0	<start time>
Step 0 - 99, *RST 0	(none)
Programs a start time for the current trapezoid: ARB:CURR:TRAP:STAR:TIM 1,(@1) Programs a start time for the voltage trapezoid: ARB:VOLT:TRAP:STAR:TIM 1,(@1) Programs a start time for the power trapezoid: ARB:POW:TRAP:STAR:TIM 1,(@1) Programs a start time for the resistance trapezoid: ARB:RESISTANCE:TRAP:STAR:TIM 1,(@1) Programs a start time for step 0: ARB:SEQ:STEP:CURR:TRAP:STAR:TIM 1, 0,(@1)	

[SOURce:]ARB:CURRent:TRAPezoid:TOP[:LEVel] <*value*>, (@<chanlist>)
[SOURce:]ARB:CURRent:TRAPezoid:TOP[:LEVel]? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:VOLTage:TRAPezoid:TOP[:LEVel] <*value*>, (@<chanlist>)
[SOURce:]ARB:VOLTage:TRAPezoid:TOP[:LEVel]? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:POWer:TRAPezoid:TOP[:LEVel] <*value*>, (@<chanlist>) N679xA
[SOURce:]ARB:POWer:TRAPezoid:TOP[:LEVel]? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:RESISTANCE:TRAPezoid:TOP[:LEVel] <*value*>, (@<chanlist>) N679xA
[SOURce:]ARB:RESISTANCE:TRAPezoid:TOP[:LEVel]? [MIN|MAX,] (@<chanlist>)

Specifies the top current, voltage, power, or resistance level of the trapezoid.

[SOURce:]ARB:SEQuence:STEP:CURRent:TRAPezoid:TOP[:LEVel] <*value*>, <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:CURRent:TRAPezoid:TOP[:LEVel]? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:VOLTage:TRAPezoid:TOP[:LEVel] <*value*>, <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:VOLTage:TRAPezoid:TOP[:LEVel]? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:POWer:TRAPezoid:TOP[:LEVel] <*value*>, <*step#*>, (@<chanlist>) N679xA
[SOURce:]ARB:SEQuence:STEP:POWer:TRAPezoid:TOP[:LEVel]? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:RESISTANCE:TRAPezoid:TOP[:LEVel] <*value*>, <*step#*>, (@<chanlist>) N679xA
[SOURce:]ARB:SEQuence:STEP:RESISTANCE:TRAPezoid:TOP[:LEVel]? [MIN|MAX,] <*step#*>, (@<chanlist>)

Specifies the top current, voltage, power, or resistance level of the trapezoid for Arb sequence steps.

Parameter	Typical Return
Current: 0 - maximum|MIN|MAX, *RST MIN Voltage: 0 - maximum|MIN|MAX, *RST MIN Power: 0 - maximum|MIN|MAX, *RST MIN Resistance: 0 - maximum|MIN|MAX, *RST MIN Values are range and module-rating dependent.	<top value>
Step 0 - 99, *RST 0	(none)
Programs the top level current: ARB:CURR:TRAP:TOP 2,(@1) Programs the top level voltage: ARB:VOLT:TRAP:TOP 20,(@1) Programs the top level power: ARB:POW:TRAP:TOP 50,(@1) Programs the top level resistance: ARB:RESISTANCE:TRAP:TOP 100,(@1) Programs a top level for step 0: ARB:SEQ:STEP:CURR:TRAP:TOP 2, 0,(@1)	

[SOURce:]ARB:CURRent:TRAPezoid:TOP:TIMe <*value*>, (@<chanlist>)
[SOURce:]ARB:CURRent:TRAPezoid:TOP:TIMe? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:VOLTage:TRAPezoid:TOP:TIMe<*value*>, (@<chanlist>)
[SOURce:]ARB:VOLTage:TRAPezoid:TOP:TIMe? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:POWer:TRAPezoid:TOP:TIMe<*value*>, (@<chanlist>) N679xA
[SOURce:]ARB:POWer:TRAPezoid:TOP:TIMe? [MIN|MAX,] (@<chanlist>)
[SOURce:]ARB:RESISTANCE:TRAPezoid:TOP:TIMe<*value*>, (@<chanlist>) N679xA
[SOURce:]ARB:RESISTANCE:TRAPezoid:TOP:TIMe? [MIN|MAX,] (@<chanlist>)

Specifies the time of the top level of the trapezoid in seconds.

[SOURce:]ARB:SEQuence:STEP:CURRent:TRAPezoid:TOP:TIMe <*value*>, <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:CURRent:TRAPezoid:TOP:TIMe? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:VOLTage:TRAPezoid:TOP:TIMe <*value*>, <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:VOLTage:TRAPezoid:TOP:TIMe? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:POWer:TRAPezoid:TOP:TIMe <*value*>, <*step#*>, (@<chanlist>) N679xA
[SOURce:]ARB:SEQuence:STEP:POWer:TRAPezoid:TOP:TIMe? [MIN|MAX,] <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:RESISTANCE:TRAPezoid:TOP:TIMe <*value*>, <*step#*>, (@<chanlist>) N679xA
[SOURce:]ARB:SEQuence:STEP:RESISTANCE:TRAPezoid:TOP:TIMe? [MIN|MAX,] <*step#*>, (@<chanlist>)

Specifies the time of the top level of the trapezoid in seconds for Arb sequence steps.

Parameter	Typical Return
0 – 262.144 | MIN | MAX, *RST 0	<top time>
Step 0 - 99, *RST 0	(none)
Programs a top time for the current trapezoid: ARB:CURR:TRAP:TOP:TIM 2,(@1) Programs a top time for the voltage trapezoid: ARB:VOLT:TRAP:TOP:TIM 2,(@1) Programs a top time for the power trapezoid: ARB:POW:TRAP:TOP:TIM 2,(@1) Programs a top time for the resistance trapezoid: ARB:RESISTANCE:TRAP:TOP:TIM 2,(@1) Programs a top time for step 0: ARB:SEQ:STEP:CURR:TRAP:TOP:TIM 2, 0,(@1)	

User-Defined

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[SOURce:]ARB:CURRent:UDEFined:BOSTep[:DATA] 0|OFF|1|ON {,0 or 1} (@<chanlist>)
[SOURce:]ARB:CURRent:UDEFined:BOSTep[:DATA]? (@<chanlist>)
[SOURce:]ARB:VOLTage:UDEFined:BOSTep[:DATA] 0|OFF|1|ON {,0 or 1} (@<chanlist>)
[SOURce:]ARB:VOLTage:UDEFined:BOSTep[:DATA]? (@<chanlist>)
[SOURce:]ARB:RESISTANCE:UDEFined:BOSTep[:DATA] 0|OFF|1|ON {,0 or 1} (@<chanlist>) N679xA
[SOURce:]ARB:RESISTANCE:UDEFined:BOSTep[:DATA]? (@<chanlist>)
[SOURce:]ARB:RESISTANCE:UDEFined:BOSTep[:DATA] 0|OFF|1|ON {,0 or 1} (@<chanlist>) N679xA
[SOURce:]ARB:RESISTANCE:UDEFined:BOSTep[:DATA]? (@<chanlist>)

Specifies which user-defined Arb points or steps will generate a trigger-out signal at the beginning of the step (BOSTep). A comma-delimited list of up to 511 steps may be programmed. The state is either ON (1) or OFF (0). A trigger is only generated when the state is set to ON.

[SOURce:]ARB:SEQuence:STEP:CURRent:UDEFined:BOSTep[:DATA] 0|OFF|1|ON {,0 or 1} <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:CURRent:UDEFined:BOSTep[:DATA]? <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:VOLTage:UDEFined:BOSTep[:DATA] 0|OFF|1|ON {,0 or 1} <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:VOLTage:UDEFined:BOSTep[:DATA]? <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:POWer:UDEFined:BOSTep[:DATA] 0|OFF|1|ON {,0 or 1} <*step#*>, (@<chanlist>)
N679xA
[SOURce:]ARB:SEQuence:STEP:POWer:UDEFined:BOSTep[:DATA]? <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:RESISTANCE:UDEFined:BOSTep[:DATA] 0|OFF|1|ON {,0 or 1} <*step#*>, (@<chanlist>)
N679xA
[SOURce:]ARB:SEQuence:STEP:RESISTANCE:UDEFined:BOSTep[:DATA]? <*step#*>, (@<chanlist>)

Specifies which user-defined Arb points or steps will generate a trigger-out signal at the beginning of the step (BOSTep) for Arb sequence steps. The last value in the sequence is the step number.

Parameter	Typical Return
0|OFF|1|ON, *RST 1 point with a value of Off	0 or 1 [,0 or 1]
Step 0 - 99, *RST 0	(none)
Output a trigger at the start of the current steps: ARB:CURR:UDEF:BOST ON,ON,ON,ON,ON,(@1) Output a trigger at the start of the voltage steps: ARB:VOLT:UDEF:BOST ON,ON,ON,ON,ON,(@1) Output a trigger at the start of the power steps: ARB:POW:UDEF:BOST ON,ON,ON,ON,ON,(@1) Output a trigger at the start of the resistance steps: ARB:RESISTANCE:UDEF:BOST ON,ON,ON,ON,ON,(@1) Output triggers at the start of the steps during sequence step 0:ARB:SEQ:STEP:CURR:UDEF:BOST ON,ON,ON,ON,ON, 0,(@1)	

- At the end of the user-defined Arb, the output state of the unit depends upon the ARB:TERMinate:LAST program settings.
- The order in which the values are entered determines the sequence of execution.
- To create a valid user-defined Arb, the current level, voltage level, power level, resistance level, BOST, and dwell lists must either all be the same length, or have a length of 1, which is interpolated as having the same length as the maximum length list.

[SOURce:]ARB:CURRent:UDEFined:BOSTep:POINts? (@<chanlist>)
[SOURce:]ARB:VOLTage:UDEFined:BOSTep:POINts? (@<chanlist>)
[SOURce:]ARB:POWer:UDEFined:BOSTep:POINts? (@<chanlist>) N679xA
[SOURce:]ARB:RESISTANCE:UDEFined:BOSTep:POINts? (@<chanlist>) N679xA

Returns the number of beginning-of-step points in the user-defined Arb, not the point values.

[SOURce:]ARB:SEQuence:STEP:CURRent:UDEFined:BOSTep:POINts? <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:VOLTage:UDEFined:BOSTep:POINts? <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:POWer:UDEFined:BOSTep:POINts? <*step#*>, (@<chanlist>) N679xA
[SOURce:]ARB:SEQuence:STEP:RESISTANCE:UDEFined:BOSTep:POINts? <*step#*>, (@<chanlist>) N679xA

Returns the number of beginning-of-step points in the user-defined Arb for Arb sequence steps.

Parameter	Typical Return
(none)	<number of points>
Step 0 - 99, *RST 0	(none)
Returns the number of current BOST points: ARB:CURR:UDEF:BOST:POIN? (@1) Returns the number of voltage BOST points: ARB:VOLT:UDEF:BOST:POIN? (@1) Returns the number of power BOST points: ARB:POW:UDEF:BOST:POIN? (@1) Returns the number of resistance BOST points: ARB:RESISTANCE:UDEF:BOST:POIN? (@1) Returns the number of BOST points for step 0: ARB:SEQ:STEP:CURR:UDEF:BOST:POIN? 0,(@1)	

[SOURce:]ARB:CURRent:UDEFined:DWELl <*value*>{<,*value*>},(@<chanlist>)
[SOURce:]ARB:CURRent:UDEFined:DWELl? (@<chanlist>)
[SOURce:]ARB:VOLTage:UDEFined:DWELl <*value*>{<,*value*>},(@<chanlist>)
[SOURce:]ARB:VOLTage:UDEFined:DWELl? (@<chanlist>)
[SOURce:]ARB:POWer:UDEFined:DWELl <*value*>{<,*value*>},(@<chanlist>) N679xA
[SOURce:]ARB:POWer:UDEFined:DWELl? (@<chanlist>)
[SOURce:]ARB:RESISTANCE:UDEFined:DWELl <*value*>{<,*value*>},(@<chanlist>) N679xA
[SOURce:]ARB:RESISTANCE:UDEFined:DWELl? (@<chanlist>)

Specifies the dwell time for each user-defined Arb point. A comma-delimited list of up to 511 points may be programmed. Dwell time is the time that the output will remain at a specific point. Dwell times can be programmed from 0 through 262.144 seconds with the resolution shown in the table below:

[SOURce:]ARB:SEQuence:STEP:CURRent:UDEFined:DWELl <*value*>{<,*value*>}, <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:CURRent:UDEFined:DWELl? <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:VOLTage:UDEFined:DWELl <*value*>{<,*value*>}, <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:VOLTage:UDEFined:DWELl? <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:POWer:UDEFined:DWELl <*value*>{<,*value*>}, <*step#*>, (@<chanlist>) N679xA
[SOURce:]ARB:SEQuence:STEP:POWer:UDEFined:DWELl? <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:RESISTANCE:UDEFined:DWELl <*value*>{<,*value*>}, <*step#*>, (@<chanlist>) N679xA
[SOURce:]ARB:SEQuence:STEP:RESISTANCE:UDEFined:DWELl? <*step#*>, (@<chanlist>)

Specifies the dwell time for each user-defined Arb point for Arb Sequence steps. The last value in the sequence is the step number.

Range in seconds	Dwell resolution	Range in seconds	Dwell resolution
All Models except N678xA		Models N678xA only	
0 - 0.262144	1 microsecond	0 - 0.268435	1.024 microsecond
0 - 2.62144	10 microseconds	0 - 2.68435	10.24 microsecond
0 - 26.2144	100 microseconds	0 - 26.8435	102.4 microsecond
0 - 262.144	1 millisecond	0 - 268.435	1.024 millisecond

Parameter	Typical Return
0 - 262.144 (all except N678xA SMU) 0 - 268.435 (N678xA SMU only *RST 1 point with a value of 0.001	<dwell time>
Step 0 - 99, *RST 0	(none)
Program a current dwell list: ARB:CURR:UDEF:DWEL 0.1,0.2,0.3,0.4,0.5,(@1) Program a voltage dwell list: ARB:VOLT:UDEF:DWEL 0.1,0.2,0.3,0.4,0.5,(@1) Program a power dwell list: ARB:POW:UDEF:DWEL 0.1,0.2,0.3,0.4,0.5,(@1) Program a resistance dwell list: ARB:RESISTANCE:UDEF:DWEL 0.1,0.2,0.3,0.4,0.5,(@1) Program a dwell list for step 0: ARB:SEQ:STEP:CURR:UDEF:DWEL 0.1,0.2,0.3,0.4,0.5, 0,(@1)	

- At the end of the user-defined Arb, the output state of the unit depends upon the ARB:TERMinate:LAST program settings.
- The order in which the values are entered determines the sequence of execution.
- To create a valid user-defined Arb, the current level, voltage level, power level, resistance level, BOST, and dwell lists must either all be the same length, or have a length of 1, which is interpolated as having the same length as the maximum length list.

[SOURce:]ARB:CURRent:UDEFined:DWELl:POINts? (@<chanlist>)
[SOURce:]ARB:VOLTage:UDEFined:DWELl:POINts? (@<chanlist>)
[SOURce:]ARB:POWer:UDEFined:DWELl:POINts? (@<chanlist>) N679xA
[SOURce:]ARB:RESISTANCE:UDEFined:DWELl:POINts? (@<chanlist>) N679xA

Returns the number of dwell points in the user-defined Arb, not the point values.

[SOURce:]ARB:SEQuence:STEP:CURRent:UDEFined:DWELl:POINts? <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:VOLTage:UDEFined:DWELl:POINts? <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:POWer:UDEFined:DWELl:POINts? <*step#*>, (@<chanlist>) N679xA
[SOURce:]ARB:SEQuence:STEP:RESISTANCE:UDEFined:DWELl:POINts? <*step#*>, (@<chanlist>) N679xA

Returns the number of dwell points in the user-defined Arb for Arb sequence steps.

Parameter	Typical Return
(none)	<number of points>
Step 0 - 99, *RST 0	(none)

Parameter	Typical Return
Returns the number of current dwell points: ARB:CURR:UDEF:DWEL:POIN? (@1) Returns the number of voltage dwell points: ARB:VOLT:UDEF:DWEL:POIN? (@1) Returns the number of power dwell points: ARB:POW:UDEF:DWEL:POIN? (@1) Returns the number of resistance dwell points: ARB:RESISTANCE:UDEF:DWEL:POIN? (@1) Returns the number of dwell points for step 0: ARB:SEQ:STEP:CURR:UDEF:DWEL:POIN? 0,(@1)	

[SOURce:]ARB:CURRent:UDEFined:LEVel <*value*>{<,*value*>},(@<chanlist>)
[SOURce:]ARB:CURRent:UDEFined:LEVel? (@<chanlist>)
[SOURce:]ARB:VOLTage:UDEFined:LEVel <*value*>{<,*value*>},(@<chanlist>)
[SOURce:]ARB:VOLTage:UDEFined:LEVel? (@<chanlist>)
[SOURce:]ARB:POWer:UDEFined:LEVel <*value*>{<,*value*>},(@<chanlist>) N679xA
[SOURce:]ARB:POWer:UDEFined:LEVel? (@<chanlist>)
[SOURce:]ARB:RESISTANCE:UDEFined:LEVel <*value*>{<,*value*>},(@<chanlist>) N679xA
[SOURce:]ARB:RESISTANCE:UDEFined:LEVel? (@<chanlist>)

Specifies the level of each current, voltage, power, or resistance point in a user-defined Arb. A comma-delimited list of up to 511 points may be programmed.

[SOURce:]ARB:SEQuence:STEP:CURRent:UDEFined:LEVel <*value*>{<,*value*>}, <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:CURRent:UDEFined:LEVel? <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:VOLTage:UDEFined:LEVel <*value*>{<,*value*>}, <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:VOLTage:UDEFined:LEVel? <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:POWer:UDEFined:LEVel <*value*>{<,*value*>}, <*step#*>, (@<chanlist>) N679xA
[SOURce:]ARB:SEQuence:STEP:POWer:UDEFined:LEVel? <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:RESISTANCE:UDEFined:LEVel <*value*>{<,*value*>}, <*step#*>, (@<chanlist>) N679xA
[SOURce:]ARB:SEQuence:STEP:RESISTANCE:UDEFined:LEVel? <*step#*>, (@<chanlist>)

Specifies the level of each current, voltage, power, or resistance point in a user-defined Arb for Arb sequence steps. The last value in the sequence is the step number.

Parameter	Typical Return
Current: 0 - maximum Voltage: 0 - maximum Power: 0 - maximum Resistance: 0 - maximum Values are range and module-rating dependent. *RST 1 point set to the minimum value.	<value> [,<value>]
Step 0 - 99, *RST 0	(none)
Program the current points: ARB:CURR:UDEF 5,4,3,2,1,(@1) Program the voltage points: ARB:VOLT:UDEF 20,21,22,23,24,(@1) Program the power points: ARB:POW:UDEF 20,30,40,50,60,(@1) Program the resistance points: ARB:RESISTANCE:UDEF 60,70,80,90,100,(@1) Program the points for step 0: ARB:SEQ:STEP:CURR:UDEF 5,4,3,2,1,0,(@1)	

- At the end of the user-defined Arb, the output state of the unit depends upon the ARB:TERMinate:LAST program settings.
- The order in which the values are entered determines the sequence of execution.

- To create a valid user-defined Arb, the current level, voltage level, power level, resistance level, BOST, and dwell lists must either all be the same length, or have a length of 1, which is interpolated as having the same length as the maximum length list.

[SOURce:]ARB:CURRent:UDEFined:LEVel:POINts? (@<chanlist>)
[SOURce:]ARB:VOLTage:UDEFined:LEVel:POINts? (@<chanlist>)
[SOURce:]ARB:POWer:UDEFined:LEVel:POINts? (@<chanlist>) N679xA
[SOURce:]ARB:RESISTANCE:UDEFined:LEVel:POINts? (@<chanlist>) N679xA

Returns the number of current, voltage, or resistance points in the user-defined Arb, not the point values.

[SOURce:]ARB:SEQuence:STEP:CURRent:UDEFined:LEVel:POINts? <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:VOLTage:UDEFined:LEVel:POINts? <*step#*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:POWer:UDEFined:LEVel:POINts? <*step#*>, (@<chanlist>) N679xA
[SOURce:]ARB:SEQuence:STEP:RESISTANCE:UDEFined:LEVel:POINts? <*step#*>, (@<chanlist>) N679xA

Returns the number of current, voltage, power, or resistance points in the user-defined Arb for Arb sequence steps.

Parameter	Typical Return
(none)	<number of points>
Step 0 - 99, *RST 0	(none)
Returns the number of current points: ARB:CURR:UDEF:LEV:POIN? (@1) Returns the number of voltage points: ARB:VOLT:UDEF:LEV:POIN? (@1) Returns the number of power points: ARB:POW:UDEF:LEV:POIN? (@1) Returns the number of resistance points: ARB:RESISTANCE:UDEF:LEV:POIN? (@1) Returns the number of points for step 0: ARB:SEQ:STEP:CURR:UDEF:LEV:POIN? 0,(@1)	

ARB Sequence

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[SOURce:]ARB:SEQuence:COUNt <*value*>, (@<chanlist>)
[SOURce:]ARB:SEQuence:COUNt? [MIN|MAX,] (@<chanlist>)

Sets the number of times that the Arb sequence is repeated. The repeat count range is 1 through 4096.

Parameter	Typical Return
1 - 4096 | MIN | MAX | INFinity, *RST 1	<sequence count>
Sets the sequence count to 10: ARB:SEQ:COUN 10, (@1)	

- Use the INFinity parameter to repeat the sequence continuously. If MAX, or a value greater than 4096 is programmed, the sequence will also repeat continuously.
- Use ABORt:TRANsient to stop the sequence at any time. When the sequence is aborted, the output returns to the settings that were in effect before the sequence started.
- If a count of 9.9E37 is returned, it means that the sequence is set to repeat continuously.

[SOURce:]ARB:SEQuence:LENGth? (@<chanlist>)

Returns the total number of steps in the Arb sequence.

Parameter	Typical Return
(none)	<number of steps>
Returns the number of steps in the Arb sequence: ARB:SEQ:LENG? (@1)	

[SOURce:]ARB:SEQuence:QUALity? (@<chanlist>)

Returns the quality of the waveforms in the Arb sequence. This is a number between 16 and 100 that is an indication of how well waveforms are represented. It is the number of points used to represent ARBs that are smooth curves (ramp, trapezoid, exponential, and sine). 16 is the minimum number of points that defines the curve (worst quality). 100 is the maximum number of points that defines the curve (best quality).

Note that the quality of a given waveform is determined by the total number and type of waveforms that comprise the sequence. The maximum number of points allowed in a sequence is 511. As more waveforms are added to the sequence, the quality of the waveforms is reduced to accommodated the 511-point limit.

Parameter	Typical Return
(none)	a value between 16 and 100
Returns the quality of the Arb sequence : ARB:SEQ:QUAL? (@1)	

[SOURce:]ARB:SEQuence:RESet (@<chanlist>)

Resets the Arb sequence to its power-on default setting: Step = 0; Shape = PULSe.

Parameter	Typical Return
(none)	(none)
Returns the number of steps in the Arb sequence: ARB:SEQ:LENG? (@1)	

[SOURce:]ARB:SEQuence:STEP:COUNt <value>, <step#>, (@<chanlist>)
[SOURce:]ARB:SEQuence:STEP:COUNt? [MIN|MAX,] <step#>, (@<chanlist>)

Sets the number of times that the sequence step is repeated. The repeat count range is 1 through >16 million. The maximum number of steps that can be programmed is 100. This setting is only valid if the ARB:SEQuence:STEP:PACing is TRIGgered

Parameter	Typical Return
Count: 1 - 16,777,216 | MIN | MAX | INFinity, *RST 1	<step count>
Step: 0 - 99, *RST 0	(none)
Sets the a repeat count of 10 for step 1: ARB:SEQ:STEP:COUN 10, 1, (@1)	

- Use the INFinity parameter to repeat the sequence step continuously. If MAX, or a value greater than 16,777,216 is programmed, the step will also repeat continuously.
- Use ABORt:TRANsient to stop the sequence at any time. When the sequence is aborted, the output returns to the settings that were in effect before the sequence started.
- If a count of 9.9E37 is returned, it means that the sequence step is set to repeat continuously.

[SOURce:]ARB:SEQuence:STEP:CURRent
[SOURce:]ARB:SEQuence:STEP:VOLTage
[SOURce:]ARB:SEQuence:STEP:POWer N679xA
[SOURce:]ARB:SEQuence:STEP:RESISTANCE N679xA

Program waveform steps within an Arb sequence.

All of the ARB:CURRent, ARB:VOLTage, ARB:POWer, and ARB:RESISTANCE commands that set waveform parameters have corresponding commands that set those same parameters for waveform steps within an Arb sequence. They follow the pattern:

[SOURce:]ARB:CURRent:EXPonential:END <level>, (@<chanlist>)
[SOURce:]ARB:**SEQuence:STEP**:CURRent:EXPonential:END <level>, **<step#>**, (@<chanlist>)

where items in bold are added to the sequence step version of the single Arb command. The <step#> parameter indicates the step number within the Arb sequence. The following Arb functions use the ARB:SEQuence <step#> format:

Exponential, Pulse, Ramp, Sinusoid, Staircase, Step, Trapezoid, and User-defined.

[SOURce:]ARB:SEQuence:STEP:FUNCtion:SHAPe <function>, <step#>, (@<chanlist>)
[SOURce:]ARB::SEQuence:STEP:FUNCtion:SHAPe? <step#>, (@<chanlist>)

Creates a new Arb sequence step or changes the waveform of an existing sequence step. The maximum number of steps that can be programmed is 100. The following waveforms may be assigned to a sequence step:

STEP	Specifies a step
RAMP	Specifies a ramp
STAircase	Specifies a staircase
SINusoid	Specifies a sine wave
PULSe	Specifies a pulse
TRAPezoid	Specifies a trapezoid
EXPonential	Specifies a exponential waveform
UDEFined	Specifies a user-defined waveform
CDWell	Specifies a constant-dwell waveform
SEQuence	Specifies a sequence of arbitrary waveforms
NONE	Specifies no arbitrary waveform

Parameter	Typical Return
STEP | RAMP | STAircase | SINusoid | PULSe | TRAPezoid | EXPonential | UDE:Fined | CDWell | SEQuence |NONE, *RST NONE	STEP, RAMP, STA, SIN, PULS, TRAP, EXP, or UDEF.
Step 0 - 99, *RST 0	(none)
Specify a shape for sequence step 1: ARB:SEQ:STEP:FUNC:SHAP SIN, 1, (@1)	

- If the <step#> specified is an existing sequence step, that step will be changed to the specified waveshape with all parameters reset to default values.
- New sequence steps must be specified sequentially. To create a new sequence step, <step#> should be specified to be the current length of the sequence (see ARB:SEQuence:LENGth?). When a step is added, all parameters of the step waveform are reset to their default values.

[SOURce:]ARB:SEQuence:STEP:PACing <pacing>, <step#>, (@<chanlist>)
[SOURce:]ARB::SEQuence:STEP:PACing? <step#>, (@<chanlist>)

Specifies the type of pacing for the specified step number as follows:

DWELl	When dwell paced, the step moves to the next step when the dwell time is finished.
TRIGgered	When trigger paced, the step waits at the last value of the step until a trigger is received. The next step is started upon receipt of the trigger.

Parameter	Typical Return
DWELl | TRIGgered, *RST DWELl	DWEL or TRIG
Step 0 - 99, *RST 0	(none)
Specify trigger pacing for sequence step 1: ARB:SEQ:STEP:PAC TRIG, 1, (@1)	

- If the <step#> specified is an existing sequence step, that step will be changed to the specified waveshape with all parameters reset to default values.
- New sequence steps must be specified sequentially. To create a new sequence step, <step#> should be specified to be the current length of the sequence (see ARB:SEQuence:LENGth?). When a step is added, all parameters of the step waveform are reset to their default values.

[SOURce:]ARB:SEQuence:TERMinate:LAST <Bool>, (@<chanlist>)
[SOURce:]ARB:SEQuence:TERMinate:LAST? (@<chanlist>)

Determines the output value when the Arb sequence terminates. The state is either ON (1) or OFF (0).

When ON	The output remains at the last Arb sequence value. The last current, voltage, power, or resistance Arb value becomes the IMMediate value when the sequence completes.
When OFF	The output returns to the settings in effect before the sequence started. This also applies when the sequence is aborted,

Parameter	Typical Return
0|OFF|1|ON, *RST Off	0 or 1
Sets the sequence to terminate with the voltage, resistance, or current set at the last sequence value: ARB:SEQ:TERM:LAST ON,(@1)	

- The query returns 0 if the output returns to the settings that were in effect before the sequence started, and 1 if the output remains at the last sequence value.

Calibrate Commands

Calibrate commands calibrate the instrument. only one channel can be calibrated at a time.

If calibration mode has not been enabled with CALibrate:STATe, the calibration commands will generate an error. Use CALibrate:SAVE to save any changes, otherwise all changes will be lost when you exit calibration mode.

NOTE Read the calibration section before calibrating. Improper calibration can reduce accuracy and reliability.

CALibrate:COUNt?

Returns the number of times the unit has been calibrated. The count is incremented whenever the calibration (or date) is saved, the administration password is changed (or reset using the internal switches), or the firmware is updated.

Parameter	Typical Return
(none)	<count>
Return the calibration count: CAL:COUN?	

CALibrate:CURRent[:LEVel] <*value*>, (@<channel>)

Calibrates the output current. The value entered selects the range that is being calibrated.

Parameter	Typical Return
The maximum current of the range.	(none)
Calibrates the output current of the 10 A range: CAL:CURR 10.2, (@1)	

CALibrate:CURRent:LIMit:NEGative <*value*>, (@<channel>) N678xA SMU N6783A-BAT

Calibrates the negative current limit. The value must be specified as negative. There is only one negative current range.

Parameter	Typical Return
The maximum current of the range.	(none)
Calibrates the negative current limit: CAL:CURR:LIM:NEG -2, (@1)	

CALibrate:CURRent:LIMit:POSitive <*value*>, (@<channel>) N678xA SMU N6783A N679xA

Calibrates the positive current limit. The value entered selects the range that is being calibrated.

Parameter	Typical Return
The maximum current of the range.	(none)
Calibrates the positive current limit: CAL:CURR:LIM:POS 2, (@1)	

CALibrate:CURRent:MEASure <*value*>, (@<channel>)

Calibrates the current measurement. The value entered selects the range that is being calibrated.

Parameter	Typical Return
The maximum current of the range.	(none)
Calibrates the current measurement range: CAL:CURR:MEAS 10.2, (@1)	

CALibrate:CURRent:PEAK (@<channel>) N675xA, N676xA

Calibrates the peak current limit.

Parameter	Typical Return
(none)	(none)
Calibrates the peak current limit: CAL:CURR:PEAK (@1)	

CALibrate:DATA <*value*>

Enters the calibration value read by the external meter. You must first select a calibration level for the value being entered. Data values are expressed in base units – either volts or amperes.

Parameter	Typical Return
The measured voltage or current value.	(none)
Specifies the measured value 10.01: CAL:DATA 10.01	

CALibrate:DATE <*"date"*>, (@<channel>)
CALibrate:DATE?

Stores the calibration date in nonvolatile memory. Enter any ASCII string up to 16 characters. The query returns the date. If no date is stored, an empty quoted string ("") is returned.

Parameter	Typical Return
<*"date"*>String program data. Enclose string parameters in single or double quotes.	Date of last calibration
Enters the calibration date: CAL:DATE "12/12/12"	

- The firmware does not interpret the string format. The command only stores the calibration date.

CALibrate:DPRog (@<channel>)

Calibrates the current downprogrammer.

Parameter	Typical Return
(none)	(none)
Calibrates the current downprogrammer: CAL:DPR (@1)	

CALibrate:LEVel P1|P2|P3

Advances to the next level in the calibration. P1 is the first level; P2 is the second, P3 is the third.

Parameter	Typical Return
P1|P2|P3	(none)
Selects the first calibration level: CAL:LEV P1	

- Some calibration sequences may require some settling time after sending CAL:LEV but before reading the data from the external meter and sending CAL:DATA.

CALibrate:PASSword <*password*>

Sets a numeric password to prevent unauthorized calibration. The new password is automatically stored in nonvolatile memory and does not have to be stored with CALibrate:SAVE.

Parameter	Typical Return
<*password*>a numeric value up to 15 digits	(none)
Set a new password to a value of 1234: CAL:PASS 1234	

- If the password is set to 0, password protection is removed and the ability to enter calibration mode is unrestricted. The factory setting is 0 (zero).
- To change the password: unsecure calibration with the old password, then set the new password.
- If you forget your password, refer to the calibration section.

CALibrate:RESistance 20|6, (@<channel>) N6781A, N6785A

Calibrates the output resistance. The parameter selects the voltage range. Note that the 6 V range only applies to Model N6781A.

Parameter	Typical Return
20|6	(none)
Calibrates the output resistance of the 20 V range: CAL:RES 20, (@1)	

CALibrate:SAVE

Saves the calibration constants in non-volatile memory. Do this at the end of the calibration to avoid losing changes.

Parameter	Typical Return
(none)	(none)
Store cal constants in non-volatile memory: CAL:SAVE	

- If calibration mode is exited by programming CALibration:STATe OFF without first saving the new constants, the previous calibration constants are restored.

CALibrate:STATe 0|OFF|1|ON [,<password>]
CALibrate:STATe?

Enables/disables calibration mode. Calibration mode must be enabled for the instrument to accept any calibration commands.

The optional parameter is the password. This is required if the existing password is not 0 (zero). If the password is not entered or is incorrect, an error is generated and the calibration mode remains disabled.

Parameter	Typical Return
0|OFF|1|ON , default OFF	0 or 1
<*password*> a numeric value up to 15 digits	(none)
Disable calibration mode and unsecure calibration: CAL:STAT OFF, 0 Enable calibration using a numeric password: CAL:STAT ON, 1234	

- If calibration mode is exited by programming CALibration:STATe OFF without first saving the new constants, the previous calibration constants are restored.

CALibrate:VOLTage[:LEVel] <*value*>, (@<channel>)

Calibrates the output voltage. The value entered selects the range that is being calibrated.

Parameter	Typical Return
The maximum voltage of the range.	(none)
Calibrates the voltage of the 50 V range: CAL:VOLT 51, (@1)	

CALibrate:VOLTage:CMRR (@<channel>) N675xA, N676xA

Calibrates the voltage common mode rejection ratio.

Parameter	Typical Return
(none)	(none)
Calibrates the voltage common mode rejection ratio: CAL:VOLT:CMRR (@1)	

CALibrate:VOLTage:LIMit:POSitive <*value*>, (@<channel>) N678xA SMU

Calibrates the positive voltage limit. The value entered selects the range that is being calibrated.

Parameter	Typical Return
The maximum voltage of the range.	(none)
Calibrates the positive voltage limit: CAL:VOLT:LIM:POS 20.4, (@1)	

CALibrate:VOLTage:MEASure <*value*>, (@<channel>)

Calibrates the voltage measurement range. The value entered selects the range that is being calibrated.

Parameter	Typical Return
The maximum voltage of the range.	(none)
Calibrates the voltage measurement range: CAL:VOLT:MEAS 51, (@1)	

CALibrate:VOLTage:MEASure:AUXiliary (@<channel>) N6781A, N6785A

Calibrates the auxiliary voltage measurement input.

Parameter	Typical Return
(none)	(none)
Calibrates the auxiliary voltage measurement input: CAL:VOLT:MEAS:AUX (@1)	

Current Commands

Current commands program the output current and current protection functions. The SOURce keyword is optional in the following commands.

[SOURce:]CURRent[:LEVel][:IMMediate][:AMPLitude] <*value*>, (@<chanlist>)
[SOURce:]CURRent[:LEVel][:IMMediate][:AMPLitude]? [MIN|MAX,] (@<chanlist>)
[SOURce:]CURRent[:LEVel]:TRIGgered[:AMPLitude] <*value*>, (@<chanlist>)
[SOURce:]CURRent[:LEVel]:TRIGgered[:AMPLitude]? [MIN|MAX,] (@<chanlist>)

Sets the immediate current level and the triggered current level when the output is in constant current mode. The triggered level is a stored value that will be programmed when a Step transient is triggered. Units are in amperes. The maximum value depends on the current rating of the unit.

Parameter	Typical Return
0 - maximum|MIN|MAX, *RST 0 The maximum value is 102% of the current rating of the module.	<current level>
Sets the output current level to 3 A: CURR 3, (@1) Sets the triggered current level to 2 A: CURR:TRIG 2, (@1)	

- The query returns the programmed current level in the form +n.nnnnnnE+nn for each channel specified. Multiple responses are separated by commas.

[SOURce:]CURRent:LIMit[:POSitive][:IMMediate][:AMPLitude] <*value*>, (@<chanlist>)

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[SOURce:]CURRent:LIMit[:POSitive][:IMMediate][:AMPLitude]? [MIN|MAX,] (@<chanlist>)
[SOURce:]CURRent:LIMit:NEGative[:IMMediate][:AMPLitude] <*value*>, (@<chanlist>)

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[SOURce:]CURRent:LIMit:NEGative[:IMMediate][:AMPLitude]? [MIN|MAX,] (@<chanlist>)

Sets the current limit when in voltage priority mode. Units are in amperes. The maximum value depends on the current rating of the unit. The minimum value is the most negative value.

Parameter	Typical Return
Positive: 0 to 102% of rating|MIN|MAX, *RST 102% Negative: -102% of rating to 0|MIN|MAX, *RST -102%	<+ current limit> <- current limit>
Sets the positive current limit to 2 A: CURR:LIM 2 (@1) Sets the negative current limit to -2 A: CURR:LIM:NEG -2 (@1)	

- MIN is the most negative value of the range. MAX is the least negative value of the range.
- The query returns the programmed current limit in the form +n.nnnnnnE+nn for each channel specified. Multiple responses are separated by commas.
- The negative current limit of Model N6783A-MFG is not programmable, but is fixed at -2A.

[SOURce:]CURRent:LIMit:COUPle 0|OFF|1|ON, (@<chanlist>) N678xA SMU
[SOURce:]CURRent:LIMit:COUPle? (@<chanlist>)

Sets the current limit tracking state.

Parameter	Typical Return
0|OFF|1|ON, *RST OFF	0 or 1
Enables the current limit tracking state: CURR:LIM:COUP ON, (@1)	

[SOURce:]CURRent:MODE FIXed|STEP|LIST, (@<chanlist>)
[SOURce:]CURRent:MODE? (@<chanlist>)

Sets the transient mode. This determines what happens to the output current when the transient system is initiated and triggered.

FIXed keeps the output current at its immediate value.
STEP steps the output to the triggered level when a trigger occurs.
LIST causes the output to follow the list values when a trigger occurs.
ARB causes the output to follow the arbitrary waveform values when a trigger occurs.

Parameter	Typical Return
FIXed|STEP|LIST|ARB, *RST FIXed	FIX, STEP, LIST. or ARB
Sets the current mode to Step: CURR:MODE STEP, (@1)	

[SOURce:]CURRent:PROTection:DELay[:TIME] <*value*>, (@<chanlist>)
[SOURce:]CURRent:PROTection:DELay[:TIME]? [MIN|MAX,] (@<chanlist>)

NOTE This command is the same as OUTPut:PROTection:DELay.

Sets the over-current protection delay. The over-current protection function will not be triggered during the delay time. After the delay time has expired, the over-current protection function will be active. This prevents momentary changes in output status from triggering the over-current protection function. Values up to 255 milliseconds can be programmed,with a resolution of 1 millisecond.

Parameter	Typical Return
0 – 0.255|MIN|MAX, *RST 0.020	<delay value>
Sets the protection delay to 0.2 seconds: CURR:PROT:DEL 0.2, (@1)	

- The operation of over-current protection is affected by the setting of the current protection delay start event, which is specified by CURRent:PROTection:DELay:STARt.

[SOURce:]CURRent:PROTection:DELay:STARt SCHange|CCTRans, (@<chanlist>)
[SOURce:]CURRent:PROTection:DELay:STARt? (@<chanlist>)

Specifies what starts the over-current protection delay timer.

SCHange starts the over-current delay timer at the END of a settings change in voltage, current, or output state; allowing for additional protection delay time. Transitions into constant current mode are ignored DURING a programmed settings change in voltage, current, or output state.

CCTRans starts the over-current delay timer by any transition of the output into current limit mode.

Parameter	Typical Return
SCHange|CCTRans, *RST SCHange	SCH or CCTR
Selects the CCTRans as the current protection delay mode: `CURR:PROT:DEL:STAR CCTR, (@1)`	

[SOURce:]CURRent:PROTection:STATe 0|OFF|1|ON, (@<chanlist>)
[SOURce:]CURRent:PROTection:STATe? (@<chanlist>)

Enables or disables the over-current protection. If the over-current protection function is enabled and the output goes into constant current operation, the output is disabled and the Questionable Condition status register OCP bit is set.

Parameter	Typical Return
0|OFF|1|ON, *RST OFF	0 or 1
Enable the current protection state: `CURR:PROT:STAT ON, (@1)`	

- The current limit setting determines when the output goes into constant current operation.
- An over-current condition can be cleared with OUTPut:PROTection:CLEar after the cause of the condition is removed.

[SOURce:]CURRent:RANGe <*value*>, (@<chanlist>)
[SOURce:]CURRent:RANGe? [MIN|MAX,](@<chanlist>)

Sets the output current range on models that have multiple ranges. The value that you enter must be the highest value in amperes that you expect to source. The instrument selects the range with the best resolution for the value entered.

Parameter	Typical Return
0 - maximum|MIN|MAX, *RST MAX The maximum value is 102% of the current rating of the power module.	<current range>
Sets the output current range to 3 A: `CURR:RANG 3, (@1)`	

- This command is coupled with [SOURce:]CURRent. This means that if a range command places an output on a range with a lower maximum current than the present current level, an out of range error occurs. This also occurs if a current is programmed that is too large for the present range. Errors can be avoided by sending both level and range commands in the same SCPI message. When the range and level information is received as a set, no range/setting conflict occurs.
- If a programmed range change occurs while the output is enabled, the output will be temporarily disabled while the range switch occurs. The transition from on-to-off and then from off-to-on will also be delayed by the settings of OUTPut:DELay:FALL and OUTPut:DELay:RISE.
- The query returns the maximum current that can be programmed on the range that is presently set. The current is in the form +n.nnnnnnE+nn for each channel specified. Multiple responses are separated by commas.

[SOURce:]CURRent:SLEW[:POSitive][:IMMediate] <*value*>, (@<chanlist>) N678xA SMU N679xA

[SOURce:]CURRent:SLEW[:POSitive][:IMMediate]? [MIN|MAX,] (@<chanlist>)

[SOURce:]CURRent:SLEW:NEGative[:IMMediate] <*value*>, (@<chanlist>) N679xA

[SOURce:]CURRent:SLEW:NEGative[:IMMediate]? [MIN|MAX,] (@<chanlist>)

Sets the current slew rate. The slew rate is set in amps per second and affects all programmed current changes, including those due to the output state turning on or off. The slew rate can be set to any value between 0 and 9.9E+37. For very large values, the slew rate will be limited by the analog performance of the output circuit. The keywords MAX or INFinity set the slew rate to maximum.

Parameter	Typical Return
0 – 9.9E+37|MIN|MAX|INFinity, *RST MAX	<slew rate>
Sets the positive output slew rate to 1 A per second: CURR:SLEW 1, (@1) Sets the negative output slew rate to 1 A per second: CURR:SLEW:NEG 1, (@1)	

- The query returns the value that was sent. If the value is less than the minimum slew rate, only the minimum value is returned. The resolution of the slew setting is also the minimum value, which can be queried using CURRent:SLEW? MIN. The exact value varies slightly based on calibration.
- The query returns the programmed slew rate in the form +n.nnnnnnE+nn for each channel specified. Multiple responses are separated by commas. If a slew rate of 9.9E37 is returned, it means that the maximum or fastest slew rate has been set.

[SOURce:]CURRent:SLEW:COUPle 0|OFF|1|ON, (@<chanlist>) N679xA

[SOURce:]CURRent:SLEW:COUPle? (@<chanlist>)

Sets the current slew tracking state.

Parameter	Typical Return
0|OFF|1|ON, *RST OFF	0 or 1
Enables the current slew tracking state: CURR:SLEW:COUP ON, (@1)	

[SOURce:]CURRent:SLEW[:POSitive]:MAXimum 0|OFF|1|ON, (@<chanlist>) N678xA SMU N679xA

[SOURce:]CURRent:SLEW[:POSitive]:MAXimum? (@<chanlist>)

[SOURce:]CURRent:SLEW:NEGative:MAXimum 0|OFF|1|ON, (@<chanlist>) N679xA

[SOURce:]CURRent:SLEW:NEGative:MAXimum? (@<chanlist>)

Enables/disables the maximum slew rate override. When enabled, the slew rate is set to its maximum value. When disabled, the slew rate is set to the immediate value set by CURRent:SLEW. Use CURRent:SLEW? MAX to query the maximum slew rate.

Parameter	Typical Return
0|OFF|1|ON, *RST OFF	0 or 1
Disable the positive maximum slew rate: CURR:SLEW:MAX OFF, (@1) Disable the negative maximum slew rate: CURR:SLEW:NEG:MAX OFF, (@1)	

- The CURRent:SLEW:MAX command is coupled to the CURRent:SLEW command. If the CURRent:SLEW command sets the slew rate to MAX or INFinity, CURRent:SLEW:MAX is enabled. If the slew rate is set to any other value, CURRent:SLEW:MAX is disabled.

Digital Commands

Digital commands program the digital control port on the rear panel of the instrument. Refer to Using the Digital Port for more information.

[SOURce:]DIGital:INPut:DATA?

Reads the state of the digital control port. Returns the binary-weighted value of the state of pins 1 through 7 in bits 0 through 6 respectively.

Parameter	Typical Return
(none)	<bit value>
Reads the state of the digital control port: DIG:INP:DATA?	

[SOURce:]DIGital:OUTPut:DATA <*value*>
[SOURce:]DIGital:OUTPut:DATA?

Sets the state of the digital control port. This only affects the pins whose function has been set to Digital IO operation. The port has seven signal pins and a digital ground pin. In the binary-weighted value that is written to the port, the pins are controlled according to the following bit assignments:

Pin	1	2	3	4	5	6	7
Bit number	0	1	2	3	4	5	6
Decimal value	1	2	4	8	16	32	64

Bit values corresponding to digital port pins that are not configured as DIO are ignored.

Parameter	Typical Return
0 – 127, *RST 0	<bit value>
Programs pins 1, 3, and 5 on: DIG:OUTP:DATA?	

[SOURce:]DIGital:PIN<1-7>:FUNCtion <*function*>
[SOURce:]DIGital:PIN<1-7>:FUNCtion?

Sets the function of the pins. The functions are saved in non-volatile memory.

DIO	General-purpose ground-referenced digital input/output function.
DINPut	Digital input-only mode.
FAULt	Pin 1 functions as an isolated fault output. Pin 2 is common for pin 1
INHibit	Pin 3 functions as an inhibit input.
ONCouple	Pins 4 -7 synchronize the output On state.
OFFCouple	Pins 4 -7 synchronize the output Off state.
TINPut	A trigger input function.
TOUTput	A trigger output function

Parameter	Typical Return
DIO | DINPut | FAULt | INHibit | ONCouple | OFFCouple TINPut | TOUTput	DIO, DINP, FAUL, INH, ONC, OFFC, TINP, or TOUT
Sets pin 1 to FAULt mode: DIG:PIN1:FUNC FAUL	

[SOURce:]DIGital:PIN<1-7>:POLarity POSitive|NEGative
[SOURce:]DIGital:PIN<1-7>:POLarity?

Sets the polarity of the pins.

POSitive means a logical true signal is a voltage high at the pin. For trigger inputs and outputs, POSitive means a rising edge.
NEGative means a logical true signal is a voltage low at the pin. For trigger inputs and outputs, NEGative means a falling edge.

The pin polarities are saved in non-volatile memory.

Parameter	Typical Return
POSitive|NEGative	POS or NEG
Sets pin 1 to POSitive polarity: DIG:PIN1:POL POS	

[SOURce:]DIGital:TOUTput:BUS[:ENABle] 0|OFF|1|ON
[SOURce:]DIGital:TOUTput:BUS[:ENABle]?

Enables/disables BUS triggers on digital port pins. This allows a BUS trigger to be sent to any digital port pin that has been configured as a trigger output. A trigger out pulse is generated when the state is on and a bus trigger is received. A BUS trigger is generated using the *TRG command.

Parameter	Typical Return
0|OFF|1|ON, *RST OFF	0 or 1
Enable BUS triggered signals on the digital pins: CURR:TOUT:BUS ON	

- The query returns 0 (OFF) if the trigger signal will NOT be generated with a BUS trigger command, and 1(ON) if a trigger signal will be generated with a BUS trigger command.

