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# AC6900 Series Three-Phase AC Power Sources

AC6903H, AC6906H, AC6912H, AC6918H - 5 kHz

AC6903L, AC6906L, AC6912L, AC6918L - 550 Hz





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## Notices

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# Safety and Regulatory Information

## General Information

The equipment is for industrial use.

Equipment operators are subject to all applicable safety regulations. Along with the warning and safety notices in this manual, all relevant safety, accident prevention, and environmental regulations must also be followed. In particular, the operators of the equipment:

- **Must be informed of the relevant safety requirements.**
- **Must have read and understood the operating manual before using the equipment.**
- **Must use the designated and recommended safety equipment.**

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.

## Safety Warnings

### 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.

### WARNING

Should network communication issues occur, the instrument settings shown in the Browser Web Control page may not represent the actual state of the instrument. This may result in unexpected hazardous voltages on the output and sense connections that could result in personal injury, death, or damage to a device under test. Before touching the output or sense connections or connecting to a device under test, always verify the state of the instrument.

---

### WARNING

## Product Grounding

The instrument is a Class 1 product and is provided with a grounding-type power cord set. The instrument chassis and cover are connected to the instrument electrical ground to minimize shock hazard. The ground pin of the cord set plug must be firmly connected to the electrical ground (safety ground) terminal at the power outlet. Any interruption of the protective earth (grounding) conductor or disconnection of the protective earth terminal will cause a potential shock hazard that could result in personal injury or death.

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**WARNING** **General Warnings**

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

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

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

DO NOT REMOVE COVERS. NO OPERATOR SERVICEABLE PARTS INSIDE. REFER SERVICING TO QUALIFIED SERVICE PERSONNEL.

SECURELY TURN OFF THE CIRCUIT BREAKER ON THE SWITCHBOARD BEFORE HANDLING THE POWER CORDS. TO AVOID AN ELECTRIC SHOCK, THE PROTECTIVE CONDUCTOR TERMINAL MUST BE CONNECTED TO AN ELECTRICAL GROUND.

NE PAS RETIRER LES COUVERTURE DE LA BOITE. AUCUN OPÉRATEUR SERVICEABLE PIÈCES À L'INTÉRIEUR. CONFIER L'ENTRETIEN DE PERSONNEL QUALIFIÉ.

CORRECTEMENT COUPER LE DISJONCTEUR ARMOIRE AVANT DE MANIPULER LES CORDONS D'ALIMENTATION. POUR ÉVITER TOUT CHOC ÉLECTRIQUE, LE CONDUCTEUR DE PROTECTION BORNE DOIT ÊTRE RELIÉE À UNE MASSE ÉLECTRIQUE.

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**WARNING** **Environmental Warnings**

This product is designed for safe indoor use. Use indoors only.

Do not operate the instrument near flammable gases or fumes.

To prevent the possibility of explosion or fire, do not use the product near alcohol, thinner or other combustible materials, or in an atmosphere containing such vapors.

Do not install the product near a heater, in direct sunlight, or in areas subject to drastic temperature changes. The operating temperature range is 0 to 40 °C (32 to 104 °F), and the storage temperature range is -10 to 60 °C (14 to 140 °F).

Do not install the product in high-humidity locations, such as near a boiler, humidifier, or water supply. The operating humidity range is 20% to 80% relative humidity (no condensation), and the storage humidity range is 90% relative humidity or less (no condensation). Condensation may occur even within the operating humidity range. In such cases, do not use the instrument until the condensation dries up completely.

Do not install the product in a corrosive atmosphere or in environments containing sulfuric acid mist, etc. This may cause corrosion of various conductors and bad contacts of connectors inside the instrument leading to malfunction and failure, or in the worst case, a fire.

Do not install the product in a dusty location. Accumulation of dust can lead to electric shock or fire.

---

**WARNING Shock Hazard**

Before making any load or sense connections be sure to turn the POWER switch off and remove the power plug from an outlet or turn off the circuit breaker at the switchboard.

When the power switch is turned off while the output is on, residual voltage still remains at the output terminals.

Do not touch the output terminal block for at least 20 seconds after the power switch is turned off.

When installing the switch between the OUTPUT terminal block and the load, be sure to turn off the circuit breaker of the switchboard.

Be sure to turn the switch off before connecting the load to the terminal at the load end of the switch.

Do not touch the switch terminal or the output terminal when the output is on.

Do not remove the instrument covers. There are no customer-serviceable parts inside. Some circuits are active and have power briefly after the power switch is turned off.

Always turn off the circuit breaker at the switchboard before cleaning.

Always ensure that the power cord ground is connected.

This product is an IEC Safety Class I equipment (equipment with a protective conductor terminal). Be sure to ground (earth) the unit.

Connect the protective conductor terminal to earth ground.

In DC mode, the Line (P1) terminals are at positive potential and the Neutral terminals are at negative potential when setting the positive value. The opposite is true when setting the negative value.

Do not use the terminal block with the terminal cover removed.

Turn off the switchboard circuit breaker before connecting the cord.

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

If a capacitor, battery, or similar device is connected as a load in DC mode, voltage remains at the section connected to the output terminal block even when the output is off until the load energy is discharged. The discharge time of the internal capacitor when no load is connected is approximately 0.1 seconds. To prevent the possibility of electric shock, do not touch the output terminal block.