Display Commands

Display commands control the front panel display.

DISPlay[:WINDow][:STATe] 0|OFF|1|ON
DISPlay[:WINDow][:STATe]?

Turns the front panel display on or off.

Parameter	Typical Return
0|OFF|1|ON, *RST ON	0 or 1
Turns the front panel display off: DISP OFF	

DISPlay[:WINDow]:CHANnel <channel>
DISPlay[:WINDow]:CHANnel?

Selects the output channel to display on the front panel in single-channel view (METER1).

Parameter	Typical Return
1|2|3|4, *RST 1	1|2|3|4
Sets the front panel to display channel 4: DISP CHAN 4	

DISPlay[:WINDow]:VIEW METER1|METER4|METER_VIP
DISPlay[:WINDow]:VIEW?

Selects the output channel view of the front panel display. METER1 displays one output channel. METER4 displays all output channels up to a maximum of four. METER_VIP displays voltage, current, and power for one channel.

Parameter	Typical Return
METER1|METER4|METER_VIP, *RST METER1	METER1, METER4, METER_VIP
Sets the front panel to display up to four channels: DISP VIEW METER4	

Fetch Commands

Fetch commands return measurement data that has been previously acquired by a MEASurement command or triggered acquisition. FETCh queries do not generate a new measurement, but allow additional measurement calculations from the same acquired data. The data is valid until the next MEASure or INITiate command occurs.

NOTE FETCh commands require Option 054 to be installed on models N673xA. N674xA, N675xA, and N677xA.

FETCh[:SCALar]:CURRent[:DC]? (@<chanlist>)
FETCh[:SCALar]:VOLTage[:DC]? (@<chanlist>)
FETCh[:SCALar]:POWer[:DC]? (@<chanlist>) N676xA N678xA SMU N679xA

Returns the averaged measurement. Values returned are either in amperes, volts, or watts. The reading is in the form +n.nnnnnnE+nn for each channel specified. Multiple responses are separated by commas.

Parameter	Typical Return
(none)	<DC value>
Returns the averaged current FETC:CURR? (@1) Returns the averaged voltage FETC:VOLT? (@1) Returns the averaged power FETC:POW? (@1)	

FETCh[:SCALar]:CURRent:ACDC? (@<chanlist>)
FETCh[:SCALar]:VOLTage:ACDC? (@<chanlist>)

Returns the RMS measurement (AC + DC). Values returned are either in amperes, or volts. See Measurement Types. The reading is in the form +n.nnnnnnE+nn for each channel specified. Multiple responses are separated by commas.

Parameter	Typical Return
(none)	<ACDC value>
Returns the measured RMS current FETC:CURR:ACDC? (@1) Returns the measured RMS voltage FETC:VOLT:ACDC? (@1)	

FETCh[:SCALar]:CURRent:HIGH? (@<chanlist>)
FETCh[:SCALar]:VOLTage:HIGH? (@<chanlist>)

Returns the High level of a pulse waveform. Values returned are either in amperes, or volts. See Measurement Types. The reading is in the form +n.nnnnnnE+nn for each channel specified. Multiple responses are separated by commas.

Parameter	Typical Return
(none)	<HIGH value>
Returns the measured high level current FETC:CURR:HIGH? (@1) Returns the measured high level voltage FETC:VOLT:HIGH? (@1)	

FETCh[:SCALar]:CURRent:LOW? (@<chanlist>)
FETCh[:SCALar]:VOLTage:LOW? (@<chanlist>)

Returns the Low level of a pulse waveform. Values returned are either in amperes, or volts. See Measurement Types. The reading is in the form +n.nnnnnnE+nn for each channel specified. Multiple responses are separated by commas.

Parameter	Typical Return
(none)	<LOW value>
Returns the measured low level current FETC:CURR:LOW? (@1) Returns the measured low level voltage FETC:VOLT:LOW? (@1)	

FETCh[:SCALar]:CURRent:MAXimum? (@<chanlist>)
FETCh[:SCALar]:VOLTage:MAXimum? (@<chanlist>)
FETCh[:SCALar]:POWer:MAXimum? (@<chanlist>) N676xA N678xA SMU N679xA
FETCh[:SCALar]:CURRent:MINimum? (@<chanlist>)
FETCh[:SCALar]:VOLTage:MINimum? (@<chanlist>)
FETCh[:SCALar]:POWer:MINimum? (@<chanlist>) N676xA N678xA SMU N679xA

Returns the maximum or minimum value. Values returned are either in amperes, volts, or Watts. See Measurement Types. The reading is in the form +n.nnnnnnE+nn for each channel specified. Multiple responses are separated by commas.

Parameter	Typical Return
(none)	<MIN value> <MAX value>
Returns the measured minimum current FETC:CURR:MIN? (@1) Returns the measured minimum voltage FETC:VOLT:MIN? (@1) Returns the measured minimum power FETC:POW:MIN? (@1)	
Returns the measured maximum current FETC:CURR:MAX? (@1) Returns the measured maximum voltage FETC:VOLT:MAX? (@1) Returns the measured maximum power FETC:POW:MAX? (@1)	

FETCh:ARRay:CURRent[:DC]? (@<chanlist>)
FETCh:ARRay:VOLTage[:DC]? (@<chanlist>)
FETCh:ARRay:POWer[:DC]? (@<chanlist>) N676xA N678xA SMU N679xA

Returns an array with the instantaneous measurement. Values returned are either in amperes, volts, or watts.

The return format depends on the settings of the FORMat:BORDer and FORMat[:DATA] commands. When the data format is set to ASCII, returned values are comma separated. When the data format is set to REAL, data is returned as single precision floating point values in definite length arbitrary block response format.

Parameter	Typical Return
(none)	<value> [,<value>] or <Block>
Returns the measured current array FETC:ARR:CURR? (@1) Returns the measured voltage array FETC:ARR:VOLT? (@1) Returns the measured power array FETC:ARR:POW? (@1)	

FETCh:ELOG? <*maxrecords*>, (@<chanlist>)

Returns the most recent external datalog records. Data must be read from the buffer periodically to avoid the buffer overflowing. Whenever data is read using FETCh:ELOG? then that buffer space is made available in the instrument for storing more acquired data.

Maxrecords specifies the maximum number of records of datalog data that the controller will return for each channel. A record is one set of voltage and current readings for one time interval. The exact format of a record depends on which functions have been enabled for external datalog sensing. If ALL datalog sense functions are enabled, one record will contain:
Current average, Current minimum, Current maximum, Voltage average, Voltage minimum, and Voltage maximum, in that order. If any of these sense functions are not enabled, that data is not part of the returned record.

The return format depends on the settings of the FORMat:BORDer and FORMat[:DATA] commands. When the data format is set to ASCII, returned values are comma separated. When the data format is set to REAL, data is returned as single precision floating point values in definite length arbitrary block response format.

Parameter	Typical Return
[<maxrecords>] the number of records returned (1 to 16,384)	<value> [,<value>] or <Block>
Returns 100 data records FETC:ELOG? 100, (@1)	

Format Commands

FORMat commands specify the format for transferring measurement data.

FORMat[:DATA] ASCII|REAL
FORMat[:DATA]?

Specifies the format of the returned data. This is used by queries that can return a block of data.

ASCII – returns data as ASCII bytes in numeric format as appropriate. The numbers are separated by commas.

REAL – returns data in a definite length block as IEEE single precision floating point values. In this case the 4 bytes of each value can be returned in either big-endian or little-endian byte order, determined by the FORMat:BORDer setting.

Parameter	Typical Return
ASCII|REAL, *RST ASCII	ASCII or REAL
Sets the data format to ASCII: FORMat ASCII	

- The data format is used by a small subset of SCPI queries that can return large quantities of data. These include: FETC:ARR:CURR? and FETC:ARR:VOLT?.

FORMat:BORDer NORMal|SWAPped
FORMat:BORDer?

Specifies how binary data is transferred. This only applies when the FORMat:DATA is set to REAL.

NORMal – transfers data in normal order. The most significant byte is returned first, and the least significant byte is returned last (big-endian).

SWAPped – transfers data in swapped-byte order. The least significant byte is returned first, and the most significant byte is returned last (little-endian).

Parameter	Typical Return
NORMal|SWAPped, *RST NORMal	NORM or SWAP
Sets the data transfer to Swapped: FORM:BORD SWAP	

- The byte order is used when fetching real data from SCPI measurements. These include: FETC:ARR:CURR? and FETC:ARR:VOLT?.

Function Command

[SOURce:]FUNCtion CURRent|VOLTage|POWer|RESistance, (@<chanlist>) N678xA SMU N679xA

[SOURce:]FUNCtion? (@<chanlist>)

Sets the output priority mode). Power and Resistance priority modes only apply to models N679xA.

In voltage priority mode the output is controlled by a bi-polar constant voltage feedback loop, which maintains the output voltage at its positive or negative programmed setting. In current priority mode the output is controlled by a bi-polar constant current feedback loop, which maintains the output sourcing or sinking current at its programmed setting.

For N679xA load modules in power or resistance priority modes, the constant current along with the constant voltage feedback loops maintain the input power and resistance at their programmed settings.

Refer to Operating Mode Tutorial for more information.

Parameter	Typical Return
CURRent|VOLTage|POWer|RESistance, *RST CURRent for N679xA *RST VOLTage for N678xA SMU	CURR, VOLT, POW, or RES
Selects current priority regulation mode: FUNC CURR, (@1)	

Hcopy Commands

HCOPy commands return the front panel display image.

HCOPy:SDUMp:DATA? [BMP|GIF|PNG]

Returns an image of the front panel display. The format may be specified by the optional parameter. If no format is specified, the format is determined by HCOPy:SDUMp:DATA:FORMat.

The response is a SCPI 488.2 definite length binary block of the form: #<nonzero digit><digits><8 bit data-bytes> where:
<nonzero digit> specifies the number of digits to follow,
<digits> specify the number of 8 bit data bytes to follow, and
<8 bit data bytes> contain the data to be transferred.

Parameter	Typical Return
[BMP|GIF|PNG[	<Block>
Returns the image in GIF format: HCOP:SDUM:DATA? GIF	

HCOPy:SDUMp:DATA:FORMat BMP|GIF|PNG
HCOPy:SDUMp:DATA:FORMat?

Specifies the format for front panel images returned.

Parameter	Typical Return
BMP|GIF|PNG, *RST PNG	BMP, GIF, or PNG
Specify GIF as the image format: HCOP:SDUM:DATA:FORM GIF	

IEEE 488.2 Common Commands

*CLS

Clear Status Command. Clears the event registers in all register groups. Also clears the Status Byte and Error Queue. If *CLS immediately follows a program message terminator (<NL>), then the Output Queue and the MAV bit are also cleared. Refer to Status Tutorial for more information.

Parameter	Typical Return
(none)	(none)
Clear Event register bits, Status byte, and Error queue: *CLS	

*ESE <*value*>
*ESE?

Event Status Enable Command and Query. Enables bits in the enable register for the Standard Event Status group. A 1 in the bit position enables the corresponding event. The selected bits are then reported to the ESB bit of the Status Byte Register. The query reads the enable register and returns a decimal value which corresponds to the binary-weighted sum of all bits set in the register. Refer to Status Tutorial for more information.

Parameter	Typical Return
A decimal value that corresponds to the binary-weighted sum of the bits in the register.	<bit value>
Enable bit 3 and 4 in the enable register: *ESE 24	

- Any or all of the enabled events of the Standard Event Status Event Register are logically ORed to cause the Event Summary Bit (ESB) of the Status Byte Register to be set.
- *CLS does not clear the enable register, but does clear the event register.
- The value returned is the binary-weighted sum of all bits set in the register.

*ESR?

Event Status Register Query. Queries the event register for the Standard Event Status group. The event register is a read-only register, which stores (latches) all standard events. Refer to Status Tutorial for more information.

Parameter	Typical Return
(none)	<bit value>
Read event status enable register: *ESR?	

- To be reported to the Standard Event Register, the corresponding bits in the event register must be enabled using *ESE.
- Once a bit is set, it remains set until cleared by this query or *CLS.
- The value returned is the binary-weighted sum of all bits set in the register.

*IDN?

Identification Query. Returns instrument's identification string, which contains four comma-separated fields. The first field is the manufacturer's name, the second field is the instrument model number, the third field is the serial number, and the fourth field is the firmware revision.

Parameter	Typical Return
(none)	<ASCII string with comma-separated fields>
Return the instrument's identification string: `*IDN?`	

- Example response: Keysight Technologies,N6700C,MY55123456,E.00.02.2266

*LRN?

Learn Query. Returns a sequence of SCPI commands that can later be used to put the instrument in the same state that it was in when the *LRN? query was sent. The scope of the returned settings is the same as for the *SAV and *RCL commands.

Parameter	Typical Return
(none)	<ASCII string with semicolon-separated fields>
Returns the sequence of SCPI commands: `*LRN?`	

- To read the string into your computer, first dimension a string variable with at least 2500 characters.

*OPC
*OPC?

Operation Complete Command and Query. *OPC sets the OPC (Operation Complete) status bit in the *Standard Event register* when the instrument has completed all pending operations sent before *OPC. This occurs at the completion of the current operation. Refer to Status Tutorial for more information.

*OPC? returns a 1 to the *Output buffer* when all pending operations complete. The response is delayed until all pending operations complete.

Parameter	Typical Return
(none)	1
Sets the Operation Complete bit: `*OPC` Returns a 1 when commands complete: `*OPC?`	

- These commands are primarily used for program synchronization.
- Used in conjunction with initiated acquisitions, initiated transients, output state changes, and output settling time to provide a way to poll or interrupt the computer when these pending operations complete.
- Other commands may be executed before the operation complete bit is set.
- The difference between *OPC and *OPC? is that *OPC? returns "1" to the output buffer when the current operation completes.

*OPT?

Option Query Returns a string identifying any installed mainframe options. A 0 (zero) indicates no options are installed.

Parameter	Typical Return
(none)	<option number>
Returns installed options: `*OPT?`	

*RCL <0-9>

Recall State Restores the instrument to a state that was previously stored in memory locations 0 through 9 with the *SAV command. All instrument states are recalled except: (1) the trigger system is set to the Idle state, (2) calibration is disabled, (3) trigger settings are set to their Idle state, and (4) non-volatile settings are not affected.

Parameter	Typical Return
0 - 9	(none)
Recall state from location 1: `*RCL 1`	

- Location 0 is automatically recalled at power turn-on when the Output Power-On state is set to RCL0.
- You cannot recall an instrument state from an empty or deleted storage location.
- Stored instrument states are affected by *RST.

*RDT?

Returns the output channel descriptions. The description is an arbitrary ASCII string with up to four semicolon-separated fields. To read the string into your computer, be sure to dimension a string variable with at least 50 characters.

Parameter	Typical Return
(none)	<ASCII string with semicolon-separated fields>
Identify the mainframe's installed power modules: *RDT?	

- Example 4-channel response: CHAN1,N6751A;CHAN2,N6752A;CHAN3,N6761A;CHAN4,N6762A

*RST

Reset Command Resets the instrument to pre-defined values that are either typical or safe. These settings are described in Factory Reset State.

Parameter	Typical Return
(none)	(none)
Reset the instrument: *RST	

- *RST forces the ABORt command. This cancels any trigger actions presently in process, and resets the WTG bit in the Status Operation Condition register.

*SAV <0-9>

Save State Saves the present state of the instrument to one of ten non-volatile memory locations. Any state previously stored in the same location will be overwritten. Refer to Reset State for a list of instrument settings that can be saved. Settings

Parameter	Typical Return
0 - 9	(none)
Save state to location 1: *SAV 1	

- If a particular state is desired at power-on, it should be stored in location 0. Location 0 is automatically recalled at power turn-on when the Output Power-On state is set to RCL 0.
- The calibration state is NOT saved as part of the *SAV operation.
- Data saved in non-volatile memory, described in the Non-volatile Settings, is not affected by the *SAV command.
- A reset (*RST) command does not affect the instrument states stored in memory. Once a state is stored, it remains until it is overwritten or specifically deleted.

*SRE <*value*>
*SRE?

Service Request Enable Command and Query. Sets the value of the Service Request Enable register. This determines which bits from the Status Byte Register are summed to set the Master Status Summary (MSS) bit and the Request for Service (RQS) summary bit. A 1 in any Service Request Enable register bit position enables the corresponding Status Byte register bit. All such enabled bits are then

logically OR-ed to cause the MSS bit of the Status Byte register to be set. Refer to Status Tutorial for more information.

The query reads the enable register and returns a decimal value which corresponds to the binary-weighted sum of all bits set in the register.

Parameter	Typical Return
A decimal value that corresponds to the binary-weighted sum of the bits in the register.	<bit value>
Enable bit 3 and 4 in the enable register: *SRE 24	

- When a serial poll is conducted in response to a service request, RQS is cleared but MSS is not.
- When *SRE is cleared (by programming it with 0), the power system cannot generate a service request.

*STB?

Status Byte Query. Reads the Status Byte Register, which contains the status summary bits and the Output Queue MAV bit. The Status Byte is a read-only register and the bits are NOT cleared when it is read. Refer to Status Tutorial for more information.

Parameter	Typical Return
(none)	<bit value>
Read status byte: *STB?	

- The status summary bits are cleared when the appropriate event registers are read. The MAV bit is cleared at power-on, by *CLS, or when there is no more response data available.
- When a serial poll is conducted in response to a service request, RQS is cleared, but MSS is not.

*TRG

Trigger Command. Generates a trigger when the trigger system has BUS selected as its source. The command has the same affect as the Group Execute Trigger (<GET>) command).

Parameter	Typical Return
(none)	(none)
Generates an immediate trigger: *TRG	

*TST?

SelfTest Query. Performs an instrument self-test. A 0 (zero) indicates the instrument passed self-test. If self-test fails, one or more error messages will provide additional information. Use SYSTem:ERRor? to read the error queue. See SCPI Error Messages for more information.

Parameter	Typical Return
(none)	0 or 1
Perform self-test: *TST?	

- *TST? also forces an *RST command.

*WAI

Pauses additional command processing until all pending operations are complete. See *OPC for more information.

Parameter	Typical Return
(none)	(none)
Wait until all pending operations complete. *WAI	

- *WAI can only be aborted by sending the instrument a Device Clear command.

Initiate Commands

Initiate commands initialize the trigger system. This enables the trigger system to receive triggers.

INITiate[:IMMediate]:ACQuire (@<chanlist>)
INITiate[:IMMediate]:ELOG (@<chanlist>)
INITiate[:IMMediate]:TRANsient (@<chanlist>)

NOTE

INItiate:ACQuire and INITiate:ELOG commands require Option 054 to be installed on models N673xA. N674xA, N675xA, and N677xA.

INITiate:ACQuire - Initiates the measurement trigger system. When a measurement trigger is initiated, an event on a selected trigger source causes the specified triggering action to occur.

INITiate:ELOG - Initiates external data logging. When the external data log is initiated, an event on a selected external data log trigger source starts the data log.

INITiate:TRANsent - Initiates the transient trigger system. When initiated, an event on the selected trigger source causes the specified triggered action to occur on the output.

Parameter	Typical Return
(none)	(none)
Initiates the measurement trigger system: INIT:ACQ (@1)	
Initiates an external data log: INIT:ELOG (@1) Initiates an external data log: INIT:ELOG (@1)	

- It takes a few milliseconds for the instrument to be ready to receive a trigger signal after receiving the INITiate command, and it can take longer if the value of SENSe:SWEep:OFFSet:POINts is negative.
- If a trigger occurs before the trigger system is ready for it, the trigger will be ignored. Check the WTG_meas and the WTG_tran bits in the operation status register to know when the instrument is ready.
- Use the appropriate ABORt command to return the instrument to the Idle state.

INITiate:CONTinuous:TRANsient 0|OFF|1|ON, (@<chanlist>)
INITiate:CONTinuous:TRANsient? (@<chanlist>)

Continuously initiates the transient trigger system. This allows multiple triggers to generate multiple output transients.

Parameter	Typical Return
0|OFF|1|ON , *RST ON	0 or 1
Continually initiates the trigger system: INIT:CONT:TRAN ON, (@1)	

- With continuous triggering disabled, the trigger system must be initiated for each trigger using the INITiate:TRANsient command.
- ABORt:TRANsient does not abort continuous triggers if INITiate:CONTinuous:TRANsient ON has been programmed. In this case, the trigger system will automatically re-initiate.

List Commands

List commands program an output sequence of multiple current, voltage, power, or resistance settings. A comma-delimited list of up to 512 steps may be programmed. Note that for Models N678xA SMU N678xA SMU, only the parameters associated with one of the priority modes (either voltage priority or current priority) may be list controlled.

NOTE LIST commands require Option 054 to be installed on models N673xA. N674xA, N675xA, and N677xA.

[SOURce:]LIST:COUNt <*value*>, (@<chanlist>)
[SOURce:]LIST:COUNt? [MIN|MAX,] (@<chanlist>)

Sets the list repeat count. This sets the number of times that a list is executed before it completes. The count range is 1 through 4096. Use the Infinity parameter to run the list continuously.

Parameter	Typical Return
1 – 4096|MIN|MAX|INFinity, *RST 1	<list count>
Sets the list count to 10: LIST:COUN 10, (@1)	

- Use ABORt:TRANsient to stop the list at any time. When the list is aborted, the output returns to the settings that were in effect before the list started.
- The query returns the list count for each channel specified. If a repeat count of 9.9E37 is returned, it means the list is set to repeat continuously.

[SOURce:]LIST:CURRent[:LEVel] <*value*>{,<*value*>}, (@<chanlist>)
[SOURce:]LIST:CURRent[:LEVel]? (@<chanlist>)
[SOURce:]LIST:VOLTage[:LEVel] <*value*>,{<*value*>}, (@<chanlist>)
[SOURce:]LIST:VOLTage[:LEVel]? (@<chanlist>)
[SOURce:]LIST:POWer[:LEVel] <*value*>,{<*value*>}, (@<chanlist>) N679xA
[SOURce:]LIST:POWer[:LEVel]? (@<chanlist>)
[SOURce:]LIST:RESistance[:LEVel] <*value*>,{<*value*>}, (@<chanlist>) N679xA
[SOURce:]LIST:RESistance[:LEVel]? (@<chanlist>)

Specifies the setting for each list step. Values are specified in amperes, volts, watts, or ohms. A comma-delimited list of up to 512 steps may be programmed.

Parameter	Typical Return
0 to maximum. Values are range and module-rating dependent. *RST 1 step set to the minimum programmable value.	<list value 1>, <list value 2>, <list value 3>...

Parameter	Typical Return
Programs a current list of 3 steps. LIST:CURR 3,2,1, (@1) Programs a voltage list of 3 steps. LIST:VOLT 20,10,5, (@1) Programs a power list of 3 steps. LIST:POW 30,40,50, (@1) Programs a resistance list of 3 steps. LIST:RES 20,50,100, (@1)	

- The order in which the list values are entered determines the sequence when the list executes.
- To create a valid list, the current, voltage, power, resistance, BOST, EOST, and dwell lists must all be the same length or have a length of 1, which is interpreted as having the same length as the longest list.
- This command overwrites any present list in active memory; it does not append to the present list.

[SOURce:]LIST:DWELl <*value*>{,<*value*>}, (@<chanlist>)
[SOURce:]LIST:DWELl? (@<chanlist>)

Specifies the dwell time for each list step. Dwell time is the time that the output will remain at a specific step. Dwell times can be programmed from 0 through 262.144 or 0 through 268.435 seconds with the following resolution:

All models except N678xA SMU and N679xA		Models N678xA SMU and N679xA only	
Range in seconds	Resolution	Range in seconds	Resolution
0 - 0.262144	1 microsecond	0 - 0.268435	1.024 microsecond
0.262144 - 2.62144	10 microseconds	0.268435 - 2.68435	10.24 microseconds
2.62144 - 26.2144	100 microseconds	2.68435 - 26.8435	102.4 microseconds
26.2144 - 262.144	1 millisecond	26.8435 - 268.435	1.024 millisecond

A comma-delimited list of up to 512 steps may be programmed. At the end of the dwell time, the output state of the unit depends upon the [SOURce:]LIST:STEP program settings.

Parameter	Typical Return
0 – 262.144 (all except N678xA and N679xA) 0 - 268.435 (N678xA SMU and N679xA only) *RST 1 step with a value of 0.001	<value 1>, <value 2>, <value 3>...
Programs a dwell list. The list contains 3 steps: LIST:DWEL 0.2,0.8,1.6, (@1)	

- The order in which the list values are entered determines the sequence when the list executes.
- To create a valid list, the current, voltage, power, resistance, BOST, EOST, and dwell lists must all be the same length or have a length of 1, which is interpreted as having the same length as the longest list.
- This command overwrites any present list in active memory; it does not append to the present list.

[SOURce:]LIST:CURRent:POINts? (@<chanlist>)
[SOURce:]LIST:DWELl:POINts? (@<chanlist>)
[SOURce:]LIST:VOLTage:POINts? (@<chanlist>)
[SOURce:]LIST:POWer:POINts? (@<chanlist>) N679xA
[SOURce:]LIST:RESistance:POINts? (@<chanlist>) N679xA
[SOURce:]LIST:TOUTput:BOSTep:POINts? (@<chanlist>)
[SOURce:]LIST:TOUTput:EOSTep:POINts? (@<chanlist>)

Returns the number of list points (same as steps). The queries do not return the point values.

Parameter	Typical Return
(none)	<points>
Returns the number of points in the current list: LIST:CURR:POIN? (@1) Returns the number of points in the dwell list: LIST:DWEL:POIN? (@1) Returns the number of points in the voltage list: LIST:VOLT:POIN? (@1) Returns the number of points in the power list: LIST:POW:POIN? (@1) Returns the number of points in the resistance list: LIST:RES:POIN? (@1) Returns the number of points in the BOST list: LIST:TOUT:BOST:POIN? (@1) Returns the number of points in the EOST list: LIST:TOUT:EOST:POIN? (@1)	

[SOURce:]LIST:STEP ONCE|AUTO, (@<chanlist>)
[SOURce:]LIST:STEP? (@<chanlist>)

Specifies how the list responds to triggers.

ONCE - the output remains at the present step until a trigger advances it to the next step. Triggers that arrive during the dwell time are ignored.

AUTO - the output automatically advances to each step, after the receipt of an initial starting trigger. Steps are paced by the dwell list. As each dwell time elapses, the next step is immediately output.

Parameter	Typical Return
ONCE|AUTO, *RST AUTO	ONCE or AUTO
Specifies the list steps to be paced by trigger signals: LIST:STEP ONCE, (@1)	

[SOURce:]LIST:TERMinate:LAST 0|OFF|1|ON, (@<chanlist>)
[SOURce:]LIST:TERMinate:LAST? (@<chanlist>)

Determines the output value when the list terminates. When ON (1), the output remains at the last list step. The value of the last list step becomes the IMMediate value. When OFF (0), and also when the list is aborted, the output returns to the settings that were in effect before the list started.

Parameter	Typical Return
0|OFF|1|ON , *RST OFF	0 or 1
Terminate with the output at the last step value: LIST:TERM:LAST ON, (@1)	

- The query command returns 0 if the output returns to the settings that were in effect before the list started, and 1 if the output voltage or current remains at the value of the last list step.

[SOURce:]LIST:TOUTput:BOSTep[:DATA] 0|OFF|1|ON {,0|OFF|1|ON}, (@<chanlist>)
[SOURce:]LIST:TOUTput:BOSTep[:DATA]? (@<chanlist>)
[SOURce:]LIST:TOUTput:EOSTep[:DATA] 0|OFF|1|ON {,0|OFF|1|ON}, (@<chanlist>)
[SOURce:]LIST:TOUTput:EOSTep[:DATA]? (@<chanlist>)

Specifies which list steps generate a trigger signal at the beginning of step (BOSTep) or end of step (EOSTep). A comma-delimited list of up to 512 steps may be programmed.

A trigger is only generated when the state is set to ON. This signal can be used as a trigger source for measurements and transients of other units, and for digital pins configured as trigger outputs.

Parameter	Typical Return
0|OFF|1|ON , *RST 1 step with a value of OFF	<value 1>,<value 2>,<value 3>...
To generate triggers at the beginning of the second step of a 3-step list: LIST:TOUT:BOST OFF,ON,OFF, (@1)	

- The order in which the list values are entered determines the sequence when the list executes.
- To create a valid list, the current, voltage, power, resistance, BOST, EOST, and dwell lists must all be the same length or have a length of 1, which is interpreted as having the same length as the longest list.
- This command overwrites any present list in active memory; it does not append to the present list.

LXI Commands

LXI:IDENtify[:STATe] 0|OFF|1|ON
LXI:IDENtify[:STATe]?

Turns the front panel LXI identify indicator on or off. When turned on, the "LAN" status indicator on the front panel blinks on and off to identify the instrument that is being addressed.

Parameter	Typical Return
0|OFF|1|ON , *RST OFF	0 or 1
To blink the front panel LXI indicator: LXI:IDEN ON	

LXI:MDNS[:STATe] 0|OFF|1|ON
LXI:MDNS[:STATe]?

Controls the state of the mDNS server. Enables or disables multitasking DNS service on a private LAN.

Parameter	Typical Return
0|OFF|1|ON , *RST OFF	0 or 1
To enable mDNS: LXI:MDNS ON	

Measure Commands

Measure commands measure the output voltage, current, or power. The MEASure queries start a new measurement immediately. They are not synchronized to any trigger event.

Use the INITiate, TRIGger, and FETCh commands if a synchronized measurement is necessary.

The default time interval and number of points settings yield a measurement time of 21 milliseconds per reading (1024 data points at 20.48 microsecond intervals). The default windowing function is Rectangular.

MEASure[:SCALar]:CURRent[:DC]? (@<chanlist>)
MEASure[:SCALar]:VOLTage[:DC]? (@<chanlist>)
MEASure[:SCALar]:POWer[:DC]? (@<chanlist>) N676xA N678xA SMU N679xA

Initiates and triggers a measurement. Returns the averaged output measurement. Values returned are either in amperes, volts, or watts. The reading is in the form +n.nnnnnnE+nn for each channel specified. Multiple responses are separated by commas.

Parameter	Typical Return
(none)	<DC value>
Returns the averaged current MEAS:CURR? (@1) Returns the averaged power MEAS:POW? (@1) Returns the averaged voltage MEAS:VOLT? (@1)	

MEASure[:SCALar]:CURRent:ACDC? (@<chanlist>)
MEASure[:SCALar]:VOLTage:ACDC? (@<chanlist>)

Initiates, triggers, and returns the total RMS measurement (AC + DC). Values returned are either in amperes, or volts. The reading is in the form +n.nnnnnnE+nn for each channel specified. Multiple responses are separated by commas.

Parameter	Typical Return
(none)	<ACDC value>
Returns the measured RMS current MEAS:CURR:ACDC? (@1) Returns the measured RMS voltage MEAS:VOLT:ACDC? (@1)	

MEASure[:SCALar]:CURRent:HIGH? (@<chanlist>)
MEASure[:SCALar]:VOLTage:HIGH? (@<chanlist>)

Initiates, triggers, and returns the High level of a pulse waveform. Values returned are either in amperes, or volts. See Measurement Types. The reading is in the form +n.nnnnnnE+nn for each channel specified. Multiple responses are separated by commas.

Parameter	Typical Return
(none)	<HIGH value>
Returns the measured high level current MEAS:CURR:HIGH? (@1) Returns the measured high level voltage MEAS:VOLT:HIGH? (@1)	

MEASure[:SCALar]:CURRent:LOW? (@<chanlist>)
MEASure[:SCALar]:VOLTage:LOW? (@<chanlist>)

Initiates, triggers, and returns the Low level of a pulse waveform. Values returned are either in amperes, or volts. See Measurement Types. The reading is in the form +n.nnnnnnE+nn for each channel specified. Multiple responses are separated by commas.

Parameter	Typical Return
(none)	<LOW value>
Returns the measured low level current MEAS:CURR:LOW? (@1) Returns the measured low level voltage MEAS:VOLT:LOW? (@1)	

MEASure[:SCALar]:CURRent:MAXimum? (@<chanlist>)
MEASure[:SCALar]:VOLTage:MAXimum? (@<chanlist>)
MEASure[:SCALar]:POWer:MAXimum? (@<chanlist>) N676xA N678xA SMU N679xA
MEASure[:SCALar]:CURRent:MINimum? (@<chanlist>)
MEASure[:SCALar]:VOLTage:MINimum? (@<chanlist>)
MEASure[:SCALar]:POWer:MINimum? (@<chanlist>) N676xA N678xA SMU N679xA

Initiates, triggers, and returns the maximum or minimum values of a measurement. Values returned are either in amperes, volts, or Watts. The reading is in the form +n.nnnnnnE+nn for each channel specified. Multiple responses are separated by commas.

Parameter	Typical Return
(none)	<MIN value> <MAX value>
Returns the measured minimum current MEAS:CURR:MIN? (@1) Returns the measured minimum voltage MEAS:VOLT:MIN? (@1) Returns the measured minimum power MEAS:POW:MIN? (@1)	
Returns the measured maximum current MEAS:CURR:MAX? (@1) Returns the measured maximum voltage MEAS:VOLT:MAX? (@1) Returns the measured maximum power MEAS:POW:MAX? (@1)	

MEASure:ARRay:CURRent[:DC]? (@<chanlist>)
MEASure:ARRay:VOLTage[:DC]? (@<chanlist>)
MEASure:ARRay:POWer[:DC]? (@<chanlist>) N676xA N678xA SMU N679xA

NOTE MEASure:ARRAy commands require Option 054 to be installed on models N673xA. N674xA, N675xA, and N677xA.

Initiates and triggers a measurement; returns a list of the digitized output measurement samples. Values returned are either in amperes, volts, or watts.

The sampling rate is set by SENSe:SWEep:TINTerval. The position of the trigger relative to the beginning of the data buffer is determined by SENSe:SWEep:OFFSet:POINts. The number of points returned is set by SENSe:SWEep:POINts.

The return format depends on the settings of the FORMat:BORDer and FORMat[:DATA] commands. When the data format is set to ASCII, returned values are comma separated. When the data format is set to REAL, data is returned as single precision floating point values in definite length arbitrary block response format.

Parameter	Typical Return
(none)	<value> [,<value>] or <Block>
Returns the measured current array MEAS:ARR:CURR? (@1) Returns the measured power array MEAS:ARR:POW? (@1) Returns the measured voltage array MEAS:ARR:VOLT? (@1)	

Output Commands

Output commands control the output, power-on, and protection clear functions.

NOTE Keysight N679xA Load Module inputs are referred to as "Outputs" throughout this document N679xA.

OUTPut[:STATe] 0|OFF|1|ON [,NORelay], (@<chanlist>)
OUTPut[:STATe]? (@<chanlist>)

Enables/disables the output. The state of a disabled output is a condition of zero output voltage and zero current. If output and sense relays are installed (Option 761), the relays will open after the output is disabled and close before the output is enabled.

NORelay - If you require shorter output turn-on delay times, and do not need the galvanic relay disconnect feature, the optional NORelay parameter lets you turn the output state on or off and leave the state of the relays closed. When not specified, the relays open and close as the output is turned off and on. Relays only open and close when the output is at zero voltage; zero current.

Parameter	Typical Return
0|OFF|1|ON , *RST OFF	0 or 1
Turns the output off: OUTP OFF, (@1)	

- Because of internal circuit start-up procedures and any installed relay options, the OUTPut ON command may take between 35 and 50 milliseconds to complete. The OUTPut OFF command may take between 20 and 25 milliseconds to complete. To mitigate this built-in delay, you can program the output to zero volts rather than using the output on/off command.
- To use the optional NORelay parameter, you must first set the relays to the closed state by programming OUTPut ON without the NORelay parameter. The relays will be set closed. For the output relays to remain closed from then on, you must subsequently include the NORelay parameter each time you program the output on or off.
- The N6700 series firmware prevents the output disconnect relays from being hot-switched.

OUTPut[:STATe]:COUPle[:STATe] 0|OFF|1|ON
OUTPut[:STATe]:COUPle[:STATe]?

Enables or disables output coupling or synchronization between multiple output channels. Enabling this function allows you to control the output state of multiple channels by controlling the output state of one output channel. This parameter is saved in non-volatile memory.

Parameter	Typical Return
0|OFF|1|ON	0 or 1
Turns the output coupling state on: OUTP:COUP ON	

- This function also allows you to control the output state of coupled outputs in multiple mainframes when the Digital connector pins have been properly configured. You must connect and configure the ONCouple and OFFCouple digital connector pins of all synchronized mainframes as described in the Synchronizing Multiple Mainframes section.
- Because some power modules have different minimum delay offsets, you must also specify a common delay offset for all of the synchronized channels. This value must be the largest delay offset of the synchronized group. Use OUTPut:COUPle:MAX:DOFFset? to query the delay offset for each channel. The largest value returned must be specified as the common delay offset for each channel.
- When this command is sent, all channels in the unit will go to the output off state.

OUTPut[:STATe]:COUPle:CHANnel [<channel> {,<channel>}]
OUTPut[:STATe]:COUPle:CHANnel?

Specifies which output channels in the mainframe are controlled by the output synchronization function. The output channels that have been synchronized or coupled will turn on and off together when any one of them is turned on or off, or when a signal is received from a digital connector pin that has been configured as an On couple or an Off couple pin as described in the Synchronizing Multiple Mainframes section. This parameter is saved in non-volatile memory.

Parameter	Typical Return
1 | 2 | 3 | 4 , *RST 0	<coupled channels>
Couples channel 1,2,and 4: OUTP:COUP:CHAN 1,2,4	

- There can be only one set of coupled channels in a mainframe. If another coupled set is programmed, the existing set is deleted and the new set applies. If you do not specify an output channel, this command will uncouple all output channels on the mainframe.
- When this command is sent, all channels in the unit will go to the output off state.

OUTPut[:STATe]:COUPle:DOFFset <*value*>
OUTPut[:STATe]:COUPle:DOFFset? [MIN|MAX,]

Sets a delay offset to synchronize coupled output state changes. Delay times can be programmed from 0 to 1.023 seconds . Setting this time to the maximum delay offset specified for any instrument that is being coupled will cause all coupled outputs to synchronize to the turn-on times specified by OUTPut:DELay:RISE. This delay only applies to coupled channels, provided OUTput:COUPle is enabled. This parameter is saved in non-volatile memory.

Parameter	Typical Return
0 to 1.023	<delay value>
Specifies a delay of 60 milliseconds: OUTP:COUP:DOFF 0.06	

- When this command is sent, all channels in the unit will go to the output off state.

OUTPut[:STATe]:COUPle:DOFFset:MODE AUTO|MANual
OUTPut[:STATe]:COUPle:DOFFset:MODE?

Specifies the mode that determines where the output coupling delay value comes from when outputs are synchronized. This parameter is saved in non-volatile memory.

AUTO - The power system automatically calculates the maximum delay offset value for all output channels in the mainframe.

MANual - The power system uses the delay offset value set by OUTPut:COUPle:DOFFSet.

Parameter	Typical Return
AUTO|MANual, *RST AUTO	AUTO or MAN
Sets the delay offset mode to manual: OUTP:COUP:DOFF:MODE MAN	

- When this command is sent, all channels in the unit will go to the output off state.

OUTPut[:STATe]:COUPle:MAX:DOFFset?

Returns the largest delay offset that is required for the output channels installed in this mainframe. As a minimum, the OUTPut:COUPle:DELay:OFFSet value must be set to the maximum delay offset returned for any coupled output.

Parameter	Typical Return
(none)	<offset value>
Returns the maximum delay offset: OUTP:COUP:MAX:DOFF?	

OUTPut[:STATe]:DELay:FALL <*value*>, (@<chanlist>)
OUTPut[:STATe]:DELay:FALL? [MIN|MAX,] (@<chanlist>)
OUTPut[:STATe]:DELay:RISE <*value*>, (@<chanlist>)
OUTPut[:STATe]:DELay:RISE? [MIN|MAX,] (@<chanlist>)

Specifies the delay in seconds that the instrument waits before turning the output on (rise) or off (fall). This allows multiple channels to turn on or off in sequence. The output will not turn on or off until its delay time has elapsed. This command affects on-to-off state transitions. It does NOT affect transitions to off caused by protection functions. Delay times can be programmed from 0 to 1023 seconds with the following resolution:

Range in seconds	Resolution	Range in seconds	Resolution
0 to 1.023E–4	100 nanoseconds	1.03E–1 to 1.023E+0	1 millisecond
1.03E–4 to 1.023E–3	1 microsecond	1.03E+0 to 1.023E+1	10 milliseconds
1.03E–3 to 1.023E–2	10 microseconds	1.03E+1 to 1.023E+2	100 milliseconds
1.03E–2 to 1.023E–1	100 microseconds	1.03E+2 to 1.023E+3	1 second

Note that both Rise and Fall commands use the same resolution; which is determined by whichever delay time (fall or rise) is the longest.

Parameter	Typical Return
0 - 1023, *RST 0	<delay value>
Sets a delay of 0.5 s before turning the output on: OUTP:DEL:RISE 0.5, (@1) Sets a delay of 0.2 s before turning the output off: OUTP:DEL:FALL 0.2, (@1)	

- Each power module exhibits 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. If you specify a turn-on delay, this delay will be added to the minimum delay offset, resulting in a turn-on delay that is actually longer than the one you programmed.
- Use OUTput:COUPle:MAX:DOFFset? to query the delay offset that is required for each instrument.

OUTPut[:STATe]:PMODe VOLTage|CURRent, (@<chanlist>) N6761A, N6762A
OUTPut[:STATe]:PMODe? (@<chanlist>)

Selects 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. Turn-on and turn-off overshoots are minimized for the preferred mode of operation.

Voltage - minimizes output on/off voltage overshoots in constant voltage operation.

Current - minimizes output on/off current overshoots in constant current operation.

Parameter	Typical Return
VOLTage|CURRent, *RST VOLTage	VOLT or CURR
Sets the preferred mode to CURRent: OUTP:PMODE CURR, (@1)	

OUTPut[:STATe]:TMODe HIGHz|LOWz, (@<chanlist>) N678xA SMU
OUTPut[:STATe]:TMODe? (@<chanlist>)

Specifies the output impedance mode at turn-off.

HIGHz - sets the output to a high impedance mode at turn-off. In high impedance mode, the output relays are opened while the output remains at its set value.

LOWZ - sets the output to a low impedance mode at turn-off. In low impedance mode, the output is first down-programmed to zero, after which the output relays are opened.

Parameter	Typical Return
HIGHz|LOWZ, *RST HIGHz	HIGH or LOWZ
Sets the turn-off mode to high impedance: OUTP:TMODE HIGH, (@1)	

OUTPut:INHibit:MODE LATChing|LIVE|OFF
OUTPut:INHibit:MODE?

Sets the operating mode of the remote inhibit digital pin. The inhibit function shuts down the output in response to an external signal on the Inhibit input pin. The Inhibit mode is stored in non-volatile memory. See Inhibit Input.

LATChing - a logic-true signal on the Inhibit input causes the output state to latch OFF. The output remains disabled until the Inhibit input is returned to logic-false and the latched INH status bit is cleared by sending the OUTPut:PROTection:CLEar command or a protection clear command from the front panel.

LIVE - allows the enabled output to follow the state of the Inhibit input. When the Inhibit input is true, the output is disabled. When the Inhibit input is false, the output is re-enabled.

OFF - The Inhibit input is ignored.

Parameter	Typical Return
LATChing|LIVE|OFF	LATC, LIVE, or OFF
Sets the Inhibit input to latching mode: `OUTP:INH:MODE LATC`	

OUTPut:PON:STATe RST|RCL0
OUTPut:PON:STATe?

This determines whether the power-on state is set to the *RST state (RST) or the state stored in memory location 0 (RCL0). Instrument states can be stored using the *SAV command. This parameter is saved in non-volatile memory.

Parameter	Typical Return
RST|RCL0	RST or RCL0
Sets the power-on state to the *RST state: `OUTP:PON:STAT RST`	

OUTPut:PROTection:CLEar (@<chanlist>)

This clears the latched protection status that disables the output when a protection condition occurs (see Programming Output Protection). The output is restored to the state it was in before the protection condition occurred.

Parameter	Typical Return
(none)	(none)
Clears the latched protection status: `OUTP:PROT:CLE (@1)`	

- All conditions that generate the fault must be removed before the latched status can be cleared. The output is restored to the state it was in before the fault condition occurred.

- If a protection shutdown occurs during an output list, the list continues running even though the output is disabled. When the protection status is cleared and the output becomes enabled again, the output will be set to the values of the step that the list is presently at.

OUTPut:PROTection:COUPle 0|OFF|1|ON

Enables or disables channel coupling for protection faults. When enabled, ALL output channels are disabled when a protection fault occurs on any output channel. When disabled, only the affected output channel is disabled when a protection fault is triggered

Parameter	Typical Return
0|OFF|1|ON , *RST OFF	0 or 1
Turns the output coupling protection on: OUTP:PROT:COUP ON	

OUTPut:PROTection:DELay <*value*>, (@<chanlist>)
OUTPut:PROTection:DELay? [MIN|MAX,] (@<chanlist>)

NOTE This command is the same as [SOURce:]CURRent:PROTection:DELay.

Sets the over-current protection delay. The over-current protection function will not be triggered during the delay time. After the delay time has expired, the over-current protection function will be active. This prevents momentary changes in output status from triggering the over-current protection function. Values up to 255 milliseconds can be programmed with a resolution of 1 millisecond.

Parameter	Typical Return
0 - 0.255|MIN|MAX, *RST 0.020	<delay value>
Sets a delay protection of 0.2 seconds: OUTP:PROT:DEL 0.2, (@1)	

- The operation of over-current protection is affected by the setting of the current protection delay start event, which is specified by [SOURce:]CURRent:PROTection:DELay:STARt.

OUTPut:PROTection:OSCillation 0|OFF|1|ON, (@<chanlist>) N678xA SMU
OUTPut:PROTection:OSCillation? (@<chanlist>)

Enables/Disables oscillation protection. If capacitive loads cause the output to oscillate on any of the bandwidth settings, this protection function will detect the oscillation and latch the output off.

Parameter	Typical Return
0|OFF|1|ON, *RST ON	0 or 1
Enables oscillation protection: OUTP:PROT:OSC ON, (@1)	

OUTPut:PROTection:TEMPerature:MARGin? (@<chanlist>)

Returns the margin remaining before the over-temperature trips. The temperature margin is the minimum difference between the internal temperature sensors and the fixed over-temperature trip level. The margin is returned in degrees Celsius.

Parameter	Typical Return
(none)	<margin value>
Returns the temperature margin: OUTP:PROT:TEMP:MARG? (@1)	

OUTPut:PROTection:WDOG[:STATe] 0|OFF|1|ON
OUTPut:PROTection:WDOG[:STATe]?

Enables/disables the I/O watchdog timer. When enabled, the output will be disabled if there is no I/O activity on any remote interface within the time period specified by OUTput:PROTection:WDOG:DELay. The output is latched off but the programmed output state is not changed.

Parameter	Typical Return
0|OFF|1|ON, *RST OFF	0 or 1
Enables the watchdog timer protection: OUTP:PROT:WDOG ON	

OUTPut:PROTection:WDOG:DELay <*value*>
OUTPut:PROTection:WDOG:DELay? [MIN|MAX,]

Sets the watchdog delay time. When the watchdog timer is enabled, the output is disabled if there is no SCPI I/O activity on any remote interface (USB, LAN, GPIB) within the delay time. The watchdog timer function is NOT reset by activity on the front panel - the output will still shut down after the time period has elapsed. Programmed values can range from 1 to 3600 seconds in 1 second increments.

Parameter	Typical Return
0 - 3600|MIN|MAX, *RST 60	<delay value>
Sets a watchdog delay of 600 seconds: OUTP:PROT:WDOG:DEL 600	

OUTPut:RELay:POLarity NORMal|REVerse, (@<chanlist>)
OUTPut:RELay:POLarity? (@<chanlist>)

NOTE This command only applies to models N673xA. N674xA, N675xA, N676xA, and N677xA with Option 760.

Sets the polarity of the output relays on power modules with polarity reversal relays installed (Option 760). Polarity reversal affects both the output and the sense terminals.

Normal causes the output polarity to be the same as the output connector labeling.

Reverse causes the output polarity to be the reverse of the output connector labeling. This briefly turns the output off while the output and sense terminal polarities are switched.

NOTE

When installed on models N6742B and N6773A, Option 760 will limit the output current of these models to a maximum of 10 A. Option 760 is **not** available on models N6741B, N6751A, N6752A, N676xA, or N678xA SMU.