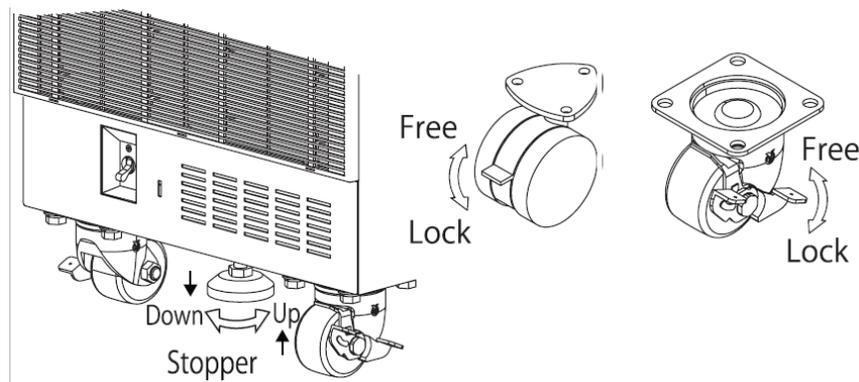
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**WARNING** Moving Warnings

Turn off the power switch before moving the instrument. Moving the unit while the power is turned on can cause electric shock or instrument damage.

Remove all wiring before moving the instrument. Moving the unit with the cables connected can cause wires to break or injuries due to the product falling over.

Do not move the instrument by yourself. Be sure to have two or more people move the instrument. Exercise special care when moving the instrument over a slope or across steps. Ensure that the instrument is not moved accidentally while it is being operated by locking the casters with your foot. For model AC6918, lower the stopper to secure the instrument in its final installation location.



If you are using a lift or bands to move the instrument, be sure to slide the lift or bands under the bottom of the instrument and then raise the instrument

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**WARNING** Installation Warnings

Have a qualified engineer connect the power cord to the switchboard.

Protective circuits inside the instrument are connected to match the input terminal polarity. Make sure the colors of the wires connected to the input terminals are correct.

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

You cannot use standard rack mounting support rails, as they would block the airflow needed for cooling.

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## Equipment Cautions

### 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.

### CAUTION

#### General Cautions

Do not place objects on the instrument. Placing objects, especially heavy objects, on top of the product can cause failures.

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### CAUTION

#### Installation Cautions

Do not block the air intake at the front of the instrument or the exhaust at the rear.

Large voltage distortion on the AC power line can lead to malfunction. Do not connect the instrument to a generator or a similar device.

Do not use the product in a location where strong magnetic or electric fields are nearby or a location where large amounts of distortion or noise are present on the input power supply waveform. The product may malfunction.

Do not install the product on an inclined surface or location subject to vibrations. The product may fall or tip over, causing damage or injuries or both.

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### CAUTION

#### Operational Cautions

You cannot set the voltage limit when the instrument is being controlled by external analog signals. An excessive external voltage may damage the load.

When the output is turned on, several volts of undershoot or overshoot may appear for a time period on the order of ten microseconds.

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### CAUTION

#### Servicing Cautions

This instrument has a void seal sticker on various locations on the chassis. This seal prohibits opening the chassis or making any modifications.

Any attempt to open or modify the instrument will void the warranty and could compromise its performance or safety. For assistance, please contact Keysight technical support.

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## Safety and Regulatory Symbols



Direct current



Alternating current



Frame or chassis terminal



On supply



Off supply



Caution, risk of electric shock



Caution, refer to accompanying documents



Earth ground terminal



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

CAN ICES/NMB-001(A) indicates compliance with the Canadian Interference- Causing Equipment Standard.

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



The TUV mark is a registered trademark of the European community. It certifies NRTL for North America.



The RCM mark is a registered trademark of the Spectrum Management Agency of Australia. This signifies compliance with the Australian EMC Framework regulations under the terms of the Radio Communications Act of 1992.



The UKCA mark Indicates United Kingdom Conformity Assessed.



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



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 environment.

사용자 안내문

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

※ 사용자 안내문은 "업무용 방송통신기자재"에만 적용한다.

## Waste Electrical and Electronic Equipment (WEEE) Directive 2012/19/EU

The following crossed out wheeled bin symbol indicates that separate collection for waste electric and electronic equipment (WEEE) is required, as obligated by DIRECTIVE 2012/19/EU and other National legislation.

Do not dispose in domestic household waste. Please refer to [about.keysight.com/en/companyinfo/environment/takeback.shtml](https://about.keysight.com/en/companyinfo/environment/takeback.shtml) to understand your trade in options with Keysight in addition to product takeback instructions.





# 1

# Getting Started

**Welcome**

**Introduction to the Instrument**

**Specifications**

**Supplemental Characteristics**

## Welcome

This manual includes user, service, and programming information for the Keysight AC6900 Series Three-Phase AC Power Sources, which can be used stand alone, or mounted in a test rack with the available bracket options. The front panel display lets you easily access and view setup and measurement information. This information may also be accessed using programming commands.

Choose from models up to 18 kVA, all with 0 to 320 Vrms,  $\pm 452$  VDC, and 1 Hz to 5 kHz output capability. Both LAN/LXI Core and USB interfaces are standard. You can choose to add GPIB or analog and digital interfaces to add basic transient signals.