Parameter	Typical Return
NORMal|REVerse, *RST NORMal	NORM or REV
Sets the output polarity to Reverse: OUTP:REL:POL REV (@1)	

OUTPut:SHORt[:STATe] 0|OFF|1|ON N679xA
OUTPut:SHORt[:STATe]?

Simulates a short circuit on the input of the load. It works in all priority modes and temporarily overrides input and slew settings. Note that the Output on/off and the output protection functions take precedence over an input short. The actual value of the short depends on the mode and range that are active when the short is programmed.

In CV mode, a short is equivalent to programming zero volts.
In CC mode, a short is equivalent to programming full-scale current for the present current range.
In CR mode, a short is equivalent to programming the minimum resistance for the present resistance range.

Turning the short circuit on does not affect the programmed settings, and the load input will return to the previously programmed values when the short is turned off.

Parameter	Typical Return
0|OFF|1|ON, *RST OFF	0 or 1
Simulate a short on the load input terminals: OUTP:SHOR ON	

Power Commands

Power commands program the output power.

[SOURce:]POWer[:LEVel][:IMMediate][:AMPLitude] <*value*>, (@<chanlist>) N679xA
[SOURce:]POWer[:LEVel][:IMMediate][:AMPLitude]? [MIN|MAX,] (@<chanlist>)
[SOURce:]POWer[:LEVel]:TRIGgered[:AMPLitude] <*value*>, (@<chanlist>) N679xA
[SOURce:]POWer[:LEVel]:TRIGgered[:AMPLitude]? [MIN|MAX,] (@<chanlist>)

Sets the immediate input power level and the triggered input power level. Values can range from zero to the maximum input power rating of the load module. The triggered level is a stored value that will be programmed when a Step transient is triggered. Units are in Watts.

Parameter	Typical Return
0 - maximum|MIN|MAX, *RST MIN	0 (zero)
Specifies a power level of 50 Watts: POW 50, (@1) Specifies a triggered power level of 75 Watts: POW:TRIG 75, (@1)	

- The query returns the programmed power in the form +n.nnnnnnE+nn for each channel specified. Multiple responses are separated by commas.

[SOURce:]POWer:LIMit <*value*>, (<@chanlist>)
[SOURce:]POWer:LIMit? [MIN|MAX,] (<@chanlist>)

Sets the power limit on output channels. Units are in Watts.

For the majority of Keysight N6700C configurations, full power is available from all installed power modules. However, it is possible to configure a mainframe in which the combined ratings of the power modules exceed the power rating of the mainframe

For these instrument configurations, the power allocation lets you programmatically limit the output power of some of the power modules so that the combined output power does not exceed the power rating of the mainframe. Refer to Power Allocation for more information.

Parameter	Typical Return
0 - maximum|MIN|MAX, *RST MAX	<power limit>
Sets the power limit to 75 W on channels 1 and 2: POW:LIM 75, (@1,2)	

- Setting a power limit of MAX on an output channel sets the output channel to its maximum rated power limit. If the power limit is left at the maximum rating, then the power module will not enable its power limit function.
- The query returns the programmed power level in the form +n.nnnnnnE+nn for each channel specified. Multiple responses are separated by commas. Querying MAX on an output channel returns the maximum rated power limit.
- For models N679xA, the query returns the input power level setting.

[SOURce:]POWer:MODE FIXed|STEP|LIST|ARB, (@<chanlist>) N679xA
[SOURce:]POWer:MODE? (@<chanlist>)

Sets the transient mode. This determines what happens to the input power when the transient system is initiated and triggered.

FIXed – keeps the input power at its immediate value.
STEP – steps the input power to the triggered level when a trigger occurs.
LIST – causes the input power to follow the list values when a trigger occurs.
ARB causes the input power to follow the arbitrary waveform values when a trigger occurs.

Parameter	Typical Return
FIXed|STEP|LIST|ARB, *RST FIXed	FIX, STEP, LIST, or ARB
Sets the input power mode to Step: POW:MODE STEP, (@1)	

[SOURce:]POWer:PROTection:DELay[:TIME] <*value*>, (@<chanlist>) N679xA
[SOURce:]POWer:PROTection:DELay[:TIME]? [MIN|MAX,] (@<chanlist>)

NOTE This command is the same as OUTPut:PROTection:DELay.

Sets the over-power protection delay. The over-power protection function will not be triggered during the delay time. This prevents momentary changes in output status from triggering the over-power protection function. If the input is regulating in power limit longer than the programmable delay time, the OPP will trip, and the input will be turned off. Programmed values can range from 0 to 0.255 seconds with a resolution of 1 millisecond.

Parameter	Typical Return
0 – 0.255|MIN|MAX, *RST 0.020	<delay value>
Sets the protection delay to 0.2 seconds: POW:PROT:DEL 0.2, (@1)	

[SOURce:]POWer:PROTection:STATe 0|OFF|1|ON, (@<chanlist>) N679xA
[SOURce:]POWer:PROTection:STATe?[MIN|MAX,] (@<chanlist>)

Enables or disables the power protection. When the input power exceeds the power rating of the module by 10%, the output is disabled and the Questionable Condition status register CP+ bit is set.

Parameter	Typical Return
0|OFF|1|ON, *RST OFF	0 or 1
Enable the power protection state: POW:PROT:STAT ON, (@1)	

- A power protection condition can be cleared with OUTPut:PROTection:CLEar after the cause of the condition is removed.

[SOURce:]POWer:RANGe <*value*>, (@<chanlist>) N679xA
[SOURce:]POWer:RANGe? [MIN|MAX,] (@<chanlist>)

Sets the power range. The value that you enter must be the highest value in Watts that you expect to source. The instrument selects the range with the best resolution for the value entered. The following ranges are available for the N679xA load modules.

	N6791A	N6792A
High power range	from 0.3 W to 100 W	from 0.5 W to 200 W
Low power range	from 0.04 W to 10 W	from 0.1 W to 20 W

Parameter	Typical Return
0 to maximum|MIN|MAX, *RST 100|200	100 or 200
Sets the low power range (from 0.04 W to 10 W): POW:RANG 5, (@1)	

- This command is coupled with [SOURce:]POWer. This means that if a range command places an output on a range with a lower maximum power than the present power level, an out of range error occurs. This also occurs if a power level is programmed that is too large for the present range. Errors can be avoided by sending both level and range commands in the same SCPI message. When the range and level information is received as a set, no range/setting conflict occurs.
- If a programmed range change occurs while the output is enabled, the output will be temporarily disabled while the range switch occurs. The transition from on-to-off and then from off-to-on will also be delayed by the settings of OUTPut:DELay:FALL and OUTPut:DELay:RISE.
- The query returns the maximum power that can be programmed on the range that is presently set. The power is in the form +n.nnnnnnE+nn for each channel specified. Multiple responses are separated by commas.

[SOURce:]POWer:SLEW[:POSitive][:IMMediate] <*value*>, (@<chanlist>) N679xA
[SOURce:]POWer:SLEW[:POSitive][:IMMediate]? [MIN|MAX,] (@<chanlist>)
[SOURce:]POWer:SLEW:NEGative[:IMMediate] <*value*>, (@<chanlist>) N679xA
[SOURce:]POWer:SLEW:NEGative[:IMMediate]? [MIN|MAX,] (@<chanlist>)

Sets the input power slew rate. The slew rate is set in watts per second and affects all programmed power changes, including those due to the output state turning on or off. The slew rate can be set to any value between 0 and 9.9E+37. For very large values, the slew rate will be limited by the analog performance of the input circuit. The keywords MAX or INFinity set the slew rate to maximum.

Parameter	Typical Return
0 – 9.9E+37|MIN|MAX|INFinity, *RST MAX	<slew rate>
Sets the input power slew rate to 10 watts per second: POW:SLEW 10, (@1) Sets the negative input power slew rate to 10 watts per second: POW:SLEW:NEG 10, (@1)	

- The query returns the value that was sent. If the value is less than the minimum slew rate, only the minimum value is returned. The resolution of the slew setting is also the minimum value, which can be queried using POWer:SLEW? MIN. The exact value varies slightly based on calibration.
- The query returns the programmed slew rate in the form +n.nnnnnnE+nn for each channel specified. Multiple responses are separated by commas. If a slew rate of 9.9E37 is returned, it means that the maximum or fastest slew rate has been set.

[SOURce:]POWer:SLEW:COUPle 0|OFF|1|ON, (@<chanlist>) N679xA
[SOURce:]POWer:SLEW:COUPle? (@<chanlist>)

Sets the input power slew tracking state.

Parameter	Typical Return
0|OFF|1|ON, *RST OFF	0 or 1
Enables the input power slew tracking state: POW:SLEW:COUP ON, (@1)	

[SOURce:]POWer:SLEW[:POSitive]:MAXimum 0|OFF|1|ON, (@<chanlist>) N679xA
[SOURce:]POWer:SLEW[:POSitive]:MAXimum? (@<chanlist>)
[SOURce:]POWer:SLEW:NEGative:MAXimum 0|OFF|1|ON, (@<chanlist>) N679xA
[SOURce:]POWer:SLEW:NEGative:MAXimum? (@<chanlist>)

Enables/disables the maximum slew rate override. When enabled, the slew rate is set to its maximum value. When disabled, the slew rate is set to the immediate value set by POWer:SLEW. Use POWer:SLEW? MAX to query the maximum slew rate.

Parameter	Typical Return
0|OFF|1|ON, *RST OFF	0 or 1
Enable the maximum slew rate override: POW:SLEW:MAX ON, (@1) Enable the negative maximum slew rate: POW:SLEW:NEG:MAX ON, (@1)	

- The POWer:SLEW:MAX command is coupled to the POWer:SLEW command. If the POWer:SLEW command sets the slew rate to MAX or INFinity, POWer:SLEW:MAX is enabled. If the slew rate is set to any other value, POWer:SLEW:MAX is disabled.

Resistance Commands

Resistance commands program the output resistance.

[SOURce:]RESistance[:LEVel][:IMMediate][:AMPLitude] <*value*>, (@<chanlist>) N6781A, N6785A N679xA

[SOURce:]RESistance[:LEVel][:IMMediate][:AMPLitude]? [MIN|MAX,] (@<chanlist>)

[SOURce:]RESistance[:LEVel]:TRIGgered[:AMPLitude] <*value*>, (@<chanlist>) N679xA

[SOURce:]RESistance[:LEVel]:TRIGgered[:AMPLitude]? [MIN|MAX,] (@<chanlist>)

Sets the immediate resistance level and the triggered resistance level. The triggered level is a stored value that will be programmed when a Step transient is triggered. Units are in ohms.

Parameter	Typical Return
- 40 mΩ to +1 Ω|MIN|MAX, *RST 0 (N6781A/85A) 80 mΩ to +8 kΩ|MIN|MAX, *RST 8 kΩ (N679xA)	0 (zero)
Specifies a resistance of 0.5 ohms: RES 0.5, (@1) Specifies a triggered resistance of 1 ohms: RES:TRIG 0.5, (@1)	

- The query returns the programmed resistance in the form +n.nnnnnnE+nn for each channel specified. Multiple responses are separated by commas.
- For models N6781A, N6785A this command has been superceded by the VOLTage:RESistance <value> command, which should be used in new applications. RESistance <value> is still available for backward compatibility, but will generate an error if an N6781A/N6785A module is programmed together with an N679xA load module.

[SOURce:]RESistance:MODE FIXed|STEP|LIST|ARB, (@<chanlist>) N679xA

[SOURce:]RESistance:MODE? (@<chanlist>)

Sets the transient mode. This determines what happens to the resistance when the transient system is initiated and triggered.

FIXed – keeps the resistance at its immediate value.
STEP – steps the resistance to the triggered level when a trigger occurs.
LIST – causes the resistance to follow the list values when a trigger occurs.
ARB – causes the resistance to follow the arbitrary waveform values when a trigger occurs.

Parameter	Typical Return
FIXed|STEP|LIST|ARB, *RST FIXed	FIX, STEP, LIST, or ARB
Sets the resistance mode to Step: RES:MODE STEP, (@1)	

[SOURce:]RESistance:RANGe <*value*>, (@<chanlist>) N679xA
[SOURce:]RESistance:RANGe? [MIN|MAX,] (@<chanlist>)

Sets the resistance range. The value that you enter must be the highest value in ohms that you expect to source. The instrument selects the range with the best resolution for the value entered. The following overlapping resistance ranges are available for the N679xA load modules.

	N6791A	N6792A
High resistance range	from 30 Ω to 8 kΩ	from 15 Ω to 8 kΩ
Medium resistance range	from 2 Ω to 100 Ω	from 2 Ω to 100 Ω
Low resistance range	from 0.08 Ω to 3 Ω	from 0.04 Ω to 3 Ω

Parameter	Typical Return
0 - maximum|MIN|MAX, *RST 8000, *RST 8000	8000
Sets the medium resistance range (from 2 to 100 ohms): RES:RANG 100, (@1)	

- This command is coupled with [SOURce:]RESistance. This means that if a resistance value is programmed that does not fall within the presently selected range, the range command automatically selects the correct range for the new resistance value. An out of range error occurs if a resistance value is less than the low-range minimum, or greater than the high-range maximum.
- The resistance level value always takes precedence over the resistance range value. Therefore, an out of range error occurs if a resistance range is changed when the presently selected resistance value does not fall within the new range. Errors can be avoided by sending both level and range commands in the same SCPI message. When the range and level information is received as a set, no range/setting conflict occurs.
- If a programmed range change occurs while the output is enabled, the output will be temporarily disabled while the range switch occurs. The transition from on-to-off and then from off-to-on will also be delayed by the settings of OUTPut:DELay:FALL and OUTPut:DELay:RISE.
- The query returns the maximum resistance that can be programmed on the range that is presently set. The resistance is in the form +n.nnnnnnE+nn for each channel specified. Multiple responses are separated by commas.

[SOURce:]RESistance:SLEW[:POSitive][:IMMediate] <*value*>, (@<chanlist>) N679xA
[SOURce:]RESistance:SLEW[:POSitive][:IMMediate]? [MIN|MAX,] (@<chanlist>)
[SOURce:]RESistance:SLEW:NEGative[:IMMediate] <*value*>, (@<chanlist>) N679xA
[SOURce:]RESistance:SLEW:NEGative[:IMMediate]? [MIN|MAX,] (@<chanlist>)

Sets the resistance slew rate. The slew rate is set in ohms per second and affects all programmed resistance changes, including those due to the output state turning on or off. The slew rate can be set to any value between 0 and 9.9E+37. For very large values, the slew rate will be limited by the analog performance of the output circuit. The keywords MAX or INFinity set the slew rate to maximum.

Parameter	Typical Return
0 – 9.9E+37|MIN|MAX|INFinity, *RST MAX	<slew rate>
Sets the slew rate to 50 ohms per second: RES:SLEW 50, (@1) Sets the negative slew rate to 25 ohms per second: RES:SLEW:NEG 25, (@1)	

- The query returns the value that was sent. If the value is less than the minimum slew rate, only the minimum value is returned. The resolution of the slew setting is also the minimum value, which can be queried using RESistance:SLEW? MIN. The exact value varies slightly based on calibration.
- The query returns the programmed slew rate in the form +n.nnnnnnE+nn for each channel specified. Multiple responses are separated by commas. If a slew rate of 9.9E37 is returned, it means that the maximum or fastest slew rate has been set.

[SOURce:]RESistance:SLEW:COUPle 0|OFF|1|ON, (@<chanlist>) N679xA
[SOURce:]RESistance:SLEW:COUPle? (@<chanlist>)

Sets the resistance slew tracking state.

Parameter	Typical Return
0|OFF|1|ON, *RST OFF	0 or 1
Enables the resistance slew tracking state: RES:SLEW:COUP ON, (@1)	

[SOURce:]RESistance:SLEW[:POSitive]:MAXimum 0|OFF|1|ON, (@<chanlist>) N679xA
[SOURce:]RESistance:SLEW[:POSitive]:MAXimum? (@<chanlist>)
[SOURce:]RESistance:SLEW:NEGative:MAXimum 0|OFF|1|ON, (@<chanlist>) N679xA
[SOURce:]RESistance:SLEW:NEGative:MAXimum? (@<chanlist>)

Enables/disables the maximum slew rate override. When enabled, the slew rate is set to its maximum value. When disabled, the slew rate is set to the immediate value set by RESistance:SLEW. Use RESistance:SLEW? MAX to query the maximum slew rate.

Parameter	Typical Return
0|OFF|1|ON, *RST OFF	0 or 1
Enable the maximum slew rate override: RES:SLEW:MAX ON, (@1) Enable the negative maximum slew rate: RES:SLEW:NEG:MAX ON, (@1)	

- The RESistance:SLEW:MAX command is coupled to the RESistance:SLEW command. If the RESistance:SLEW command sets the slew rate to MAX or INFinity, RESistance:SLEW:MAX is enabled. If the slew rate is set to any other value, RESistance:SLEW:MAX is disabled.

[SOURce:]RESistance:STATe 0|OFF|1|ON, (@<chanlist>) N6781A, N6785A
[SOURce:]RESistance:STATe? (@<chanlist>)

Enables/disables output resistance programming.

Parameter	Typical Return
0|OFF|1|ON , *RST OFF	0 or 1
Turns resistance programming on: RES:STAT ON, (@1)	

- This command has been superceded by the VOLTage:RESistance:STAte command, which should be used in new applications. RESistance:STATe is still available for backward compatibility.

Sense Commands

Sense commands select the measurement ranges, parameters, and window. They also program the external datalog function.

NOTE SENSe:ELOG, SENSe:SWEep, and SENSe:WINDow commands require Option 054 to be installed on models N673xA. N674xA, N675xA, and N677xA.

SENSe:CURRent:CCOMpensate 0|OFF|1|ON, (@<chanlist>)
SENSe:CURRent:CCOMpensate? (@<chanlist>)

NOTE This command does NOT apply to models N678xA SMU or N679xA loads not N678xA SMU not N679xA. On models N676xA N676xA this command only applies in the High current range.

Enables or disables the capacitive current compensation.

When turned ON, this function corrects the output current measurement for the current that flows into the output capacitor. This current is only significant when high dv/dt occurs, and because this current does not flow into the output load, it represents an error when not corrected. Note that turning on the current measurement compensation increases the peak to peak noise in current measurements.

Parameter	Typical Return
0|OFF|1|ON, *RST ON	0 or 1
Disable sense current compensation: CURR:CCOM OFF, (@1)	

SENSe:CURRent[:DC]:RANGe[:UPPer] <*value*>, (@<chanlist>)
SENSe:CURRent[:DC]:RANGe[:UPPer]? [MIN|MAX,] (@<chanlist>)

Selects a DC current measurement range. The value that you enter must be the highest value that you expect to measure. Units are in amperes. The instrument selects the range with the best resolution for the value entered.

Parameter	Typical Return
0 to maximum|MIN|MAX	<max current>
Selects the 2 A range: SENS:CURR:RANG 2, (@1)	

- The query returns the maximum current that can be measured on the range that is presently set.

SENSe:CURRent[:DC]:RANGe:AUTO 0|OFF|1|ON, (@<chanlist>) N678xA SMU Option SMR
SENSe:CURRent[:DC]:RANGe:AUTO? (@<chanlist>)

Enables or disables seamless measurement autoranging.

Parameter	Typical Return
0|OFF|1|ON, *RST OFF	0 or 1
Enable current measurement autoranging: SENS:CURR:RANG:AUTO ON, (@1)	

SENSe:ELOG:CURRent[:DC]:RANGe[:UPPer] <*value*>, (@<chanlist>)
SENSe:ELOG:CURRent[:DC]:RANGe[:UPPer]? [MIN|MAX,] (@<chanlist>)
SENSe:ELOG:VOLTage[:DC]:RANGe[:UPPer] <*value*>, (@<chanlist>)
SENSe:ELOG:VOLTage[:DC]:RANGe[:UPPer]? [MIN|MAX,] (@<chanlist>)

Selects the Elog current or voltage measurement range. The value that you enter must be the highest value that you expect to measure. Units are in amperes or volts. The instrument selects the range with the best resolution for the value entered.

Parameter	Typical Return
0 to maximum|MIN|MAX	<maximum value of range>
Selects the 1 A range: SENS:ELOG:CURR:RANG 1, (@1) Selects the 2 V range: SENS:ELOG:VOLT:RANG 2, (@1)	

- The query returns the maximum current that can be measured on the range that is presently set.

SENSe:ELOG:CURRent[:DC]:RANGe:AUTO 0|OFF|1|ON, (@<chanlist>) N678xA SMU Option SMR
SENSe:ELOG:CURRent[:DC]:RANGe:AUTO? (@<chanlist>)
SENSe:ELOG:VOLTage[:DC]:RANGe:AUTO 0|OFF|1|ON , (@<chanlist>) N6781A, N6782A
SENSe:ELOG:VOLTage[:DC]:RANGe:AUTO? (@<chanlist>)

Enables or disables seamless measurement autoranging.

Parameter	Typical Return
0|OFF|1|ON, *RST OFF	0 or 1
Enable Elog measurement autoranging: SENS:ELOG:CURR:RANG:AUTO ON, (@1) SENS:ELOG:VOLT:RANG:AUTO ON, (@1)	

SENSe:ELOG:FUNCtion:CURRent 0|OFF|1|ON, (@<chanlist>)
SENSe:ELOG:FUNCtion:CURRent? (@<chanlist>)
SENSe:ELOG:FUNCtion:VOLTage 0|OFF|1|ON, (@<chanlist>)
SENSe:ELOG:FUNCtion:VOLTage? (@<chanlist>)

Enables or disables the Elog current or voltage measurement function.

Parameter	Typical Return
0|OFF|1|ON, *RST current OFF; voltage ON	0 or 1
Enables datalog current measurements: SENS:ELOG:FUNC:CURR ON, (@1) Enables datalog voltage measurements: SENS:ELOG:FUNC:VOLT ON, (@1)	

SENSe:ELOG:FUNCtion:CURRent:MINMax 0|OFF|1|ON, (@<chanlist>)
SENSe:ELOG:FUNCtion:CURRent:MINMax? (@<chanlist>)
SENSe:ELOG:FUNCtion:VOLTage:MINMax 0|OFF|1|ON, (@<chanlist>)
SENSe:ELOG:FUNCtion:VOLTage:MINMax? (@<chanlist>)

Enables or disables logging of the minimum and maximum current or voltage values.

Parameter	Typical Return
0|OFF|1|ON, *RST OFF	0 or 1
Enables MIN/MAX current logging values: SENS:ELOG:FUNC:CURR:MINM ON, (@1) Enables MIN/MAX voltage logging values: SENS:ELOG:FUNC:VOLT:MINM ON, (@1)	

SENSe:ELOG:PERiod <*value*>, (@<chanlist>)
SENSe:ELOG:PERiod? [MIN|MAX,] (@<chanlist>)

Sets the integration time of an Elog measurement. Although the absolute minimum logging period is 102.4 microseconds, the actual minimum varies as a function of the number of readings that are being logged (see Integration Period).

Parameter	Typical Return
0.0001024 to 60|MIN|MAX, *RST MAX	<period>
Specifies a datalog period of 0.01 seconds: SENS:ELOG:PER 0.01, (@1)	

SENSe:FUNCtion "CURRent"|"VOLTage"|"NONe", (@<chanlist>)
SENSe:FUNCtion? (@<chanlist>)

Selects a measurement function on models that do not have simultaneous voltage and current measurement capability. This command is required so that the acquisition system knows which function to acquire when a measurement is triggered. Selecting NONE disables the measurement function.

Parameter	Typical Return
"CURRent"|"VOLTage"|"NONE", *RST VOLTage	CURR, VOLT, or NONE
Selects the current measurement function: SENS:FUNC "CURR", (@1)	

- This command has been superceded by the SENSe:FUNCtion:CURRent and SENSe:FUNCtion:VOLTage commands, which should be used in new applications. SENSe:FUNCtion is still available for backward compatibility.

SENSe:FUNCtion:CURRent 0|OFF|1|ON, (@<chanlist>)
SENSe:FUNCtion:CURRent? (@<chanlist>)
SENSe:FUNCtion:VOLTage 0|OFF|1|ON, (@<chanlist>)
SENSe:FUNCtion:VOLTage? (@<chanlist>)

Enables or disables the current or voltage measurement function.

Parameter	Typical Return
0|OFF|1|ON, *RST current OFF; voltage ON	0 or 1
Enables current measurements: SENS:FUNC:CURR ON, (@1) Enables voltage measurements: SENS:FUNC:VOLT ON, (@1)	

- These commands replace the previous SENSe:FUNCtion command and should be used in new applications. SENSe:FUNCtion is still available for backward compatibility.

SENSe:FUNCtion:VOLTage:INPut MAIN|AUXiliary, (@<chanlist>) N6781A, N6785A
SENSe:FUNCtion:VOLTage:INPut? (@<chanlist>)

Selects the voltage measurement input.

MAIN – selects the front panel binding posts as the measurement inputs.
AUXiliary – selects the rear panel auxiliary voltage inputs as the measurement inputs.

Parameter	Typical Return
MAIN|AUXiliary, *RST MAIN	MAIN or AUX
Selects the auxiliary voltage input: SENS:FUNC:VOLT:INP AUX, (@1)	

SENSe:SWEep:OFFSet:POINts <*value*>, (@<chanlist>)
SENSe:SWEep:OFFSet:POINts? [MIN|MAX,] (@<chanlist>)

Defines the offset in a data sweep for triggered measurements. Positive values represent the delay after the trigger occurs but before the samples are acquired. Negative values represent data samples taken prior to the trigger.

Parameter	Typical Return
–524,287 to 2,000,000,000|MIN|MAX, *RST 0	<offset points>
Specifies -2048 offset points: SENS:SWE:OFFS:POIN -2048, (@1)	

SENSe:SWEep:POINts <*value*>, (@<chanlist>)
SENSe:SWEep:POINts? [MIN|MAX,] (@<chanlist>)

Defines the number of points in a measurement. The number of points depends on the line frequency (50 Hz or 60 Hz). The default number of points result in a measurement of 1 NPLC.

Parameter	Typical Return
1 to 524,288|MIN|MAX, *RST 3255 (60 Hz); 3906 (50 Hz)	<points>
Specifies 2048 points: SENS:SWE:POIN 2048, (@1)	

SENSe:SWEep:TINTerval <*value*>, (@<chanlist>)
SENSe:SWEep:TINTerval? [MIN|MAX,] (@<chanlist>)

Defines the time period between measurement samples. Units are in seconds. Values are rounded to the nearest 20.48 microsecond increment. Below 20.48 microseconds, values are rounded to the nearest 10.24 or 5.12 microsecond increment respectively.

Parameter	Typical Return
0.00000512 to 40,000|MIN|MAX, *RST 0.00000512	<time interval>
Specifies an interval of 1 ms between points: SENS:SWE:TINT 0.001, (@1)	

SENSe:SWEep:TINTerval:RESolution RES20|RES40
SENSe:SWEep:TINTerval:RESolution?

Sets the resolution used in setting the time interval between digitized measurements. Applies for time intervals above 20.48 microseconds. External data log measurements also use this setting.

RES20 – rounds all values above 20.48 microseconds to the nearest 20.48 µs multiple.
RES40 – rounds all values above 20.48 microseconds to the nearest 40.96 µs multiple.

Parameter	Typical Return
RES20|RES40, *RST 20.48 µs	RES20 or RES40
Specifies a 40 µs resolution: SENS:SWE TINT:RES RES40	

SENSe:VOLTage[:DC]:RANGe[:UPPer] <*value*>, (@<chanlist>)
SENSe:VOLTage[:DC]:RANGe[:UPPer]? [MIN|MAX,] (@<chanlist>)

Selects a DC voltage measurement range. The value that you enter must be the highest value that you expect to measure. Units are in volts. The instrument selects the range with the best resolution for the value entered.

Parameter	Typical Return
0 to maximum|MIN|MAX	<max voltage>
Selects the 2 V range: SENS:VOLT:RANG 2, (@1)	

- The query returns the maximum voltage that can be measured on the range that is presently set.

SENSe:VOLTage[:DC]:RANGe:AUTO 0|OFF|1|ON, (@<chanlist>) N6781A, N6782A
SENSe:VOLTage[:DC]:RANGe:AUTO? (@<chanlist>)

Enables or disables seamless measurement autoranging.

Parameter	Typical Return
0|OFF|1|ON, *RST OFF	0 or 1
Enable voltage measurement autoranging: SENS:VOLT:RANG:AUTO ON, (@1)	

SENSe:WINDow[:TYPE] HANNing|RECTangular, (@<chanlist>)
SENSe:WINDow[:TYPE]? (@<chanlist>)

Selects the signal conditioning function used in scalar DC measurement calculations. Neither window function alters the instantaneous voltage or current data returned in the measurement array.

Hanning – window is a "raised cosine" function. It is a signal conditioning function that reduces errors in DC measurement calculations in the presence of periodic signals such as AC line ripple. This window only works up to 4883 measurement points. The instrument will revert to a rectangular window when the points exceed 4883.

Rectangular – window returns measurement calculations with no signal conditioning.

Parameter	Typical Return
HANNing|RECTangular, *RST RECTangular	RECT or HANN
Specifies a Hanning window function: SENS:WIND HANN, (@1)	

Status Commands

Status commands let you determine the operating condition of the instrument at any time. The instrument has three groups of status registers; Operation, Questionable, and Standard Event. The Operation and Questionable status groups each consist of the Condition, Enable, and Event registers as well as NTR and PTR filters. Refer to Status Tutorial for more information.

Instrument status is also programmed using the IEEE 488.2 Common commands: *CLS, *ESE, *ESR?, *OPC, *OPC?, *SRE, *STB? and *WAI discussed under IEEE 488.2 Common Commands.

STATus:OPERation[:EVENt]? (@<chanlist>)

Queries the event register for the Operation Status group. This is a read-only register, which stores (latches) all events that are passed by the Operation NTR and PTR filter. Reading the Operation Status Event register clears it.

Parameter	Typical Return
(none)	<bit value>
Read the operation status event register: STAT:OPER? (@1)	

- *RST has no effect on this register.
- The value returned is the binary-weighted sum of all bits set in the register.

STATus:OPERation:CONDition? (@<chanlist>)

Queries the condition register for the Operation Status group. This is a read-only register, which holds the live (unlatched) operational status of the instrument. Reading the Operation Status Condition register does not clear it.

Parameter	Typical Return
(none)	<bit value>
Read the operation status condition register: STAT:OPER:COND? (@1)	

- The condition register bits reflect the current condition. If a condition goes away, the corresponding bit is cleared.
- The value returned is the binary-weighted sum of all bits set in the register.

STATus:OPERation:ENABle <*value*>, (@<chanlist>)
STATus:OPERation:ENABle? (@<chanlist>)

Sets and queries bits in the enable register for the Operation Status group. The enable register is a mask for enabling specific bits from the Operation Event register to set the OPER (operation summary) bit of the Status Byte register. STATus:PRESet clears all bits in the enable register.

Parameter	Typical Return
A decimal value that corresponds to the binary-weighted sum of the bits in the register.	<bit value>
Enable bit 3 and 4 in the enable register: STAT:OPER:ENAB 24, (@1)	

- *CLS does not clear the enable register, but does clear the event register.

STATus:OPERation:NTRansition <*value*>, (@<chanlist>)
STATus:OPERation:NTRansition? (@<chanlist>)
STATus:OPERation:PTRansition <*value*>, (@<chanlist>)
STATus:OPERation:PTRansition?

Sets and queries the value of the NTR (Negative-Transition) and PTR (Positive-Transition) registers. These registers serve as a polarity filter between the Operation Condition and Operation Event registers.

When a bit in the NTR register is set to 1, then a 1-to-0 transition of the corresponding bit in the Operation Condition register causes that bit in the Operation Event register to be set.

When a bit in the PTR register is set to 1, then a 0-to-1 transition of the corresponding bit in the Operation Condition register causes that bit in the Operation Event register to be set.

STATus:PRESet sets all bits in the PTR registers and clears all bits in the NTR registers.

Parameter	Typical Return
A decimal value that corresponds to the binary-weighted sum of the bits in the register.	<bit value>
Enable bit 3 and 4 in the NTR register: STAT:OPER:NTR 24, (@1) Enable bit 3 and 4 in the PTR register: STAT:OPER:PTR 24, (@1)	

- If the same bits in both NTR and PTR registers are set to 1, then any transition of that bit at the Operation Condition register sets the corresponding bit in the Operation Event register.
- If the same bits in both NTR and PTR registers are set to 0, then no transition of that bit at the Operation Condition register can set the corresponding bit in the Operation Event register .
- The value returned is the binary-weighted sum of all bits set in the register.

STATus:PRESet

Presets all Enable, PTR, and NTR registers.

Operation register	Questionable register	Preset setting
STAT:OPER:ENAB	STAT:QUES:ENAB	all defined bits are disabled
STAT:OPER:NTR	STAT:QUES:NTR	all defined bits are disabled
STAT:OPER:PTR	STAT:QUES:PTR	all defined bits are enabled

Parameter	Typical Return
(none)	(none)
Preset the Operation and Questionable registers: STAT:PRES	

STATus:QUEStionable[:EVENt]? (@<chanlist>)

Queries the event register for the Questionable Status group. This is a read-only register, which stores (latches) all events that are passed by the Operation NTR and PTR filter. Reading the Questionable Status Event register clears it.

Parameter	Typical Return
(none)	<bit value>
Read questionable status event register: STAT:QUES? (@1)	

- *RST has no effect on this register.
- The value returned is the binary-weighted sum of all bits set in the register.

STATus:QUEStionable:CONDition? (@<chanlist>)

Queries the condition register for the Questionable Status group. This is a read-only register, which holds the live (unlatched) operational status of the instrument. Reading the Questionable Status Condition register does not clear it.

Parameter	Typical Return
(none)	<bit value>
Read questionable status condition register: STAT:QUES:COND? (@1)	

- The condition register bits reflect the current condition. If a condition goes away, the corresponding bit is cleared.
- *RST clears this register, other than those bits where the condition still exists after *RST.
- The value returned is the binary-weighted sum of all bits set in the register.

STATus:QUEStionable:ENABle <*value*>, (@<chanlist>)
STATus:QUEStionable:ENABle? (@<chanlist>)

Sets and queries bits in the enable register for the Questionable Status group. The enable register is a mask for enabling specific bits from the Operation Event register to set the QUES (questionable summary) bit of the Status Byte register. STATus:PRESet clears all bits in the enable register.

Parameter	Typical Return
A decimal value that corresponds to the binary-weighted sum of the bits in the register.	<bit value>
Enable bit 2 and 4 in the questionable enable register: STAT:QUES:ENAB 24, (@1)	

- *CLS does not clear the enable register, but does clear the event register.

STATus:QUEStionable:NTRansition <*value*>, (@<chanlist>)
STATus:QUEStionable:NTRansition? (@<chanlist>)
STATus:QUEStionable:PTRansition <*value*>, (@<chanlist>)
STATus:QUEStionable:PTRansition? (@<chanlist>)

Sets and queries the value of the NTR (Negative-Transition) and PTR (Positive-Transition) registers. These registers serve as a polarity filter between the Questionable Condition and Questionable Event registers.

When a bit in the NTR register is set to 1, then a 1-to-0 transition of the corresponding bit in the Questionable Condition register causes that bit in the Questionable Event register to be set.

When a bit in the PTR register is set to 1, then a 0-to-1 transition of the corresponding bit in the Questionable Condition register causes that bit in the Questionable Event register to be set.

STATus:PRESet sets all bits in the PTR registers and clears all bits in the NTR registers.

Parameter	Typical Return
A decimal value that corresponds to the binary-weighted sum of the bits in the register.	<bit value>
Enable bit 3 and 4 in the questionable NTR register: STAT:QUES:NTR 24, (@1) Enable bit 3 and 4 in the questionable PTR register: STAT:QUES:PTR 24, (@1)	

- If the same bits in both NTR and PTR registers are set to 1, then any transition of that bit at the Questionable Condition register sets the corresponding bit in the Questionable Event register.
- If the same bits in both NTR and PTR registers are set to 0, then no transition of that bit at the Questionable Condition register can set the corresponding bit in the Questionable Event register .
- The value returned is the binary-weighted sum of all bits set in the register.

Step Command

[SOURce:]STEP:TOUTput 0|OFF|1|ON, (<@chanlist>)
[SOURce:]STEP:TOUTput? [MIN|MAX,] (<@chanlist>)

Specifies whether a trigger out is generated when a transient step occurs. A trigger is generated when the state is on (true).

Parameter	Typical Return
0|OFF|1|ON , *RST OFF	0 or 1
Sets the step trigger signal to ON: STEP:TOUT ON	

- The query command returns 0 if the trigger signal will NOT be generated (OFF) when a step occurs, and 1 if a trigger signal will be generated (ON) when a step occurs.

System Commands

System commands control system functions that are not directly related to output control, measurement, or status functions. IEEE 488.2 Common Commands also control system functions such as self-test, saving and recalling states, and others.

SYSTem:CHANnel[:COUNt]?

Returns the number of output channels in a mainframe.

Parameter	Typical Return
(none)	4
Returns the number of channels: SYST:COUN?	

SYSTem:CHANnel:MODel? (@<chanlist>)

Returns the model numbers of the selected channels. Multiple responses are separated by commas.

Parameter	Typical Return
<channel list>	N6751A, N6761A
Returns the model numbers in channels 2 and 3: SYST:MOD? (@2,3)	

SYSTem:CHANnel:OPTion? (@<chanlist>)

Returns the options installed in the selected channels. The query returns an ASCII string enclosed in double quotes. If no option is installed, an empty quoted string ("") is returned. Multiple responses are separated by commas.

Parameter	Typical Return
<channel list>	"Opt 760","Opt 760",""
Returns the options in channels 1 through 3: SYST:OPT? (@1:3)	

SYSTem:CHANnel:SERial? (@<chanlist>)

Returns the serial numbers of the selected channels. Multiple responses are separated by semicolons.

Parameter	Typical Return
<channel list>	MY00123456; MY00234567
Returns the serial numbers in channels 2 and 3: SYST:SER? (@2,3)	

SYSTem:COMMunicate:RLSTate LOCal|REMote|RWLock
SYSTem :COMMunicate:RLSTate?

Configures the remote/local state of the instrument.

Remote and Local do the same thing and are included for compatibility with other products. Both allow front panel control.

RWLock disables the front panel keys. Then the instrument can only be controlled remotely.

Parameter	Typical Return
LOCal|REMote|RWLock, default LOCal	LOC, REM, or RWL
Sets the remote/local state to remote: SYST:COMM:RLST REM	

- The remote/local state is unaffected by *RST or any SCPI commands other than SYSTem:COMMunicate:RLState.
- The remote/local instrument state can also be set by other interface commands over the GPIB and some other I/O interface.
- When multiple remote programming interfaces are active, the interface with the most recently changed remote/local state determines the instrument's remote/local state.

SYSTem:COMMunicate:TCPip:CONTrol?

Returns the initial socket control connection port number. After the control port number is obtained, a control socket connection can be opened.

Parameter	Typical Return
(none)	5000 (0 if sockets are not supported)
Query the Control connection port number: SYST:COMM:TCP:CONT?	

- The control socket connection can only be used by a client to send a Device Clear to the instrument or to detect Service Request (SRQ) events.
- Refer to Using Sockets for more information.

SYSTem:ERRor?

Reads and clears one error from the error queue.

Parameter	Typical Return
(none)	<+0,"No error">
Reads and clears the first error in error queue: SYST:ERR?	

- The front-panel ERR annunciator turns on when one or more errors are currently stored in the error queue. Error retrieval is first-in-first-out (FIFO), and errors are cleared as you read them. When you have read all errors from the error queue, the ERR annunciator turns off.
- If more have accumulated than the queue can hold, the last error stored in the queue (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 have occurred when you read the error queue, the instrument responds with +0,"No error".
- The error queue is cleared by the *CLS and when power is cycled. It is not cleared by a *RST.
- Errors have the following format (the error string may contain up to 80 characters). <*error code*>,<*error string*> For a list of error codes and message strings, see SCPI Error Messages.

SYSTem:GROup:CATalog?

NOTE This command does NOT apply to models N678xA SMU not N678xA SMU.

Returns the groups that have been defined. The defined groups are enclosed in quotes.

Parameter	Typical Return
(none)	<grouped channels>
returns the channels that are grouped: SYST:GRO:CAT?	

- Example response with 4 channels; no channels grouped: "1","2","3","4"
- Example response with channels 1 and 2 grouped; 3 and 4 grouped: "1,2","3,4"
- Example response channels 1 - 3 grouped; channel 4 not grouped: "1,2,3","4"

SYSTem:GROup:DEFine (@<chanlist>)

NOTE This command does NOT apply to models N678xA SMU not N678xA SMU.

Groups multiple channels to create a single channel. This effectively creates a single output with higher current and power capability. You can group up to four channels per mainframe.

Parameter	Typical Return
<channel list>	(none)
Define channels 1 , 2, and 3 as a group: SYST:GRO:DEF (@1:3) Define channels 1 and 4 as a group: SYST:GRO:DEF (@1,4)	

- All channels in a group must have identical model numbers and have identical options installed. Refer to Output Groups for more information.

- For the group definitions to take effect, reboot the unit by cycling AC power or sending the SYSTem:REBoot command.
- Group channel definitions are stored in non-volatile memory and are unaffected by *RST or *RCL. Group channel *settings* (voltage, current, etc.) are set and saved by *RST or *RCL

SYSTem:GROup:DELete (@<channel>)

NOTE This command does NOT apply to models N678xA SMU not N678xA SMU.

Removes the specified channel from the group. Other channels in the group are left intact.

When ungrouping a channel, you must also remove the parallel connections between the output and sense terminals of that channel.

Parameter	Typical Return
<channel>	(none)
Delete channel 3 from the group: SYST:GRO:DEL (@3)	

- For the group definitions to take effect, reboot the unit by cycling AC power or sending the SYSTem:REBoot command.

SYSTem:GROup:DELete:ALL

NOTE This command does NOT apply to models N678xA SMU not N678xA SMU.

Deletes all groups. Returns any channels that have been grouped back to an ungrouped state.

When ungrouping a channel, you must also remove the parallel connections between the output and sense terminals of that channel.

Parameter	Typical Return
(none)	(none)
Delete all groups: SYST:GRO:DEL:ALL	

- For the group definitions to take effect, reboot the unit by cycling AC power or sending the SYSTem:REBoot command.

SYSTem:PASSword:FPANel:RESet

Resets the front panel lockout password to zero. This command does not reset the calibration password.

The front panel password can also be reset to 0 by setting an internal switch on the unit. Refer to Calibration Switches for more information.

Parameter	Typical Return
(none)	(none)
To reset the front panel password: SYST:PASS:FPAN:RES	

SYSTem:PERSona:MANufacturer "Agilent"|"Keysight"
SYSTem:PERSona:MANufacturer?
SYSTem:PERSona:MANufacturer:DEFault

Changes the manufacturer identity. This command is used to change the manufacturer's ID string for backward compatibility. This affects the following identity items:

- *IDN? contains "Agilent" instead of "Keysight"
- Default LAN hostname has the prefix A instead of K
- The LXI XML file fields include "Agilent" instead of "Keysight"
- The mDNS service name contains "Agilent" instead of "Keysight"

The DEFault command returns the manufacturer's ID back to Keysight.

Parameter	Typical Return
"Agilent"|"Keysight"	Keysight
Changes the manufacturer's ID to Agilent: SYST:PERS:MAN "Agilent"	

SYSTem:PERSona:MODel "<model number>"
SYSTem:PERSona:MODel?
SYSTem:PERSona:MODel:DEFault

Changes the model number. This command is used to change the mainframe model ID string for backward compatibility.

Compatibility	Factory setting
N6700B N6701A N6702A	N6700C N6701C N6702C

The DEFault command returns the model's ID to the factory setting.

Parameter	Typical Return
"<model number>"	N6700C, N6701C, or N6702C
Changes the model ID to N6700B: SYST:PERS:MOD "N6700B"	

SYSTem:REBoot

Reboots the instrument to its power-on state. Refer to Reset State for more information.

Parameter	Typical Return
(none)	(none)
To reboot the instrument: SYST:REB	

SYSTem:SECurity:IMMediate

Clears all user memory and reboots the instrument. This command is typically used to prepare the instrument for removal from a secure area. It sanitizes all user data by writing all zeros to flash memory and then performing a chip erase as per manufacturer's data sheet. Identification data (instrument firmware, model number, serial number, MAC address and calibration data) is not erased. After the data is cleared, the instrument is rebooted.

This procedure is not recommended for use in routine applications because of the possibility of unintended loss of data.

Parameter	Typical Return
(none)	(none)
Sanitizes the instrument: SYST:SEC:IMM	

SYSTem:VERSion?

Returns the SCPI version that the instrument complies with. Cannot be determined from front panel.

Parameter	Typical Return
(none)	<"version">
Return the SCPI version: SYST:VERS?	

- The command returns a string in the form "YYYY.V", where YYYY represents the year of the version and V represents a version for that year.

Trigger Commands

Trigger commands control the transient and acquisition subsystems.

NOTE All TRIGger commands except for TRIGger:TRANsient[:IMMediate] and TRIGger:TRANsient:SOURce require Option 054 to be installed on models N673xA. N674xA, N675xA, and N677xA.

TRIGger:ACQuire[:IMMediate] (@<chanlist>)
TRIGger:ELOG[:IMMediate] (@<chanlist>)
TRIGger:TRANsient[:IMMediate] (@<chanlist>)

These commands override any selected trigger source and generate immediate triggers.

TRIGger:ACQuire - Generates an immediate measurement trigger.
TRIGger:ELOG - Generates an immediate trigger for external data logging.
TRIGger:TRANsient - Generates an immediate output transient trigger.

Parameter	Typical Return
(none)	(none)
Generates an acquisition trigger: TRIG:ACQ (@1)	

- You must initiate the applicable trigger system before you can send any trigger.
- At acquire trigger completion, the WTG-meas bit in the Status Operation Condition register is cleared.
- At transient trigger completion, the WTG-tran bit in the Status Operation Condition register is cleared.

TRIGger:ACQuire:CURRent[:LEVel] <*value*>, (@<chanlist>)
TRIGger:ACQuire:CURRent[:LEVel]? [MIN|MAX,] (@<chanlist>)
TRIGger:ACQuire:VOLTage[:LEVel] <*value*>, (@<chanlist>)
TRIGger:ACQuire:VOLTage[:LEVel]? [MIN|MAX,] (@<chanlist>)

Sets the triggered level of the output. Applies when the measurement trigger source is set to a level. Values are specified in either amperes or volts. The MIN and MAX values depend on the ratings of the unit.

Parameter	Typical Return
Current: 0 - maximum|MIN|MAX, *RST 0 Voltage: 0 - maximum|MIN|MAX, *RST 0 The maximum values are 102% of the rating of the module.	<triggered level>
Set the triggered current level to 3 A: TRIG:ACQ:CURR 3, (@1) Set the triggered voltage level to 50 V: TRIG:ACQ:VOLT 50, (@1)	

TRIGger:ACQuire:CURRent:SLOPe POSitive|NEGative, (@<chanlist>)
TRIGger:ACQuire:CURRent:SLOPe? (@<chanlist>)
TRIGger:ACQuire:VOLTage:SLOPe POSitive|NEGative, (@<chanlist>)
TRIGger:ACQuire:VOLTage:SLOPe? (@<chanlist>)

Sets the slope of the signal. Applies when the measurement trigger source is set to a level.

POSitive specifies a rising slope of the output signal.

NEGative specifies a falling slope of the output signal.

Parameter	Typical Return
POSitive|NEGative, *RST POSitive	POS or NEG
Sets the current slope to falling edge: TRIG:ACQ:CURR:SLOP NEG, (@1) Sets the voltage slope to falling edge: TRIG:ACQ:VOLT:SLOP NEG, (@1)	

TRIGger:ACQuire:TOUTput[:ENABle] 0|OFF|1|ON, (@<chanlist>)
TRIGger:ACQuire:TOUTput[:ENABle]? (@<chanlist>)

Enables measurement triggers to be sent to a digital port pin. The digital port pin must be configured as trigger output before it can be used as a trigger source (see Trigger I/O).

Parameter	Typical Return
0|OFF|1|ON, *RST OFF	0 or 1
Enable sending measurement triggers to digital pins: TRIG:ACQ:TOUT ON, (@1)	

TRIGger:ACQuire:SOURce <*source*>, (@<chanlist>)
TRIGger:ACQuire:SOURce? (@<chanlist>)
TRIGger:ARB:SOURce <*source*>
TRIGger:ARB:SOURce?
TRIGger:ELOG:SOURce <*source*>, (@<chanlist>)
TRIGger:ELOG:SOURce? (@<chanlist>)
TRIGger:TRANsient:SOURce <*source*>, (@<chanlist>)
TRIGger:TRANsient:SOURce? (@<chanlist>)

TRIGger:ACQuire:SOURce - selects the trigger source for the acquisition system.
TRIGger:ARB:SOURce - selects the trigger source for the arbitrary waveform generator.
TRIGger:ELOG:SOURce - selects the trigger source for external data logging.
TRIGger:TRANsient:SOURce - selects the trigger source for the transient system.

The following trigger sources can be selected for the specified trigger system:

Trigger Source	Description	Trigger System
BUS	Selects a remote interface trigger command.	All trigger systems
CURRent<1-4>	Selects the output current level of a channel.	Acquire triggers only
EXTernal	Selects all digital port pins that have been configured as trigger inputs.	All trigger systems
IMMediate	Generates a trigger as soon as the trigger system is INITiated.	All trigger systems
PIN<1-7>	Selects a digital port pin configured as a trigger input.	All trigger systems except ARB
TRANsient<1-4>	Selects the transient system as the trigger source.	Acquire and Transient triggers only
VOLTage<1-4>	Selects the output voltage level of a channel.	Acquire triggers only

Parameter	Typical Return
BUS|CURRent<1-4>|EXTernal|PIN<1-7>| TRANsient<1-4>|VOLTage<1-4>, *RST BUS	BUS, CURR<n>, EXT, PIN<n>, TRAN<n>, or VOLT<n>
Selects a current level on channel 1 as the acquire trigger:TRIG:ACQ:SOUR CURR1, (@1) Selects a digital port pin 1 as the Elog trigger source: TRIG:ELOG:SOUR PIN1, (@1) Selects the transient system of channel 4 as the trigger source: TRIG:TRAN:SOUR TRAN4, (@1) Selects the voltage level of channel 3 as the acquisition trigger: TRIG:ACQ:SOUR VOLT3, (@1)	

TRIGger:MEASure:TALign:CORRection[:STATe] 0|OFF|1|ON, (@chanlist) N678xA SMU
TRIGger:MEASure:TALign:CORRection[:STATe]? (@chanlist)

Improves the time alignment of measurement triggers with measurement data when enabled. The power-on state is OFF for backwards compatibility.

Parameter	Typical Return
0|OFF|1|ON, *RST OFF	0 or 1
To improve the measurement trigger alignment: TRIG:MEAS:TAL:CORR ON, (@1)	

Voltage Commands

Voltage commands program the output voltage and voltage protection functions. The SOURce keyword is optional in the following commands.

[SOURce:]VOLTage[:LEVel][:IMMediate][:AMPLitude] <*value*>, (@<chanlist>)
[SOURce:]VOLTage[:LEVel][:IMMediate][:AMPLitude]? [MIN|MAX,] (@<chanlist>)
[SOURce:]VOLTage[:LEVel]:TRIGgered[:AMPLitude] <*value*>, (@<chanlist>)
[SOURce:]VOLTage[:LEVel]:TRIGgered[:AMPLitude]? [MIN|MAX,] (@<chanlist>)

Sets the immediate voltage level and the triggered voltage level when the output is in constant voltage mode. The triggered level is a stored value that will be programmed when a Step transient is triggered.Units are in volts. The maximum value depends on the voltage rating of the unit.

Parameter	Typical Return
0 - maximum|MIN|MAX, *RST 0 The maximum value is 102% of the voltage rating of the power module	<voltage level>
Sets the output voltage level to 20 V: VOLT 20, (@1) Sets the triggered voltage level to 25 V: VOLT:TRIG 25, (@1)	

The query returns the programmed voltage level in the form +n.nnnnnnE+nn for each channel specified. Multiple responses are separated by commas.

[SOURce:]VOLTage:BWIDth[:RANGe] LOW|HIGH1|HIGH2|HIGH3, (@<chanlist>) N678xA SMU
[SOURce:]VOLTage:BWIDth[:RANGe]? (@<chanlist>)
[SOURce:]VOLTage:BWIDth:LEVel LOW|HIGH1|HIGH2|HIGH3, <frequency>, (@<chanlist>) N678xA SMU
[SOURce:]VOLTage:BWIDth:LEVel? (@<chanlist>)

Sets the voltage bandwidth. This lets you optimize output response time with capacitive loads. Refer to Output Bandwidth for additional information. These compensation modes only apply when the unit is operating in voltage priority mode.

LOW -	optimized for stability with a wide range of load capacitance from 0 to 150 µF
HIGH1 -	provides faster up-programming speed and faster response time with load capacitance from 0–1 µF
HIGH2 -	provides faster up-programming speed and faster response time with load capacitance from 0–7 µF
HIGH3 -	provides faster up-programming speed and faster response time with load capacitance from 7–150 µF
<frequency>	specifies the bandwidth range frequency. This setting is optional, for faster output response time above the default frequency. The minimum frequencies are also the *RST settings.

Parameter	Typical Return
LOW|HIGH1|HIGH2|HIGH3, *RST LOW	LOW, HIGH1, HIGH2, or HIGH3
1,440 to 1,000,000 Hz (LOW) 33,000 to 1,000,000 (HIGH1) 20,500 to 1,000,000 (HIGH2) 8,300 to 1,000,000 (HIGH3)	<range frequency>
Sets the voltage bandwidth to HIGH3: VOLT:BWID HIGH3, (@1) Sets the bandwidth frequency to 25 kHz: VOLT:BWID:LEV HIGH3, 25,000, (@1)	

[SOURce:]VOLTage:INHibit:VON[:LEVel] <*value*>, (@<chanlist>) N679xA
[SOURce:]VOLTage:INHibit:VON[LEVel]? (@<chanlist>)

When enabled, as specified by VOLTage:INHibit:VON:MODE, the load module will not sink current until the input voltage rises above the voltage-on setting. Units are in volts.

Parameter	Typical Return
0 to 60 V | MIN | MAX, *RST 0.01	<voltage-on value>
Specifies a voltage-on of 4 volts: VOLT:INH:VON 4, (@1)	

[SOURce:]VOLTage:INHibit:VON:MODE LATChing|LIVE|OFF N679xA
[SOURce:]VOLTage:INHibit:VON:MODE?

Specifies the behavior of the under-voltage inhibit function. When enabled (not OFF), the load module will not sink current until the input voltage rises above the voltage-on setting specified by VOLTage:INHibit:VON <value>.

LIVE - turns the input off whenever the voltage drops below the voltage-on setting. Turns the input back on when the voltage reaches the voltage-on setting.
LATChing - allows the load to sink current even if the voltage subsequently drops below the voltage-on setting.
OFF - turns the under-voltage inhibit function off.

Parameter	Typical Return
LIVE|LATChing|OFF, *RST OFF	LIVE, LATC, or OFF
Sets the inhibit mode to latching: VOLT:INH:VON:MODE LATC	

- The under-voltage inhibit function will ignore any programmed on/off delays.
- The under-voltage inhibit function is not available when load modules are grouped.
- The under-voltage inhibit function is not available in CV operating mode.

[SOURce:]VOLTage:LIMit[:POSitive][:IMMediate][:AMPLitude] <*value*> , (@<chanlist>)

N678xA SMU

[SOURce:]VOLTage:LIMit[:POSitive][:IMMediate][:AMPLitude]? [MIN|MAX,] (@<chanlist>)

[SOURce:]VOLTage:LIMit:NEGative[:IMMediate][:AMPLitude] <*value*>, (@<chanlist>)

N6784A

[SOURce:]VOLTage:LIMit:NEGative[:IMMediate][:AMPLitude]? [MIN|MAX,] (@<chanlist>)

Sets the voltage limit when in current and resistance priority mode. Units are in volts. The maximum value depends on the voltage rating of the unit. The minimum value is the most negative value.

Parameter	Typical Return
Positive: 0 to 102% of rating|MIN|MAX, *RST 102% Negative: -102% of rating to 0|MIN|MAX, *RST -102%	<+ voltage limit> <- voltage limit>
Sets the positive voltage limit to 20.4 V: VOLT:LIM 20, (@1) Sets the negative voltage limit to -20.4 V: VOLT:LIM:NEG -20, (@1)	

- MIN is the most negative value of the range. MAX is the least negative value of the range.
- The query returns the programmed voltage limit in the form +n.nnnnnnE+nn for each channel specified. Multiple responses are separated by commas.

[SOURce:]VOLTage:LIMit:COUPle 0|OFF|1|ON, (@<chanlist>)

N6784A

[SOURce:]VOLTage:LIMit:COUPle? (@<chanlist>)

Sets the voltage limit tracking state. The negative voltage limit tracks the positive voltage limit.

Parameter	Typical Return
0|OFF|1|ON, *RST OFF	0 or 1
Enables the voltage limit tracking state: VOLT:LIM:COUP ON, (@1)	

[SOURce:]VOLTage:MODE FIXed|STEP|LIST, (@<chanlist>)

[SOURce:]VOLTage:MODE? (@<chanlist>)

Sets the transient mode. This determines what happens to the output voltage when the transient system is initiated and triggered.

FIXed – keeps the output voltage at its immediate value.
STEP – steps the output to the triggered level when a trigger occurs.
LIST – causes the output to follow the list values when a trigger occurs.
ARB – causes the output to follow the arbitrary waveform values when a trigger occurs.

Parameter	Typical Return
FIXed|STEP|LIST|ARB, *RST FIXed	FIX, STEP, LIST, or ARB
Sets the voltage mode to Step: VOLT:MODE STEP, (@1)	

[SOURce:]VOLTage:PROTection[:LOCal][:LEVel] <*value*>, (@<chanlist>)
[SOURce:]VOLTage:PROTection[:LOCal][:LEVel]? [MIN|MAX,] (@<chanlist>)

NOTE

This command does NOT apply to models N678xA SMU not N678xA SMU. For models N678xA SMU, refer to VOLTage:PROTection:REMote.

Only the query applies to models N679xA N679xA. Load models have a fixed over-voltage protection level.

Sets the over-voltage protection level.Units are in volts. If the output voltage exceeds the OVP level, the output is disabled and the Questionable Condition status register OV bit is set.

Parameter	Typical Return
0 – maximum|MIN|MAX, *RST MAX The maximum value is 120% of the voltage rating of the power module.	<over-voltage level>
Sets the over-voltage protection to 60 V: VOLT:PROT 60, (@1)	

- An over-voltage condition can be cleared with the OUTput:PROTection:CLEar command after the cause of the condition has been removed.
- The query returns the programmed voltage protection level in the form +n.nnnnnnE+nn for each channel specified. Multiple responses are separated by commas.

[SOURce:]VOLTage:PROTection:DELay[:TIME] <*value*>, (@<chanlist>) N678xA SMU N6783A
[SOURce:]VOLTage:PROTection:DELay[:TIME]? [MIN|MAX,] (@<chanlist>)

Sets the over-voltage protection delay. The over-voltage protection function will not be triggered during the delay time. After the delay time has expired, the over-voltage protection function will be active. This prevents momentary changes in output status from triggering the over-voltage protection function. Programmed values can range from 60 microseconds to 5 milliseconds with a resolution of 20.48 microseconds.

Parameter	Typical Return
60 µs - 5 ms | MIN | MAX, *RST 0	<delay value>
Sets the protection delay to 1 millisecond: VOLT:PROT:DEL 0.001, (@1)	

[SOURce:]VOLTage:PROTection:REMote[:POSitive][:LEVel] <*value*> , (@<chanlist>)

N678xA SMU

[SOURce:]VOLTage:PROTection:REMote[:POSitive][:LEVel]? [MIN|MAX,] (@<chanlist>)

[SOURce:]VOLTage:PROTection:REMote:NEGative[:LEVel] <*value*>, (@<chanlist>)

N6784A

[SOURce:]VOLTage:PROTection:REMote:NEGative[:LEVel]? [MIN|MAX,] (@<chanlist>)

Sets the remote over-voltage protection level.Units are in volts. If the remote voltage exceeds the OVP level, the output is disabled and the Questionable Condition status register OV bit is set.

Parameter	Typical Return
Positive: 0 – 22|MIN|MAX, *RST MAX Negative: -22 to 0|MIN|MAX, *RST MAX	<remote over-voltage level>
Sets the over-voltage protection to 15 V: VOLT:PROT:REM 15, (@1) Sets the over-voltage protection to -15 V: VOLT:PROT:REM:NEG -15, (@1)	

- The remote OVP trips if the output terminal voltage is >1.5 V over the sense terminal voltage.
- MIN is the most negative value of the range. MAX is the least negative value of the range.
- The query returns the programmed voltage protection level in the form +n.nnnnnnE+nn for each channel specified. Multiple responses are separated by commas.

[SOURce:]VOLTage:PROTection:REVerse:STATe 0|OFF|1|ON, (@<chanlist>) N679xA

[SOURce:]VOLTage:PROTection:REVerse:STATe? (@<chanlist>)

Specifies the state of the input when a reverse voltage is detected. This feature is available starting with firmware revision E.02.07.3231 and up. For wire size guidance, refer to Note 6 under Wire Sizing.

OFF - the input remains on when the reverse voltage is detected.
ON - the input is latched off when the reverse voltage is detected and will remain off until a protection clear command is sent.

Parameter	Typical Return
0|OFF|1|ON, *RST OFF	0 or 1
Turns the input off when a reverse voltage occurs: VOLT:PROT:REV:STAT ON, (@1)	

[SOURce:]VOLTage:PROTection:TRACking[:STATe] 0|OFF|1|ON, (@<chanlist>)

[SOURce:]VOLTage:PROTection:TRACking[:STATe]? (@<chanlist>)

NOTE This command only applies to models N6752A, N6754A, and N6762A with Option J01.

Enables or disables the tracking over-voltage protection (OVP) function of the output channel.

Parameter	Typical Return
0|OFF|1|ON, *RST OFF	0 or 1
Enable the tracking OVP function: VOLT:PROT:TRAC ON, (@1)	

[SOURce:]VOLTage:PROTection:TRACking:OFFSet <*value*>, (@<chanlist>)
[SOURce:]VOLTage:PROTection:TRACking:OFFSet? [MIN|MAX,] (@<chanlist>)

NOTE This command only applies to models N6752A, N6754A, and N6762A with Option J01.

Set the tracking over-voltage protection (OVP) offset of the output channel. This lets you set an overvoltage protection limit that is an offset from the programmed voltage. This is an addition to the existing overvoltage limit. The tracking OVP threshold automatically tracks the programmed output setting. The output voltage is monitored at the + sense and - sense terminals.

Parameter	Typical Return
0 to maximum|MIN|MAX, *RST MAX The maximum value is dependent on the voltage rating of the power module.	<tracking offset>
Sets the tracking OVP offset to 2 V: VOLT:PROT:TRAC:OFFS 2, (@1)	

[SOURce:]VOLTage:RANGe <*value*>, (@<chanlist>)
[SOURce:]VOLTage:RANGe? [MIN|MAX,] (@<chanlist>)

Sets the output voltage range on models that have multiple ranges. The value that you enter must be the highest value in volts that you expect to source. The instrument selects the range with the best resolution for the value entered.

Parameter	Typical Return
0 to maximum|MIN|MAX, *RST MAX The maximum value is 102% of the voltage rating of the power module.	<voltage range>
Sets the output voltage range to 5 V: VOLT:RANG 5, (@1)	

- This command is coupled with [SOURce:]VOLTage. This means that if a range command places an output on a range with a lower maximum voltage than the present voltage level, an out of range error occurs. This also occurs if a voltage is programmed that is too large for the present range. Errors can be avoided by sending both level and range commands in the same SCPI message. When the range and level information is received as a set, no range/setting conflict occurs.
- If a programmed range change occurs while the output is enabled, the output will be temporarily disabled while the range switch occurs. The transition from on-to-off and then from off-to-on will also be delayed by the settings of OUTPut:DELay:FALL and OUTPut:DELay:RISE.
- The query returns the maximum voltage that can be output on the range that is presently set. The voltage is in the form +n.nnnnnnE+nn for each channel specified. Multiple responses are separated by commas.

[SOURce:]VOLTage:RESistance[:LEVel][:IMMediate][:AMPLitude] <*value*>, (@<chanlist>) N6781A, N6785A

[SOURce:]VOLTage:RESistance[:LEVel][:IMMediate][:AMPLitude]?

Sets the output resistance level when in voltage priority mode. Units are in volts.

Parameter	Typical Return
0 to 60 V | MIN | MAX, *RST MAX	<resistance level>
Specifies the voltage priority resistance level: VOLT:RES 30, (@1)	

- This command replaces the previous RESistance <value> command and should be used in new applications. RESistance <value> is still available for backward compatibility.

[SOURce:]VOLTage:RESistance:STATe 0|OFF|1|ON, (@<chanlist>) N6781A, N6785A
[SOURce:]VOLTage:RESistance:STATe? (@<chanlist>)

Enables or disables output resistance in voltage priority mode.

Parameter	Typical Return
0|OFF|1|ON, *RST OFF	0 or 1
Enable resistance in voltage priority mode: VOLT:RES:STAT ON, (@1)	

- This command replaces the previous RESistance:STATe command and should be used in new applications. RESistance:STATe is still available for backward compatibility.

[SOURce:]VOLTage:SLEW[:POSitive][:IMMediate] <*value*>, (@<chanlist>)
[SOURce:]VOLTage:SLEW[:POSitive][:IMMediate]? [MIN|MAX,] (@<chanlist>)
[SOURce:]VOLTage:SLEW:NEGative[:IMMediate] <*value*>, (@<chanlist>) N679xA
[SOURce:]VOLTage:SLEW:NEGative[:IMMediate]? [MIN|MAX,] (@<chanlist>)

Sets the voltage slew rate. The slew rate is set in volts per second and affects all programmed voltage changes, including those due to the output state turning on or off. The slew rate can be set to any value between 0 and 9.9E+37. For very large values, the slew rate will be limited by the analog performance of the output circuit. The keywords MAX or INFinity set the slew rate to maximum.

Parameter	Typical Return
0 – 9.9E+37|MIN|MAX|INFinity, *RST MAX	<slew rate>
Sets the output slew rate to 5 V per second: VOLT:SLEW 5, (@1) Sets the negative output slew rate to 5 V per second: VOLT:SLEW:NEG 5, (@1)	

- The query returns the value that was sent. If the value is less than the minimum slew rate, only the minimum value is returned. The resolution of the slew setting is also the minimum value, which can be queried using VOLTage:SLEW? MIN. The exact value varies slightly based on calibration.

- The query returns the programmed slew rate in the form +n.nnnnnnE+nn for each channel specified. Multiple responses are separated by commas. If a slew rate of 9.9E37 is returned, it means that the maximum or fastest slew rate has been set.

[SOURce:]VOLTage:SLEW:COUPle 0|OFF|1|ON, (@<chanlist>) N679xA
[SOURce:]VOLTage:SLEW:COUPle? (@<chanlist>)

Sets the voltage slew tracking state.

Parameter	Typical Return
0|OFF|1|ON, *RST OFF	0 or 1
Enables the voltage slew tracking state: VOLT:SLEW:COUP ON, (@1)	

[SOURce:]VOLTage:SLEW[:POSitive]:MAXimum 0|OFF|1|ON, (@<chanlist>)
[SOURce:]VOLTage:SLEW[:POSitive]:MAXimum? (@<chanlist>)
[SOURce:]VOLTage:SLEW:NEGative:MAXimum 0|OFF|1|ON, (@<chanlist>) N679xA
[SOURce:]VOLTage:SLEW:NEGative:MAXimum? (@<chanlist>)

Enables/disables the maximum slew rate override. When enabled, the slew rate is set to its maximum value. When disabled, the slew rate is set to the immediate value set by VOLTage:SLEW. Use VOLTage:SLEW? MAX to query the maximum slew rate.

Parameter	Typical Return
0|OFF|1|ON, *RST OFF	0 or 1
Enable the maximum slew rate override: VOLT:SLEW:MAX ON, (@1) Enable the negative maximum slew rate: VOLT:SLEW:NEG:MAX ON, (@1)	

- The VOLTage:SLEW:MAX command is coupled to the VOLTage:SLEW command. If the VOLTage:SLEW command sets the slew rate to MAX or INFinity, VOLTage:SLEW:MAX is enabled. If the slew rate is set to any other value, VOLTage:SLEW:MAX is disabled.

Status Tutorial

This section provides a detailed description of the individual registers and register groups. The status diagram at the end of this topic shows how the status registers and groups are interconnected.

Status Registers

Operation Status Group

Questionable Status Group

Standard Event Status Group

Status Byte Register

Error and Output Queues

Status Diagram

Status Registers

The Operation and Questionable status groups use four different type of registers to track qualify, flag, and enable instrument events.

- A Condition register continuously monitors the state of the instrument. The bits in the condition register are updated in real time and the bits are not latched or buffered.
- An PTR/NTR register qualifies the signal that passes to the event register. When a PTR bit is set, signals with positive edge transition pass to the event register. When an NTR bit is set, signals with a negative edge transition pass to the event register. When both bits are set, all signal pass. When neither bits are set, no signals pass.
- An Event register latches the various events from the condition register. There is no buffering in this register; while an event bit is set, subsequent events corresponding to that bit are ignored. This is a read-only register.
- An Enable register defines which bits in the event register will be reported to the Status Byte register group. You can write to or read from an enable register.

To program individual bits in any register group, you must send a value that corresponds to the binary-weighted value of all the bits that you wish to enable. For example, to enable bit 2 (decimal value = 4) and bit 4 (decimal value = 16), the corresponding decimal value would be 20 (4 + 16).Similarly, any register queries return the binary-weighted value of the bits that have been set. For example, with bit 3 (value 8) and bit 5 (value 32) being set, the query returns +40.

Operation Status Group

These registers record signals that occur during normal operation. The group consists of a Condition, PTR/NTR, Event, and Enable register. The outputs of the Operation Status register group are logically-ORed into the OPERation summary bit (7) of the Status Byte register. Refer to Status Registers for a description of each register. The following table describes the bit assignments.

Bit	Bit Name	Decimal Value	Definition
0	CV	1	Output is in constant voltage
1	CC	2	Output is in constant current
2	OFF	4	Output is programmed off
3	WTG-meas	8	Measurement system is waiting for a trigger
4	WTG-tran	16	Transient system is waiting for a trigger
5	MEAS-active	32	Measurement system is initiated
6	TRAN-active	64	Transient system is initiated
7-8	not used	not used	0 is returned
9	CR	256	Output is in constant resistance mode
10	CP	512	Output is in constant power mode
11	SH	1024	Load Input terminals are shorted
12-15	not used	not used	0 is returned

Questionable Status Group

These register groups record signals that indicate abnormal operation. The group consists of a Condition, PTR/NTR, Event, and Enable register. The outputs of the Questionable Status group are logically-ORed into the QUEStionable summary bit (3) of the Status Byte register. Refer to Status Registers for a description of each register. The following table describes the bit assignments.

Bit	Bit Name	Decimal Value	Definition
0	OV	1	Output is disabled by the over-voltage protection
1	OC	2	Output is disabled by the over-current protection
2	PF	4	Output is disabled by an AC power-fail (low-line or brownout)
3	CP+	8	Output is limited (or disabled) by the positive power limit
4	OT	16	Over-temperature protection has tripped
5	CP–	32	Output is limited by the negative power limit
6	OV–	64	Negative over-voltage protection has tripped
7	LIM+	128	In voltage priority mode, the output is in positive current limit In current priority mode, the output is in positive voltage limit In power and resistance priority modes, the output is in positive current limit
8	LIM–	256	In voltage priority mode, the output is in negative current limit In current priority mode, the output is in negative voltage limit
9	INH	512	Output is disabled by an external INHibit signal
10	UNR	1024	Output is unregulated
11	PROT	2048	Output has been disabled because it is coupled to a protection condition that occurred on another channel

Bit	Bit Name	Decimal Value	Definition
12	OSC	4096	Oscillation detector has tripped
13	not used	not used	0 is returned
14	UVI	16,384	Output is disabled by the under-voltage inhibit protection
15	not used	not used	0 is returned

Standard Event Status Group

These registers are programmed by Common commands. The group consists of an Event and Enable register.The Standard Event event register latches events relating to communication status. It is a read-only register that is cleared when read. The Standard Event enable register functions similarly to the enable registers of the Operation and Questionable status groups. Refer to Status Registers for a description of each register. The following table describes the bit assignments.

Bit	Bit Name	Decimal Value	Definition
0	Operation Complete	1	All commands before and including *OPC have been executed.
1	not used	not used	0 is returned
2	Query Error	4	The instrument tried to read the output buffer but it was empty, a new command line was received before a previous query has been read, or both the input and output buffers are full.
3	Device-Specific Error	8	A device-specific error, including a self-test error, calibration error or other device-specific error occurred. Error Messages
4	Execution Error	16	An execution error occurred. Error Messages
5	Command	32	A command syntax error occurred. Error Messages
6	not used	not used	0 is returned
7	Power On	128	Power has been cycled since the last time the event register was read or cleared.

Status Byte Register

This register summarizes the information from all other status groups as defined in the IEEE 488.2 Standard Digital Interface for Programmable Instrumentation. The following table describes the bit assignments.

Bit	Bit Name	Decimal Value	Definition
0	not used	not used	0 is returned
1	not used	not used	0 is returned
2	Error Queue	4	One or more errors in the Error Queue. Use SYSTem:ERRor? to read and delete errors.
3	Questionable Status Summary	8	One or more bits are set in the Questionable Data Register. Bits must be enabled, see STATus:QUEStionable:ENABle.

Bit	Bit Name	Decimal Value	Definition
4	Message Available	16	Data is available in the instrument's output buffer.
5	Event Status Summary	32	One or more bits are set in the Standard Event Register. Bits must be enabled, see *ESE.
6	Master Status Summary	64	One or more bits are set in the Status Byte Register and may generate a Service Request. Bits must be enabled, see *SRE.
7	Operation Status Summary	128	One or more bits are set in the Operation Status Register. Bits must be enabled, see STATus:OPERation:ENABle.

MSS and RQS Bits

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

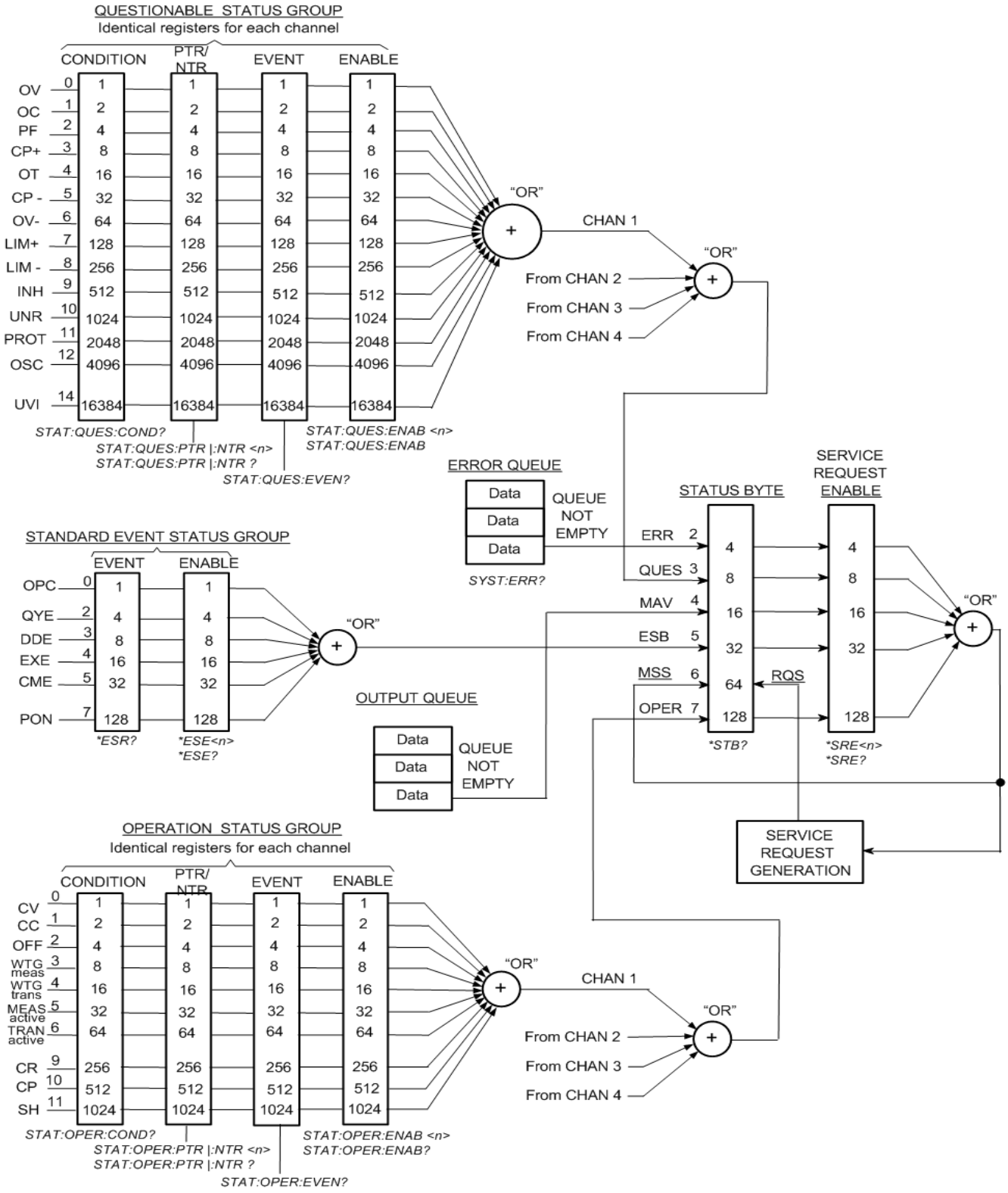
The RQS bit is a latched version of the MSS bit. Whenever the instrument requests service, it sets the SRQ interrupt line true and latches RQS into bit 6 of the Status Byte register. When the controller does a serial poll, RQS is cleared inside the register and returned in bit position 6 of the response.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

Error and Output Queues

The Error Queue is a first-in, first-out (FIFO) data register that stores numerical and textual description of an error or event. Error messages are stored until they are read with SYSTem:ERRor? If the queue overflows, the last error/event in the queue is replaced with error -350,"Queue overflow".

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

Status Diagram



Reset (*RST) and Non-Volatile Settings

Reset State

Non-Volatile Settings

Reset State (*RST)

The following tables show the reset state. These parameters are set to the indicated values at power-on or after *RST.

NOTE The power-on/reset state may differ from that shown below if you have enabled power-on state recall mode from the **States** menu (see Instrument State Storage).

CPI Command *RST Settings			
ARB:COUNt	1	OUTPut:PROTect:DELay	0.02
ARB:CURRent|VOLTage:CDWell:DWELl	0.001	OUTPut:PROTect:OSCillation	ON
ARB:CURRent|VOLTage:CDWell:LEVel	MIN	OUTPut:PROTect:WDOG	OFF
ARB:CURRent|VOLTage:EXPonential:END	MIN	OUTPut:RELay:POLarity	NORM
ARB:CURRent|VOLTage:EXPonential:STARt	MIN	OUTPut:SHORt	OFF
ARB:CURRent|VOLTage:EXPonential:STARt:TIMe	0	OUTPut:TMODe	LOWZ
ARB:CURRent|VOLTage:EXPonential:TCONstant	1	POWer	MIN
ARB:CURRent|VOLTage:EXPonential:TIMe	1	POWer:LIMit	MAX
ARB:CURRent|VOLTage:PULSe:END:TIMe	0	POWer:MODE	FIX
ARB:CURRent|VOLTage:PULSe:STARt	MIN	POWer:PROTection:DELay	0.02
ARB:CURRent|VOLTage:PULSe:STARt:TIMe	0	POWer:PROTection:STATe	OFF
ARB:CURRent|VOLTage:PULSe:TOP	MIN	POWer:RANGe	MAX
ARB:CURRent|VOLTage:PULSe:TOP:TIMe	1	POWer:SLEW	MAX
ARB:CURRent|VOLTage:RAMP:END	MIN	POWer:SLEW:COUPle	ON
ARB:CURRent|VOLTage:RAMP:END:TIMe	0	POWer:SLEW:MAX	ON
ARB:CURRent|VOLTage:RAMP:RTIMe	1	POWer:SLEW:NEGative	MAX
ARB:CURRent|VOLTage:RAMP:STARt	MIN	POWer:SLEW:NEGative:MAX	ON
ARB:CURRent|VOLTage:RAMP:STARt:TIMe	0	POWer:TRIGgered	MIN
ARB:CURRent|VOLTage:SINusoid:AMPLitude	MIN	RESistance	0 or 8,000

CPI Command *RST Settings			
ARB:CURRent|VOLTage:SINusoid:FREQuency	1	RESistance:MODE	FIX
ARB:CURRent|VOLTage:SINusoid:OFFSet	0	RESistance:RANGe	HIGH
ARB:CURRent|VOLTage:STAircase:END	MIN	RESistance:SLEW	MAX
ARB:CURRent|VOLTage:STAircase:END:TIMe	0	RESistance:SLEW:COUPle	ON
ARB:CURRent|VOLTage:STAircase:NSTeps	10	RESistance:SLEW:MAX	ON
ARB:CURRent|VOLTage:STAircase:STARt	MIN	RESistance:SLEW:NEGative	MAX
ARB:CURRent|VOLTage:STAircase:STAR:TIMe	0	RESistance:SLEW:NEGative:MAX	ON
ARB:CURRent|VOLTage:STAircase:TIMe	1	RESistance:STATe	OFF
ARB:CURRent|VOLTage:STEP:END	MIN	RESistance:TRIGgered	8000
ARB:CURRent|VOLTage:STEP:STARt	MIN	SENSe:CURRent:CCOMmunicate	ON
ARB:CURRent|VOLTage:STEP:STARt:TIMe	0	SENSe:CURRent:RANGe	MAX
ARB:CURRent|VOLTage:TRAPezoid:END:TIMe	0	SENSe:CURRent:RANGe:AUTO	OFF
ARB:CURRent|VOLTage:TRAPezoid:FTIMe	1	SENSe:ELOG:CURRent:RANGe:AUTO	OFF
ARB:CURRent|VOLTage:TRAPezoid:RTIMe	1	SENSe:ELOG:FUNCtion:CURRent	ON
ARB:CURRent|VOLTage:TRAPezoid:STARt	MIN	SENSe:ELOG:FUNCtion:CURRent:MINMax	OFF
ARB:CURRent|VOLTage:TRAPezoid:STARt:TIMe	0	SENSe:ELOG:FUNCtion:VOLTage	OFF
ARB:CURRent|VOLTage:TRAPezoid:TOP	MIN	SENSe:ELOG:FUNCtion:VOLTage:MINMax	OFF
ARB:CURRent|VOLTage:TRAPezoid:TOP:TIMe	1	SENSe:ELOG:PERiod	0.1
ARB:CURRent|VOLTage:UDEFined:BOSTep	OFF	SENSe:ELOG:VOLTage:RANGe:AUTO	OFF
ARB:CURRent|VOLTage:UDEFined:DWELl	0.001	SENSe:FUNCtion	"VOLT"
ARB:CURRent|VOLTage:UDEFined:LEVel	MIN	SENSe:FUNCtion:CURRent	OFF
ARB:FUNCtion:SHAPe	NONE	SENSe:FUNCtion:VOLTage	ON
ARB:FUNCtion:TYPE	VOLT	SENSe:FUNCtion:VOLTage:INPut	MAIN
ARB:SEQuence:COUNt	1	SENSe:SWEep:POINts	1024 or 4883
ARB:SEQuence:STEP:COUNt	1	SENSe:SWEep:OFFset:POINts	0
ARB:SEQuence:STEP:FUNCtion:SHAPe	PULS	SENSe:SWEep:TINTerval	20.48E–6
ARB:SEQuence:STEP:PACing	DWEL	SENSe:SWEep:TINTerval:RESolution	RES20
ARB:SEQuence:TERMinate:LAST	ON	SENSe:VOLTage:RANGe	MAX
ARB:TERMinate:LAST	OFF	SENSe:VOLTage:RANGe:AUTO	OFF

CPI Command *RST Settings			
CALibrate:STATe	OFF	SENSe:WINDow	RECT
CURRent	MIN	STEP:TOUTput	FALSE
CURRent:LIMit	MAX	TRIGger:ACQuire:CURRent	MIN
CURRent:LIMit:COUPle	ON	TRIGger:ACQuire:CURRent:SLOPe	POS
CURRent:LIMit:NEGative	MIN	TRIGger:ACQuire:SOURce	BUS
CURRent:MODE	FIX	TRIGger:ACQuire:TOUTput	OFF
CURRent:PROTection:DELay	0.02	TRIGger:ACQuire:VOLTage	MIN
CURRent:PROTection:DELay:STARt	SCH	TRIGger:ACQuire:VOLTage:SLOPe	POS
CURRent:PROTection:STATe	OFF	TRIGger:ARB:SOURce	IMM
CURRent:RANGe	MAX	TRIGger:ELOG:SOURce	BUS
CURRent:SLEW	MAX	TRIGger:TRANsient:SOURce	BUS
CURRent:SLEW:COUPle	ON	VOLTage	MIN
CURRent:SLEW:MAX	ON	VOLTage:BWIDth	LOW
CURRent:SLEW:NEGative	MAX	VOLTage:INHibit:VON	0.01
CURRent:SLEW:NEGative:MAX	ON	VOLTage:INHibit:VON:MODE	OFF
CURRent:TRIGgered	MIN	VOLTage:LIMit	MAX
DIGital:OUTPut:DATA	0	VOLTage:LIMit:COUPle	ON
INITiate:CONTinuous:TRANsient	OFF	VOLTage:LIMit:NEGative	MIN
LIST:COUNt	1	VOLTage:MODE	FIX
LIST:CURRent	MIN	VOLTage:PROTection	MAX
LIST:DWELl	0.001	VOLTage:PROTection:DELay	0
LIST:STEP	AUTO	VOLTage:PROTection:REMote	MAX
LIST:TERMinate:LAST	OFF	VOLTage:PROTection:REMote:NEGative	MIN
LIST:TOUTput:BOSTep	OFF	VOLTage:PROTection:REVerse:STATe	OFF
LIST:TOUTput:EOSTep	OFF	VOLTage:RANGe	MAX
LIST:VOLTage	MIN	VOLTage:SLEW	MAX
OUTPut	OFF	VOLTage:SLEW:COUPle	ON
OUTPut:DELay:FALL	0	VOLTage:SLEW:MAX	ON
OUTPut:DELay:RISE	0	VOLTage:SLEW:NEGative	MAX

CPI Command *RST Settings			
OUTPut:PMODe	VOLT	VOLTage:SLEW:NEGative:MAX	ON
OUTPut:PROTect:COUPle	OFF	VOLTage:TRIGgered	MIN

Non-Volatile Settings

The following table shows the as-shipped settings of the **non-volatile** parameters. These are not affected by power cycling or *RST.

NOTE The power-on/reset state may differ from that shown below if you have enabled power-on state recall mode from the **States** menu (see Instrument State Storage).

Factory as-shipped settings	
Admin/Calibration password	0 (zero)
Calibraton date	March 6, 2016
Channel grouping	No groups
Digital port function (all pins)	Digital In
Digital port polarity (all pins)	Positive
Firmware update password protected	Disabled
Front panel lockout	Disabled
Front panel meter view	1-channel
GPIB address	5
GPIB interface	Enabled
Key clicks	Enabled
LAN interface	Enabled
On/Off key affects all channels	Disabled
Output inhibit mode	Off
Saved states	*RST command
Screen saver	Enabled
Screen saver delay	60 minutes
USB interface	Enabled
Wake on I/O	Enabled
Web server	Enabled

LAN Interface as-shipped settings	
These settings are optimized for connecting your power system to a site network. They should also work well for other network configurations. The LAN as-shipped settings can be restored by selecting the **System\IO\LAN\Defaults** menu.	
Get IP Address	Automatic
Subnet mask	255.255.0.0
Default gateway	0.0.0.0
Host name	Keysight-<serial number>
mDNS service name	Keysight N67xxx Modular Power System <serial number>
LAN service - VXI-11	Enabled
LAN service - Telnet	Enabled
LAN service - mDNS	Enabled
LAN service - Web server	Enabled
LAN service - sockets	Enabled
Web password	Blank

SCPI Error Messages

The Keysight instrument returns error messages in accord with the SCPI standard.

- Up to 20 errors can be stored in each interface-specific error queue (one each for GPIB, USB, VXI-11, and Telnet/Sockets.) Errors appear in the error queue of the I/O session that caused the error.
- The instrument beeps each time a command syntax or hardware error is generated. The front-panel ERROR annunciator turns on when one or more errors are in the error queue.
- A special global error queue holds all power-on and hardware-related errors (for example, over-temperature).
- Error retrieval is first-in-first-out (FIFO), and errors are cleared as you read them. Once you have read all interface-specific errors, the errors in the global error queue are retrieved. When you have read all errors from the error queue, the ERR annunciator turns off.
- If more than 20 errors have occurred, the last error stored in the queue (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 have occurred when you read the error queue, the instrument responds with +0,"No error".
- The front panel reports errors from all I/O sessions and the global error queue. To read the error queue from the front panel, press the ERROR key.
- Error conditions are also summarized in the Status Byte Register. See Status Subsystem Introduction for details.
- The interface-specific error queues are cleared by power cycles and *CLS. The error queue is not cleared by *RST.
- The SYSTem:ERRor? query reads and clears one error from the error queue. Errors have the following format -113,"Undefined header". The error string may contain up to 255 characters.

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.

114 Wrong status

An incorrect status function has been reported.

116 Locked out by internal switch setting

This function has been locked out by an internal switch.

117 Calibration error

A calibration error has occurred. Do not save calibration constants. Try re-calibrating the unit.

200 Hardware error channel <1>

A hardware error has occurred on the output.

201 Invalid configuration, empty slots

There is an empty slot between modules. This configuration is not allowed.

202 Self-test Fail

A self-test failure has occurred. See self-test 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.

207 Cal file version error

The calibration file was written or read using old firmware. Firmware must be updated.

208 Running backup firmware

The instrument is presently running the backup (previous) version of the firmware.

209 Internal communication error

An internal communication error has occurred in the instrument.

210 Frame NVRAM error

A non-volatile RAM error has occurred in the instrument.

211 Output state couple modules do not match

One or more modules in the group does not match the non-volatile configurations settings.

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 transient generator. Either the voltage or current function is set to Fixed mode.

310 The command is not supported by this model

This power modules either does not have the hardware capability or the options required to support this command.

311 This group of channel has non-identical features

One or more modules in this group does not match the ratings or options of the other modules.

312 The command is disabled when the channel is grouped

This command is disabled when the output channel is grouped.

315 Settings conflict error

A data element could not be programmed because of the present instrument state.

320 Firmware update error

This may be due to the instrument hardware not being able to support the firmware version.

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.

-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.

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.

Self-test Errors (these errors set Standard Event Status register bit #3)

202 Self-test 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 Self-test 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 Self-test 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 Self-test 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 Self-test 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.

Compatibility With A and B Version MPS

Persona Commands

New Feature Comparison With A and B MPS Mainframes

The Persona commands described in this section are provided for compatibility with the existing N6700B, N6701A, and N6702A Modular Power System (MPS). This section also compares the new features to the previous A and B MPS Mainframes.

Persona Commands

Persona commands are provided to allow users to change the programmatic identity of the N6700C series mainframes back to the "A" or "B" version mainframes for code compatibility. The manufacturer string can also be changed for code compatibility. The persona commands are non-volatile.

Model Number

The following list documents the model number compatibility:

N6700C is compatible with N6700B
N6701C is compatiblewith N6701A
N6702C is compatiblewith N6702A

To change the model number ID of an N6700C to N6700B:
SYST:PERS:MOD "N6700B"

To return the model number to the factory shipped setting:
SYST:PERS:MOD:DEF

Manufacturer ID

The following list documents the manufacturer compatibility:

Keysight Technologies is compatible with Agilent Technologies

To change the manufacturer ID to Agilent Technologies:
SYST:PERS:MAN Agilent Technologies

To return the manufacturer to the factory shipped setting:
SYST:PERS:MAN:DEF

New Feature Comparison With A and B MPS Mainframes

Feature	N6700C series Implementation	N6700A/B Implementation
Color	Phantom gray	Quartz gray
Start-up time	Approximately 30 seconds	Approximately 15 seconds
Compliance	LXI 1.4 Core, HiSLIP, IPv6	LXI 1.1 Class C
Ethernet connectivity	Up to 1000 Mbps	Up to 100 Mbps
Auto-MDIX	Supported	Not available
*IDN response	Keysight Technologies N6700C, N6701C, N6702C	Agilent Technologies N6700B, N6701A, N6702A
Firmware update lockout from front panel	Requires Admin password to update firmware	Not available
ID strings - LAN, USB, GPIB, and Web page	Keysight, K-<hostname>	Agilent, A-<hostname>
Saved state locations	10	2
Calibration count	CALibrate:COUNt	Returns -100 Command error
Front panel display enable/disable	DISPlay[:WINDow][:STAte]	Returns -100 Command error
Display image capture commands	HCOPy:SDUMp:DATA? HCOPy:SDUMp:DATA:FORMat	Returns -100 Command error
LXI identify and MDNS commands	LXI:IDENtify[:STATe] LXI:MDNS[:STATe]	Returns -100 Command error
Difference between the internal temperature and the OT trip point	OUTPut:PROTection:TEMPerature:MARgin	Returns -100 Command error
PERSona commands switch manufacturer and model number for backward compatibility	SYSTem:PERSona:MANufacturer SYSTem:PERSona:MANufacturer:DEFault SYSTem:PERSona:MODel SYSTem:PERSona:MODel:DEFault	Returns -100 Command error
Memory sanitization NISPOM compatible	SYSTem:SECurity:IMMediate	Returns -100 Command error

6
Verification and Calibration

Test Equipment and Setups

Performance Verification

Module Calibration

Test Record Forms

The verification procedures described in this section verify that the Keysight Series N6700C Modular Power System is operating normally and is within published specifications.

Perform the verification tests before calibrating your power system. If the power system passes the verification tests, the power modules are operating within their calibration limits and do not need to be re-calibrated.

NOTE Keysight N6700C, N6701C, and N6702C MPS mainframes do not require calibration.

Test Equipment and Setups

Equipment Required

Measurement Setups

Equipment Required

The test equipment recommended for the performance verification and adjustment procedures is listed below. If the exact instrument is not available, substitute calibration standards of equivalent accuracy.

Instrument	Requirements	Recommended Model	Use[1]
Digital Multimeter	Resolution: 10 nV @ 1V Readout: 8 1/2 digits Accuracy: 20 ppm	Keysight 3458A or equivalent (2 required for N679xA verification)	V, C
Current Shunt[2]	15 A (0.1Ω) 30 A (0.1Ω) 50 A (0.05Ω)	Guildline 9230A-15R Guildline 9230A-30 Guildline 9230A-50	V, C
Load Resistors	25 Ω, 250 W, 1% (N6751A/52A/61A/62A) 4 Ω, 250 W, 1% (N6751A/52A/61A/62A) 20 kΩ, 1%, 1/8W (for option 1UA/2UA) 10 Ω, 1%, 1/8W (N678xA SMU) 10 kΩ, 1%, 1/8W (N678xA SMU) 1 MΩ, 1%, 1/8W (N678xA SMU)	Vishay NH-250-25Ω-1% Vishay NH-250-4Ω-1%	C C V, C V, C V, C V, C
Electronic load[2]	150 V, 50 A minimum, with transient capability and a slew rate of 833 kA/s or better	Keysight N3300A mainframe, with N330xA modules	V, C
Keysight N6784A	Load for N678xA SMU and N6783A (set to CC load mode)	Keysight N6784A	V
GPIB controller	Full GPIB capabilities	Keysight 82350B or equivalent	V, C
Oscilloscope	Sensitivity: 1 mV Bandwidth Limit: 20 MHz Probe: 1:1 with RF tip	Keysight DSO6054A or equivalent	V
RMS Voltmeter	True RMS Bandwidth: 20 MHz Sensitivity: 100 µV	Rhode and Schwartz Model URE3 or equivalent	V
Differential Amplifier	Bandwidth: 20 MHz	LeCroy DA1855A, DA1850A, or equivalent	V
Terminations	1 – 50 Ω BNC termination 2 – 50 Ω 1/8 W termination resistors		V
Power supply	80 V, 50 A, 300 W minimum (for N679xA load modules)	Keysight N6763A, N6764A, and N6776A or equivalent	V, C

Instrument	Requirements	Recommended Model	Use[1]
Variable voltage transformer or AC source	Adjustable to highest rated input voltage Power: 500 VA	Keysight 6813B or equivalent	V
RC – for N678xA transient test	Capacitor: 150 µF fixed film Resistor 50 mΩ	EPCOS B32526R0157K Vishay LVR01R0500FE70	V

1 V = Verification C = Calibration
2 Dependent on rating of model being tested

Measurement Setups

Voltmeter

To ensure that the values read by the voltmeter during both the verification procedure and the calibration procedure are not affected by the instantaneous measurement of the AC peaks of the output current ripple, make several DC measurements and average them. You can set up the voltmeter to do this automatically by programming 100 power line cycles per measurement.