## Models

The AC6900 Series Three-Phase AC Power Sources include eight models:

Model and frequency	Maximum power (VA)
AC6903L 550 Hz/AC6903H 5 kHz	3 kVA
AC6906L 550 Hz/AC6906H 5 kHz	6 kVA
AC6912L 550 Hz/AC6912H 5 kHz	12 kVA
AC6918L 550 Hz/AC6918H 5 kHz	18 kVA

The "H" or High frequency models are designed to generate output frequencies up to 5000 Hz.

The "L" or Low frequency models are designed to generate output frequencies up to 550 Hz in 3 phase operation only.

## Options and Accessories

To order any of the following, please contact your nearest [Keysight Sales and Support Office](#)

### Input Options

Input options must be ordered when purchasing the instrument. Not available for AC6903 units.

Option	Description
200	3 phase AC, 200-230V, 50/60Hz (4-wire L1, L2, L3, and  )
400	3 phase AC, 380-480, 50/60Hz (5-wire L1, L2, L3, N, and  )

### Interface Accessories

Accessory	Description
AC69GPBU	GPIB interface board
AC69ALGU	Analog interface connector - controls the output with external analog signals.
AC69DIGU	Digital interface connector - controls the output with external digital signals

**Parallel Cables**

Not available for AC6903 units.

Parallel Cables	Description
AC69PAR1	Parallel operation cable - for paralleling units; length = 1 m
AC69SYN1	Synchronization cable - for synchronizing power switches on parallel units; length = 1 m

**Rack Mount Brackets**

Rack Mount	Description
AC69RAC3	Rack mount flange kit for AC6903 units.
AC69RAC6	Bracket for mounting AC6906 units in a standard EIA inch instrument rack.
AC69RAC12	Bracket for mounting AC6912 units in a standard EIA inch instrument rack.

**Base Hold Kit**

Base Hold Kit	Description
AC69RAC18	Base hold angle kit for permanently fastening AC6918 units to the floor

**Power Cords**

Refer to [Power Cord Requirements](#) for details.

**Option MEM**

Option MEM provides a micro-SD card, which can be easily removed for sanitization purposes. Option MEM can only be ordered when the instrument is purchased. Refer to [Removing and Installing an SD Card](#) for details.

Note that instruments with Option MEM will not turn on if the original SD card is not installed in the unit.

**Documentation, Firmware, and Technical Support**

You can download the latest version of this document and access the latest firmware from the AC6900 product page at [www.keysight.com/find/AC6900](http://www.keysight.com/find/AC6900).

For technical support, please refer to [www.keysight.com/find/assist](http://www.keysight.com/find/assist).

**Contacting Keysight Technologies**

United States: (800) 829-4444

Europe: 31 20 547 2111

Japan: 0120-421-345

Use [www.keysight.com/find/assist](http://www.keysight.com/find/assist) to contact Keysight worldwide.