If you are using a Keysight 3458A DMM also turn on auto-calibration (ACAL) and the autorange function (ARANGE). For best results, auto-calibration should be performed every 24 hours when verifying or calibrating models N678xA SMU.

Current Monitoring Shunt

The 4-terminal current shunt is used to make accurate current measurements. It has two monitoring terminals as well as two load terminals. Connect the voltmeter directly to the monitoring terminals. Also allow sufficient airflow for cooling.

Electronic Load

Many of the test procedures require the use of a variable load capable of dissipating the required power. If a variable resistor is used, switches should be used to connect, disconnect, or short the load resistor. For most tests, an electronic load can be used. The electronic load is considerably easier to use than load resistors, but it may not be fast enough to test transient recovery time and may be too noisy for the noise (PARD) tests. Fixed load resistors may be used in place of a variable load, with minor changes to the test procedures.

Note that an N6784A SMU power module should be used as the load when testing transient response on models N678xA SMU and N6783A.

Program Control

You may chose to automate the calibration and verification procedures. If computer controlled test setups are used, the relatively slow settling times and slew rates of the power system must be taken into account. "Wait" statements can be used in the test program to allow for the appropriate settling times for the power system.

Performance Verification

Verification Description

Verification Test Setups

Constant Voltage Tests

Transient Recovery Time

Auxiliary Voltage Measurement Accuracy - Models N6781A and N6785A

Constant Current Tests

Resistance Programming Accuracy - Models N6781A and N6785A

Negative Current Output - Models N6783A-BAT and N6783A-MFG

Load Module Verification Tests

Verification Description

The verification procedures described in this section verify that the Keysight N6700C series MPS is operating normally and is within published specifications. The following types of performance verification tests are available:

Performance Tests - These tests verify that the power system is operating normally and meets the specifications published in the Keysight N6700 Modular Power System Family Specifications Guide.

Calibration Tests - These tests verify that the power system is operating within its calibration limits.

Keysight Technologies recommends that complete verification should always be performed at the calibration interval. If the power system passes the verification tests, the unit is operating within its calibration limits and does not need to be re-calibrated. This ensures that the instrument will remain within specifications for the next calibration interval and provides the best long-term stability. Performance data measured using this method may be used to extend future calibration intervals.

If the instrument fails any of the tests or if abnormal test results are obtained, try calibrating the unit. If calibration is unsuccessful, return the unit to a Keysight Technologies Service Center.

Verification Test Setups

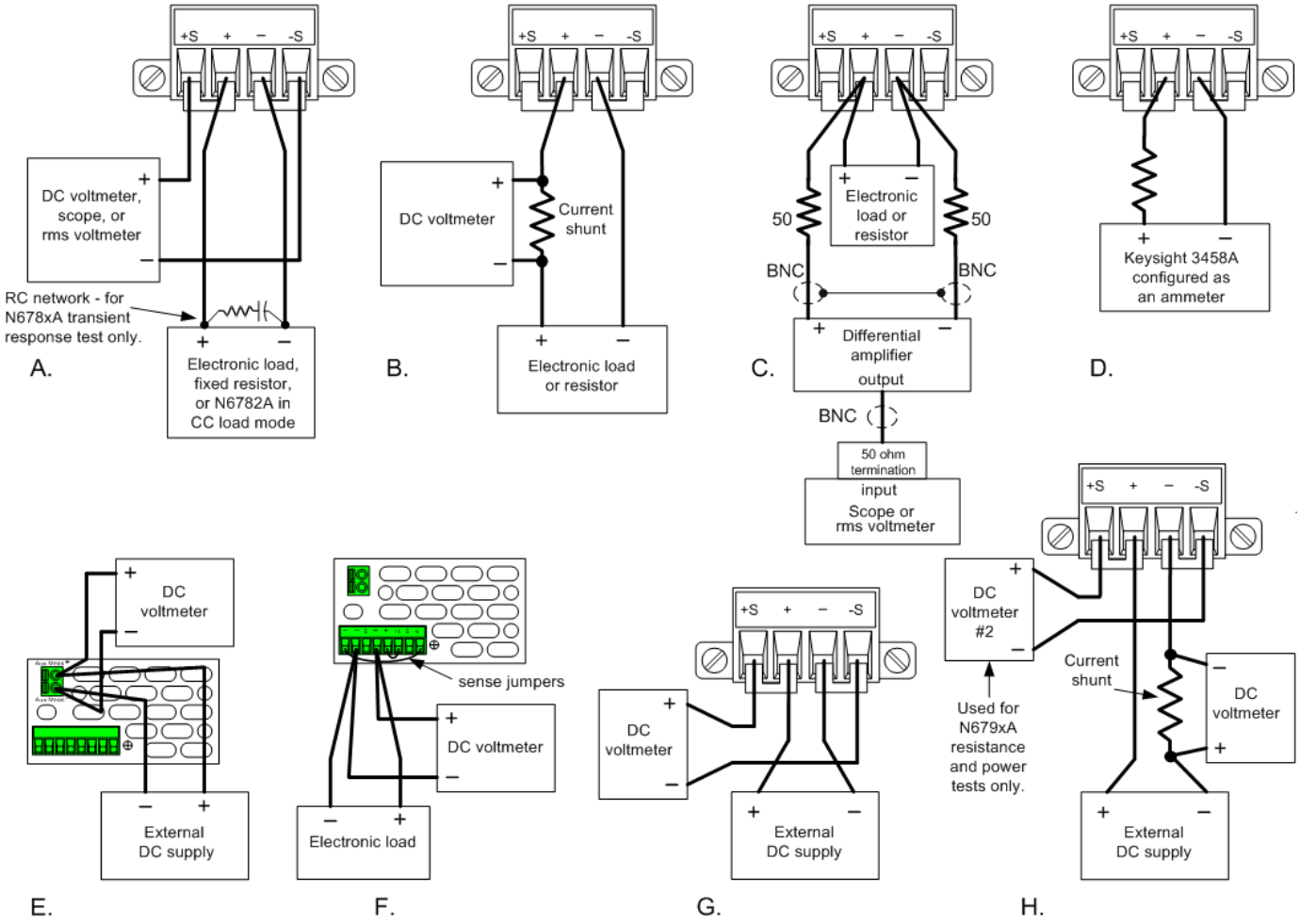
NOTE

Refer to Test Equipment for the equipment required for verification. Refer to the Measurement Techniques section for information about setting up the voltmeter, connecting the current shunt, and connecting the electronic load.

Test each output channel individually. Refer to the appropriate test record form for the instrument settings of the power module you are checking. For optimum performance, all verification and calibration procedures should comply with the following recommendations:

- Ambient temperature is stable, at 23°C ±5°C.
- Ambient relative humidity is less than 70%.
- 30 minute warm-up period before verification or adjustment.
- Cables as short as possible, twisted or shielded to reduce noise and inductance.
- Load lead lengths for models N678xA SMU must be between 1 and 4 feet.

The following figures show the verification test set-ups. Connect all leads to the output terminals as shown in the figure. The 50 A load and sense connections are shown under Connecting the Outputs.



Constant Voltage Tests

Voltage Programming and Readback Accuracy (all except N679xA not N679xA)

Test category = performance, calibration

This test verifies that the voltage programming and measurement functions are within specifications.

Step 1. Turn off the power system and connect a DMM across the sense terminals (see Test Setup A). Do not connect the load.

Step 2. Turn on the power system and program the instrument settings as described in the test record form under “Voltage Programming & Readback, Min Voltage”. Turn the output on. The output status should be “CV” and the output current should be close to zero.

Step 3. Record the output voltage reading from the DMM and the voltage measured over the interface. The readings should be within the limits specified in the test record form for the appropriate model under “Voltage Programming & Readback, Minimum Voltage”.

Step 4. Program the instrument settings as described in the test record form under “Voltage Programming & Readback, High Voltage”.

Step 5. Record the output voltage reading from the DMM and the voltage measured over the interface. The readings should be within the limits specified in the test record form for the appropriate model under “Voltage Programming & Readback, High Voltage”.

Step 6. *For models N6761A, N6762A, N6781A, N6782A, and N6784A only.* Set both the voltage programming and the voltage measurement to the low range (5.5 V for models N676xA; 6 V programming and 1 V measurement for models N678xA). Set the instrument as described under “Voltage Programming & Readback, Low Voltage”. Repeat step 5 for the low voltage range. The readings should be within the limits specified under “Voltage Programming & Readback Low Voltage”.

Step 7. *For models N6781A, N6782A, and N6784A only.* Set the voltage programming to the 600 mV range and the voltage measurement to the 100 mV range. Set the instrument as described under “600 mV Programming & 100 mV Readback”. Repeat step 5. The readings should be within the limits specified under “600 mV Programming & 100 mV Readback”.

Step 8. *For models N6763A – N6766A only.* Set the instrument as described under “Voltage Readback, Low Voltage”. Record the voltage measured over the interface. The reading should be within the limits specified under “Voltage Readback Low Range”.

Constant Voltage Load Effect (all except N679xA not N679xA)

Test category = performance

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

Step 1. Turn off the power system and connect a DMM and an electronic load (see Test Setup A).

Step 2. Turn on the power system and program the instrument settings as described in the test record form under “CV Load Effect”.

Step 3. Set the electronic load for the output channel’s current as described in the test record form under “CV Load Effect”. The output status should be “CV”. If it isn’t, adjust the load so that the output current drops slightly.

Step 4. Record the output voltage reading from the DMM.

Step 5. Open the load. Record the voltage reading from the DMM again. The difference between the DMM readings in steps 4 and 5 is the load effect, which should not exceed the value listed in the test record form for the appropriate model under “CV Load Effect”.

Step 6. *For models N6781A, N6782A, and N6784A only.* Repeat steps 2 through 5 for the 6 V range.

Constant Voltage Source Effect (all except N678xA SMU, N679xA not N678xA SMU not N679xA)

Test category = performance

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

Step 1. Turn off the power system and connect the ac power line through a variable voltage transformer or an AC source.

Step 2. Connect a DMM and an electronic load (see Test Setup A). Set the transformer or AC source to nominal line voltage.

Step 3. Turn on the power system and program the instrument settings as described in the test record form under “CV Source Effect”.

Step 4. Set the electronic load for the output channel’s current as described in the test record form under “CV Source Effect”. The output status should be “CV”. If it isn’t, adjust the load so that the output current drops slightly.

Step 5. Adjust the AC input to the lowest rated line voltage (86 Vac for 120 Vac nominal); (180 Vac for 220 Vac nominal).

Step 6. Record the output voltage reading from the DMM.

Step 7. Adjust the AC input to the highest rated line voltage (132 Vac for 120 Vac nominal); (264 Vac for 220 Vac nominal).

Step 8. Record the output voltage reading on the DMM. The difference between the DMM reading in steps 6 and 8 is the source effect, which should not exceed the value listed in the test record form for the appropriate model under “CV Source Effect”.

Constant Voltage Ripple and Noise (all except N679xA not N679xA)

Test category = performance

Periodic and random deviations in the output combine to produce a residual AC voltage superimposed on the DC output voltage. This residual voltage is specified as the rms or peak-to-peak noise in the frequency range specified in the Keysight N6700 Modular Power System Family Specifications Guide.

Step 1. Turn off the power system and connect a load resistor or electronic load, differential amplifier, and an oscilloscope (ac coupled) to the output (see Test Setup C).

Step 2. *For models N6751A/52A, N6761A/62A, and N678xA SMU* - use an appropriate load resistor to keep the power system at the instrument setting specified in the test record form under “CV Ripple and Noise”. For all other power modules - use an electronic load to keep the power system at the instrument setting specified in the test record form under “CV Ripple and Noise”.

Step 3. As shown in the diagram, use two BNC cables to connect the differential amplifier to the + and – output terminals. Each cable should be terminated by a 50 Ω resistor. The shields of the two BNC cables should be connected together. Connect the output of the differential amplifier to the oscilloscope with a 50 Ω termination at the input of the oscilloscope.

Step 4. Set the differential amplifier to multiply by ten, divide by one, and 1 MΩ input resistance. The positive and negative inputs of the differential amplifier should be set to AC coupling. Set the oscilloscope’s time base to 5 ms/div, and the vertical scale to 10 mV/div. Turn the bandwidth limit on (usually 20 or 30 MHz), and set the sampling mode to peak detect.

Step 5. Program the power system to the settings indicated in the in the test record form for the appropriate model under “CV Ripple and Noise” and enable the output. Let the oscilloscope run for a few seconds to generate enough measurement points. On the Keysight Infiniium scope, the maximum peak-to-peak voltage measurement is indicated at the bottom of the screen on the right side. Divide this value by 10 to get the CV peak-to-peak noise measurement. The result should not exceed the peak-to-peak limits in the test record form for the appropriate model under “CV Ripple and Noise, peak-to-peak”.

NOTE If the measurement contains any question marks, clear the measurement and try again. This means that some of the scope data received was questionable.

Step 6. Disconnect the oscilloscope and connect an rms voltmeter in its place. Do not disconnect the 50 ohm termination. Divide the reading of the rms voltmeter by 10. The result should not exceed the rms limits in the test record form for the appropriate model under “CV Ripple and Noise, rms”.

Step 7. *For models N6781A, N6782A, and N6784A only.* Repeat steps 2 through 6 for the 6 V range.

Transient Recovery Time

For all except N678xA SMU, N6783A, N679xA not N678xA SMU not N6783A not N679xA

Test category = performance

This test measures the time for the output voltage to recover to within the specified value following a 50% change in the load current.

Step 1. Turn off the power system and connect an oscilloscope across the sense terminals (see Test Setup A). Connect an electronic load to the output terminals.

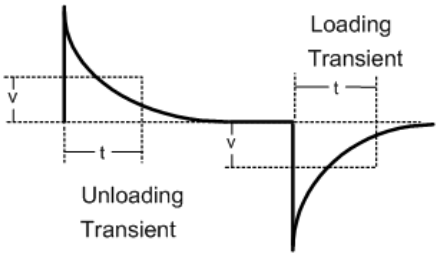
Step 2. Turn on the power system and program the instrument settings as described in the test record form under “Transient Response”.

Step 3. Set the electronic load to operate in constant current mode. Program its load current to the lower current value indicated in the test record form under “Transient Response”.

Step 4. Set the electronic load's transient generator frequency to 100 Hz and its duty cycle to 50%.

Step 5. Program the load's transient current level to the higher current value indicated in the test record form under “Transient Response”, and turn the transient generator on.

Step 6. Adjust the oscilloscope for a waveform similar to that shown in the following figure.



Step 7. The output voltage should return to within the specified voltage at the specified time following the 50% load change. Check both loading and unloading transient by triggering on the positive and negative slope. Record the voltage at time “t” in the performance test record form under “Transient Response”.

For N678xA SMU and N6783A N678xA SMU N6783A

Test category = performance

This test measures the time for the output voltage to recover to within the specified value following a 50% change in the load current of the specified range for models N678xA SMU and N6783A.

Step 1. Turn off the power system and connect an oscilloscope across the sense terminals (see Test Setup A). Connect an N6784A as a load to the output terminals. For models N678xA SMU only, observe the following additional connection requirements:
a. Twist the load leads, length must be between 1 and 4 ft.
b. Connect a 150 µF capacitor and 50 mΩ resistor across the load.
c. Disconnect the sense jumpers. Keep 4-wire sensing enabled.

d. Connect a 22 AWG twisted-pair from the +/- sense terminal to the output terminals of the N6784A load.

Step 2. Turn on the power system and program the instrument settings as described in the test record form under “Transient Response 6V”.

Step 3. Set the N6784A that is being used as the load as follows:
a. Emulation Mode = CC Load (in current priority mode)
b. + Voltage limit = 6.12 V
c. Current Slew setting:
N678xA: Maximum (the default)
N6783A: 67500 A/s (for a pulse rise/fall time of 20 µs)
d. Arb = Current Pulse
e. Load pulse properties:
N678xA: I0= –0.1 A; I1= –1.5A; T0= 1ms; T1= 1ms; T2= 1ms
N6783A: I0= –0.15A; I1= –1.5A; T0= 0.5ms; T1= 0.5ms; T2= 0.5ms
f. Continuous = ON
g. Press Arb run.

Step 4. Adjust the oscilloscope for a waveform similar to that shown in the previous figure.

Step 5. The output voltage should return to within the specified voltage at the specified time following the 50% load change. Check both loading and unloading transient by triggering on the positive and negative slope. Record the voltage at time “t” in the performance test record form under “Transient Response”.

Step 6. *For models N6781A, N6782A, and N6784A only.* Repeat steps 3 through 5 for the 20 V range. Program the instrument settings as described on the test record form under “Transient Response 20 V”. Change the settings of the N6784A that is being used as the load as follows:
b. + Voltage limit = 20.4 V
e. Load pulse properties:
N678xA: I0= –0.1 A; I1= –0.9A; T0= 1ms; T1= 1ms; T2= 1ms

Auxiliary Voltage Measurement Accuracy - Models N6781A and N6785A N6781A, N6785A

Test category = performance

Step 1. Turn off the power system and connect the external DMM and an external power supply to the auxiliary voltage inputs (see Test Setup E).

Step 2. Turn on the external power supply and set the output to 20 volts. Turn on the power system. In the front panel menu, select Measure\Input and then select Auxiliary.

Step 3. Record the external DMM reading and the auxiliary DVM readings. The auxiliary voltage reading should be within the designated voltage limit indicated in the test record form under “Auxiliary Voltage Readback”.

Step 4. Reverse the leads of the external power supply and repeat step 3.

Constant Current Tests

Current Programming and Readback Accuracy (all except N679xA not N679xA)

Test category = performance, calibration

This test verifies that the current programming and measurement functions are within specifications.

Step 1. Turn off the power system and connect the current shunt directly across the output terminals. Connect the DMM directly across the current shunt (see Test Setup B). Note that the electronic load is not used in this portion of the test.

Step 2. Turn on the power system and program the instrument settings as described in the test record form under “Current Programming & Readback, Min Current”. The output status should be “CC”, and the output voltage should be close to zero.

Step 3. Divide the voltage drop (DMM reading) across the current shunt by the shunt resistance to convert to amps and record this value (Iout). Also, record the current measured over the interface. The readings should be within the limits specified in the test record form for the appropriate model under “Current Programming & Readback, Minimum Current”.

Step 4. Program the instrument settings as described in the test record form under “Current Programming & Readback, High Current”.

Step 5.Divide the voltage drop (DMM reading) across the current shunt by the shunt resistance to convert to amps and record this value (Iout). Also, record the current reading measured over the interface. The readings should be within the limits specified in the test record form for the appropriate model under “Current Programming & Readback, High Current”.

Step 6. *For models N6761A and N6762A only.* Connect the Keysight 3458A directly across the output (see Test Setup D without the resistor). Set the Keysight 3458A to the 100 mA range (no autoranging). Set both the current programming and the current measurement functions to the low range. Set the instrument as described under “Current Programming & Readback, Low Current”. Record the current reading of the 3458A. Also, record the current reading measured over the interface. The readings should be within the limits specified under “Current Programming & Readback, Low Range”.

Step 7. *For models N6761A and N6762A with option 2UA only.* Connect the Keysight 3458A and a 20k resistor to the output (see Test Setup D). Set the Keysight 3458A to measure current using the 1 mA range. Set the current measurement to the 200 µA range. Set the instrument as described in the test record form under “Current Readback, 200 µA Current”. Record the current reading of the Keysight 3458A and the current measured over the interface. Readings should be within limits specified for the appropriate model under “Current Readback, 200µA Range”.

Step 8. *For models N6763A–N6766A, N6783A, and N679xA only.* Set the current measurement to the low range. Set the instrument as described under “Current Readback, Low Current”. Repeat step 5. Record the current measured over the interface. The readings should be within the limits specified under “Low Current Readback Low Range”.

Step 9. *Steps 9 and 10 for models N6781A, N6782A, N6784A only.* Connect the Keysight 3458A directly across the output (see Test Setup D without the resistor). Set the Keysight 3458A to the 100 mA range (no autoranging). Set the current programming to the low ranges - 300 mA for N6781A and N6782A; 100 mA for the N6784A. Set the instrument as described under "Current Programming 300 mA & 100 mA ranges". Record the current readings of the 3458A. The readings should be within the limits specified under "300 mA and 100 mA range Current Iout".

Step 10. Set the current programming to the 10 mA range for the N6784A. Set the instrument as described under "Current Programming 10 mA range". Record the current reading of the 3458A. The reading should be within the limits specified under "10 mA range Current Iout".

Step 11. *Steps 11 and 12 for models N6781A, N6782A, N6784A, N6785A, and N6786A only.* Connect the Keysight 3458A in series with a 10 Ω resistor to the output (see Test Setup D). Set the Keysight 3458A to measure current using the 100 mA range. Set the current measurement to the 100 mA range. Set the instrument as described under "Current Readback 100 mA Range". Record the current reading of the 3458A and the current measured over the interface. The readings should be within the limits specified under "100 mA Range Readback".

Step 12. Connect the Keysight 3458A in series with a 10 kΩ resistor to the output (see Test Setup D). Set the Keysight 3458A to measure current using the 10 mA range. Set the current measurement to the 1 mA range. Set the instrument as described under "Current Readback 1 mA Range". Record the current reading of the 3458A and the current measured over the interface. The readings should be within the limits specified under "1 mA Range Readback".

Step 13. *For models N6781A, N6782A, and N6784A only.* Connect the Keysight 3458A in series with a 1 MΩ resistor to the output (see Test Setup D). Set the Keysight 3458A to measure current using the 100 µA range. The remote command is "DCI 100e-6". Set the current measurement to the 10 µA range. Set the instrument as described under "Current Readback, 10 µA Range". Record the current reading of the 3458A and the current measured over the interface. The readings should be within the limits specified under "10 µA Range Readback".

Constant Current Load Effect (all except N679xA not N679xA)

Test category = performance

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

Step 1. Turn off the power system and connect the current shunt, DMM, and electronic load (see Test Setup B). Connect the DMM directly across the current shunt.

Step 2. Turn on the power system and program the instrument settings as described in the test record under "CC Load Effect".

Step 3. Set the electronic load for CV mode and program it to the output channel's voltage as described in the test record under "CC Load Effect". The output status should be "CC". If it isn't, adjust the load so that the output voltage drops slightly.

Step 4. Divide the voltage drop (DMM reading) across the current shunt by the shunt resistance to convert to amps and record this value (Iout).

Step 5. Short the electronic load. For models N6751A and N6752A, wait 10 seconds for the output to stabilize. For models N6761A and N6762A, wait 60 seconds for the output to stabilize. Divide the voltage drop (DMM reading) across the current shunt by the shunt resistance to convert to amps and record this value (Iout). The difference in the current readings in steps 4 and 5 is the load effect, which should not exceed the value listed in the test record for the appropriate model under “CC Load Effect”.

Step 6. *For models N6781A and N6782A only.* Repeat steps 2 through 5 for the 1 A range and the 300 mA range.

Step 7. *For model N6784A only.* Repeat steps 2 through 5 for the 1 A range, the 100 mA range, and the 10 mA range.

Constant Current Source Effect (all except N678xA SMU, N679xA not N678xA SMU not N679xA)

Test category = performance

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

Step 1. Turn off the power system and connect the ac power line through a variable voltage transformer or an AC source.

Step 2. Connect the current shunt, DMM, and electronic load (see Test Setup B). Connect the DMM directly across the current shunt. Set the transformer or AC source to nominal line voltage.

Step 3. Turn on the power system and program the instrument settings as described in the test record form under “CC Source Effect”.

Step 4. Set the electronic load for the output channel’s voltage as described in the test record form under “CC Source Effect”. The output status should be “CC”. If it isn’t, adjust the load so that the output voltage drops slightly.

Step 5. Adjust the AC input to the lowest rated line voltage (86 Vac for 120 Vac nominal); (180 Vac for 220 Vac nominal).

Step 6. Divide the voltage drop (DMM reading) across the current shunt by the shunt resistance to convert to amps and record this value (Iout).

Step 7. Adjust the AC input to the highest rated line voltage (132 Vac for 120 Vac nominal); (264 Vac for 220 Vac nominal).

Step 8. Divide the voltage drop (DMM reading) across the current shunt by the shunt resistance to convert to amps and record this value (Iout). The difference between the DMM reading in steps 6 and 8 is the source effect, which should not exceed the value listed in the test record form for the appropriate model under “CC Source Effect”.

Resistance Programming Accuracy

For N6781A and N6785A N6781A, N6785A

Test category = performance, calibration

NOTE Current readback accuracy must be verified prior to this test.

Step 1. Turn off the power system and connect an external DMM and an electronic load directly to the output (see Test Setup F).

Step 2. Turn on the power system and set the 20 V range, and program the output to 10 V. Turn the output on and record the voltage reading on the DMM. This is the voltage with no load (Vnl).

Step 3. Program the output resistance to 1 ohm. Turn on the electronic load. Select CC mode, current: 1 A, Input On.

Step 4. Record the voltage reading on the DMM. This is the voltage with a load (Vwl). Record the current reading on the front panel of the power system. This is the current with a load (Iwl).

Step 5. Calculate the resistance value as follows: R = (Vnl–Vwl)/Iwl This is the output resistance, which should not exceed value listed in the test record under “Resistance Programming”.

Step 6. For Model N6781A, repeat steps 2 through 5 for the 6 V range. Set the output voltage to 6 V and the load current to 3 A.

Negative Current Output - Models N6783A-BAT and N6783A-MFG N6783A

Test category = performance, calibration

Step 1. Turn off the power system and connect the DMM, current shunt, and an external power supply to the output (see Test Setup H). Connect plus to plus, minus to minus. Set the external power supply to 3V, 3A.

Step 2. Turn on the power system and set the N6783A power module to the values indicted in the test record under “Negative Current Output”. The display should read approximately -2 A.

Step 3. Divide the voltage drop (DMM reading) across the current shunt by its resistance to convert to amperes and record this value. The reading should be within the limits specified on the test record under Constant Current Tests, “Negative Current Output”.

Load Module Verification Tests - Models N6791A and N6792A N679xA

Voltage Programming and Readback Accuracy

Test category = performance, calibration

This test verifies that the voltage programming and measurement functions are within specifications.

Step 1. Turn off the power system and connect a DMM across the sense terminals and an external power supply across the input terminals (see Test Setup G).

Step 2. Turn on the power system and program the N679xA load settings as described in the test record form for “Voltage Programming & Readback, Minimum voltage”. Turn on the power supply and program it to the power supply settings described in the test record form.

Step 3.Turn the load input on. The load status should be “CV” and the input current should be close to zero.

Step 4. Record the voltage reading from the DMM and the voltage measured over the interface. The readings should be within the limits specified in the test record form for the appropriate model under “Voltage Programming & Readback, Minimum voltage”.

Step 5. Program the N679xA load settings as described in the test record form for “Voltage Programming & Readback, High voltage”.

Step 6. Record the voltage reading from the DMM and the voltage measured over the interface. The readings should be within the limits specified in the test record form for the appropriate model under “Voltage Programming & Readback, High voltage”.

Current Programming and Readback Accuracy

Test category = performance, calibration

This test verifies that the current programming and measurement functions are within specifications.

High Range

Step 1. Turn off the power system and connect the DMM, current shunt, and an external power supply across the input terminals (see Test Setup H). Connect the DMM directly across the current shunt.

Step 2. Turn on the power system and program the N679xA load settings as described in the test record form under “Current Programming & Readback - High range, Minimum current”. Turn on the power supply and program it to the power supply settings described in the test record form.

Step 3.Turn the load input on. The load status should be “CC”, and the input voltage should be close to zero.

Step 4. Divide the voltage drop (DMM reading) across the current shunt by the shunt resistance to convert to amps and record this value (Iin). Also record the current measured over the interface. The readings should be within the limits specified in the test record form for the appropriate model under “Current Programming & Readback - High range, Minimum current”.

Step 5. Program the N679xA load settings as described in the test record form under “Current Programming & Readback, High current”.

Step 6. Divide the voltage drop (DMM reading) across the current shunt by the shunt resistance to convert to amps and record this value (Iin). Also record the current reading measured over the interface. The readings should be within the limits specified in the test record form for the appropriate model under “Current Programming & Readback, High current”.

Low Range

Step 7. Program the N679xA load settings as described in the test record form under “Current Programming & Readback - Low range, Minimum current”.

Step 8. Divide the voltage drop (DMM reading) across the current shunt by the shunt resistance to convert to amps and record this value (Iin). Also record the current reading measured over the interface. The readings should be within the limits specified in the test record form for the appropriate model under “Current Programming & Readback, Low range, Minimum current”.

Step 9. Program the N679xA load settings as described in the test record form under “Current Programming & Readback - Low range, Low current”.

Step 10. Divide the voltage drop (DMM reading) across the current shunt by the shunt resistance to convert to amps and record this value (Iin). Also record the current reading measured over the interface. The readings should be within the limits specified in the test record form for the appropriate model under “Current Programming & Readback, Low range, Low current”.

Resistance Programming Accuracy

Test category = performance

This test verifies that the resistance programming is within specification. The programmed resistance values are checked by recording the voltage across the current monitor resistor and the input voltage (voltage at the modules + and – sense terminals), then calculating the resistance as follows;

Resistance = Input Voltage / (voltage across current monitor / monitor resistor value)

The Resistance value must then be converted to Siemens by inverting the value: S = 1/R

High Range

Step 1. Turn off the power system and connect the current shunt, DMM, and an external power supply (see Test Setup H). Connect the DMM directly across the current shunt. Connect the second DMM across the sense terminals.

Step 2. Turn on the power system and program the N679xA load settings as described in the test record form for “Resistance Programming - High range, Minimum resistance”. Turn on the power supply and program it to the power supply settings described in the test record form.

Step 3. Turn the load input on. The load status should be “CR”

Step 4. Divide the voltage drop (DMM reading) across the current shunt by the shunt resistance to convert to amps and record this value (Iin).

Step 5. Calculate the resistance value as follows: R = Vin/Iin. Vin is the voltage measured by the second DMM. Convert the input resistance (R) to Siemens by inverting the value: S = 1/R. The value in Siemens should not exceed value listed in the test record under “Resistance Programming - High range, Minimum resistance”.

Step 6. Program the N679xA load settings as described in the test record form under “Resistance Programming - High range, High resistance”. Program the power supply to the power supply settings described in the test record form.

Step 7. Divide the voltage drop (DMM reading) across the current shunt by the shunt resistance to convert to amps and record this value (Iin).

Step 8. Calculate the resistance value as follows: R = Vin/Iin. Vin is the voltage measured by the second DMM. Convert the input resistance (R) to Siemens by inverting the value: S = 1/R. The value in Siemens should not exceed value listed in the test record under “Resistance Programming - High range, High resistance”.

Medium Range

Step 9. Program the N679xA load settings as described in the test record form for “Resistance Programming - Medium range, Minimum resistance”. Program the power supply to the power supply settings described in the test record form.

Step 10. Divide the voltage drop (DMM reading) across the current shunt by the shunt resistance to convert to amps and record this value (Iin).

Step 11. Calculate the resistance value as follows: R = Vin/Iin. Vin is the voltage measured by the second DMM. Convert the input resistance (R) to Siemens by inverting the value: S = 1/R. The value in Siemens should not exceed value listed in the test record under “Resistance Programming - Medium range, Minimum resistance”.

Step 12. Program the N679xA load settings as described in the test record form under “Resistance Programming - Medium range, High resistance”. Program the power supply to the power supply settings described in the test record form.

Step 13. Divide the voltage drop (DMM reading) across the current shunt by the shunt resistance to convert to amps and record this value (Iin).

Step 14. Calculate the resistance value as follows: R = Vin/Iin. Vin is the voltage measured by the second DMM. Convert the input resistance (R) to Siemens by inverting the value: S = 1/R. The value in Siemens should not exceed value listed in the test record under “Resistance Programming - Medium range, High resistance”.

Low Range

Step 15. Program the N679xA load settings as described in the test record form for “Resistance Programming - Low range, Minimum resistance”. Program the power supply to the power supply settings described in the test record form.

Step 16.Divide the voltage drop (DMM reading) across the current shunt by the shunt resistance to convert to amps and record this value (Iin).

Step 17. Calculate the resistance value as follows: R = Vin/Iin. Vin is the voltage measured by the second DMM. Convert the input resistance (R) to Siemens by inverting the value: S = 1/R. The value in Siemens should not exceed value listed in the test record under “Resistance Programming - Low range, Minimum resistance”.

Step 18. Program the N679xA load settings as described in the test record form under “Resistance Programming - Low range, High resistance”. Program the power supply to the power supply settings described in the test record form.

Step 19.Divide the voltage drop (DMM reading) across the current shunt by the shunt resistance to convert to amps and record this value (Iin).

Step 20. Calculate the resistance value as follows: R = Vin/Iin. Vin is the voltage measured by the second DMM. Convert the input resistance (R) to Siemens by inverting the value: S = 1/R. The value in Siemens should not exceed value listed in the test record under “Resistance Programming - Low range, High resistance”.

Power Programming and Readback Accuracy

Test category = performance

This test verifies that the power programming and measurement functions are within specifications.

High Range

Step 1. Turn off the power system and connect the current shunt, DMM, and an external power supply (see Test Setup H). Connect the DMM directly across the current shunt. Connect the second DMM across the sense terminals.

Step 2. Turn on the power system and program the N679xA load settings as described in the test record form under “Power Programming & Readback - High range, Minimum power”. Turn on the power supply and program it to the power supply settings described in the test record form.

Step 3.Turn the load input on. The load status should be “CP”.

Step 4.Divide the voltage drop (DMM reading) across the current shunt by the shunt resistance to convert to amps and record this value (Iin). Also record the current measured over the interface. Calculate the power as follows: P = Iin x Vin. Vin is the voltage measured by the second DMM. The readings should be within the limits specified in the test record form for the appropriate model under “Power Programming & Readback - High range, Minimum power”.

Step 5. Program the N679xA load settings as described in the test record form under “Power Programming & Readback High range, High power”.

Step 6.Divide the voltage drop (DMM reading) across the current shunt by the shunt resistance to convert to amps and record this value (Iin). Also record the current reading measured over the interface. Calculate the power as follows: P = Iin x Vin. Vin is the voltage measured by the second DMM. The readings should be within the limits specified in the test record form for the appropriate model under “Power Programming & Readback - High range, High power”.

Low Range

Step 7. Program the N679xA load settings as described in the test record form under “Power Programming & Readback - Low range, Minimum power”.

Step 8.Divide the voltage drop (DMM reading) across the current shunt by the shunt resistance to convert to amps and record this value (Iin). Also, record the current reading measured over the interface. Calculate the power as follows: P = Iin x Vin. Vin is the voltage measured by the second DMM. The readings should be within the limits specified in the test record form for the appropriate model under “Power Programming & Readback, Low range, Minimum power”.

Step 9. Program the N679xA load settings as described in the test record form under “Power Programming & Readback - Low range, Low power”.

Step 10.Divide the voltage drop (DMM reading) across the current shunt by the shunt resistance to convert to amps and record this value (Iin). Also, record the current reading measured over the interface. The readings should be within the limits specified in the test record form for the appropriate model under “Power Programming & Readback, Low range, Low power”.

Module Calibration Procedure

Calibration Description

Calibration Setups

Calibration Procedure – Models N673xB, N674xB, N677xA

Calibration Procedure – Models N675xA and N676xA

Calibration Procedure – Models N678xA SMU

Calibration Procedure – Models N6783A-BAT and N6783A-MFG

Calibration Procedure – Models N6791A and N6792A

Calibration Description

NOTE Perform the verification tests before calibrating your power system. If the power system passes the verification tests, the unit is operating within its calibration limits and does not need to be re-calibrated.

The Keysight N6700C series MPS features closed-case electronic calibration; no internal mechanical adjustments are required. The instrument calculates correction factors based on input reference values that you set and stores correction factors in non-volatile memory until the next calibration adjustment is performed. This EEPROM calibration memory is not changed by cycling power or *RST.

- The correct password is required to enter the Admin menu, which contains the calibration function. The password is factory-set to 0 (zero). You can change the password once calibration mode is entered to prevent unauthorized access to the calibration function. Refer to Password Protection for details.
- Calibrate only ONE channel at a time. The calibration commands accept only a single channel number for the channel parameter. Calibration cannot be performed on channels that have been grouped. If any channels are grouped, they must be ungrouped before they can be calibrated.
- When calibrating the unit using SCPI commands, most steps involve sending a *OPC? query to synchronize with the power system's command completion before proceeding. The response from the instrument must be read each time *OPC? is given. In some steps, it may take up to 30 seconds for *OPC? to respond.
- When calibrating the unit using SCPI commands, most steps involve sending a *OPC? query to synchronize with the instrument's command completion before proceeding. The response from the instrument must be read each time *OPC? is given. Additionally, the relatively slow settling times and slew rates of the power system must be taken into account. Use "Wait" statements to allow for the appropriate settling times for the power system.

- Once started, you must perform the complete voltage or current calibration procedure in its entirety. As each calibration section is completed, the instrument calculates new calibration constants and begins using them. However, these constants are not saved in nonvolatile memory until a SAVE command is explicitly given.
- Exit the calibration mode either by logging out of the Admin menu or by sending CAL:STAT OFF. Note that any channels that were calibrated but not saved will revert to their previous calibration constants.

Calibration Interval

The power modules should be calibrated on a regular interval determined by the accuracy requirements of your application. The recommended calibration interval for Keysight N6700 Series power modules is one year. Keysight N6700C, N6701C, and N6702C MPS mainframes do not require calibration.

Calibration Switches

If the password is lost, access 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 Calibration Switches for more information.

Calibration Count

The power system records the number of times the unit is calibrated. The calibration count is incremented whenever the caljikklmibration (or date) is saved, the administration password is changed (or reset using the internal switches), or the firmware is updated.

Front Panel Menu Reference	SCPI Command
Select **System\Admin\Cal\Count**	CAL:COUN?

Calibration Setups

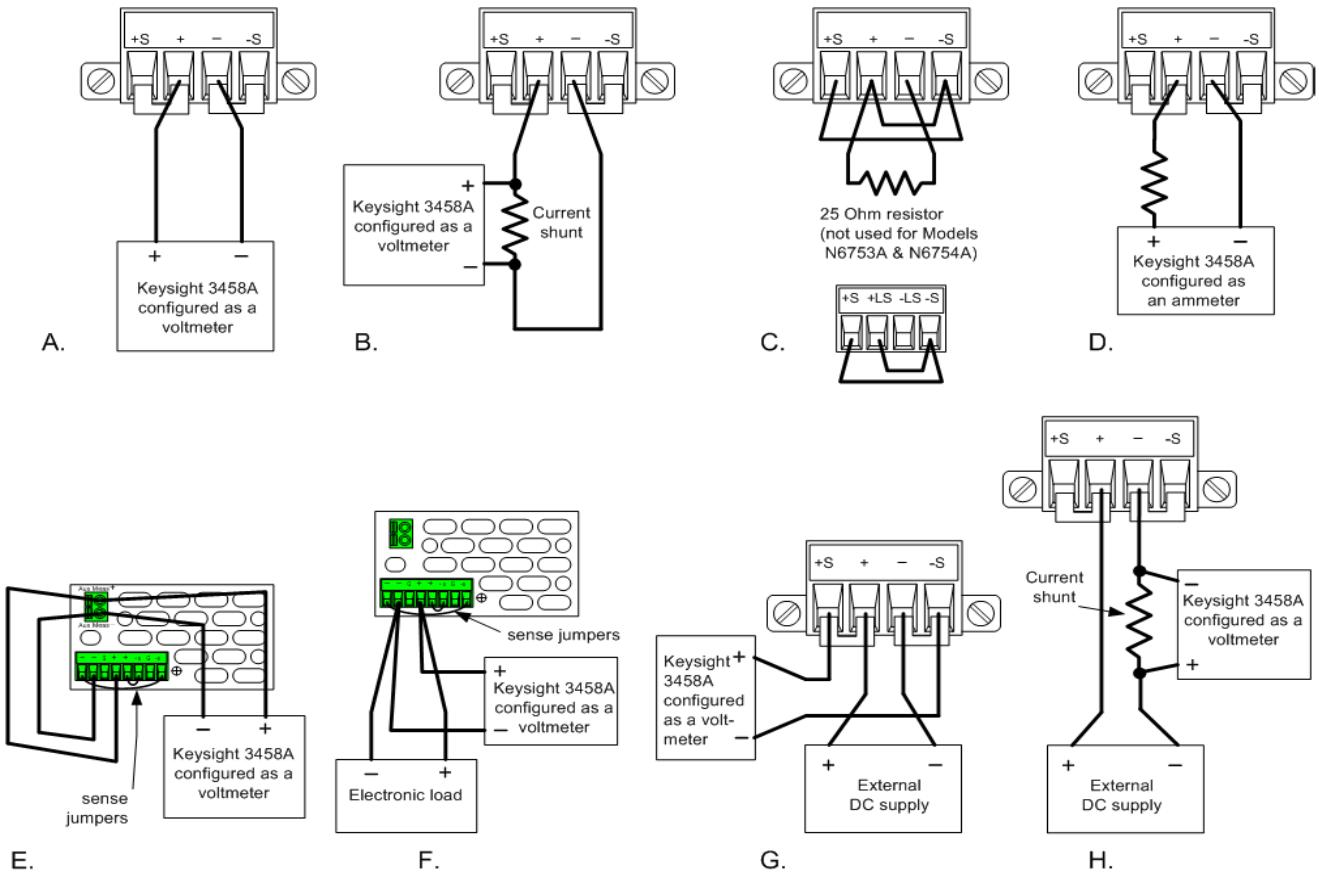
NOTE

Refer to Test Equipment for the equipment required for calibration. Refer to the Measurement Techniques section for information about setting up the voltmeter, connecting the current shunt, and connecting the electronic load.

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

- Ambient temperature is stable, at 23°C ±5°C.
- Ambient relative humidity is less than 70%.
- 30 minute warm-up period before verification or adjustment.
- Cables as short as possible, twisted or shielded to reduce noise and inductance.
- Load lead lengths for Models N678xA SMU must be between 1 and 4 feet. This is also recommended for other power modules.

The following figures show the calibration test set-ups. Connect all leads to the output terminals as shown in the figure. The 50 A load and sense connections are shown under Connecting the Outputs.



Calibration Procedure – Models N673xB, N674xB, N677xA

Enter Calibration Mode

Front Panel Menu Reference	SCPI Command
Select **System\Admin\Login**. Enter your password. Then press **Select**.	CAL:STAT ON <password>

Voltage Calibration

High Range Programming and Measurement

Step 1. Connect the voltage input of the Keysight 3458A DMM to an output channel as shown in Cal Setup A.

Step 2. Select the full-scale voltage programming and measurement range. The value entered must be the maximum voltage of the range that you are calibrating. The following example selects the 60 V full-scale range of output 1. Full-scale ranges vary according to model.

Front Panel Menu Reference	SCPI Command
Select **System\Admin\Cal\Volt\Vprog**. Select the High range. Then press Next.	CAL:VOLT 60, (@1)

Step 3. Select the first voltage calibration point and enter the data.

Front Panel Menu Reference	SCPI Command
Display shows: "Enter P1 measured data" Enter the data from the external DMM. Press Select when done.	CAL:LEV P1 *OPC? CAL:DATA <data>

Step 4. Select the second voltage calibration point and enter the data.

Front Panel Menu Reference	SCPI Command
Display shows: "Enter P2 measured data" Enter the data from the external DMM. Press Select when done. Press Next to finish calibration.	CAL:LEV P2 *OPC? CAL:DATA <data>

Current Calibration

High Range Programming and Measurement

NOTE The output voltage may go negative at some point during this procedure on units that have polarity reversal relays (Option 760).

Step 1. Connect a precision shunt resistor to the output. The shunt resistor should be able to measure at least 120% of the output's full-scale current (see Cal Setup B). Connect the Keysight 3458A DMM across the shunt resistor.

Step 2. Select the full-scale current programming range. The value to program a range must be the maximum current of the range. The following example selects the 5 A full-scale range of output 1. Full-scale ranges vary according to model.

Front Panel Menu Reference	SCPI Command
Select **System\Admin\Cal\Volt\Iprog** Select the High range. Then press Next.	CAL:CURR 5, (@1)

Step 3. Select the first current calibration point and enter the data.

Front Panel Menu Reference	SCPI Command
Display shows: "Enter P1 measured data" Calculate the shunt current (I=V/R) and enter the data. Press Select when done.	CAL:LEV P1 *OPC? CAL:DATA <data>

Step 4. Select the second current calibration point and enter the data.

Front Panel Menu Reference	SCPI Command
Display shows: "Enter P2 measured data" Calculate the shunt current (I=V/R) and enter the data. Press Select when done. Press Next to finish calibration.	CAL:LEV P2 *OPC? CAL:DATA <data>

Enter a Calibration Date, Save, and Log Out

Front Panel Menu Reference	SCPI Command
Select **System\Admin\CAL\DATE**. Enter the calibration date in the Date field.	To enter a calibration date: CAL:DATE "<date>"
Select **System\Admin\CAL\Save**. Select Save to save all calibration data.	To save the calibration data: CAL:SAVE
Select **System\Admin\Logout** to exit calibration mode.	To exit calibration mode: CAL:STAT OFF

Calibration Procedure – Models N675xA and N676xA

NOTE Models N6761A and N6762A require a 30-minute warm-up period in the reset (*RST) state before starting calibration.

Enter Calibration Mode

Front Panel Menu Reference	SCPI Command
Select System\Admin\Login. Enter your password. Then press Select.	CAL:STAT ON <password>

Voltage Calibration

High Range Programming and Measurement

Step 1. Connect the voltage input of the Keysight 3458A DMM to an output channel as shown in Cal Setup A.

Step 2. Select the full-scale voltage programming and measurement range. The value entered must be the maximum voltage of the range that you are calibrating. The following example selects the 50 V full-scale range of output 1. Full-scale ranges vary according to model.

Front Panel Menu Reference	SCPI Command
Select System\Admin\Cal\Volt\Vprog. Select the High range. Then press Next.	CAL:VOLT 50, (@1)

Step 3. Select the first voltage calibration point and enter the data.

Front Panel Menu Reference	SCPI Command
Display shows: "Enter P1 measured data"Enter the data from the external DMM. Press Select when done.	CAL:LEV P1 *OPC? CAL:DATA <data>

Step 4. Select the second voltage calibration point and enter the data.

Front Panel Menu Reference	SCPI Command
Display shows: "Enter P2 measured data"Enter the data from the external DMM. Press Select when done. Press Next to finish calibration.	CAL:LEV P2 *OPC? CAL:DATA <data>

Low Range Voltage Programming - Models N6761A through N6766A

Step 1. Select the low-voltage programming range. The value entered must be the maximum voltage of the range to be calibrated. This example selects the 5 V range of output 1.

Front Panel Menu Reference	SCPI Command
Select **System\Admin\Cal\Volt\Vprog**. Select the Low1 range. Then press Next.	CAL:VOLT 5, (@1)

Step 2. Select the first voltage calibration point and enter the data. This value may be positive or negative.

Front Panel Menu Reference	SCPI Command
Display shows: "Enter P1 measured data"Enter the data from the external DMM. Press Select when done.	CAL:LEV P1 *OPC? CAL:DATA <data>

Step 3. Select the second voltage calibration point and enter the data.

Front Panel Menu Reference	SCPI Command
Display shows: "Enter P2 measured data"Enter the data from the external DMM.Press Select when done. Press Next to finish calibration.	CAL:LEV P2 *OPC? CAL:DATA <data>

Low Range Voltage Measurement - Models N6761A through N6766A

Step 1. Select the low-voltage measurement range. The value entered must be the maximum voltage of the range to be calibrated. This example selects the 5 V range of output 1.

Front Panel Menu Reference	SCPI Command
Select **System\Admin\Cal\Volt\Vmeas**. Select the Low1 range. Then press Next.	CAL:VOLT:MEAS 5, (@1)

Step 2. Select the first voltage calibration point and enter the data.

Front Panel Menu Reference	SCPI Command
Display shows: "Enter P1 measured data"Enter the data from the external DMM. Press Select when done.	CAL:LEV P1 *OPC? CAL:DATA <data>

Step 3. Select the second voltage calibration point and enter the data.

Front Panel Menu Reference	SCPI Command
Display shows: "Enter P2 measured data"Enter the data from the external DMM. Press Select when done. Press Next to finish calibration.	CAL:LEV P2 *OPC? CAL:DATA <data>

Voltage Common Mode Rejection Ratio Calibration

Step 1. Make the connections as shown in Cal Setup C. Connect an external jumper between the +sense and the –sense terminals. Connect a second jumper from the +output to the –sense terminal.

For models N6751A, N6752A, N6761A, and N6762A only, connect a 25 Ω load resistor across the +output and –output terminals. This procedure is automatic and only takes a few seconds.

Front Panel Menu Reference	SCPI Command
Select System\Admin\Cal\Misc\CMRR. Then press Next.	CAL:VOLT:CMRR (@1) *OPC?

After calibration completes, disconnect all jumpers and resistors.

Current Calibration

High Range Programming and Measurement

NOTE The output voltage may go negative at some point during this procedure on units that have polarity reversal relays (Option 760).

Step 1. Connect a precision shunt resistor to the output. The shunt resistor should be able to measure at least 120% of the output's full-scale current (see Cal Setup B). Connect the Keysight 3458A DMM across the shunt resistor.

Step 2. Select the full-scale current programming range. The value to program a range must be the maximum current of the range. The following example selects the 5 A full-scale range of output 1. Full-scale ranges vary according to model.

Front Panel Menu Reference	SCPI Command
Select System\Admin\Cal\Curr\Iprog Select the High range. Then press Next.	CAL:CURR 5, (@1)

Step 3. Select the first current calibration point and enter the data.

Front Panel Menu Reference	SCPI Command
Display shows: "Enter P1 measured data" Calculate the shunt current (I=V/R) and enter the data. Press Select when done.	CAL:LEV P1 *OPC? CAL:DATA <data>

Step 4. Select the second current calibration point and enter the data.

Front Panel Menu Reference	SCPI Command
Display shows: "Enter P2 measured data" Calculate the shunt current (I=V/R) and enter the data. Press Select when done. Press Next to finish calibration.	CAL:LEV P2 *OPC? CAL:DATA <data>

Low Range Current Programming - Models N6761A through N6766A

Step 1. Connect only the current measurement terminals of the Keysight 3458A to the output terminals (see Cal Setup D without the resistor).

Step 2. Select the low-current programming range. The value to program a range must be the maximum current of the range. This example selects the 100 mA range of output 1.

Front Panel Menu Reference	SCPI Command
Select **System\Admin\Cal\Curr\Iprog** Select the Low range. Then press Next.	CAL:CURR 0.1, (@1)

Step 3. Select the first current calibration point and enter the data. For models N6761A and N6762A only, wait a minimum of 5 minutes for the output current to stabilize. before entering the data.

Front Panel Menu Reference	SCPI Command
Display shows: "Enter P1 measured data" Measure the current with the Keysight 3458A and enter the data. Press Select when done.	CAL:LEV P1 *OPC? CAL:DATA <data>

Step 4. Select the second current calibration point and enter the data. Wait a minimum of 30 seconds for the output current to stabilize

Front Panel Menu Reference	SCPI Command
Display shows: "Enter P2 measured data" Measure the current with the Keysight 3458A and enter the data. Press Select when done. Press Next to finish calibration.	CAL:LEV P2 *OPC? CAL:DATA <data>

Low Range Current Measurement - Models N6761A through N6766A

Step 1. Connect only the current measurement terminals of the Keysight 3458A to the output terminals (see Cal Setup D without the resistor).

Step 2. Select the low-current measurement range. The value to program a range must be the maximum current of the range. This example selects the 100 mA range of output 1.

Front Panel Menu Reference	SCPI Command
Select **System\Admin\Cal\Curr\Imeas** Select the Low1 range. Then press Next.	CAL:CURR:MEAS 0.1, (@1)

Step 3. Select the first current calibration point and enter the data. For models N6761A and N6762A only, wait a minimum of 5 minutes for the output current to stabilize before entering the data.

Front Panel Menu Reference	SCPI Command
Display shows: "Enter measured data" Measure the current with the Keysight 3458A and enter the data. Press Select when done.	CAL:LEV P1 *OPC? CAL:DATA <data>

Steps 4 and 5 apply only to models N6761A and N6762A

Step 4. Disconnect the Keysight 3458A from the output terminals. Then select the second current calibration point.

Front Panel Menu Reference	SCPI Command
The second calibration point is automatically selected. "Disconnect Meter" should be displayed. Press Enter when done.	CAL:LEV P2

Step 5. Wait a minimum of 5 minutes for the internal temperature to stabilize. Then select the third current calibration point.

Front Panel Menu Reference	SCPI Command
The third calibration point is automatically selected. "Wait 5 minutes, press Next" should be displayed. Wait 5 minutes and press Next.	CAL:LEV P3 *OPC?

100 uA/200 uA Range Measurement - Models N6761A/N6762A with Option 1UA or 2UA

Step 1. Remove all loads from the output. Leave the sense terminals connected to the output terminals.

Step 2. Select either the 100 µA measurement range or the 200 µA measurement range. Then wait 10 seconds.

Front Panel Menu Reference	SCPI Command
Select **System\Admin\Cal\Curr\Imeas** Select the Low2 range. Then press Next.	CAL:CURR:MEAS 0.0001, (@1) *OPC? or CAL:CURR:MEAS 0.0002, (@1) *OPC?

Step 3. Select the first current calibration point.

Front Panel Menu Reference	SCPI Command
The first calibration point is automatically selected. "Waiting 10 seconds" should be displayed.	CAL:LEV P1 *OPC?

Step 4. Connect the Keysight 3458A and a 20 k Ω resistor to the output (see Cal Setup D).

Front Panel Menu Reference	SCPI Command
Measure the output current with the Keysight 3458A and enter the value. Press Select when done. Press Next to finish calibration.	CAL:DATA <data>

Peak Current Limit Calibration

NOTE For models N6753A through N6756A and N6763A through N6766A, the peak current limit calibration is valid for five years.

Step 1. Connect only the electronic load or equivalent resistor (up to 500 W rating) across the output terminals for the first calibration point.

Model	1st calibration point	2nd calibration point
N6751A/N6752A N6761A/N6762A	25 Ω resistor (do not use electronic load)	4 Ω resistor (do not use electronic load)
N6753A/N6763A	Electronic load set to 26.25A, CC mode (0.6 Ω equivalent, including lead resistance)	Electronic load set to 13.12A, CC mode (1.2 Ω equivalent, including lead resistance)
N6754A/N6764A	Electronic load set to 10.5A, CC mode (3.8 Ω equivalent, including lead resistance)	Electronic load set to 5.25A, CC mode (7.6 Ω equivalent, including lead resistance)
N6755A/N6765A	Electronic load set to 43.75A, CC mode (0.37 Ω equivalent, including lead resistance)	Electronic load set to 21.88A, CC mode (0.73Ω equivalent, including lead resistance)
N6756A/N6766A	Electronic load set to 17.5A, CC mode (2.3 Ω equivalent, including lead resistance)	Electronic load set to 8.75A, CC mode (8.75Ω equivalent, including lead resistance)

Step 2. Select peak current limit calibration.

Front Panel Menu Reference	SCPI Command
Select **System\Admin\Cal\Misc\Ipeak**	CAL:CURR:PEAK (@1)

Step 3. Select the first current calibration point.

Front Panel Menu Reference	SCPI Command
Select Next. The calibration is automatic.	CAL:LEV P1 *OPC?

Step 4. Set the electronic load or connect the appropriate resistor for the second calibration point.

Step 5.Select the second current calibration point.

Front Panel Menu Reference	SCPI Command
Select Next. The calibration is automatic.	CAL:LEV P2 *OPC?

Downprogrammer Calibration

Step 1. Remove all loads from the output. This procedure is automatic and takes a few seconds.

Front Panel Menu Reference	SCPI Command
Select **System\Admin\Cal\Misc\Dprog**	CAL:DPRog (@1)

Enter a Calibration Date, Save, and Log Out

Front Panel Menu Reference	SCPI Command
Select **System\Admin\CAL\DATE**. Enter the calibration date in the Date field.	To enter a calibration date: CAL:DATE "<date>"
Select **System\Admin\CAL\Save**. Select Save to save all calibration data.	To save the calibration data: CAL:SAVE
Select **System\Admin\Logout** to exit calibration mode.	To exit calibration mode: CAL:STAT OFF

Calibration Procedure – Models N678xA SMU

Enter Calibration Mode

Front Panel Menu Reference	SCPI Command
Select **System\Admin\Login**. Enter your password. Then press **Select**.	CAL:STAT ON <password>

Voltage Calibration

High Range Programming and Measurement - All Models

Step 1. Connect the voltage input of the Keysight 3458A DMM to an output channel as shown in Cal Setup A.

Step 2. Select the full-scale voltage programming and measurement range. The value entered must be the maximum voltage of the range that you are calibrating. The following example selects the 20 V full-scale range of output 1. Full-scale ranges vary according to model.

Front Panel Menu Reference	SCPI Command
Select **System\Admin\Cal\Volt\Vprog**. Select the High range. Then press Next.	CAL:VOLT 20, (@1)

Step 3. Select the first voltage calibration point and enter the data.

Front Panel Menu Reference	SCPI Command
Display shows: "Enter P1 measured data"Enter the data from the external DMM. Press Select when done.	CAL:LEV P1 *OPC? CAL:DATA <data>

Step 4. Select the second voltage calibration point and enter the data.

Front Panel Menu Reference	SCPI Command
Display shows: "Enter P2 measured data"Enter the data from the external DMM. Press Select when done. Press Next to finish calibration.	CAL:LEV P2 *OPC? CAL:DATA <data>

Step 5 applies only to model N6784A

Step 5. Select the third voltage calibration point for the negative range and enter the data. This value should be negative.

Front Panel Menu Reference	SCPI Command
Display shows: "Enter P3 measured data" Enter the data from the external DMM. Press Select when done. Press Next to finish calibration.	CAL:LEV P3 *OPC? CAL:DATA <data>

Low Range Voltage Programming - Models N6781A, N6782A, N6784A

Step 1. Select the low-voltage programming range. The value entered must be the maximum voltage of the range to be calibrated. This example selects the 6 V range of output 1.

Front Panel Menu Reference	SCPI Command
Select **System\Admin\Cal\Volt\Vprog**. Select the Low1 range. Then press Next.	CAL:VOLT 6, (@1)

Step 2. Select the first voltage calibration point and enter the data. This value may be positive or negative.

Front Panel Menu Reference	SCPI Command
Display shows: "Enter P1 measured data"Enter the data from the external DMM. Press Select when done.	CAL:LEV P1 *OPC? CAL:DATA <data>

Step 3. Select the second voltage calibration point and enter the data.

Front Panel Menu Reference	SCPI Command
Display shows: "Enter P2 measured data"Enter the data from the external DMM. Press Select when done. Press Next to finish calibration.	CAL:LEV P2 *OPC? CAL:DATA <data>

Step 4 applies only to models N6781A and N6782A

Step 4. Repeat steps 1 through 3 for the 600 mV range. This time, select the Low2 range.

Steps 5 and 6 apply only to model N6784A

Step 5. Select the third voltage calibration point for the negative range and enter the data. This value should be negative.

Front Panel Menu Reference	SCPI Command
Display shows: "Enter P3 measured data" Enter the data from the external DMM. Press Select when done. Press Next to finish calibration.	CAL:LEV P3 *OPC? CAL:DATA <data>

Step 6. Repeat steps 1 through 3, and 5 for the 600 mV range. This time, select the Low2 range.

Low Range Voltage Measurement - Models N6781A, N6782A, N6784A

Step 1. Select the low-voltage measurement range. The value entered must be the maximum voltage of the range to be calibrated. This example selects the 1 V range of output 1.

Front Panel Menu Reference	SCPI Command
Select **System\Admin\Cal\Volt\Vmeas**. Select the Low1 range. Then press Next.	CAL:VOLT:MEAS 1, (@1)

Step 2. Select the first voltage calibration point and enter the data. This value may be positive or negative.

Front Panel Menu Reference	SCPI Command
Display shows: "Enter P1 measured data"Enter the data from the external DMM. Press Select when done.	CAL:LEV P1 *OPC? CAL:DATA <data>

Step 3. Select the second voltage calibration point and enter the data.

Front Panel Menu Reference	SCPI Command
Display shows: "Enter P2 measured data"Enter the data from the external DMM.Press Select when done. Press Next to finish calibration.	CAL:LEV P2 *OPC? CAL:DATA <data>

Step 4 applies only to models N6781A and N6782A

Step 4. Repeat steps 1 through 3 for the 100 mV range. This time, select the Low2 range.

Steps 5 and 6 apply only to model N6784A

Step 5. Select the third voltage calibration point for the negative range and enter the data. This value should be negative.

Front Panel Menu Reference	SCPI Command
Display shows: "Enter P3 measured data" Enter the data from the external DMM. Press Select when done. Press Next to finish calibration.	CAL:LEV P3 *OPC? CAL:DATA <data>

Step 6. Repeat steps 1 through 3, and 5 for the 100 mV range. This time, select the Low2 range.

Positive Voltage Limit - Models N6781A, N6782A, N6784A

Step 1. Select the positive voltage limit range. The value to program a range must be the maximum voltage of the range to be calibrated. This example selects the 20 V positive limit range of output 1.

Front Panel Menu Reference	SCPI Command
Select **System\Admin\Cal\Volt\Vlim**. Select the High range. Then press Next.	CAL:VOLT:LIM:POS 20, (@1)

Step 2. Select the first voltage calibration point and enter the data.

Front Panel Menu Reference	SCPI Command
Display shows: "Enter P1 measured data" Enter the data from the external DMM. Press Select when done.	CAL:LEV P1 *OPC? CAL:DATA <data>

Step 3. Select the second voltage calibration point and enter the data.

Front Panel Menu Reference	SCPI Command
Display shows: "Enter P2 measured data"Enter the data from the external DMM. Press Select when done. Press Next to finish calibration.	CAL:LEV P2 *OPC? CAL:DATA <data>

Step 4. Repeat steps 1 through 3 for the 6 V positive limit range. This time, select the Low range.

Auxiliary Voltage Measurement - Models N6781A, N6785A

Step 1. Connect the auxiliary input terminals to the output terminals of model N6781A. Also connect the voltage input of the Keysight 3458A to the output terminals of model N6781A (see Cal Setup E).

Step 2. Select the auxiliary voltage measurement input of output 1.

Front Panel Menu Reference	SCPI Command
Select **System\Admin\Cal\Volt\Vmeas**. Select the Aux voltage range. Then press Next.	CAL:VOLT:MEAS:AUX (@1)

Step 3. Select the first voltage calibration point and enter the data.

Front Panel Menu Reference	SCPI Command
Display shows: "Enter P1 measured data" Enter the data from the external DMM. Press Select when done.	CAL:LEV P1 *OPC? CAL:DATA <data>

Step 4. Select the second voltage calibration point and enter the data.

Front Panel Menu Reference	SCPI Command
Display shows: "Enter P2 measured data" Enter the data from the external DMM. Press Select when done. Press Next to finish calibration.	CAL:LEV P2 *OPC? CAL:DATA <data>

Step 5. Select the third voltage calibration point for the negative range and enter the data. This value should be negative.

Front Panel Menu Reference	SCPI Command
Display shows: "Enter P3 measured data" Enter the data from the external DMM. Press Select when done. Press Next to finish calibration.	CAL:LEV P3 *OPC? CAL:DATA <data>

Current Calibration

High Range Programming and Measurement - All Models

NOTE Do not connect anything to the Sense terminals

Step 1. Connect a precision shunt resistor to the output. The shunt resistor should be able to measure at least 120% of the output's full-scale current (see Cal Setup B). Connect the Keysight 3458A DMM across the shunt resistor.

Step 2. Select the full-scale current programming range. The value to program a range must be the maximum current of the range. The following example selects the full-scale range of output 1. For models N6781A, N6782A, and N6784A, the full-scale 3 A range calibrates both the 3 A and 1 A ranges.

Front Panel Menu Reference	SCPI Command
Select **System\Admin\Cal\Curr\Iprog** Select the High range. Then press Next.	For N6785A, N6786A: CAL:CURR 8, (@1) For N6781A, N6782A, N6784A: CAL:CURR 3, (@1)

Step 3. Select the first current calibration point and enter the data. This value may be positive or negative.

Front Panel Menu Reference	SCPI Command
Display shows: "Enter P1 measured data" Calculate the shunt current (I=V/R) and enter the data. Press Select when done.	CAL:LEV P1 *OPC? CAL:DATA <data>

Step 4. Select the second current calibration point and enter the data. Wait a minimum of 1 minute for the output current to stabilize before entering the data.

Front Panel Menu Reference	SCPI Command
Wait 1 minute and select Next. Display shows: "Enter P2 measured data" Calculate the shunt current (I=V/R) and enter the data. Press Select when done.	CAL:LEV P2 *OPC? CAL:DATA <data>

Step 5. Select the third current calibration point for the negative range and enter the data. The value should be negative.

Front Panel Menu Reference	SCPI Command
Display shows: "Enter P3 measured data" Calculate the shunt current (I=V/R) and enter the data. Press Select when done. Press Next to finish calibration.	CAL:LEV P3 *OPC? CAL:DATA <data>

Low Range Current Programming - Models N6781A, N6782A, N6784A

Step 1. Connect only the current measurement terminals of the Keysight 3458A to the output terminals (see Cal Setup D without the resistor).

Step 2. Select the low-current programming range. The value to program a range must be the maximum current of the range. Models N6781A and N6782A have 300 mA range. Model N6784A has a 100 mA and a 10 mA range. This example selects the 300 mA programming range of output 1. For model N6784A, select the 100 mA programming range.

Front Panel Menu Reference	SCPI Command
Select **System\Admin\Cal\Curr\Iprog** Select the Low1 range. Then press Next.	CAL:CURR 0.3, (@1)

Step 3. Select the first current calibration point and enter the data. This value may be positive or negative.

Front Panel Menu Reference	SCPI Command
Display shows: "Enter P1 measured data" Measure the current with the Keysight 3458A and enter the data. Press Select when done.	CAL:LEV P1 *OPC? CAL:DATA <data>

Step 4. Select the second current calibration point and enter the data.

Front Panel Menu Reference	SCPI Command
Wait 5 minutes and select Next. Display shows: "Enter P2 measured data" Measure the current with the Keysight 3458A and enter the data. Press Select when done.	CAL:LEV P2 *OPC? CAL:DATA <data>

Step 5. Select the third current calibration point for the negative range and enter the data. The value should be negative.

Front Panel Menu Reference	SCPI Command
Display shows: "Enter P3 measured data" Measure the current with the Keysight 3458A and enter the data. Press Select when done. Press Next to finish calibration.	CAL:LEV P3 *OPC? CAL:DATA <data>

Step 6. Repeat steps 1 through for the 10 mA programming range of Model N6784A. This time, select the Low2 range.

100 mA Measurement Range - All Models

Step 1. Connect only the current measurement terminals of the Keysight 3458A to the output terminals (see Cal Setup D without the resistor).

Step 2. Select the 100 mA measurement range of output 1.

Front Panel Menu Reference	SCPI Command
Select **System\Admin\Cal\Curr\Imeas** Select the Low1 range. Then press Next.	CAL:CURR:MEAS 0.1, (@1)

Step 3. Select the first current calibration point and enter the data.

Front Panel Menu Reference	SCPI Command
Display shows: "Enter P1 measured data" Measure the current with the Keysight 3458A and enter the data. Press Select when done.	CAL:LEV P1 *OPC? CAL:DATA <data>

Step 4. Select the second current calibration point for the negative range and enter the data. The value should be negative.

Front Panel Menu Reference	SCPI Command
Display shows: "Enter P2 measured data" Measure the current with the Keysight 3458A and enter the data. Press Select when done.	CAL:LEV P2 *OPC? CAL:DATA <data>

1 mA Measurement Range - All Models

Step 1. Connect the Keysight 3458A in series with a 10 kΩ resistor to the output (see Equipment Required and Cal Setup D).

Step 2. Select the 1 mA measurement range of output 1.

Front Panel Menu Reference	SCPI Command
Select **System\Admin\Cal\Curr\Imeas** Select the Low2 range. Then press Next.	CAL:CURR:MEAS 0.001, (@1)

Step 3. Select the first current calibration point and enter the data.

Front Panel Menu Reference	SCPI Command
Display shows: "Enter P1 measured data" Measure the current with the Keysight 3458A and enter the data. Press Select when done.	CAL:LEV P1 *OPC? CAL:DATA <data>

Step 4 applies only to models N6781A, N6782A, and N6784A

Step 4. Select the second current calibration point for the negative range and enter the data. The value should be negative.

Front Panel Menu Reference	SCPI Command
Display shows: "Enter P2 measured data" Measure the current with the Keysight 3458A and enter the data. Press Select when done.	CAL:LEV P2 *OPC? CAL:DATA <data>

10 µA Measurement Range - Models N6781A, N6782A, N6784A

Step 1. Connect the Keysight 3458A in series with a 1 MΩ resistor to the output (see Equipment Required and Cal Setup D). Set the Keysight 3458A to measure current using the 100 µA range (no autoranging). The remote command to do this is "DCI 100e-6".

Step 2. Select the 10 µA measurement range of output 1.

Front Panel Menu Reference	SCPI Command
Select **System\Admin\Cal\Curr\Imeas** Select the Low3 range. Then press Next.	CAL:CURR:MEAS 0.00001, (@1)

Step 3. Select the first current calibration point and enter the data.

Front Panel Menu Reference	SCPI Command
Display shows: "Enter P1 measured data" Measure the current with the Keysight 3458A and enter the data. Press Select when done.	CAL:LEV P1 *OPC? CAL:DATA <data>

Step 4. Select the second current calibration point for the negative range and enter the data. The value should be negative.

Front Panel Menu Reference	SCPI Command
Display shows: "Enter P2 measured data" Measure the current with the Keysight 3458A and enter the data. Press Select when done.	CAL:LEV P2 *OPC? CAL:DATA <data>

Current Limit - All Models

CAUTION This calibrates the POSITVE current limit for Models N6781A, N6782A, and N6784A. It calibrates the NEGATIVE current limit for Models N6785A and N6786A.

Step 1. Connect a precision shunt resistor to the output. The shunt resistor should be able to measure at least 120% of the output's rated full-scale current (see Cal Setup B). Connect the Keysight 3458A across the shunt resistor.

Step 2. Select the 3 A current limit of output 1 for models N6781A, N6782A, and N6784A. Select the -8A current limit of output 1 for models N6785A and N6786A.

Front Panel Menu Reference	SCPI Command
Select **System\Admin\Cal\Curr\Ilim**	For N6781A, N6782A, N6784A: CAL:CURR:LIM:POS 3, (@1) For N6785A, N6786A: CAL:CURR:LIM:NEG -8, (@1)

Step 3. Select the first current calibration point and enter the data.

Front Panel Menu Reference	SCPI Command
Display shows: "Enter P1 measured data" Calculate the shunt current (I=V/R) and enter the data. Press Select when done.	CAL:LEV P1 *OPC? CAL:DATA <data>

Step 4. Select the second current calibration point and enter the data. Wait a minimum of 1 minute for the output current to stabilize before entering the data.

Front Panel Menu Reference	SCPI Command
Wait 1 minute and select Next. Display shows: "Enter P2 measured data" Calculate the shunt current (I=V/R) and enter the data. Press Select when done. Press Next to finish calibration.	CAL:LEV P2 *OPC? CAL:DATA <data>

Resistance Calibration - Models N6781A, N6785A

Step 1. Connect an electronic load directly to the output terminals. Also connect the voltage input of the Keysight 3458A to the output terminals (see Cal Setup F). Set the load to constant current mode, current to 0.95A.

Step 2. Select the 20 V resistance range of output 1.

Front Panel Menu Reference	SCPI Command
Select **System\Admin\Cal\Misc\Resistance**. Select the High range. Then press Next.	CAL:RES 20 (@1)

Step 3. Select the first resistance calibration point and enter the data.

Front Panel Menu Reference	SCPI Command
Display shows: "Enter P1 measured data" Enter the data from the external DMM. Press Select when done.	CAL:LEV P1 *OPC? CAL:DATA <data>

Step 4. Select the second resistance calibration point and enter the data.

Front Panel Menu Reference	SCPI Command
Display shows: "Enter P2 measured data" Enter the data from the external DMM. Press Select when done.	CAL:LEV P2 *OPC? CAL:DATA <data>

Step 5. Select the third resistance calibration point and enter the data.

Front Panel Menu Reference	SCPI Command
Display shows: "Enter P3 measured data" Enter the data from the external DMM. Press Select when done. Press Next to finish calibration.	CAL:LEV P3 *OPC? CAL:DATA <data>

Step 6. For Model N6781A repeat steps 1 through 5 for the 6 V resistance range. This time, select the Low range.

Enter a Calibration Date, Save, and Log Out

Front Panel Menu Reference	SCPI Command
Select System\Admin\CAL\DATE. Enter the calibration date in the Date field.	To enter a calibration date: CAL:DATE "<date>"
Select System\Admin\CAL\Save. Select Save to save all calibration data.	To save the calibration data: CAL:SAVE
Select System\Admin\Logout to exit calibration mode.	To exit calibration mode: CAL:STAT OFF

Calibration Procedure – Models N6783A-BAT and N6783A-MFG

Enter Calibration Mode

Front Panel Menu Reference	SCPI Command
Select **System\Admin\Login**. Enter your password. Then press **Select**.	CAL:STAT ON <password>

Voltage Calibration

High Range Programming and Measurement

Step 1. Connect the voltage input of the Keysight 3458A DMM to an output channel as shown in Cal Setup A.

Step 2. Select the full-scale voltage programming and measurement range. The value entered must be the maximum voltage of the range that you are calibrating. The following example selects the 6 V full-scale range of output 1. Full-scale ranges vary according to model.

Front Panel Menu Reference	SCPI Command
Select **System\Admin\Cal\Volt\Vprog**. Select the High range. Then press Next.	CAL:VOLT 6, (@1)

Step 3. Select the first voltage calibration point and enter the data.

Front Panel Menu Reference	SCPI Command
Display shows: "Enter P1 measured data" Enter the data from the external DMM. Press Select when done.	CAL:LEV P1 *OPC? CAL:DATA <data>

Step 4. Select the second voltage calibration point and enter the data.

Front Panel Menu Reference	SCPI Command
Display shows: "Enter P2 measured data" Enter the data from the external DMM. Press Select when done. Press Next to finish calibration.	CAL:LEV P2 *OPC? CAL:DATA <data>

Current Calibration

High Range Programming and Measurement

NOTE The output voltage may go negative at some point during this procedure on units that have polarity reversal relays (Option 760).

Step 1. Connect a precision shunt resistor to the output. The shunt resistor should be able to measure at least 120% of the output's full-scale current (see Cal Setup B). Connect the Keysight 3458A DMM across the shunt resistor.

Step 2. Select the full-scale current programming range. The value to program a range must be the maximum current of the range. The following example selects the 3 A full-scale range of output 1. Full-scale ranges vary according to model.

Front Panel Menu Reference	SCPI Command
Select System\Admin\Cal\Volt\Iprog	CAL:CURR 3, (@1)
Select the High range. Then press Next.	

Step 3. Select the first current calibration point and enter the data.

Front Panel Menu Reference	SCPI Command
Display shows: "Enter P1 measured data" Calculate the shunt current (I=V/R) and enter the data. Press Select when done.	CAL:LEV P1 *OPC? CAL:DATA <data>

Step 4. Select the second current calibration point and enter the data.

Front Panel Menu Reference	SCPI Command
Display shows: "Enter P2 measured data" Calculate the shunt current (I=V/R) and enter the data. Press Select when done. Press Next to finish calibration.	CAL:LEV P2 *OPC? CAL:DATA <data>

Low Range Current Measurement

Step 1. Connect only the current measurement terminals of the Keysight 3458A to the output terminals (see Cal Setup D without the resistor).

Step 2. Select the low-current measurement range. The value to program a range must be the maximum current of the range. This example selects the 100 mA range of output 1.

Front Panel Menu Reference	SCPI Command
Select System\Admin\Cal\Curr\Imeas	CAL:CURR:MEAS 0.15, (@1)
Select the Low1 range. Then press Next.	

Step 3. Select the first current calibration point and enter the data.

Front Panel Menu Reference	SCPI Command
Display shows: "Enter measured data" Measure the current with the Keysight 3458A and enter the data. Press Select when done.	CAL:LEV P1 *OPC? CAL:DATA <data>

Negative Current Limit Calibration

Step 1. Connect the Keysight 3458A, current shunt, and an external power supply to the output (see Cal Setup H). Connect plus to plus, minus to minus. Set the external power supply to 3V, 3A.

Step 2. Select the negative-current range. The value to select the range must be negative and the maximum current of the range.

Front Panel Menu Reference	SCPI Command
Select **System\Admin\Cal\Curr\Ilim**	CAL:CURR:LIM:NEG -2, (@1)

Step 3. Select the first current calibration point and enter the data. This value should be negative.

Front Panel Menu Reference	SCPI Command
Display shows: "Enter P1 measured data" Calculate the shunt current (I=V/R) and enter the data. Press Select when done.	CAL:LEV P1 *OPC? CAL:DATA <data>

Step 4. Select the second current calibration point and enter the data. This value should be negative.

Front Panel Menu Reference	SCPI Command
Display shows: "Enter P2 measured data" Calculate the shunt current (I=V/R) and enter the data. Press Select when done. Press Next to finish calibration.	CAL:LEV P2 *OPC? CAL:DATA <data>

Enter a Calibration Date, Save, and Log Out

Front Panel Menu Reference	SCPI Command
Select **System\Admin\CAL\DATE**. Enter the calibration date in the Date field.	To enter a calibration date: CAL:DATE "<date>"
Select **System\Admin\CAL\Save**. Select Save to save all calibration data.	To save the calibration data: CAL:SAVE
Select **System\Admin\Logout** to exit calibration mode.	To exit calibration mode: CAL:STAT OFF

Calibration Procedure – Models N6791A and N6792A

Enter Calibration Mode

Front Panel Menu Reference	SCPI Command
Select **System\Admin\Login**. Enter your password. Then press **Select**.	CAL:STAT ON <password>

Voltage Calibration

High Range Measurement

Step 1. · Connect an external power supply to the load module's input terminals. Set the power supply to 60 V with a current limit of 0.5 A. Connect a DVM capable of handling 60 V in parallel with the unit's input (see Cal Setup G). Turn on the output of the power supply.

Step 2. Select the full-scale voltage range.

Front Panel Menu Reference	SCPI Command
Select **System\Admin\Cal\Volt\Vprog**. Select the High range. Then press Next.	CAL:VOLT 60, (@1)

Step 3. Select the first voltage calibration point and enter the data. Wait a minimum of 1 minute for the current to stabilize before entering the data.

Front Panel Menu Reference	SCPI Command
Display shows: "Enter P1 measured data"Enter the data from the external DMM.Press Select when done.	CAL:LEV P1 *OPC? CAL:DATA <data>

Step 4. Select the second voltage calibration point and enter the data. Wait a minimum of 1 minute for the current to stabilize before entering the data.

Front Panel Menu Reference	SCPI Command
Display shows: "Enter P2 measured data"Enter the data from the external DMM.Press Select when done. Press Next to finish calibration.	CAL:LEV P2 *OPC? CAL:DATA <data>

Current Calibration

NOTE Voltage calibration must be completed prior to calibrating current.

High Range Programming and Measurement

Step 1. · Connect an external power supply to the module's input terminals configured to source 3 V with a current limit of 21 A (42 A for N6792A). Connect a precision current shunt resistor in series with the unit's input and a precision voltmeter to measure the voltage across the shunt. The shunt resistor should be suitable for measuring current corresponding to 120% of the rated current of the load module's high current programming range. (see Cal Setup H). Turn on the output of the power supply.

Step 2. Select the full-scale current programming range. The value to program a range must be the maximum current of the range. The following example selects the 20 A full-scale range of output 1. Full-scale ranges vary according to model.

Front Panel Menu Reference	SCPI Command
Select **System\Admin\Cal\Curr\Iprog** Select the High range. Then press Next.	CAL:CURR 20, (@1)

Step 3. Select the first current calibration point. Wait a minimum of 10 seconds for the temperature to stabilize before measuring the input current and entering the data.

Front Panel Menu Reference	SCPI Command
Display shows: “Enter P1 measured data” Calculate the shunt current (I=V/R) and enter the data. Press Select when done.	CAL:LEV P1 *OPC? CAL:DATA <data>

Step 4. Select the second current calibration point. Wait a minimum of 5 minutes for the temperature to stabilize before measuring the input current and entering the data.

Front Panel Menu Reference	SCPI Command
Display shows: “Enter P2 measured data” Calculate the shunt current (I=V/R) and enter the data.Press Select when done.	CAL:LEV P2 *OPC? CAL:DATA <data>

Step 5. Select the third current calibration point. Wait a minimum of 5 minutes for the temperature to stabilize before measuring the input current and entering the data.

Front Panel Menu Reference	SCPI Command
Display shows: “Enter P3 measured data”Calculate the shunt current (I=V/R) and enter the data. Press Select when done.Press Next to finish calibration.	CAL:LEV P3 *OPC? CAL:DATA <data>

Low Range Current Programming and Measurement

Step 1. Keep the power supply, shunt resistor, and precision voltmeter as described under "High Range Programming and Measurement" connected to the load module. Turn on the output of the power supply.

Step 2. Select the low-current programming range. The value to program a range must be the maximum current of the range. This example selects the 2 A programming range of output 1. Low ranges vary according to model.

Front Panel Menu Reference	SCPI Command
Select **System\Admin\Cal\Curr\Iprog|** Select the Low range. Then press Next.	CAL:CURR: 2, (@1)

Step 3. Select the first current calibration point. Wait a minimum of 5 minutes for the temperature to stabilize before measuring the input current and entering the data.

Front Panel Menu Reference	SCPI Command
Display shows: "Enter P1 measured data" Calculate the shunt current (I=V/R) and enter the data. Press Select when done.	CAL:LEV P1 *OPC? CAL:DATA <data>

Step 4. Select the second current calibration point and enter the data. Wait a minimum of 5 minutes for the temperature to stabilize before measuring the input current and entering the data.

Front Panel Menu Reference	SCPI Command
Wait 5 minutes and select Next. Display shows: "Enter P2 measured data"Calculate the shunt current (I=V/R) and enter the data. Press Select when done. Press Next to finish calibration.	CAL:LEV P2 *OPC? CAL:DATA <data>

Current Limit Programming

Step 1. · Connect an external power supply to the module's input terminals configured to source 3 V with a current limit of 21 A (42 A for N6792A). Connect a precision current shunt resistor in series with the unit's input and a precision voltmeter to measure the voltage across the shunt. The shunt resistor should be suitable for measuring current corresponding to 120% of the rated current of the load module's high current programming range (see Cal Setup H). Turn on the output of the power supply.

Step 2. Select the full-scale current programming range. The value to program a range must be the maximum current of the range. The following example selects the 20 A full-scale range of output 1. Full-scale ranges vary according to model.

Front Panel Menu Reference	SCPI Command
Select **System\Admin\Cal\Curr\Ilim** Select the High range. Then press Next.	CAL:CURR:LIM:POS 20, (@1)

Step 3. Select the first current calibration point. Wait a minimum of 5 minutes for the temperature to stabilize before measuring the input current and entering the data.

Front Panel Menu Reference	SCPI Command
Display shows: "Enter P1 measured data" Calculate the shunt current (I=V/R) and enter the data. Press Select when done.	CAL:LEV P1 *OPC? CAL:DATA <data>

Step 4. Select the second current calibration point. Wait a minimum of 5 minutes for the temperature to stabilize before measuring the input current and entering the data.

Front Panel Menu Reference	SCPI Command
Display shows: "Enter P2 measured data" Calculate the shunt current (I=V/R) and enter the data.Press Select when done.Press Next to finish calibration.	CAL:LEV P2 *OPC? CAL:DATA <data>

Test Record Forms

Test Record Form - Keysight N6731B and N6741B

Test Record Form - Keysight N6732B and N6742B

Test Record Form - Keysight N6733B and N6743B

Test Record Form - Keysight N6734B and N6744B

Test Record Form - Keysight N6735B and N6745B

Test Record Form - Keysight N6736B and N6746B

Test Record Form - Keysight N6751A and N6752A

Test Record Form - Keysight N6753A and N6755A

Test Record Form - Keysight N6754A and N6756A

Test Record Form - Keysight N6761A and N6762A

Test Record Form - Keysight N6763A and N6765A

Test Record Form - Keysight N6764A and N6766A

Test Record Form - Keysight N6773A

Test Record Form - Keysight N6774A

Test Record Form - Keysight N6775A

Test Record Form - Keysight N6776A

Test Record Form - Keysight N6777A

Test Record Form - Keysight N6781A, N6782A, and N6784A

Test Record Form - Keysight N6785A and N6786A

Test Record Form - Keysight N6783A-BAT and N6783A-MFG

Test Record Form - Keysight N6791A

Test Record Form - Keysight N6792A

Test Record Form - Keysight N6731B and N6741B

N6731B and N6741B	Report Number _____		Date_____	
Test Description	**Model**	**Min. Specs**	**Results**	**Max. Specs**
		Constant Voltage Tests		
Voltage Programming & Readback				
Minimum voltage (Vout):	Both	– 4 mV	_____	+ 34 mV
Voltage measured over interface:	Both	Vout – 20 mV	_____	Vout + 20 mV
High voltage (Vout):	Both	4.976 V	_____	5.024 V
Voltage measured over interface:	Both	Vout – 25 mV	_____	Vout + 25 mV
CV Load Effect:	Both	– 5 mV	_____	+ 5 mV
CV Source Effect:	Both	– 1 mV	_____	+ 1 mV
CV Ripple and Noise				
peak-to-peak:	N6731B	N/A	_____	+ 10 mV
	N6741BBoth	N/A	_____	+20 mV
rms:		N/A	_____	+ 2 mV
Transient response				
Voltage @ 200 µs:	N6731B	– 80 mV	_____	+ 80 mV
	N6741B	– 100 mV	_____	+ 100 mV
Voltage @ 200 µs with Option 760/761:	N6731B	– 100 mV	_____	+ 100 mV
	N6741B	– 125 mV	_____	+ 125 mV
		Constant Current Tests		
Current Programming & Readback				
Minimum current (Iout):	Both	+ 40 mA	_____	+ 80 mA
Current measured over interface:	Both	Iout – 20 mA	_____	Iout + 20 mA
High current (Iout):	N6731B	9.965 A	_____	10.035 A
	N6741B	19.95 A	_____	20.05 A
Current measured over interface:	N6731B	Iout – 35 mA	_____	Iout + 35 mA
	N6741B	Iout – 50 mA	_____	Iout + 50 mA
CC Load Effect:	Both	– 2 mA	_____	+ 2 mA
CC Source Effect:	Both	– 1 mA	_____	+ 1 mA

Test Description	N6731B Setting	N6741B Setting
Voltage Programming & Readback Min Voltage:	15 mV, 10 A	15 mV, 20 A
Voltage Programming & Readback High Voltage:	5 V, 10 A	5 V, 20 A
CV Load Effect, Source Effect, Ripple and Noise:	5 V, 10 A	5 V, 20 A
Transient Response:	5 V, from 5 A to 10 A	5 V, from 10 A to 20 A
Current Programming & Readback Min Current:	60 mA, 5 V	60 mA, 5 V
Current Programming & Readback High Current:	10 A, 5 V	20 A, 5 V
CC Load Effect, Source Effect:	10 A, 5 V	20 A, 5 V

Test Record Form - Keysight N6732B and N6742B

N6732B and N6742B	Report Number _____		Date_____	
Test Description	**Model**	**Min. Specs**	**Results**	**Max. Specs**
		Constant Voltage Tests		
Voltage Programming & Readback				
Minimum voltage (Vout):	Both	– 4 mV	_____	+ 34 mV
Voltage measured over interface:	Both	Vout – 20 mV	_____	Vout + 20 mV
High voltage (Vout):	Both	7.973 V	_____	8.027 V
Voltage measured over interface:	Both	Vout – 28 mV	_____	Vout + 28 mV
CV Load Effect:	Both	– 6 mV	_____	+ 6 mV
CV Source Effect:	Both	– 2 mV	_____	+ 2 mV
CV Ripple and Noise				
peak-to-peak:	Both	N/A	_____	+ 12 mV
rms:	Both	N/A	_____	+ 2 mV
Transient response				
Voltage @ 200 µs:	N6732B	– 80 mV	_____	+ 80 mV
	N6742B	– 100 mV	_____	+ 100 mV
Voltage @ 200 µs with Option 760/761:	N6732B	– 100 mV	_____	+ 100 mV
	N6742B	– 125 mV	_____	+ 125 mV
		Constant Current Tests		
Current Programming & Readback				
Minimum current (Iout):	Both	+ 20 mA	_____	+ 60 mA
Current measured over interface:	Both	Iout – 10 mA	_____	Iout + 10 mA
High current (Iout):	N6732B	6.2206 A	_____	6.2794 A
	N6742B	12.46 A	_____	12.54 A
Current measured over interface:	N6732B	Iout – 19.37 mA	_____	Iout + 19.37 mA
	N6742B	Iout – 29 mA	_____	Iout + 29 mA
CC Load Effect:	Both	– 2 mA	_____	+ 2 mA
CC Source Effect:	Both	– 1 mA	_____	+ 1 mA

Test Description	N6732B Setting	N6742B Setting
Voltage Programming & Readback Min Voltage:	15 mV, 6.25 A	15 mV, 12.5 A
Voltage Programming & Readback High Voltage:	8 V, 6.25 A	8 V, 12.5 A
CV Load Effect, Source Effect, Ripple and Noise:	8 V, 6.25 A	8 V, 12.5 A
Transient Response:	8 V, from 3.125 A to 6.25 A	8V, from 6.25A to 12.5A
Current Programming & Readback Min Current:	40 mA, 8 V	40 mA, 8 V
Current Programming & Readback High Current:	6.25 A, 8 V	12.5 A, 8 V
CC Load Effect, Source Effect:	6.25 A, 8 V	12.5 A, 8 V

Test Record Form - Keysight N6733B and N6743B

N6733B and N6743B	Report Number _____		Date_____	
Test Description	**Model**	**Min. Specs**	**Results**	**Max. Specs**
		Constant Voltage Tests		
Voltage Programming & Readback				
Minimum voltage (Vout):	Both	– 10 mV	_____	+ 50 mV
Voltage measured over interface:	Both	Vout – 20 mV	_____	Vout + 20 mV
High voltage (Vout):	Both	19.96 V	_____	20.04 V
Voltage measured over interface:	Both	Vout – 40 mV	_____	Vout + 40 mV
CV Load Effect:	Both	– 9 mV	_____	+ 9 mV
CV Source Effect:	Both	– 2 mV	_____	+ 2 mV
CV Ripple and Noise				
peak-to-peak:	Both	N/A	_____	+ 14 mV
rms:	Both	N/A	_____	+ 3 mV
Transient response				
Voltage @ 200 µs:	N6733B	– 200 mV	_____	+ 200 mV
	N6743B	– 300 mV	_____	+ 300 mV
		Constant Current Tests		
Current Programming & Readback				
Minimum current (Iout):	Both	+ 10 mA	_____	+ 30 mA
Current measured over interface:	Both	Iout – 5 mA	_____	Iout + 5 mA
High current (Iout):	N6733B	2.4762 A	_____	2.5237 A
	N6743B	4.9725 A	_____	5.0275 A
Current measured over interface:	N6733B	Iout – 8.75 mA	_____	Iout + 8.75 mA
	N6743B	Iout – 12.5 mA	_____	Iout + 12.5 mA
CC Load Effect:	Both	– 2 mA	_____	+ 2 mA
CC Source Effect:	Both	– 1 mA	_____	+ 1 mA

Test Description	N6733B Setting	N6743B Setting
Voltage Programming & Readback Min Voltage:	30 mV, 2.5 A	30 mV, 5 A
Voltage Programming & Readback High Voltage:	20 V, 2.5 A	20 V, 5 A
CV Load Effect, Source Effect, Ripple and Noise:	20 V, 2.5 A	20 V, 5 A
Transient Response:	20 V, from 1.25 A to 2.5 A	5 V, from 2.5 A to 5 A
Current Programming & Readback Min Current:	10 mA, 20V	10 mA, 20 V
Current Programming & Readback High Current:	2.5 A, 20 V	5 A, 20 V
CC Load Effect, Source Effect:	2.5 A, 20 V	5 A, 20 V

Test Record Form - Keysight N6734B and N6744B

N6734B and N6744B	Report Number _____		Date_____	
Test Description	**Model**	**Min. Specs**	**Results**	**Max. Specs**
		Constant Voltage Tests		
Voltage Programming & Readback				
Minimum voltage (Vout):	Both	+ 5 mV	_____	+ 75 mV
Voltage measured over interface:	Both	Vout – 35 mV	_____	Vout + 35 mV
High voltage (Vout):	Both	34.93 V	_____	35.07 V
Voltage measured over interface:	Both	Vout – 70 mV	_____	Vout + 70 mV
CV Load Effect:	Both	– 11 mV	_____	+ 11 mV
CV Source Effect:	Both	– 4 mV	_____	+ 4 mV
CV Ripple and Noise				
peak-to-peak:	Both	N/A	_____	+ 15 mV
rms:	Both	N/A	_____	+ 5 mV
Transient response				
Voltage @ 200 µs:	N6734B	– 200 mV	_____	+ 200 mV
	N6744B	– 300 mV	_____	+ 300 mV
		Constant Current Tests		
Current Programming & Readback				
Minimum current (Iout):	Both	– 15 mA	_____	+ 25 mA
Current measured over interface:	Both	Iout – 4 mA	_____	Iout + 4 mA
High current (Iout):	N6734B	1.47775 A	_____	1.52225 A
	N6744B	2.9755 A	_____	3.0245 A
Current measured over interface:	N6734B	Iout – 6.25 mA	_____	Iout + 6.25 mA
	N6744B	Iout – 8.5 mA	_____	Iout + 8.5 mA
CC Load Effect:	Both	– 2 mA	_____	+ 2 mA
CC Source Effect:	Both	– 1 mA	_____	+ 1 mA

Test Description	N6734B Setting	N6744B Setting
Voltage Programming & Readback Min Voltage:	40 mV, 1.5 A	40 mV, 3 A
Voltage Programming & Readback High Voltage:	35 V, 1.5 A	35 V, 3 A
CV Load Effect, Source Effect, Ripple and Noise:	35 V, 1.5 A	35 V, 3 A
Transient Response:	35 V, from 0.75 A to 1.5 A	35 V, from 1.5 A to 3 A
Current Programming & Readback Min Current:	5 mA, 35 V	5 mA, 35 V
Current Programming & Readback High Current:	1.5 A, 35 V	3 A, 35 V
CC Load Effect, Source Effect:	1.5 A, 35 V	3 A, 35 V

Test Record Form - Keysight N6735B and N6745B

N6735B and N6745B	Report Number _____		Date_____	
Test Description	**Model**	**Min. Specs**	**Results**	**Max. Specs**
		Constant Voltage Tests		
Voltage Programming & Readback				
Minimum voltage (Vout):	Both	+ 10 mV	_____	+ 130 mV
Voltage measured over interface:	Both	Vout – 60 mV	_____	Vout + 60 mV
High voltage (Vout):	Both	59.88 V	_____	60.12 V
Voltage measured over interface:	Both	Vout – 120 mV	_____	Vout + 120 mV
CV Load Effect:	N6735B	– 13 mV	_____	+ 13 mV
	N6745B	– 16 mV	_____	+ 16 mV
CV Source Effect:	Both	– 6 mV	_____	+ 6 mV
CV Ripple and Noise				
peak-to-peak:	Both	N/A	_____	+ 25 mV
rms:	Both	N/A	_____	+ 9 mV
Transient response				
Voltage @ 200 µs:	N6735B	– 400 mV	_____	+ 400 mV
	N6745B	– 500 mV	_____	+ 500 mV
		Constant Current Tests		
Current Programming & Readback				
Minimum current (Iout):	Both	– 17.5 mA	_____	+ 22.5 mA
Current measured over interface:	Both	Iout – 4 mA	_____	Iout + 4 mA
High current (Iout):	N6735B	0.7788 A	_____	0.8212 A
	N6745B	1.5776 A	_____	1.6224 A
Current measured over interface:	N6735B	Iout – 5.2 mA	_____	Iout + 5.2 mA
	N6745B	Iout – 6.4 mA	_____	Iout + 6.4 mA
CC Load Effect:	Both	– 2 mA	_____	+ 2 mA
CC Source Effect:	Both	– 1 mA	_____	+ 1 mA

Test Description	N6735B Setting	N6745B Setting
Voltage Programming & Readback Min Voltage:	70 mV, 0.8 A	70 mV, 1.6 A
Voltage Programming & Readback High Voltage:	60 V, 0.8 A	60 V, 1.6 A
CV Load Effect, Source Effect, Ripple and Noise:	60 V, 0.8 A	60 V, 1.6 A
Transient Response:	60 V, from 0.4 A to 0.8 A	60 V, from 0.8 A to 1.6 A
Current Programming & Readback Min Current:	2.5 mA, 60 V	2.5 mA, 60 V
Current Programming & Readback High Current:	0.8 A, 60 V	1.6 A, 60 V
CC Load Effect, Source Effect:	0.8 A, 60 V	1.6 A, 60 V