## Introduction to the Instrument

### Front Panel at a Glance

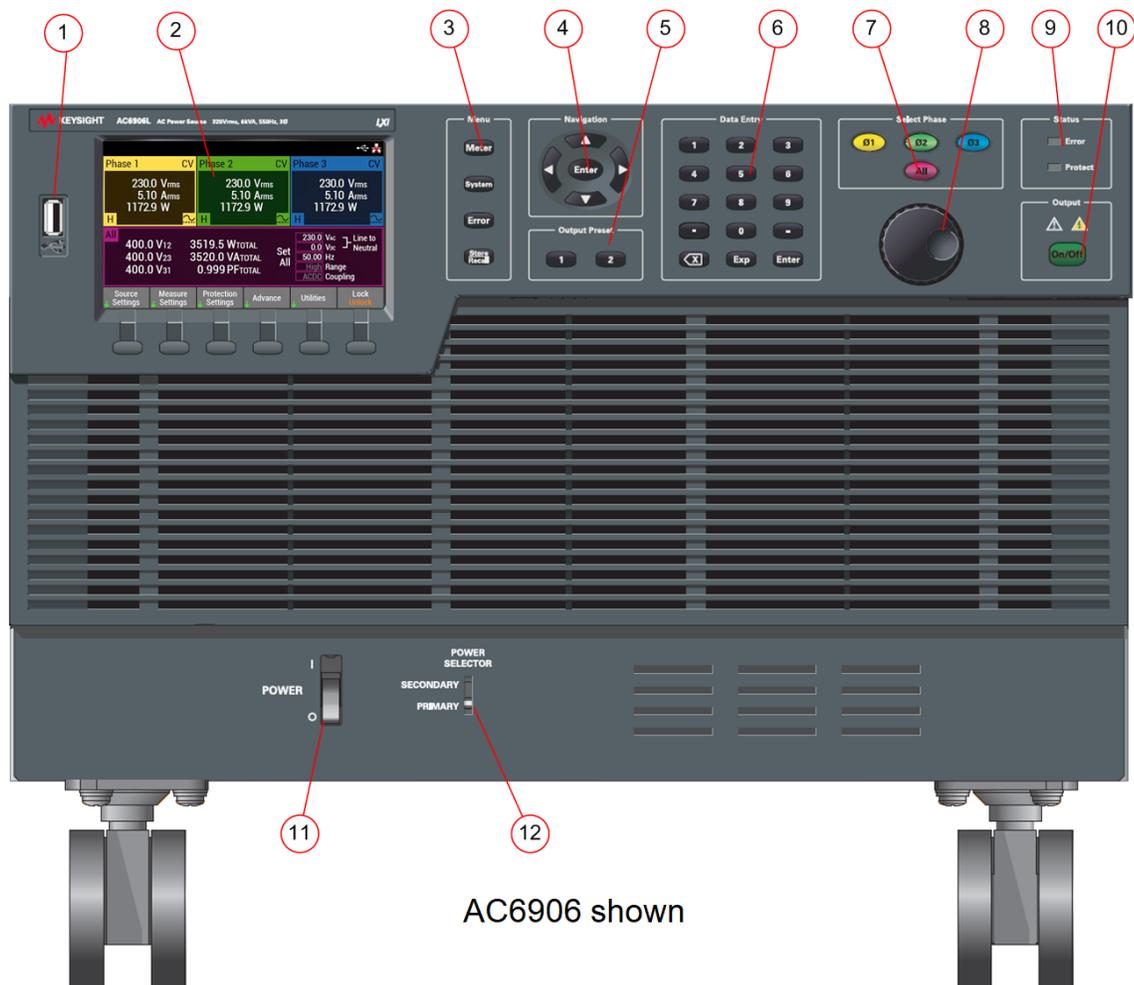
### Front Panel Display at a Glance

### Rear Panel at a Glance

### Instrument Ratings

### Voltage Ranges, Phases, and Output Characteristics

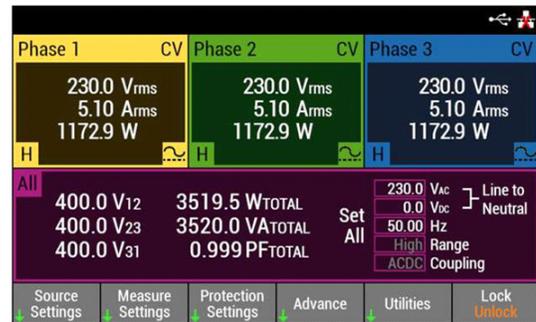
## Front Panel at a Glance



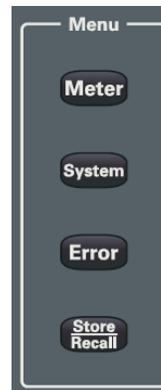
The following table lists the main parts of the front panel, from left to right:

## 1 USB port

- 2 The display lets you configure and monitor the instrument.  
Repeatedly pressing the Meter key selects from 3 meter views:  
3 phases + All, as shown  
3 phases only, in larger format - top to bottom  
1 phase in largest format, 2 phases in smallest format



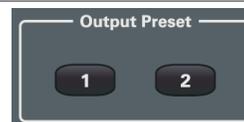
- 3 **[Meter]** selects the metering view. Pressing it repeatedly cycles the display through three formats as described above.  
**[System]** accesses the Utilities\System settings menu.  
**[Error]** accesses the Utilities>Error menu  
**[Store&Recall]** accesses the Utilities\Store&Recall menu



- 4 The **▲▶▼◀** arrows move around the command menus and select characters in alphanumeric entry fields. The **[Enter]** key makes a selection in a menu and enters the edit mode for numeric parameters.



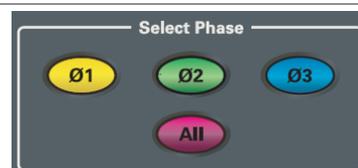
- 5 The **Output Preset** keys lets you save to or recall instrument states in memory locations 1 and 2.



- 6 **Data Entry** keys let you enter numeric values.  
**[0]** through **[9]** enter numbers.  
**[.]** enters the decimal point.  
**[-]** toggles between positive and negative numbers.  
**[X]** backspace key to delete characters.  
**[Exp]** enters the letter E to allow you to enter an exponent to the right of it.  
**[Enter]** enters a value. If you exit a field without pressing **[Enter]**, the value is ignored.



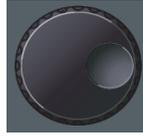
- 7 **Select Phase** selects an output phase (1-3) or selects All output phases.



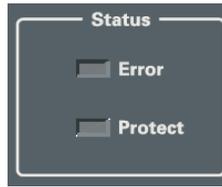
## 1 Getting Started

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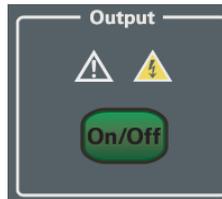
- 8 The **RPG** quickly lets you scroll through any numeric or alpha-numeric data fields



- 9 The **Status** LEDs indicate when an error or a protection event has occurred.



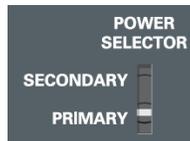
- 10 The **[On/Off]** key turns the selected output phase or all output phase on or off.



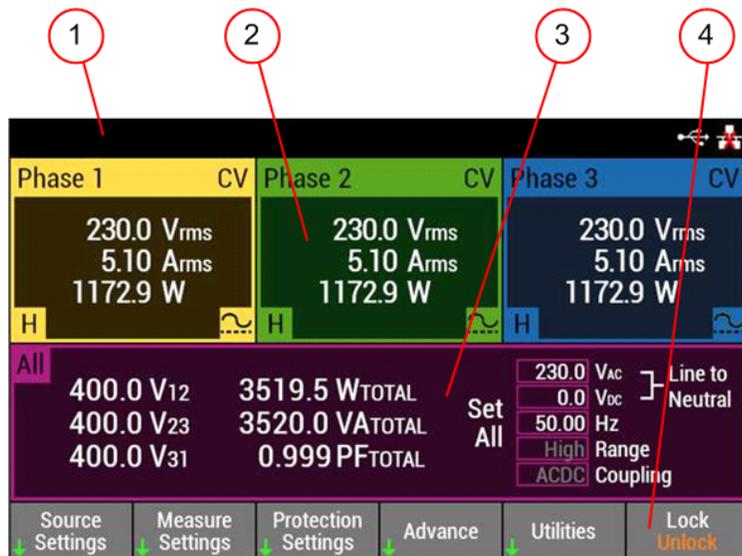
- 11 The **Power** switch powers the unit on or off. Located directly under the display on AC6903 units.



- 12 The **Power Selector** switch specifies the instrument's hierarchy in a parallel configuration. Not available on AC6903 units.

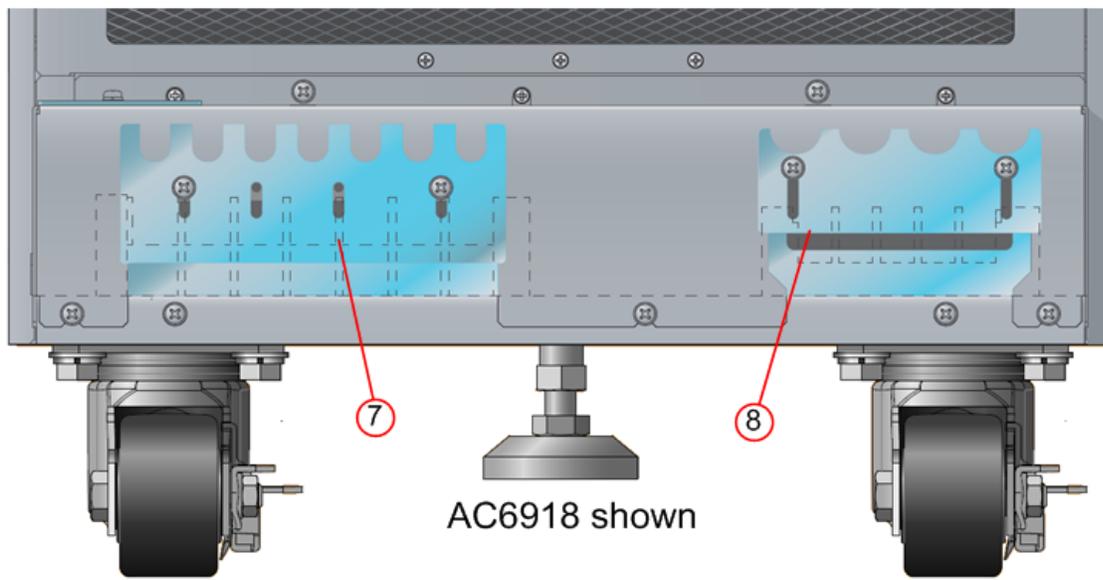
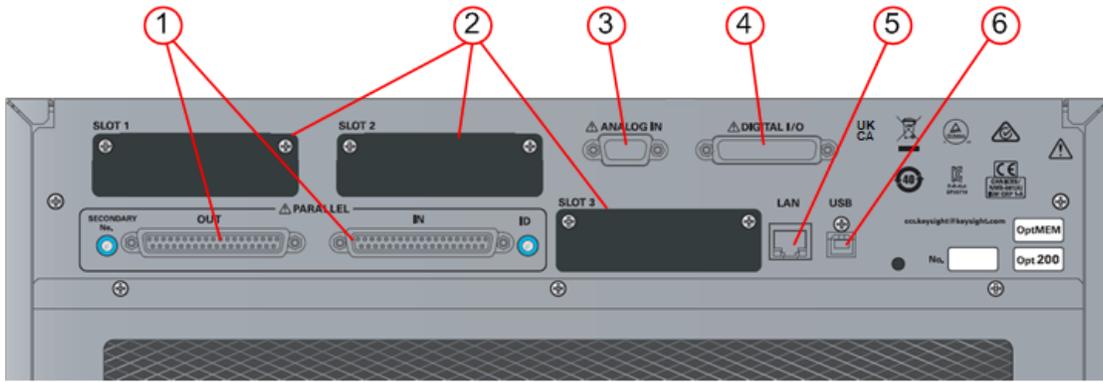