Test Record Form - Keysight N6736B and N6746B

N6736B and N6746B	Report Number _____		Date_____	
Test Description	**Model**	**Min. Specs**	**Results**	**Max. Specs**
		Constant Voltage Tests		
Voltage Programming & Readback				
Minimum voltage (Vout):	Both	+ 0 mV	_____	+ 200 mV
Voltage measured over interface:	Both	Vout – 100 mV	_____	Vout + 100 mV
High voltage (Vout):	Both	99.8 V	_____	100.2 V
Voltage measured over interface:	Both	Vout – 200 mV	_____	Vout + 200 mV
CV Load Effect:	N6736B	– 20 mV	_____	+ 20 mV
	N6746B	– 30 mV	_____	+ 30 mV
CV Source Effect:	Both	– 10 mV	_____	+ 10 mV
CV Ripple and Noise				
peak-to-peak:	Both	N/A	_____	+ 30 mV
rms:	Both	N/A	_____	+ 18 mV
Transient response				
Voltage @ 200 µs:	N6736B	– 500 mV	_____	+ 500 mV
	N6746B	– 1000 mV	_____	+ 1000 mV
		Constant Current Tests		
Current Programming & Readback				
Minimum current (Iout):	Both	– 8.5 mA	_____	+ 11.5 mA
Current measured over interface:	Both	Iout – 2 mA	_____	Iout + 2 mA
High current (Iout):	N6736B	0.4893 A	_____	0.5107 A
	N6746B	0.9885 A	_____	1.0115 A
Current measured over interface:	N6736B	Iout – 2.75 mA	_____	Iout + 2.75 mA
	N6746B	Iout – 3.5 mA	_____	Iout + 3.5 mA
CC Load Effect:	Both	– 2 mA	_____	+ 2 mA
CC Source Effect:	Both	– 1 mA	_____	+ 1 mA

Test Description	N6736B Setting	N6746B Setting
Voltage Programming & Readback Min Voltage:	100 mV, 0.5 A	100 mV, 1 A
Voltage Programming & Readback High Voltage:	100 V, 0.5 A	100 V, 1 A
CV Load Effect, Source Effect, Ripple and Noise:	100 V, 0.5 A	100 V, 1 A
Transient Response:	100 V, from 0.25 A to 0.5 A	100 V, from 0.5 A to 1 A
Current Programming & Readback Min Current:	1.5 mA, 100 V	1.5 mA, 100 V
Current Programming & Readback High Current:	0.5 A, 100 V	1 A, 100 V
CC Load Effect, Source Effect:	0.5 A, 100 V	1 A, 100 V

Test Record Form - Keysight N6751A and N6752A

N6751A and N6752A	Report Number _____		Date_____	
Test Description	**Model**	**Min. Specs**	**Results**	**Max. Specs**
		Constant Voltage Tests		
Voltage Programming & Readback				
Minimum voltage (Vout):	Both	– 1 mV	_____	+ 39 mV
Voltage measured over interface:	Both	Vout – 20 mV	_____	Vout + 20 mV
High voltage (Vout):	Both	49.951 V	_____	50.049 V
Voltage measured over interface:	Both	Vout – 45 mV	_____	Vout + 45 mV
CV Load Effect:	Both	– 2 mV	_____	+ 2 mV
CV Source Effect:	Both	– 1 mV	_____	+ 1 mV
CV Ripple and Noise				
peak-to-peak:	Both	N/A	_____	+ 4.5 mV
rms:	Both	N/A	_____	+ 0.35 mV
Transient response				
Voltage @ 100 µs:	Both	– 75 mV	_____	+ 75 mV
Voltage @ 100 µs with Option 761:	N6752A	– 125 mV	_____	+ 125 mV
		Constant Current Tests		
Current Programming & Readback				
Minimum current (Iout):	Both	– 10 mA	_____	+ 30 mA
Current measured over interface:	Both	Iout – 4 mA	_____	Iout + 4 mA
High current (Iout):	N6751A	4.975 A	_____	5.025 A
	N6752A	9.970 A	_____	10.030 A
Current measured over interface:	N6751A	Iout – 9 mA	_____	Iout + 9 mA
	N6752A	Iout – 14 mA	_____	Iout + 14 mA
CC Load Effect:	Both	– 2 mA	_____	+ 2 mA
CC Source Effect:	Both	– 1 mA	_____	+ 1 mA

Test Description	N6751A Setting	N6752A Setting
Voltage Programming & Readback Min Voltage:	20 mV, 1 A	20 mV, 2 A
Voltage Programming & Readback High Voltage:	50 V, 1 A	50 V, 2 A
CV Load Effect, Source Effect, Ripple and Noise:	50 V, 1 A	50 V, 2 A
Transient Response:	10 V, from 3 A to 5 A	8.5 V, from 5 A to 10 A
Current Programming & Readback Min Current:	10 mA, 10 V	10 mA, 8.5 V
Current Programming & Readback High Current:	5 A, 10 V	10 A, 8.5 V
CC Load Effect, Source Effect:	5 A, 10 V	10 A, 8.5 V

Test Record Form - Keysight N6753A and N6755A

N6753A and N6755A	Report Number _____		Date_____	
Test Description	**Model**	**Min. Specs**	**Results**	**Max. Specs**
		Constant Voltage Tests		
Voltage Programming & Readback				
Minimum voltage (Vout):	Both	0 mV	_____	+ 20 mV
Voltage measured over interface:	Both	Vout – 10 mV	_____	Vout + 10 mV
High voltage (Vout):	Both	19.978 V	_____	20.022 V
Voltage measured over interface:	Both	Vout – 20 mV	_____	Vout + 20 mV
CV Load Effect:	Both	– 2 mV	_____	+ 2 mV
CV Source Effect:	Both	– 0.5 mV	_____	+ 0.5 mV
CV Ripple and Noise				
peak-to-peak:	Both	N/A	_____	+ 5 mV
rms:	Both	N/A	_____	+ 1 mV
Transient response				
Voltage @ 100 µs:	Both	– 30 mV	_____	+ 30 mV
Voltage @ 100 µs with Option 760/761:	Both	– 200 mV	_____	+ 200 mV
		Constant Current Tests		
Current Programming & Readback				
Minimum current (Iout):	Both	+ 20 mA	_____	+ 80 mA
Current measured over interface:	Both	Iout – 30 mA	_____	Iout + 30 mA
High current (Iout):	Both	49.920 A	_____	50.080 A
Current measured over interface:	Both	Iout – 80 mA	_____	Iout + 80 mA
CC Load Effect:	Both	– 12 mA	_____	+ 12 mA
CC Source Effect:	Both	– 5 mA	_____	+ 5 mA

Test Description	N6753A Setting	N6755A Setting
Voltage Programming & Readback Min Voltage:	10 mV, 15 A	10 mV, 25 A
Voltage Programming & Readback High Voltage:	20 V, 15 A	20 V, 25 A
CV Load Effect, Source Effect, Ripple and Noise:	20 V, 15 A	20 V, 25 A
Transient Response:	6 V, from 25 A to 50 A	10 V, from 25 A to 50 A
Current Programming & Readback Min Current:	50 mA, 6V	50 mA, 10 V
Current Programming & Readback High Current:	50 A, 6 V	50 A, 10 V
CC Load Effect, Source Effect:	50 A, 6 V	50 A, 10 V

Test Record Form - Keysight N6754A and N6756A

N6754A and N6756A	Report Number _____		Date_____	
Test Description	**Model**	**Min. Specs**	**Results**	**Max. Specs**
		Constant Voltage Tests		
Voltage Programming & Readback				
Minimum voltage (Vout):	Both	0 mV	_____	+ 50 mV
Voltage measured over interface:	Both	Vout – 25 mV	_____	Vout + 25 mV
High voltage (Vout):	Both	59.939 V	_____	60.061 V
Voltage measured over interface:	Both	Vout – 55 mV	_____	Vout + 55 mV
CV Load Effect:	Both	– 2 mV	_____	+ 2 mV
CV Source Effect:	Both	– 1.2 mV	_____	+ 1.2 mV
CV Ripple and Noise				
peak-to-peak:	Both	N/A	_____	+ 6 mV
rms:	Both	N/A	_____	+ 1 mV
Transient response				
Voltage @ 100 µs:	Both	– 90 mV	_____	+ 90 mV
Voltage @ 100 µs with Option 760/761:	Both	– 350 mV	_____	+ 350 mV
		Constant Current Tests		
Current Programming & Readback				
Minimum current (Iout):	Both	+ 8 mA	_____	+ 32 mA
Current measured over interface:	Both	Iout – 8 mA	_____	Iout + 8 mA
High current (Iout):	N6754A	19.968 A	_____	20.032 A
	N6756A	16.071 A	_____	17.029 A
Current measured over interface:	N6754A	Iout – 28 mA	_____	Iout + 28 mA
	N6756A	Iout – 25 mA	_____	Iout + 25 mA
CC Load Effect:	Both	– 5 mA	_____	+ 5 mA
CC Source Effect:	Both	– 2 mA	_____	+ 2 mA

Test Description	N6754A Setting	N6756A Setting
Voltage Programming & Readback Min Voltage:	25 mV, 5 A	25 mV, 8.33 A
Voltage Programming & Readback High Voltage:	60 V, 5 A	60 V, 8.33 A
CV Load Effect, Source Effect, Ripple and Noise:	60 V, 5 A	60 V, 8.33 A
Transient Response:	15 V, from 10 A to 20 A	29 V, from 8.5 A to 17 A
Current Programming & Readback Min Current:	20 mA, 15 V	20 mA, 29 V
Current Programming & Readback High Current:	20 A, 15 V	17 A, 29 V
CC Load Effect, Source Effect:	20 A, 15 V	17 A, 29 V

Test Record Form - Keysight N6761A and N6762A

N6761A and N6762A	Report Number _____		Date_____	
Test Description	**Model**	**Min. Specs**	**Results**	**Max. Specs**
Constant Voltage Tests				
Voltage Programming & Readback				
Minimum voltage (Vout):	Both	+ 9 mV	_____	+ 21 mV
Voltage measured over interface:	Both	Vout – 6 mV	_____	Vout + 6 mV
High voltage (Vout):	Both	49.986 V	_____	50.014 V
Voltage measured over interface:	Both	Vout – 14 mV	_____	Vout + 14 mV
Low Range Voltage Prog. & Readback				
Low Voltage Vout:	Both	5.4976 V	_____	5.5024 V
Voltage measured over interface:	Both	Vout – 2.4 mV	_____	Vout + 2.4 mV
CV Load Effect:	Both	– 0.5 mV	_____	+ 0.5 mV
CV Source Effect:	Both	– 0.5 mV	_____	+ 0.5 mV
CV Ripple and Noise				
peak-to-peak:	Both	N/A	_____	+ 4.5 mV
rms:	Both	N/A	_____	+ 0.35 mV
Transient response				
Voltage @ 150 µs:	Both	– 75 mV	_____	+ 75 mV
Constant Current Tests				
Current Programming & Readback				
Minimum current (Iout):	Both	– 0.8 mA	_____	+ 1.2 mA
Current measured over interface:	Both	Iout – 160 µA	_____	Iout + 160 µA
High current (Iout):	N6761A	1.4992 A	_____	1.5008 A
	N6762A	2.9986 A	_____	3.0014 A
Current measured over interface:	N6761A	Iout – 0.76 mA	_____	Iout + 0.76 mA
	N6762A	Iout – 1.36 mA	_____	Iout + 1.36 mA
Low Range Current Prog. & Readback				
Low Current (full-scale) Iout:	Both	0.099930 A	_____	0.100070 A
Current measured over interface:	Both	Iout – 45 µA	_____	Iout + 45 µA
CC Load Effect:	Both	– 65 µA	_____	+ 65 µA
CC Source Effect:	Both	– 30 µA	_____	+ 30 µA

Test Description	N6761A Setting	N6762A Setting
Voltage Programming & Readback Min Voltage:	15 mV, 1 A	15 mV, 2 A
Voltage Programming & Readback High Voltage:	50 V, 1 A	50 V, 2 A
Voltage Programming & Readback Low Voltage:	5.5 V 1 A	5,5 V, 2 A
CV Load Effect, Source Effect, Ripple and Noise:	50 V, 1 A	50 V, 2 A
Transient Response:	33 V, from 0.9 A to 1.5 A	33 V, from 1.5 A to 3 A
Current Programming & Readback Min Current:	1 mA, 33 V	1 mA, 33 V
Current Programming & Readback High Current:	1.5 A, 33 V	3 A, 33 V
Current Programming & Readback Low Current:	0.1 A, 33 V	0.1 A, 33 V
Current Readback 100 µA Current:	1 mA, 1.9 V	1 mA, 1.9 V
Current Readback 200 µA Current:	1 mA, 3.9 V	1 mA, 3.9 V
CC Load Effect, Source Effect:	1.5 A, 33 V	3 A, 33 V

Test Record Form - Keysight N6763A and N6765A

N6763A and N6765A	Report Number _____		Date_____	
Test Description	**Model**	**Min. Specs**	**Results**	**Max. Specs**
Constant Voltage Tests				
Voltage Programming & Readback				
Minimum voltage (Vout):	Both	+5 mV	_____	+ 20 mV
Voltage measured over interface:	Both	Vout – 10 mV	_____	Vout + 10 mV
High voltage (Vout):	Both	19.989 V	_____	20.011 V
Voltage measured over interface:	Both	Vout – 16 mV	_____	Vout + 16 mV
Low Voltage measured over interface:	Both	Vout – 2.1 mV	_____	Vout + 2.1 mV
CV Load Effect:	Both	– 2 mV	_____	+ 2 mV
CV Source Effect:	Both	– 0.5 mV	_____	+ 0.5 mV
CV Ripple and Noise				
peak-to-peak:	Both	N/A	_____	+ 5 mV
rms:	Both	N/A	_____	+ 1 mV
Transient response				
Voltage @ 100 µs:	Both	– 30 mV	_____	+ 30 mV
Voltage @ 100 µs with Option 760/761:	Both	– 200 mV	_____	+ 200 mV
Constant Current Tests				
Current Programming & Readback				
Minimum current (Iout):	Both	+ 35 mA	_____	+ 65 mA
Current measured over interface:	Both	Iout – 60 mA	_____	Iout + 60 mA
High current (Iout):	Both	49.935 A	_____	50.065 A
Current measured over interface:	Both	Iout – 60 mA	_____	Iout + 60 mA
Low Current measured over interface:	Both	Iout – 1.85 mA	_____	Iout + 1.85 mA
CC Load Effect:	Both	– 12 mA	_____	+ 12 mA
CC Source Effect:	Both	– 5 mA	_____	+ 5 mA

Test Description	N6763A Setting	N6765A Setting
Voltage Programming & Readback Min Voltage:	10 mV, 15 A	10 mV, 25 A
Voltage Programming & Readback High Voltage:	20 V, 15 A	20 V, 25 A
Voltage Readback Low:	2 V 15 A	2 V, 25 A
CV Load Effect, Source Effect, Ripple and Noise:	20 V, 15 A	20 V, 25 A
Transient Response:	6 V, from 25 A to 50 A	10 V, from 25 A to 50 A
Current Programming & Readback Min Current:	50 mA, 6V	50 mA, 10 V
Current Programming & Readback High Current:	50 A, 6 V	50 A, 10 V
Current Readback Low:	1.5 A, 6 V	1.5 A, 10 V
CC Load Effect, Source Effect:	50 A, 6 V	50 A, 10 V

Test Record Form - Keysight N6764A and N6766A

N6764A and N6766A	Report Number _____		Date_____	
Test Description	**Model**	**Min. Specs**	**Results**	**Max. Specs**
		Constant Voltage Tests		
Voltage Programming & Readback				
Minimum voltage (Vout):	Both	+13 mV	_____	+ 37 mV
Voltage measured over interface:	Both	Vout – 25 mV	_____	Vout + 25 mV
High voltage (Vout):	Both	59.970 V	_____	60.030 V
Voltage measured over interface:	Both	Vout – 43 mV	_____	Vout + 43 mV
Low Voltage measured over interface:	Both	Vout – 6.8 mV	_____	Vout + 6.8 mV
CV Load Effect:	Both	– 2 mV	_____	+ 2 mV
CV Source Effect:	Both	– 1.2 mV	_____	+ 1.2 mV
CV Ripple and Noise				
peak-to-peak:	Both	N/A	_____	+ 6 mV
rms:	Both	N/A	_____	+ 1 mV
Transient response				
Voltage @ 100 µs:	Both	– 90 mV	_____	+ 90 mV
Voltage @ 100 µs with Option 760/761:	Both	– 350 mV	_____	+ 350 mV
		Constant Current Tests		
Current Programming & Readback				
Minimum current (Iout):	Both	+ 16 mA	_____	+ 24 mA
Current measured over interface:	Both	Iout – 5 mA	_____	Iout + 5 mA
High current (Iout):	N6764A	19.981 A	_____	20.019 A
	N6766A	16.9833 A	_____	17.0167 A
Current measured over interface:	N6764A	Iout – 25 mA	_____	Iout + 25 mA
Low Current measured over interface:	N6766A	Iout – 22 mA	_____	Iout + 22 mA
	Both	Iout – 1 mA	_____	Iout + 1 mA
CC Load Effect:		– 5 mA	_____	+ 5 mA
CC Source Effect:		– 2 mA	_____	+ 2 mA

Test Description	N6764A Setting	N6766A Setting
Voltage Programming & Readback Min Voltage:	25 mV, 5 A	25 mV, 8.33 A
Voltage Programming & Readback High Voltage:	60 V, 5 A	60 V, 8.33 A
Voltage Readback Low:	6 V 5 A	6 V, 8.33 A
CV Load Effect, Source Effect, Ripple and Noise:	60 V, 5 A	60 V, 8.33 A
Transient Response:	15 V, from 10 A to 20 A	29 V, from 8.5 A to 17 A
Current Programming & Readback Min Current:	20 mA, 15 V	20 mA, 29 V
Current Programming & Readback High Current:	20 A, 15 V	17 A, 29 V
Current Readback Low:	0.5 A, 15 V	0.5 A, 29 V
CC Load Effect, Source Effect:	20 A, 15 V	17 A, 29 V

Test Record Form - Keysight N6773A

Keysight N6773A	Report Number _____		Date_____	
Test Description	**Model**	**Min. Specs**	**Results**	**Max. Specs**
		Constant Voltage Tests		
Voltage Programming & Readback				
Minimum voltage (Vout):		+ 10 mV	_____	+ 50 mV
Voltage measured over interface:		Vout – 20 mV	_____	Vout + 20 mV
High voltage (Vout):		19.96 V	_____	20.04 V
Voltage measured over interface:		Vout – 40 mV	_____	Vout + 40 mV
CV Load Effect:		– 13 mV	_____	+ 13 mV
CV Source Effect:		– 2 mV	_____	+ 2 mV
CV Ripple and Noise				
peak-to-peak:		N/A	_____	+ 20 mV
rms:		N/A	_____	+ 3 mV
Transient response				
Voltage @ 250 µs:		– 300 mV	_____	+ 300 mV
Voltage @ 250 µs with Option 760/761:		– 350 mV	_____	+ 350 mV
		Constant Current Tests		
Current Programming & Readback				
Minimum current (Iout):		– 30 mA	_____	+ 90 mA
Current measured over interface:		Iout – 15 mA	_____	Iout + 15 mA
High current (Iout):		14.9175 A	_____	15.0825 A
Current measured over interface:		Iout – 37.5 mA	_____	Iout + 37.5 mA
CC Load Effect:		– 6 mA	_____	+ 6 mA
CC Source Effect:		– 1 mA	_____	+ 1 mA

Test Description	N6773A Setting
Voltage Programming & Readback Min Voltage:	30 mV, 15 A
Voltage Programming & Readback High Voltage:	20 V, 15 A
CV Load Effect, Source Effect, Ripple and Noise:	20 V, 15 A
Transient Response:	20 V, from 7.5 A to 15 A
Current Programming & Readback Min Current:	30 mA, 20V
Current Programming & Readback High Current:	15 A, 20 V
CC Load Effect, Source Effect:	15 A, 20 V

Test Record Form - Keysight N6774A

Keysight N6774A	Report Number _____		Date_____	
Test Description	**Model**	**Min. Specs**	**Results**	**Max. Specs**
		Constant Voltage Tests		
Voltage Programming & Readback				
Minimum voltage (Vout):		+ 5 mV	_____	+ 75 mV
Voltage measured over interface:		Vout – 35 mV	_____	Vout + 35 mV
High voltage (Vout):		34.93 V	_____	35.07 V
Voltage measured over interface:		Vout – 70 mV	_____	Vout + 70 mV
CV Load Effect:		– 16 mV	_____	+ 16 mV
CV Source Effect:		– 4 mV	_____	+ 4 mV
CV Ripple and Noise				
peak-to-peak:		N/A	_____	+ 22 mV
rms:		N/A	_____	+ 5 mV
Transient response				
Voltage @ 250 µs:		– 300 mV	_____	+ 300 mV
Voltage @ 250 µs with Option 760/761:		– 350 mV	_____	+ 350 mV
		Constant Current Tests		
Current Programming & Readback				
Minimum current (Iout):		– 45 mA	_____	+ 75 mA
Current measured over interface:		Iout – 12 mA	_____	Iout + 12 mA
High current (Iout):		8.42725 A	_____	8.57275 A
Current measured over interface:		Iout – 24.75 mA	_____	Iout + 24.75 mA
CC Load Effect:		– 6 mA	_____	+ 6 mA
CC Source Effect:		– 1 mA	_____	+ 1 mA

Test Description	N6774A Setting
Voltage Programming & Readback Min Voltage:	40 mV, 8.5 A
Voltage Programming & Readback High Voltage:	35 V, 8.5 A
CV Load Effect, Source Effect, Ripple and Noise:	35 V, 8.5 A
Transient Response:	35 V, from 4.25 A to 8.5 A
Current Programming & Readback Min Current:	15 mA, 35 V
Current Programming & Readback High Current:	8.5 A, 35 V
CC Load Effect, Source Effect:	8.5 A, 35 V

Test Record Form - Keysight N6775A

Keysight N6775A	Report Number _____		Date_____	
Test Description	**Model**	**Min. Specs**	**Results**	**Max. Specs**
		Constant Voltage Tests		
Voltage Programming & Readback				
Minimum voltage (Vout):		+ 10 mV	_____	+ 130 mV
Voltage measured over interface:		Vout – 60 mV	_____	Vout + 60 mV
High voltage (Vout):		59.88 V	_____	60.12 V
Voltage measured over interface:		Vout – 120 mV	_____	Vout + 120 mV
CV Load Effect:		– 24 mV	_____	+ 24 mV
CV Source Effect:		– 6 mV	_____	+ 6 mV
CV Ripple and Noise				
peak-to-peak:		N/A	_____	+ 35 mV
rms:		N/A	_____	+ 9 mV
Transient response				
Voltage @ 250 µs:		– 500 mV	_____	+ 500 mV
		Constant Current Tests		
Current Programming & Readback				
Minimum current (Iout):		– 52.5 mA	_____	+ 67.5 mA
Current measured over interface:		Iout – 12 mA	_____	Iout + 12 mA
High current (Iout):		4.9325 A	_____	5.0675 A
Current measured over interface:		Iout – 19.5 mA	_____	Iout + 19.5 mA
CC Load Effect:		– 6 mA	_____	+ 6 mA
CC Source Effect:		– 1 mA	_____	+ 1 mA

Test Description	N6774A Setting
Voltage Programming & Readback Min Voltage:	70 mV, 5 A
Voltage Programming & Readback High Voltage:	60 V, 5 A
CV Load Effect, Source Effect, Ripple and Noise:	60 V, 5 A
Transient Response:	60 V, from 2.5 A to 5 A
Current Programming & Readback Min Current:	7.5 mA, 60 V
Current Programming & Readback High Current:	5 A, 60 V
CC Load Effect, Source Effect:	5 A, 60 V

Test Record Form - Keysight N6776A

Keysight N6776A	Report Number _____		Date_____	
Test Description	**Model**	**Min. Specs**	**Results**	**Max. Specs**
		Constant Voltage Tests		
Voltage Programming & Readback				
Minimum voltage (Vout):		+ 0 mV	_____	+ 200 mV
Voltage measured over interface:		Vout – 100 mV	_____	Vout + 100 mV
High voltage (Vout):		99.8 V	_____	100.2 V
Voltage measured over interface:		Vout – 200 mV	_____	Vout + 200 mV
CV Load Effect:		– 45 mV	_____	+ 45 mV
CV Source Effect:		– 10 mV	_____	+ 10 mV
CV Ripple and Noise				
peak-to-peak:		N/A	_____	+ 45 mV
rms:		N/A	_____	+ 18 mV
Transient response				
Voltage @ 250 µs:		– 1000 mV	_____	+ 1000 mV
		Constant Current Tests		
Current Programming & Readback				
Minimum current (Iout):		– 25.5 mA	_____	+ 34.5 mA
Current measured over interface:		Iout – 6 mA	_____	Iout + 6 mA
High current (Iout):		2.9655 A	_____	3.0345 A
Current measured over interface:		Iout – 10.5 mA	_____	Iout + 10.5 mA
CC Load Effect:		– 6 mA	_____	+ 6 mA
CC Source Effect:		– 1 mA	_____	+ 1 mA

Test Description	N6776A Setting
Voltage Programming & Readback Min Voltage:	100 mV, 3 A
Voltage Programming & Readback High Voltage:	100 V, 3 A
CV Load Effect, Source Effect, Ripple and Noise:	100 V, 3 A
Transient Response:	100 V, from 1.5 A to 3 A
Current Programming & Readback Min Current:	4.5 mA, 100 V
Current Programming & Readback High Current:	3 A, 100 V
CC Load Effect, Source Effect:	3 A, 100 V

Test Record Form - Keysight N6777A

Keysight N6777A	Report Number _____		Date_____	
Test Description	**Model**	**Min. Specs**	**Results**	**Max. Specs**
		Constant Voltage Tests		
Voltage Programming & Readback				
Minimum voltage (Vout):		+ 0 mV	_____	+ 300 mV
Voltage measured over interface:		Vout – 150 mV	_____	Vout + 150 mV
High voltage (Vout):		149.7 V	_____	150.3 V
Voltage measured over interface:		Vout – 300 mV	_____	Vout + 300 mV
CV Load Effect:		– 68 mV	_____	+ 68 mV
CV Source Effect:		– 15 mV	_____	+ 15 mV
CV Ripple and Noise				
peak-to-peak:		N/A	_____	+ 68 mV
rms:		N/A	_____	+ 27 mV
Transient response				
Voltage @ 250 µs:		– 2.0 V	_____	+ 2.0 V
		Constant Current Tests		
Current Programming & Readback				
Minimum current (Iout):		– 27 mA	_____	+ 33 mA
Current measured over interface:		Iout – 6 mA	_____	Iout + 6 mA
High current (Iout):		1.967 A	_____	2.033 A
Current measured over interface:		Iout – 9 mA	_____	Iout + 9 mA
CC Load Effect:		– 6 mA	_____	+ 6 mA
CC Source Effect:		– 1 mA	_____	+ 1 mA

Test Description	N6777A Setting
Voltage Programming & Readback Min Voltage:	150 mV, 2 A
Voltage Programming & Readback High Voltage:	150 V, 2 A
CV Load Effect, Source Effect, Ripple and Noise:	150 V, 2 A
Transient Response:	150 V, from 1 A to 2 A
Current Programming & Readback Min Current:	3 mA, 150 V
Current Programming & Readback High Current:	2 A, 150 V
CC Load Effect, Source Effect:	2 A, 150 V

Test Record Form - Keysight N6781A, N6782A, and N6784A

N6781A, '82A, and '84A	Report Number _____		Date_____	
Test Description	**Model**	**Min. Specs**	**Results**	**Max. Specs**
		Constant Voltage Tests		
Voltage Programming & Readback				
Minimum voltage (Vout):	All	– 1.8 mV	_____	+ 1.8 mV
Voltage measured over interface:	All	Vout – 1.2 mV	_____	Vout + 1.2 mV
High voltage (Vout):	All	19.9932 V	_____	20.0068 V
Voltage measured over interface:	All	Vout – 6.2 mV	_____	Vout + 6.2 mV
Voltage Prog. & Readback Low Range				
1 V Voltage Vout:	All	0.99915 V	_____	1.00085 V
Voltage measured over interface:	All	Vout – 325 µV	_____	Vout + 325 µV
600 mV Prog. & 100 mV Readback				
100 mV Voltage Vout:	All	99.775 mV	_____	100.225 mV
Voltage measured over interface:	All	Vout – 75 µV	_____	Vout + 75 µV
CV Load Effect				
20 V output range:	All	– 700 µV	_____	+ 700 µV
6 V output range:	All	– 400 µV	_____	+ 400 µV
CV Ripple and Noise				
peak-to-peak 20 V output range:	All	N/A	_____	+ 12 mV
rms 20V output range:	All	N/A	_____	+ 1.2 mV
peak-to-peak 6 V output range:	All	N/A	_____	+ 12 mV
rms 6V output range:	All	N/A	_____	+ 1.2 mV
Transient response				
6 V output range @ 35 µs:	All	– 20 mV	_____	+ 20 mV
20 V output range @ 35 µs:	All	– 10 mV	_____	+ 10 mV
Auxiliary voltage readback:	N6781A	Vout – 10 mV	_____	Vout + 10 mV
		Constant Current Tests		
Current Programming & Readback				
Minimum current (Iout):	All	– 300 µA	_____	+ 300 µA
Current measured over interface:	All	Iout – 250 µA	_____	Iout + 250 µA
High current (Iout):	All	2.9985 A	_____	3.0015 A
Current measured over interface:	All	Iout – 1.15 mA	_____	Iout + 1.15 mA
300mA, 100mA, 10mA Programming				
300 mA range Current Iout:	N6781A/N6782A	99.82 mA	_____	100.18 mA
100 mA range Current Iout:	N6784A	99.958 mA	_____	100.042 mA
10 mA range Current Iout:	N6784A	9.9925 mA	_____	10.0075 mA
100 mA, 1 mA, 10 µA Readback				
100mA rng measured over interface:	All	Iout – 35 µA	_____	Iout + 35 µA
1 mA range measured over interface:	All	Iout – 350 µA	_____	Iout + 350 µA
(when installed in N6705 analyzer):		(Iout – 360 µA)	(_____)	(Iout + 360 µA)
10µA range measured over interface:	All	Iout – 10.5 nA	_____	Iout + 10.5 nA
(when installed in N6705 analyzer):		(Iout – 22.5 nA)	(_____)	(Iout + 22.5 nA)

N6781A, '82A, and '84A	Report Number _____		Date_____	
Test Description	**Model**	**Min. Specs**	**Results**	**Max. Specs**
CC Load Effect				
3 A output range:	All	– 100 µA	_____	+ 100 µA
1 A output range:	All	– 50 µA	_____	+ 50 µA
300 mA output range:	N6781A/N6782A	– 50 µA	_____	+ 50 µA
100 mA & 10 mA output ranges:	N6784A	– 1 µA	_____	+ 1 µA
	N6781A Resistance Tests			
Resistance Programming				
20 V output range:	N6781A	0.996 Ω	_____	1.004 Ω
6 V output range:	N6781A	0.9975 Ω	_____	1.0025 Ω

Test Description	N6781A, '82A, and '84A Settings
Voltage Programming & Readback Min Voltage:	Voltage Priority; 0 V, 1 A
Voltage Programming & Readback High Voltage:	Voltage Priority; 20 V, 1 A
Voltage Programming & Readback Low Voltage:	Voltage Priority; 1 V, 1 A
600 mV Programming & 100 mV Readback	Voltage Priority; 0.1 V, 1 A
CV Load Effect, 20 V range	Voltage Priority; 20 V, 1 A
CV Load Effect, 6 V range	Voltage Priority; 6 V, 3 A
CV Load Effect, 600 mV range	Voltage Priority; 100 mV, 3 A
CV Ripple and Noise, 20 V range	Voltage Priority; 20 V, 1 A
CV Ripple and Noise, 6 V range	Voltage Priority; 6 V, 3 A
Transient Response, 6 V range	Voltage Priority; Comp.= HIGH3; 6V, from 0.1 to 1.5 A
Transient Response, 20 V range	Voltage Priority; Comp.= HIGH3; 20V, from 0.1 to 0.9 A
Current Programming & Readback, Min Current	Current Priority; 0 A, 6 V
Current Programming & Readback, High Current	Current Priority; 3 A, 6 V
Current Programming 300 mA & 100 mA ranges	Current Priority; 100 mA, 20 V
Current Programming 10 mA range	Current Priority; 10 mA, 20 V
Current Readback 100 mA range	Voltage Priority; 100 mA, 1 V
Current Readback 1 mA Range	Voltage Priority; 1 mA, 10 V
Current Readback 10 µA Range	Voltage Priority; 10 µA, 10 V
CC Load Effect, 3 A range	Current Priority; 3 A, 6 V
CC Load Effect, 1 A range	Current Priority; 1 A, 6 V
CC Load Effect, 300 mA range	Current Priority; 100 mA, 6 V
CC Load Effect, 100 mA range	Current Priority; 100 mA, 6 V
CC Load Effect, 10 mA range	Current Priority; 10 mA, 6 V
N6781A Resistance Programming, 20 V range	Voltage Priority; 10 V, 1 Ω (Elect. load: CC mode, 20 V, 1A)
N6781A Resistance Programming, 6 V range	Voltage Priority; 6 V, 1 Ω (Elect. load: CC mode, 20 V, 3A)

Test Record Form - Keysight N6785A and N6786A

N6785A and N6786A	Report Number _____		Date_____	
Test Description	**Model**	**Min. Specs**	**Results**	**Max. Specs**
		Constant Voltage Tests		
Voltage Programming & Readback				
Minimum voltage (Vout):	Both	– 1.8 mV	_____	+ 1.8 mV
Voltage measured over interface:	Both	Vout – 1.8 mV	_____	Vout + 1.8 mV
High voltage (Vout):	Both	19.9932 V	_____	20.0068 V
Voltage measured over interface:	Both	Vout – 6.8 mV	_____	Vout + 6.8 mV
CV Load Effect	Both	– 700 µV	_____	+ 700 µV
CV Ripple and Noise				
peak-to-peak:	Both	N/A	_____	+ 15 mV
rms:	Both	N/A	_____	+ 1.5 mV
Transient response				
6 V output range @ 35 µs:	Both	– 20 mV	_____	+ 20 mV
Auxiliary voltage readback:	N6785A	Vout – 10 mV	_____	Vout + 10 mV
		Constant Current Tests		
Current Programming & Readback				
Minimum current (Iout):	Both	– 1.5 mA	_____	+ 1.5 mA
Current measured over interface:	Both	Iout – 1.5 mA	_____	Iout + 1.5 mA
High current (Iout):	Both	7.9953 A	_____	8.0047 A
Current measured over interface:	Both	Iout – 4.7 mA	_____	Iout + 4.7 mA
100 mA and 1 mA Readback				
100mA rng measured over interface:	Both	Iout – 35 µA	_____	Iout + 35 µA
1 mA range measured over interface:	Both	Iout – 350 µA	_____	Iout + 350 µA
(when installed in N6705 analyzer):		(Iout – 360 µA)	(_____)	(Iout + 360 µA)
CC Load Effect:	Both	– 400 µA	_____	+ 400 µA
		N6781A Resistance Tests		
Resistance Programming	N6785A	0.998 Ω	_____	1.002 Ω

Test Description	N6781A, '82A, and '84A Settings
Voltage Programming & Readback Min Voltage:	Voltage Priority; 0 V, 4 A
Voltage Programming & Readback High Voltage:	Voltage Priority; 20 V, 4 A
CV Load Effect	Voltage Priority; 20 V, 4 A
CV Ripple and Noise	Voltage Priority; 20 V, 4 A
Transient Response	Voltage Priority; Comp.= HIGH3; 6V, from 0.1 to 1.5 A
Current Programming & Readback, Min Current	Current Priority; 0 A, 6 V
Current Programming & Readback, High Current	Current Priority; 8 A, 6 V
Current Readback 100 mA range	Current Priority; 100 mA, 1 V
Current Readback 1 mA Range	Voltage Priority; 1 mA, 10 V
CC Load Effect	Current Priority; 8 A, 6 V
N6781A Resistance Programming	Voltage Priority; 10 V, 1 Ω (Elect. load: CC mode, 20 V, 1A)

Test Record Form - Keysight N6783A-BAT and N6783A-MFG

N6783A-BAT, N6783A-MFG	Report Number _____		Date_____	
Test Description	**Model**	**Min. Specs**	**Results**	**Max. Specs**
		Constant Voltage Tests		
Voltage Programming & Readback				
Minimum voltage (Vout):	Both	– 5 mV	_____	+ 25 mV
Voltage measured over interface:	Both	Vout – 5 mV	_____	Vout + 5 mV
High voltage (Vout):	N6783A-BAT	7.982 V	_____	8.018 V
	N6783A-MFG	5.984 V	_____	6.016 V
Voltage measured over interface:	N6783A-BAT	Vout – 9 mV	_____	Vout + 9 mV
	N6783A-MFG	Vout – 8 mV	_____	Vout +8 mV
CV Load Effect:	Both	– 6 mV	_____	+ 6 mV
CV Source Effect:	Both	– 2 mV	_____	+ 2 mV
CV Ripple and Noise				
peak-to-peak:	Both	N/A	_____	+ 8 mV
rms:	Both	N/A	_____	+ 1.5 mV
Transient response 6 V				
Voltage @ 45 µs:	N6732B	– 75 mV	_____	+ 75 mV
Voltage @ 75 µs with Option 761:	N6742B	– 90 mV	_____	+ 90 mV
		Constant Current Tests		
Current Programming & Readback				
Minimum current (Iout):	Both	+ 3.2 mA	_____	+ 6.8 mA
Current measured over interface:	Both	Iout – 0.6 mA	_____	Iout + 0.6 mA
High current (Iout):	Both	2.9952 A	_____	3.0048 A
Current measured over interface:	Both	Iout – 3.6 mA	_____	Iout + 3.6 mA
Low current measured over interface:	Both	Iout – 225 µA	_____	Iout + 225 µA
CC Load Effect:	Both	– 2 mA	_____	+ 2 mA
CC Source Effect:	Both	– 1 mA	_____	+ 1 mA
Negative Current Output:	Both	– 1.9942 A	_____	+ 2.0058 A

Test Description	**N6783A-BAT Setting**	**N6783A-MFG Setting**
Voltage Programming & Readback Min Voltage:	15 mV, 3 A	15 mV, 3 A
Voltage Programming & Readback High Voltage:	8 V, 3 A	6 V, 3 A
CV Load Effect, Source Effect, Ripple and Noise:	8 V, 3 A	6 V, 3 A
Transient Response:	6 V, from 0.15 A to 1.5 A	6 V, from 0.15 A to 1.5 A
Current Programming & Readback Min Current:	5 mA, 8 V	40 mA, 6 V
Current Programming & Readback High Current:	3 A, 8 V	3, 6 V
Current Readback Low Current:	150 mA, 8 V	150 mA, 6 V
CC Load Effect, Source Effect:	3 A, 8 V	3 A, 6 V
Negative current output:	0 V, – 2 A	0 V, – 2 A

Test Record Form - Keysight N6791A

Keysight N6791A	Report Number _____		Date_____	
Test Description	Model	Min. Specs	Results	Max. Specs
Voltage Priority Tests				
Voltage Programming & Readback				
Minimum voltage:		2.9919 V	_____	3.0081 V
Voltage measured over interface:		Vin – 8.1 mV	_____	Vin + 8.1 mV
High voltage:		59.9748 V	_____	60.0252 V
Voltage measured over interface:		Vin – 25.2 mV	_____	Vin + 25.2 mV
Current Priority Tests				
Current Programming & Readback - High range				
Minimum current:		2.398 mA	_____	7.602 mA
Current measured over interface:		Iin – 2.402 mA	_____	Iin + 2.402 mA
High current:		19.9894 A	_____	20.0106 A
Current measured over interface:		Iin – 10.4 mA	_____	Iin + 10.4 mA
Current Programming & Readback - Low range				
Minimum current:		0.5396 mA	_____	1.4604 mA
Current measured over interface:		Iin – 0.4004 mA	_____	Iin + 0.4004 mA
Low current:		1.99874 A	_____	2.00126 A
Current measured over interface:		Iin – 1.2 mA	_____	Iin + 1.2 mA
Resistance Priority Tests				
Resistance Programming - High range				
Minimum resistance:		1.0975 mS	_____	3.9025 mS
High resistance:		0 S	_____	1.5251 mS
Resistance Programming - Medium range				
Minimum resistance:		0.318999 S	_____	0.347666 S
High resistance:		0 S	_____	0.02401 S
Resistance Programming - Low range				
Minimum resistance:		12.1075 S	_____	12.8925 S
High resistance:		2.1175 S	_____	2.8825 S
Power Priority Tests				
Power Programming & Readback - High range				
Minimum power:		49.79 W	_____	50.21 W
Power measured over interface:		Win – 190 mW	_____	Win + 190 mW
High power:		99.76 W	_____	100.24 W
Power measured over interface:		Win – 220 mW	_____	Win + 220 mW
Power Programming & Readback - Low range				
Minimum power:		4.967 W	_____	5.033 W
Power measured over interface:		Win – 28 mW	_____	Win + 28 mW
Low power:		9.964 W	_____	10.036 W
Power measured over interface:		Win – 31 mW	_____	Win + 31 mW

Test Description	N6791A Settings	Power Supply Settings
Voltage Programming & Readback Minimum voltage:	Voltage priority; 3 V	65 V; 1.5 A
Voltage Programming & Readback High voltage:	Voltage priority; 60 V	65 V; 1.5 A
Current Programming & Readback - High Range, Minimum current	Current priority; 0.005 A	5 V; 25 A
Current Programming & Readback - High Range, High current	Current priority; 20 A	5 V; 25 A
Current Programming & Readback - Low Range, Minimum current	Current priority; 0.001 A	5 V; 25 A
Current Programming & Readback - Low Range, Low current	Current priority; 2 A	5 V; 25 A
Resistance Programming - High range, Minimum resistance	Resistance priority; 400 Ω	40 V; 1 A
Resistance Programming - High range, High resistance	Resistance priority; 8000 Ω	60 V; 1 A
Resistance Programming - Medium range, Minimum resistance	Resistance priority; 3.0 Ω	5 V; 3 A
Resistance Programming - Medium range, High resistance	Resistance priority; 100 Ω	5 V; 1 A
Resistance Programming - Low range, Minimum resistance	Resistance priority; 0.08 Ω	1 V; 15 A
Resistance Programming - Low range, High resistance	Resistance priority; 0.40 Ω	0.5 V; 3 A
Power Programming & Readback - High Range, Minimum power	Power priority; 50 W	25 V; 3 A
Power Programming & Readback - High Range, High power	Power priority; 100 W	25 V; 5 A
Power Programming & Readback - Low Range, Minimum power	Power priority; 5 W	25 V; 0.5 A
Power Programming & Readback - Low Range, Low power	Power priority; 10 W	25 V; 0.5 A

Test Record Form - Keysight N6792A

Keysight N6792A	Report Number _____		Date_____	
Test Description	**Model**	**Min. Specs**	**Results**	**Max. Specs**
Voltage Priority Tests				
Voltage Programming & Readback				
Minimum voltage:		2.9919 V	_____	3.0081 V
Voltage measured over interface:		Vin – 8.1 mV	_____	Vin + 8.1 mV
High voltage:		59.9748 V	_____	60.0252 V
Voltage measured over interface:		Vin – 25.2 mV	_____	Vin + 25.2 mV
Current Priority Tests				
Current Programming & Readback - High range				
Minimum current:		4.796 mA	_____	15.204 mA
Current measured over interface:		Iin – 4.604 mA	_____	Iin + 4.604 mA
High current:		39.9788 A	_____	40.0212 A
Current measured over interface:		Iin – 20.6 mA	_____	Iin + 20.6 mA
Current Programming & Readback - Low range				
Minimum current:		1.0792 mA	_____	2.9208 mA
Current measured over interface:		Iin – 0.8208 mA	_____	Iin + 0.8208 mA
Low current:		3.99748 A	_____	4.00252 A
Current measured over interface:		Iin – 2.42 mA	_____	Iin + 2.42 mA
Resistance Priority Tests				
Resistance Programming - High range				
Minimum resistance:		0 S	_____	5.3025 mS
High resistance:		0 S	_____	2.9251 mS
Resistance Programming - Medium range				
Minimum resistance:		0.313999 S	_____	0.352666 S
High resistance:		0 S	_____	0.02901 S
Resistance Programming - Low range				
Minimum resistance:		11.9375 S	_____	13.0625 S
High resistance:		1.9475 S	_____	3.0525 S
Power Priority Tests				
Power Programming & Readback - High range				
Minimum power:		99.58 W	_____	100.42 W
Power measured over interface:		Win – 380 mW	_____	Win + 380 mW
High power:		199.52 W	_____	200.48 W
Power measured over interface:		Win – 440 mW	_____	Win + 440 mW
Power Programming & Readback - Low range				
Minimum power:		9.929 W	_____	10.071 W
Power measured over interface:		Win – 56 mW	_____	Win + 56 mW
Low power:		19.923 W	_____	20.077 W
Power measured over interface:		Win – 62 mW	_____	Win + 62 mW

Test Description	N6792A Settings	Power Supply Settings
Voltage Programming & Readback Minimum voltage:	Voltage priority; 3 V	65 V; 1.5 A
Voltage Programming & Readback High voltage:	Voltage priority; 60 V	65 V; 1.5 A
Current Programming & Readback - High Range, Minimum current	Current priority; 0.01 A	5 V; 45 A
Current Programming & Readback - High Range, High current	Current priority; 40 A	5 V; 45 A
Current Programming & Readback - Low Range, Minimum current	Current priority; 0.002 A	5 V; 45 A
Current Programming & Readback - Low Range, Low current	Current priority; 4 A	5 V; 45 A
Resistance Programming - High range, Minimum resistance	Resistance priority; 400 Ω	40 V; 1 A
Resistance Programming - High range, High resistance	Resistance priority; 8000 Ω	60 V; 1 A
Resistance Programming - Medium range, Minimum resistance	Resistance priority; 3.0 Ω	5 V; 3 A
Resistance Programming - Medium range, High resistance	Resistance priority; 100 Ω	5 V; 1 A
Resistance Programming - Low range, Minimum resistance	Resistance priority; 0.08 Ω	1 V; 15 A
Resistance Programming - Low range, High resistance	Resistance priority; 0.40 Ω	0.5 V; 3 A
Power Programming & Readback - High Range, Minimum power	Power priority; 100 W	25 V; 5 A
Power Programming & Readback - High Range, High power	Power priority; 200 W	6 V; 40 A
Power Programming & Readback - Low Range, Minimum power	Power priority; 10 W	25 V; 0.5 A
Power Programming & Readback - Low Range, Low power	Power priority; 20 W	25 V; 1.0 A

7
Service and Maintenance

Introduction

Firmware Update

Instrument Sanitize

Calibration Switches

Redundant Ground for 400 Hz Operation

Disassembly

Troubleshooting

Replaceable Parts

KEYSIGHT TECHNOLOGIES

Introduction

Types of Service Available

If your instrument fails during the warranty period, Keysight Technologies will repair or replace it under the terms of your warranty. After your warranty expires, Keysight offers repair services at competitive prices.

Many Keysight products have optional service contracts that extend coverage after the standard warranty expires.

Obtaining Repair Service (Worldwide)

To obtain service for your instrument, contact your nearest Keysight Technologies Service Center. They will arrange to have your unit repaired or replaced, and can provide warranty or repair–cost information where applicable. Ask the Keysight Technologies Service Center for shipping instructions, including what components to ship. Keysight recommends that you retain the original shipping carton for return shipments.

Before Returning the Unit

Before returning the unit,

- Make sure the failure is in the instrument rather than any external connections.
- Make sure that the instrument was accurately calibrated within the last year.
- Perform the Preliminary Checkout procedures in the troubleshooting section.

Repackaging for Shipment

To ship the unit to Keysight for service or repair:

- Attach a tag to the unit identifying the owner and indicating the required service or repair. Include the model number and full serial number.
- Place the unit in its original container with appropriate packaging material.
- Secure the container with strong tape or metal bands.
- If the original shipping container is unavailable, use a container that will ensure at least 10 cm (4 in.) of compressible packaging material around the entire instrument. Use static-free packaging materials.

Keysight suggests that you always insure shipments.

Firmware Update

NOTE Refer to Instrument Identification to determine which firmware version is installed on your instrument.