## Front Panel Display at a Glance



- |                       |  |   |
|-----------------------|--|---|
| <p>1 Title bar</p>    | <p>Left side displays the following information:</p> <ul style="list-style-type: none"> <li>F.RESP = fast CV response is set</li> <li>S.RESP = slow CV response is set</li> <li>SYNC = frequency synchronization is enabled</li> <li>SNS = remote sensing is enabled</li> <li>SS = soft start/stop is enabled</li> <li>SIM = simulation mode is enabled</li> <li>SEQ = sequence mode is enabled</li> <li>OUT.Z = output impedance control is enabled</li> <li>WAV = a custom waveform is enabled</li> <li>Follower# = information about the follower is displayed</li> <li>AIN = the analog input is enabled</li> </ul>  | <p>Center displays the following information:</p> <ul style="list-style-type: none"> <li>!ERR = an error has occurred</li> <li>!UNB = the output voltage or phase is unbalanced</li> </ul> <p>Right side displays the following information:</p> <ul style="list-style-type: none"> <li> = the LAN is connected</li> <li> = the LAN is not connected</li> <li> = the USB is connected</li> <li>RWL = the remote front panel lock is enabled</li> <li>RMt = the instrument is set to remote mode</li> </ul>  |
| <p>2 Phases (1-3)</p> | <p>Displays information about the selected phase</p> <p>Right side displays the following information: status:</p> <ul style="list-style-type: none"> <li>OFF = the output is off</li> <li>CV = the output is in constant voltage mode</li> <li>~CV = CV with surge suppression OFF</li> <li>CL = the output is in current limit</li> <li>IPK = the output is in peak current limit</li> <li>OV = the output is disabled by the over voltage protection</li> <li>UV = the output is disabled by the under voltage protection</li> <li>OC = the output is disabled by the over current protection</li> <li>OT = the over temperature protection has tripped</li> <li>OP = the overpower protection has tripped</li> </ul> | <ul style="list-style-type: none"> <li>INP = the input protection has tripped</li> <li>EXT = the external protection has tripped</li> <li>WDG = watchdog protection - no I/O activity</li> <li>INH = the remote inhibit is active</li> </ul> <p>Lower left indicates the voltage range setting</p> <ul style="list-style-type: none"> <li>L = low range</li> <li>H = high range</li> </ul> <p>Lower right indicates the output coupling:</p> <ul style="list-style-type: none"> <li> AC coupled</li> <li> DC coupled</li> <li> AC+DC coupled</li> </ul> |
| <p>3 All phases</p>   | <p>Displays the line to line measurements for all phases</p> <p>Sets global values for V<sub>ac</sub>, V<sub>dc</sub> (line to neutral), and Hz</p>  |   |
| <p>4 Soft keys</p>    | <p>Refer to the <b>Front Panel Menu</b> reference</p>  |   |

### Rear Panel at a Glance



AC6903 shown

The following table lists the main parts of the rear panel:

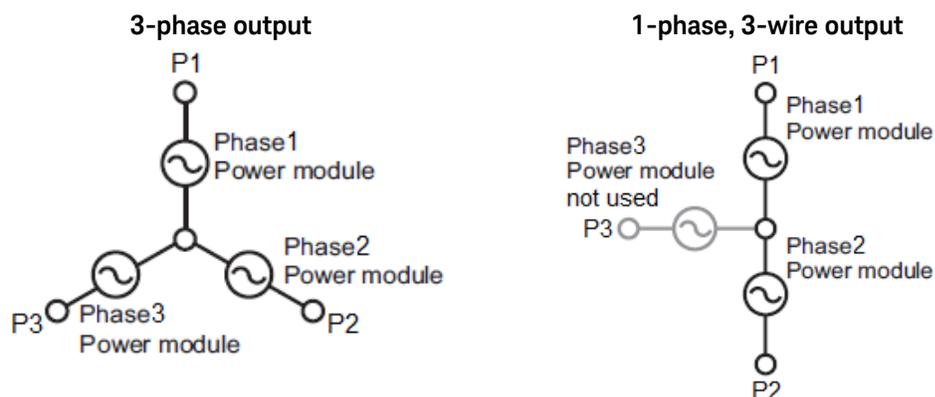
1	<b>Parallel</b> The connectors for parallel operation. Not available on AC6903 units.
2	<b>Slots 1 - 3</b> The expansion slots for accessory control boards.
3	<b>Analog IN</b> The connector port for analog control.
4	<b>Digital IO</b> The connector port for digital control.
5	<b>LAN</b> The port for remote control.
6	<b>USB</b> The port for remote control.
7	<b>OUTPUT</b> The terminal block connects the output terminals to the load.
8	<b>AC INPUT</b> The barrier block connects the AC mains power cord.

Refer to [Output Power Connections](#) and [Power Cord connections](#) for installation details.

## Instrument Ratings

Rated Output Capacity	AC6903	AC6906	AC6912	AC6918
1 phase and 3 phase output	3 kVA	6 kVA	12 kVA	18 kVA
1 phase 3-wire output	2 kVA	4 kVA	8 kVA	12 kVA
Maximum Output Current				
1 phase output (L/H)	30 A/15 A	60 A/30 A	120 A/60 A	180 A/90 A
1 phase 3-wire and 3 phase output (L/H)	10 A/5 A	20 A/10 A	40 A/20 A	60 A/30 A
Internal Power Module Ratings				
1 phase output	3 kVA total	6 kVA total	12 kVA total	18 kVA total
1 phase 3-wire output	2 kVA total	4 kVA total	8 kVA total	12 kVA total
3 phase output	1 kVA each phase	2 kVA each phase	4 kVA each phase	6 kVA each phase

During single-phase output and three-phase output, all power modules are used. During single-phase three-wire output, the phase 3 power module is not used.



## Voltage Ranges, Phases, and Output Characteristics

### Settings and Limits Ranges

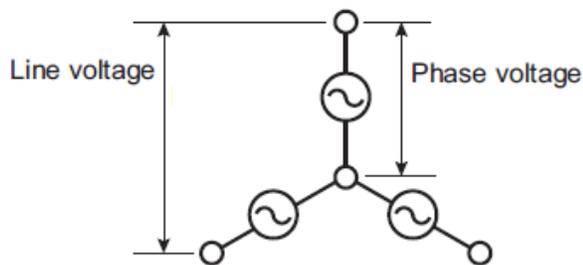
The instrument has two voltage ranges: 160 V (low) and 320 V (high).

The table below indicates the output voltage setting and limits ranges. Set the limits so that the upper limit is greater than or equal to the lower limit.

Voltage range		Voltage Setting Range	Voltage Limit Range
L range (low)	AC Mode	0.0 to 161.0 V	0.0 to 322.0 V
	DC mode	-227.5 to +227.5 V	-455.0 to +455.0 V
H range (high)	AC Mode	0.0 to 322.0 V	0.0 to 322.0 V
	DC mode	-455.0 to +455.0 V	-455.0 to +455.0 V

### Phase vs Line

The following illustrates the difference between phase voltage and line voltage.



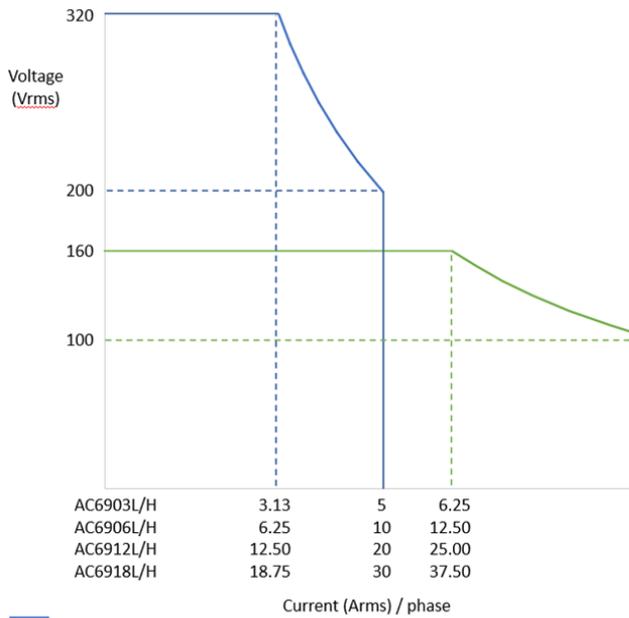
In three-phase AC output, when the phase difference between the three phases is  $120^\circ$  and the output voltages are equal, line voltage =  $\sqrt{3} \times$  phase voltage.

Voltage range		Voltage Setting Range	
		1 phase, 3 wire output	3 phase output
L range (low)	AC Mode	0.0 to 322.0 V	0.0 to 278.8 V
	DC mode	-455.0 to +455.0 V	N/A
H range (high)	AC Mode	0.0 to 644.0 V	0.0 to 557.7 V
	DC mode	-910.0 to +910.0 V	N/A

### Output Characteristic

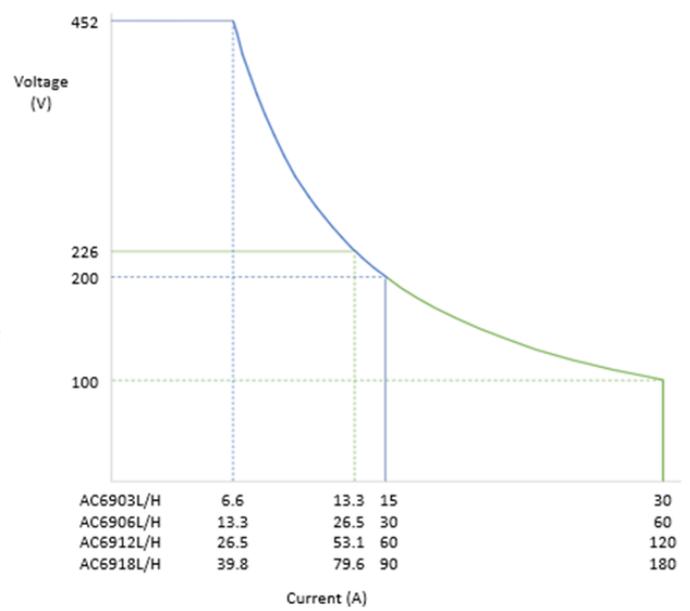
The following figures illustrate the derating characteristic for both output voltage and output frequency.