To upgrade your instrument with the latest firmware revision, go to www.keysight.com/find/N6700firmware. The upgrade procedure consists of the following steps:

- Download and unzip the Keysight N6700 Firmware Update file located under "Documents & Downloads" at the bottom of the Web page. Make a note of where you saved the unzipped file.
- Download and install the Keysight N6700 Firmware Update Utility located under "Documents & Downloads" at the bottom of the Web page. You can skip this step if the utility is already installed on your computer.
- Run the Keysight N6700 Firmware Update Utility and update the firmware on your instrument. Select Start > Programs > Keysight > Firmware Update Utility.
- Cycle power to the mainframe. The updated firmware will be running when power is reapplied.

Restricting Access

Note that you can restrict access to the instrument by the firmware update utility. This prevents unauthorized users from updating the firmware.

Front Panel Menu Reference	SCPI Command
Select **System\Admin\Update** Check the Must log in as admin box. This requires a user to log into the Admin menu before the firmware update utility performs a firmware update.	Not available

Instrument Sanitize

NOTE This procedure is not recommended for use in routine applications because of the possibility of unintended loss of data.

Sanitize removes all user-data from the instrument and restores the factory-shipped settings. Refer to Non-Volatile Settings for a list of the factory settings.

This procedure is typically used to prepare the instrument for removal from a secure area. It writes all zeros to flash memory and then performs a full chip erase as per the manufacturer's data sheet. Identification data such as instrument firmware, model number, serial number, MAC address, and calibration data is not erased. After the data is cleared, the instrument is rebooted.

If you cannot access the Admin menu, it may be password protected.

Front Panel Menu Reference	SCPI Command
Select **System\Admin\Sanitize**	SYST:SEC:IMM
Select Sanitize.	
Selecting Sanitize removes all user-data from the instrument and cycles power.	

Turn-on After Sanitization

The first time the unit is turned on after it has been sanitized, several NVRAM checksum errors will be generated. These errors annunciate the fact that two files were missing, which have been recreated with default values. The next time the unit tuns on, there should be no errors.

Calibration Switches

Accessing the Calibration Switches

Switch Functions

Switch Location

WARNING SHOCK HAZARD. FAN HAZARD. Only qualified, service-trained personnel who are aware of the hazards involved should remove instrument covers. Disconnect the power cable and any external circuits before removing instrument covers.

Two switches control the access to calibration commands. The switches are located on the interface board and are accessible by removing the blower and interface covers (see figure).

Accessing the Calibration Switch

Step 1. Remove the blower cover. Remove three screws from the top of the cover and two screws on the sides. Tilt the cover up and slide it out.

Step 2. Remove the interface cover. Remove the three screws along the left side of the unit. Then remove the screw at the front of the cover. Lift off the cover.

Step 3. The calibration switch is on the interface board near the ribbon cable. To change the calibration switch settings, use a small screwdriver to move the switches.

CAUTION Do not use a pencil to move the switches. Any graphite dust that gets on the switches will conduct electricity.

Step 4. Replace all covers when finished.

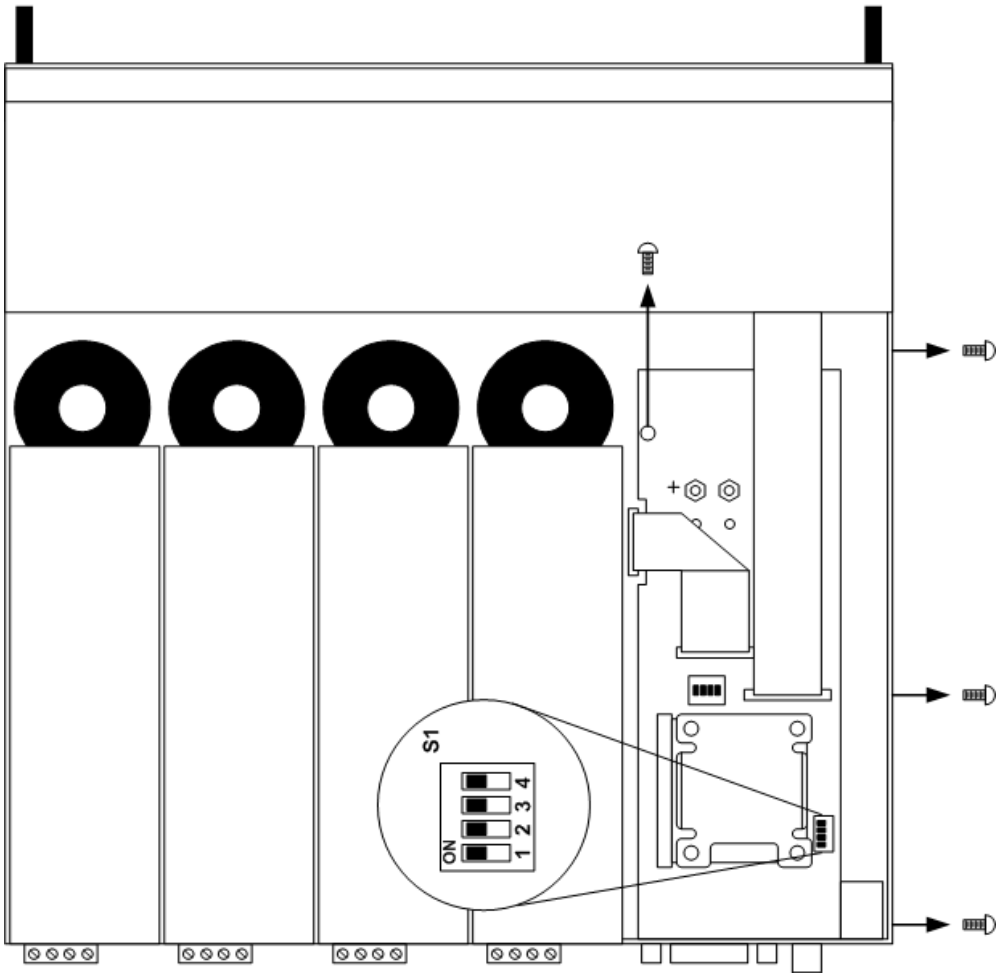
Switch Functions

Switches 1 and 2 set the calibration configuration as shown. Switches 3 and 4 are not used.

	Sw 1	Sw 2	Description
Normal	ON	ON	This is the default or as-shipped switch setting. The calibration functions are accessible after entering a numeric password. The default password is 0 (zero).
Clear Password	OFF	ON	The admin/calibration password is reset to 0 when the instrument is first powered on. Use this setting if you have forgotten the password.
Inhibit Calibration	OFF	OFF	All calibration commands are disabled. This is useful where calibration access is guarded by instrument seals.

Switch Location

Switches shown
in the ON position



Redundant Ground for 400 Hz Operation

WARNING SHOCK HAZARD. FAN HAZARD. Only qualified, service-trained personnel who are aware of the hazards involved should remove instrument covers. Disconnect the power cable and any external circuits before removing instrument covers.

Operation at 400 Hz requires the installation of a redundant ground from the instrument chassis to earth ground. The redundant ground must be permanently attached to the unit as well as to the earth ground point.

The following procedure only describes how to make the permanent connection at the unit. The user must ensure the integrity and permanence of the connection at the earth ground point.

The following customer-supplied hardware is required:

- Ground wire (14/16 AWG)
- Uninsulated ring terminal for attaching wire to unit (Tyco p/n 34124 or equivalent)
- Hardware for attaching ground wire to earth ground point

The following tools are required for installing the redundant ground:

- 3/8 inch hex wrench

Installation Procedure (see figure)

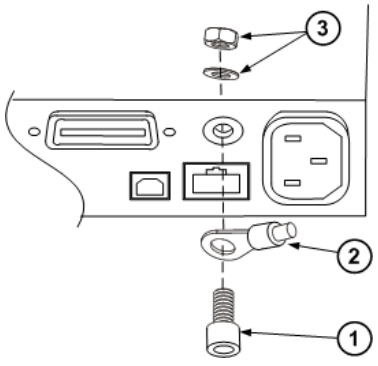
Step 1. Remove the blower and interface covers. Refer to Accessing the Calibration Switch.

Step 2. Use the wrench and remove the rear panel binding post (1) from the chassis.

Step 3. Crimp the appropriate ring terminal (2) onto the end of the ground wire.

Step 4. Place the ring terminal onto the threaded end of the binding post. Re-install the binding post on the chassis with the washer and nut (3).

Step 5. Rotate the ring terminal so that the ground wire does not interfere with any other connectors on the back of the unit. Use the wrench to tighten the binding post (Torque = 20 – 25 in-lb.).



Disassembly

Electrostatic Discharge

Disassembly Procedures

This section discusses the disassembly procedures for troubleshooting and repairing Keysight N6700C, N6701C, and N6702C MPS mainframes.

Electrostatic Discharge (ESD) Precautions

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

The following guidelines will help prevent ESD damage during service operations:

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

Disassembly Procedures

WARNING SHOCK HAZARD. FAN HAZARD. Only qualified, service-trained personnel who are aware of the hazards involved should remove instrument covers. Disconnect the power cable and any external circuits before removing instrument covers.

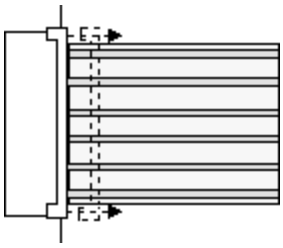
Required Disassembly Tools

- 9/32 Hex driver - for removing GPIB connector
- 5/16 Hex driver - for removing DC cable assembly from bias supply
- T10 Torx driver - for removing covers and board assemblies
- T20 Torx driver - for removing bias/processor board, handles, and bulk supply

Ribbon Cables

- Note the position of the conductive side of the cable for re-installation. (The blue tab is on the non-conductive side.)

- Release the ribbon cable by pulling up on the locking tab as shown by the arrows in the next figure.



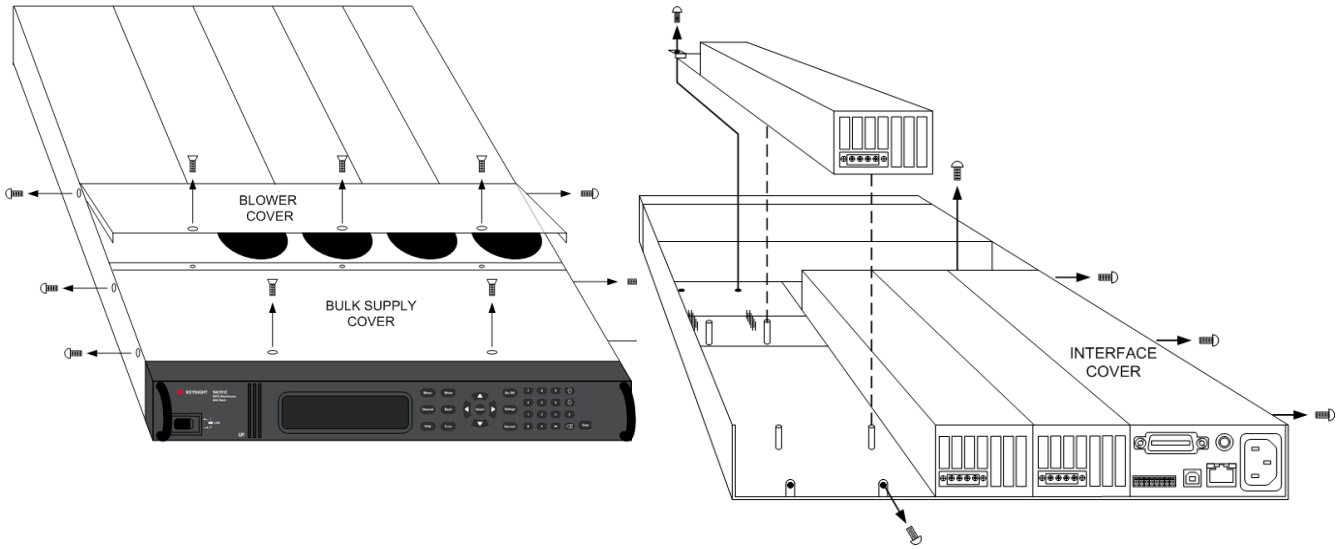
- To replace the cable, fully insert the cable into the connector; then push down on the locking tab to secure the cable.

Removing/Installing Modules

CAUTION Modules must be installed next to one another, starting with slot 1. Do not leave any empty slots between modules, otherwise the power system will not operate. Any remaining unused slots must have a filler module installed to ensure proper cooling. Do not install filler modules between power modules

Step 1. Remove the blower cover. Remove three screws from the top of the cover and two screws on the sides. Tilt the cover up and slide it out.

Step 2. To remove a module, first remove the two fastening screws at either end of the module. Grasp the module at the ends (near the fan and the output connector), and lift it straight up out of the mainframe.



Step 3. To install a module, align the module over the alignment pins, and push it down onto the mainframe connector.

Step 4. Fasten the module to the mainframe. Install the two screws from the power module or filler module at either end of the module. Because the RFI strips are applying upward pressure, continue pushing down on the module until the screws are fully tightened.

Step 5. Replace the blower cover when finished.

Removing/Installing the P600 Processor

Step 1. Remove the blower cover. Remove three screws from the top of the cover and two screws on the sides. Tilt the cover up and slide it out.

Step 2. Remove the interface cover. Remove the three screws along the left side of the unit. Then remove the screw at the front of the cover. Lift off the cover.

Step 3. Remove the four screws that attach the heat spreader to the P600 board using a T10 driver. Slide the board out of the connector.

Step 4. When installing the P600 board, insert the board on an angle into the connector. Then position the heat spreader over the board and gently push the heat spreader down. Install the four screws. Replace all covers.

Removing/Installing the Bias/Processor Carrier

Step 1. Remove the blower and interface covers as previously described.

Step 2. Use a hex wrench to remove the GPIB connector from the rear of the mainframe Disconnect all cable assemblies from the interface board.

Step 3. Disconnect all cable assemblies from the bias/processor carrier board.

Step 4. Use a T10 driver and remove the screws that attach the board to the chassis. Use a T20 driver and remove the 4 screws that attach the board to the backplane assembly. Lift the board out.

Step 5. To reinstall the bias/processor carrier board, perform the above steps in reverse. Replace all covers.

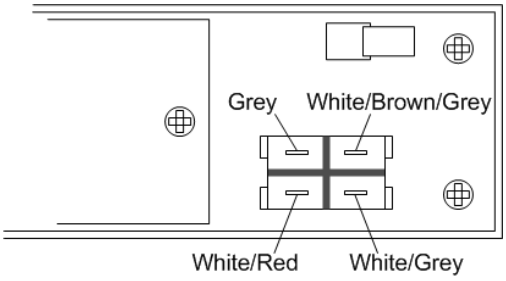
Removing/Installing the Front Panel Assembly

Step 1. Remove the two screws along the front of the bulk supply cover as well as the four screws on each side of the front panel assembly that attach the front panel assembly to the chassis.

Step 2. Slide the front panel assembly forward and away from the chassis to access the test points for troubleshooting.

Step 3. To completely remove the front panel assembly, disconnect the ribbon cable between the front panel board and the bias/processor carrier board at the front panel board.

Step 4. Disconnect the wires going to the S1 switch assembly. For reassembly, make a note of the color coding of the wires and the pins to which they are connected.



Step 5. To remove the front panel board, remove the six screws that secure the board to the front frame assembly.

Step 5. To remove the display module, first disconnect the cable at the P1 connector and the ribbon cable at the J2 connector. Then untwist the tabs that hold the display module to the front panel board.

Step 7. To reinstall the front panel assembly, perform the above steps in reverse.

Removing/Installing the Bulk Supply

Step 1. Remove the blower cover, bulk supply cover, and interface cover as previously described.

Step 2. Remove the power module from slot #3 in the mainframe. You now have access to two of the screws that install the bulk supply.

Step 3. Remove the four screws on each side of the front panel assembly that attach the front panel assembly to the chassis. Slide the front panel assembly forward and away from the chassis. You now have access to the remaining screws that install the bulk supply.

Step 4. Use a T20 driver and remove all screws that fasten the bulk supply to the chassis.

Step 5. Disconnect the DC and AC cable assemblies and lift the bulk supply out of the unit.

Step 6. To reinstall the bulk supply, perform the above steps in reverse.

NOTE For reassembly, make a note of the color-coding of all the wires as well as the pins to which the wires are connected (see table below).

N6702C mainframes use two DC cable assemblies connected in parallel.

N6701C and N6702C mainframes use an additional 2-wire sense cable, which must be connected to the 2 –pin connector on the bulk supply.

Cable assembly	Connected to Pin	Cable assembly	Connected to Pin
Red (DC)	+48 V	Red/white (AC)	ACC
Black (DC)	–48 V	Green/yellow (AC)	ground
Grey (AC)	AC	Sense cable	2-pin connector

Troubleshooting

Preliminary Checkout

Overall Troubleshooting

Font Panel Troubleshooting

Bias Assembly Troubleshooting

Backplane Board Troubleshooting

Calibration and Passwords

Before performing the Overall Troubleshooting procedures, perform the Preliminary Checkout procedure below.

If the power system passes self-test and there are no obvious faults, perform the Verification Procedures to determine if any power modules are not calibrated, or are not operating properly. This will help isolate a problem to a specific power module.

The following test equipment is required for troubleshooting Keysight N6700 MPS mainframes:

- Keysight 34401A or equivalent - Digital multimeter for measuring voltage and resistance

WARNING SHOCK HAZARD. FAN HAZARD. Only qualified, service-trained personnel who are aware of the hazards involved should perform the troubleshooting procedures described here.

Preliminary Checkout

Is the instrument inoperative?

- Verify that the AC power cord is connected to the instrument.
- Verify that the front-panel On/Standby switch has been pushed.

Is the display working?

- If the display is hard to read, but the front-panel “line” LED is lit and the fans are working, the display contrast setting may be too light or too dark. Use the front panel menu to set the display contrast.

Does the instrument fail self-test?

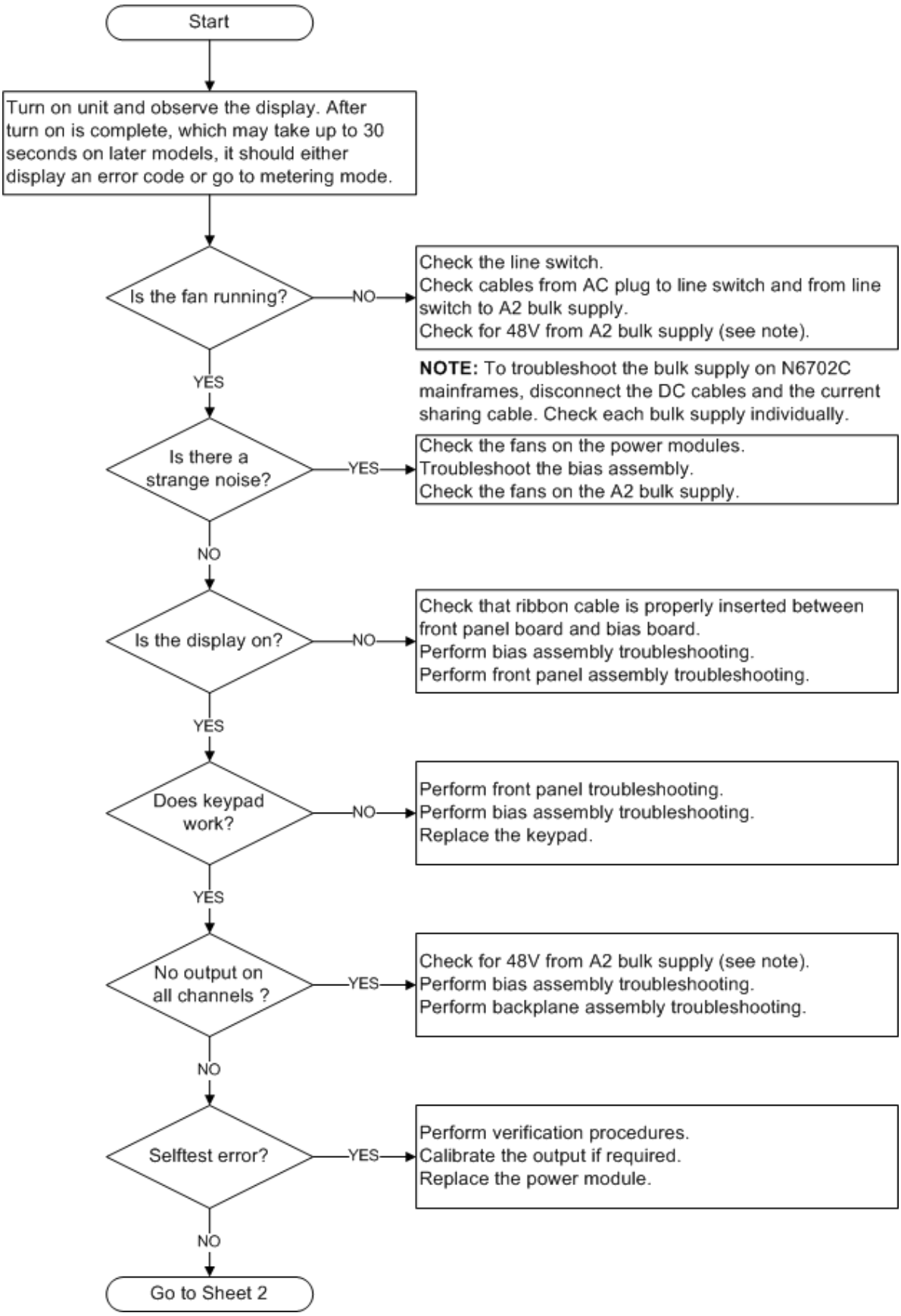
A power-on self-test occurs automatically when you turn the unit on. You can also initiate a self-test by sending the *TST? query.

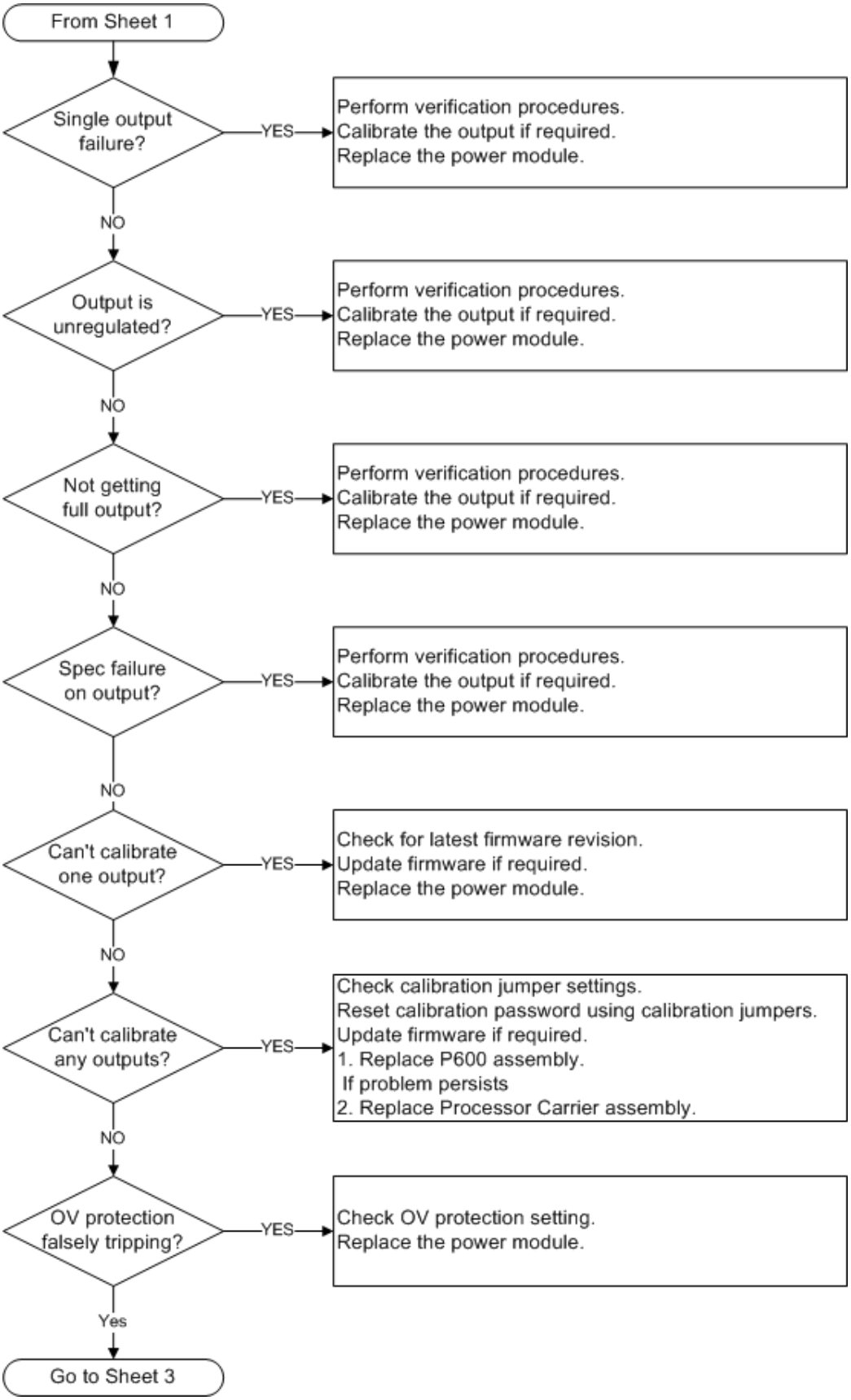
If self-test fails, the front panel ERR indicator comes on. Press the Error key to view the error log. Refer to Self-test Errors for a list of self test error codes.

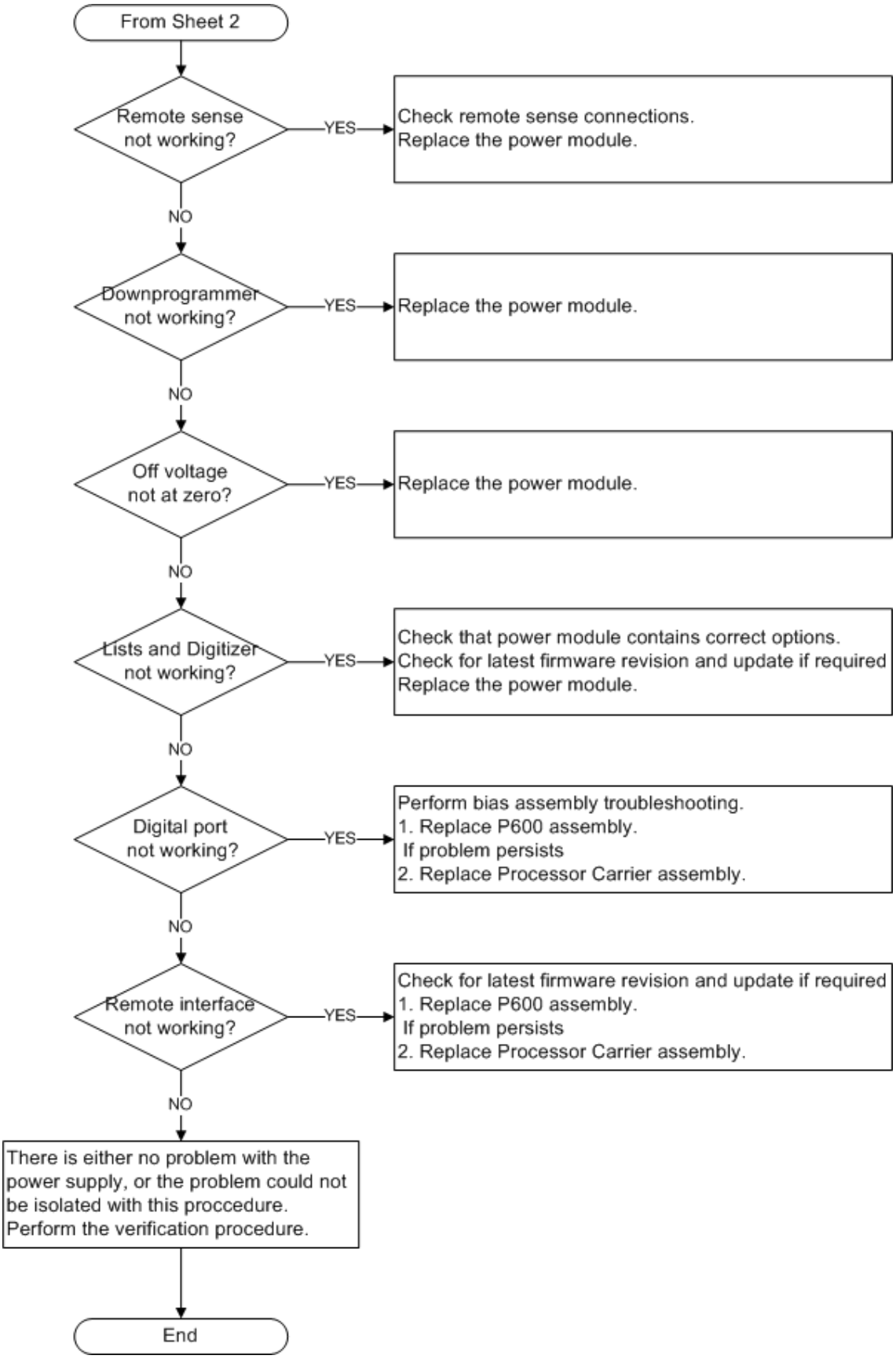
- Remove all external connections to the instrument.
- Check that modules are installed next to each other, starting with slot 1. If there are any empty slots (or filler modules) between the power modules, the power system will not operate.
- Check that the mainframe has the latest firmware installed.
- Turn off the unit and cycle power to run self-test again.

If the supply passes self-test and there are no obvious faults, perform the Verification Procedures to determine if any functions are not calibrated, or are not operating properly.

Overall Troubleshooting



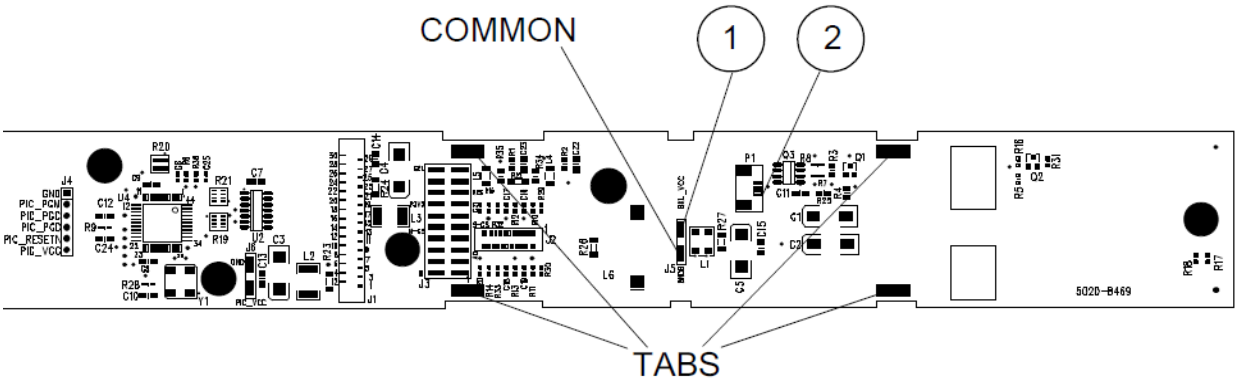

From Sheet 1
Single output failure?
YES
Perform verification procedures.
Calibrate the output if required.
Replace the power module.
NO
Output is unregulated?
YES
Perform verification procedures.
Calibrate the output if required.
Replace the power module.
NO
Not getting full output?
YES
Perform verification procedures.
Calibrate the output if required.
Replace the power module.
NO
Spec failure on output?
YES
Perform verification procedures.
Calibrate the output if required.
Replace the power module.
NO
Can't calibrate one output?
YES
Check for latest firmware revision.
Update firmware if required.
Replace the power module.
NO
Can't calibrate any outputs?
YES
Check calibration jumper settings.
Reset calibration password using calibration jumpers.
Update firmware if required.
1. Replace P600 assembly.
If problem persists
2. Replace Processor Carrier assembly.
NO
OV protection falsely tripping?
YES
Check OV protection setting.
Replace the power module.
Yes
Go to Sheet 3


From Sheet 2
Remote sense not working?
YES
Check remote sense connections.
Replace the power module.
NO
Downprogrammer not working?
YES
Replace the power module.
NO
Off voltage not at zero?
YES
Replace the power module.
NO
Lists and Digitizer not working?
YES
Check that power module contains correct options.
Check for latest firmware revision and update if required
Replace the power module.
NO
Digital port not working?
YES
Perform bias assembly troubleshooting.
1. Replace P600 assembly.
If problem persists
2. Replace Processor Carrier assembly.
NO
Remote interface not working?
YES
Check for latest firmware revision and update if required
1. Replace P600 assembly.
If problem persists
2. Replace Processor Carrier assembly.
NO
There is either no problem with the power supply, or the problem could not be isolated with this proccedure.
Perform the verification procedure.
End

Front Panel Troubleshooting

Troubleshooting the front panel board involves checking for the presence of the correct bias voltages on the board. Refer to the following table and figure.

Test Point	Location	Voltage	Description
TP 1	BKL_VCC	+ 12 V	If bias not present, troubleshoot the bias board or replace the front panel board.
TP 2	P1 pin 3	+ 12 V	If backlight voltage not present, replace the front panel board. If voltage is present and the display is not lit, replace the display.
Common	GNDB	common	

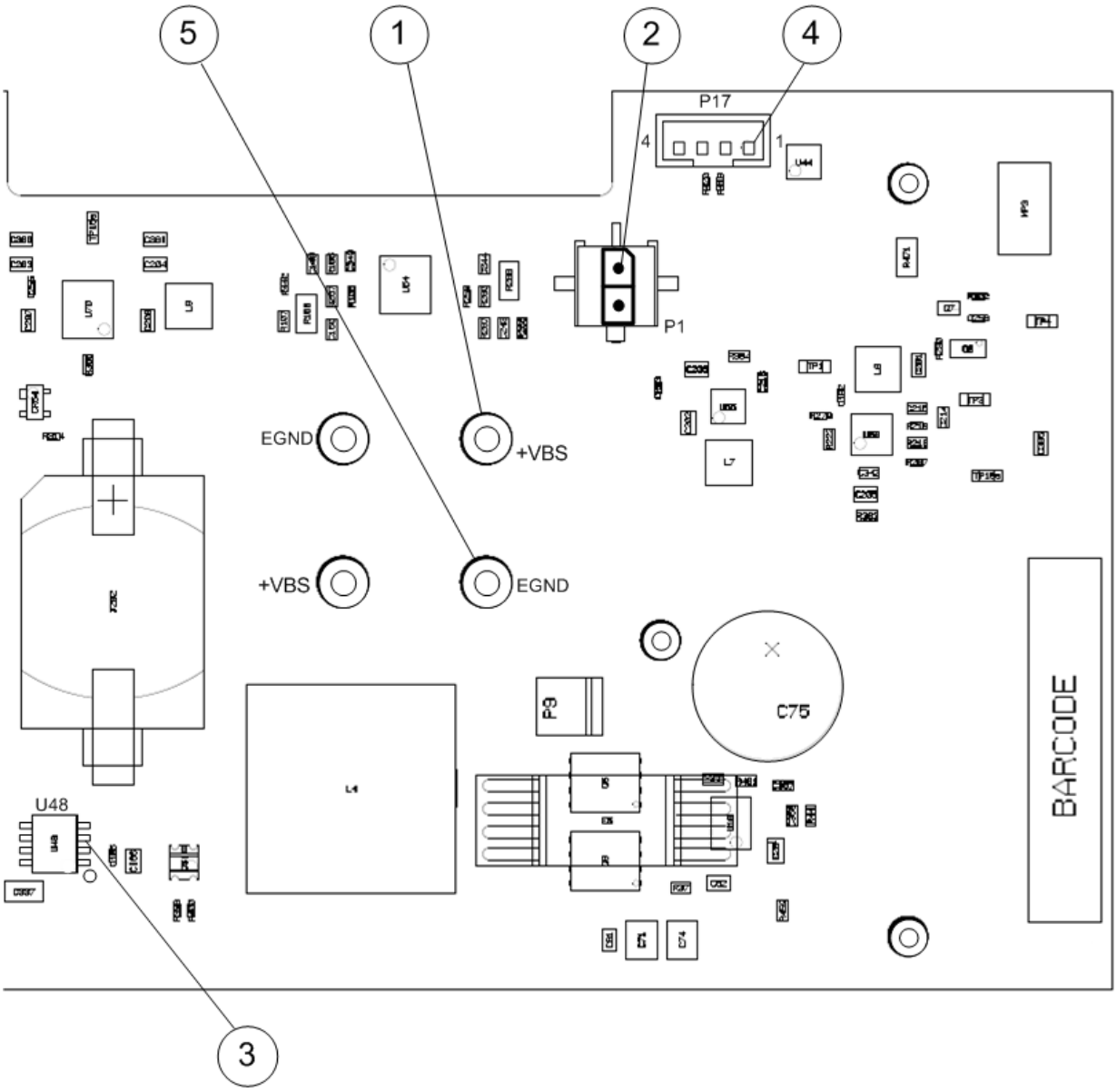


Bias Assembly Troubleshooting

Troubleshooting the bias circuits involves checking for the presence of the correct bias voltages on the Bias/Processor Carrier board. Refer to the following table and figures.

Note that if the bias voltages at test points 2 - 4 in the following table are not present, it could be caused by a defect in the power module, backplane, or front panel board that is pulling the bias voltage low.

Test Point	Location	Voltage	Description
TP 1	+ VBS (red)	+ 48 V	Output of bulk supply. If not present, replace the bulk supply.
TP 2	P1 - 1	+ 12 V	If biases at TP 2, TP 3, or TP 4 are not present, disconnect the backplane and front panel cable assemblies and recheck. If biases are still not present, replace the interface/bias board.
TP 3	U48 - 2,3	+ 5 V	Same as above.
TP 4	P17 - 1	+ 3.3 V	Same as above.
TP 5	EGND (black)	common	



Backplane Board Troubleshooting

Troubleshooting the backplane board consists of visually inspecting the pins and pin connections.

If there are missing or broken pins, replace the board.

If there are bent pins, carefully try to straighten the pin. If you are unsuccessful, replace the board.

Closely examine the solder connections at the pins. If there are cracks in the solder, carefully re-solder the connector. If unsuccessful, replace the board.

Calibration and Passwords

Calibration is not required after the mainframe has been repaired. All calibration information is module-specific and resides in each power module.

However, if the A5 board that contains the calibration switches has been replaced, any calibration password that has been set will be lost. Passwords that are used to prevent access to the front panel Admin menu will also be lost.

The calibration password will automatically be reset to the factory default, which is zero (0). Front panel access to the Admin menu will be unrestricted unless a password is set.

Refer to Password Protection for information on setting the calibration password as well as the Admin menu password.

Replaceable Parts

Parts List

Location Diagrams

Parts List

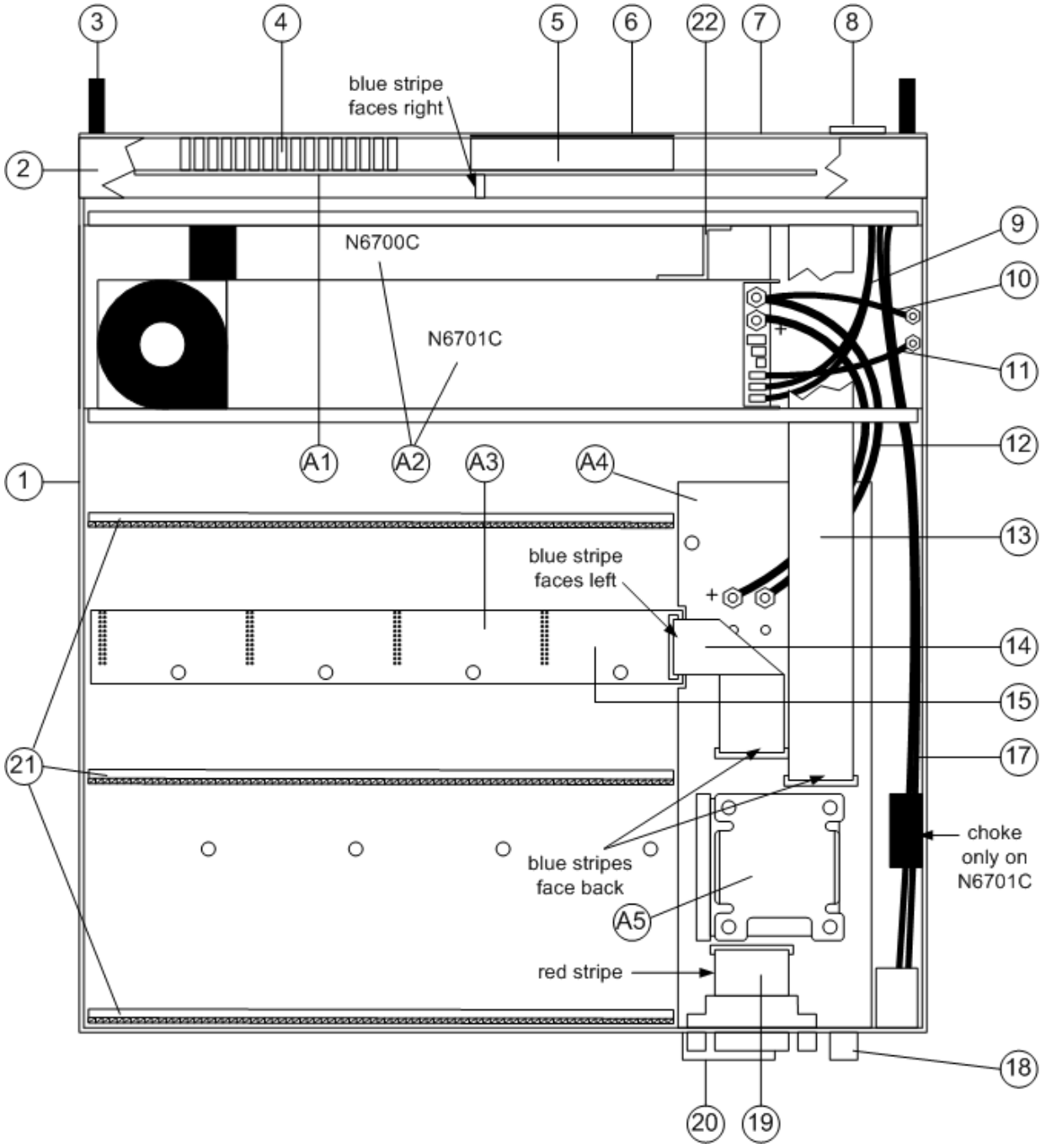
The following table lists the available replaceable parts. The location diagrams below the table show the location of these parts.

Reference Designator	N6700C Part number	N6701C Part number	N6702C Part number	Description
		Electrical Assemblies		
A1	5067-5076	5067-5076	5067-5076	Front Panel PCA
A2	N6700-60016	0950-5349	N6700-60018	Bulk Supply
A3	5067-5091	5067-5091	5067-5091	Backplane PCA
A4	5067-5849	5067-5849	5067-5849	Bias/Processor Carrier PCA
A5		Contact Keysight Service and Support		P600 Processor Module
	5003-1139	5003-1139	5003-1139	Heat spreader for P600 module
		Individual Parts		
1	5003-2059	5003-2059	5003-2060	Chassis frame
2	5188-9215	5188-9215	5188-9215	Front frame
3	1390-1079	1390-1079	1390-1079	Handles
4	5066-1914	5066-1914	5066-1914	Keypad
5	5067-5993	5067-5993	5067-5993	Display
6	4040-2556	4040-2556	4040-2556	Window
7	5188-9214	5188-9214	5188-9214	Front panel overlay
8	3101-4019	3101-4019	3101-4019	Line switch
9	5185-1357	5185-1357	5185-1357	AC cable, bulk supply to switch
10	5185-1358	5185-1358	5185-1358	Cable, minus terminal to chassis
11	5190-4482	5190-4482	5190-4482	Cable, bulk supply to chassis
12	5188-4206	5188-4206	5188-8430 (qty. 2)	DC power cable
13	5185-1354	5185-1354	5185-1354	Ribbon cable, to front panel

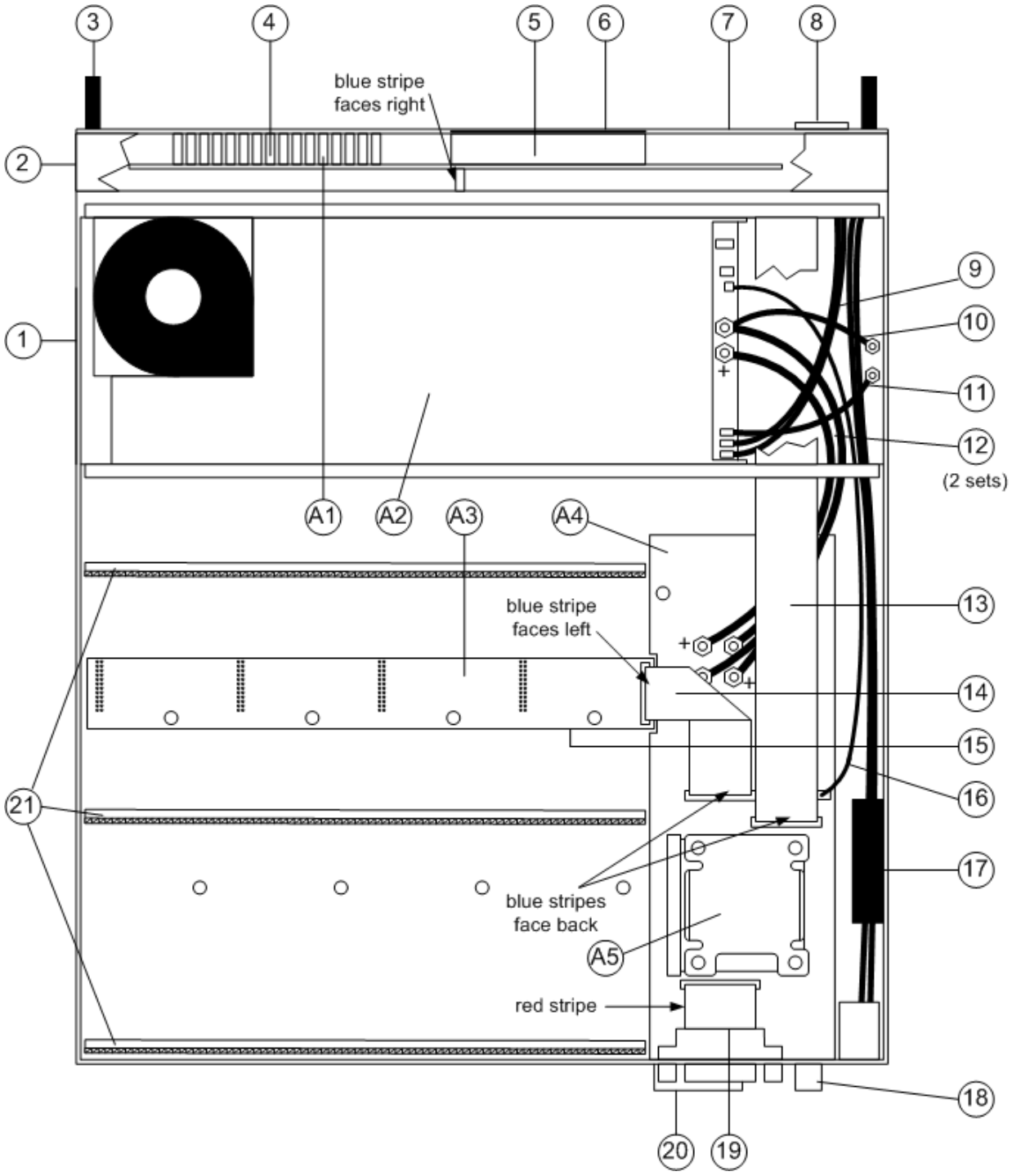
Reference Designator	N6700C Part number	N6701C Part number	N6702C Part number	Description
14	5185-1382	5185-1382	5185-1382	Ribbon cable, to backplane
15	5185-1352	5185-1352	5185-1352	Insulator, under backplane
16	N/A	N/A	5188-9177	AC range cable
17	5185-1397	5185-8856	5188-4213	AC cable assembly
18	1510-0038	1510-0038	1510-0038	Binding post
19	E5810-61605	E5810-61605	E5810-61605	GPIB connector with cable
20	1253-6408	1253-6408	1253-6408	Digital plug
21	8160-1713	8160-1713	8160-1713	RFI strips (qty. 3)
22	N/A	5002-2830	N/A	Bulk supply bracket
		Covers and Labels		
	5002-2809	5002-2809	5003-2184	Bulk supply cover
	5002-2810	5002-2810	5002-2810	Blower cover
	5002-2807	5002-2807	5002-2807	Interface cover
	N6700C-80001	N6701C-80001	N6702C-80001	Front/Rear/Cover labels

Location Diagrams

N6700C/N6701C Mainframe Part Locations



N6702C Mainframe Part Locations



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