### 3-phase AC Derating Characteristic



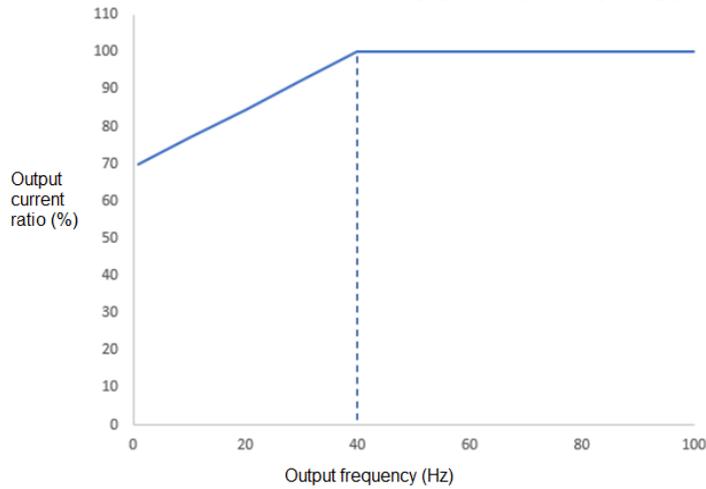
High voltage range  
Low voltage range

### DC Derating Characteristic



High voltage range  
Low voltage range

### Output Current Ratio vs Output Frequency



## Specifications

Unless otherwise noted, specifications are warranted where the product operates in an environment with an ambient temperature of 23 °C ±5 °C, after a 30-minute warm-up period. Specifications apply at the output terminals, with the sense terminals connected to the output terminals (local sensing).

## Output

Output AC <sup>1</sup>		AC6903H 5 kHz AC6903L 550 Hz	AC6906H 5 kHz AC6906L 550 Hz	AC6912H 5 kHz AC6912L 550 Hz	AC6918H 5 kHz AC6918L 550 Hz
AC voltage (L/H)	Rating (L/H) <sup>2</sup>	160 V / 320 V			
	Setting range (L/H)	0.0 ~ 161.0 V / 0.0 ~ 322.0 V			
	Resolution	0.1 V			
	Accuracy (L/H) <sup>3,4</sup>	±(0.15% + 0.3 V) (45 Hz - 500 Hz) ±(1% + 0.3 V) / ±(1% + 0.6 V) (500 Hz - 5 kHz)			
Maximum rms current (L/H) <sup>5</sup>	1 phase	30 A/15 A	60 A/30 A	120 A/60 A	180 A/90 A
	1 phase 3 wire, 3 phase	10 A/5 A	20 A/10 A	40 A/20 A	60 A/30 A
Power capacity	1 phase, 3 phase	3 kVA	6 kVA	12 kVA	18 kVA
	1 phase 3 wire	2 kVA	4 kVA	8 kVA	12 kVA
Load power factor	0 ~ 1 (leading or lagging)				
Frequency	Range <sup>6</sup>	1 Hz ~ 5 kHz (5 kHz -3dB, < 40 Hz power derating is required)			
	Resolution	0.01 Hz (1.00 Hz ~ 99.99 Hz), 0.1 Hz (100.0 Hz ~ 999.9 Hz), 1 Hz (1000 Hz ~ 5000 Hz)			
	Accuracy	±0.01%, temperature coefficient: ±0.005%/°C			
Phase	Resolution	0.1° (waveform bank 0 and 1 Hz ~ 500 Hz), 1° (500 Hz ~ 4 kHz), 2° (> 4 kHz)			
	Accuracy <sup>7</sup>	Within 120° ±(0.4° +fo×0.9°) where fo = output frequency (kHz)			
Output DC <sup>1</sup>					
DC voltage (L/H)	Rating <sup>8</sup>	±226 V / ±452 V			
	Setting range (L/H)	0 - ±227.5 V / 0 - ±455 V			
	Resolution	0.1 V			
	Accuracy	±(0.15% + 0.3 V)			
Maximum current <sup>9</sup>		30 A/15 A	60 A/30 A	120 A/60 A	180 A/90 A
Power capacity		3 kW	6 kW	12 kW	18 kW

1. When combined with AC and DC output, the peak voltage must be between -455 V to 455 V (H range) or -227.5 V to 227.5 V (L range).

2. The specified guaranteed voltage range is 1 V to 160 V and 2 V to 320 V.

3. At no load, the output response is in Fast or Medium, using the compensation function.

4. At the phase angle of 120° of each phase for Line voltage.

5. When the output voltage is between 100 Vac and 160 Vac or 200 Vac and 320 Vac, the output current is reduced by the output voltage.  
When the output frequency is between 1 Hz and 40 Hz, the output current is reduced by the output frequency. The output current is 70 % at 1 Hz.

6. On the L models, the frequency is between 1 Hz to 550.0 Hz for three-phase output.

7. Example in which the angle conversion is at a given frequency: within 120° ± 0.5° at 60 Hz output, within 120° ± 0.8° at 400 Hz output.

8. The guaranteed voltage range is 1.4 Vdc to 226 Vdc, 2.8 Vdc to 452 Vdc.

9. When the output voltage is between 100 Vdc and 226 Vdc (L range) or 200 Vdc and 452 Vdc (H range), the output current is reduced by the output voltage.

## Measurement and Stability

Measurement		AC6903H 5 kHz AC6903L 550 Hz	AC6906H 5 kHz AC6906L 550 Hz	AC6912H 5 kHz AC6912L 550 Hz	AC6918H 5 kHz AC6918L 550 Hz
AC voltage	Resolution	0.1 V			
	Accuracy	$\pm(0.03\% \text{ of reading} + 100 \text{ mV})$ (45 Hz ~ 100 Hz) $\pm(0.1\% \text{ of reading} + 100 \text{ mV})$ (100 Hz ~ 999.9 Hz) $\pm(0.5\% \text{ of reading} + 1 \text{ V})$ (1 kHz ~ 5 kHz)			
rms current	Resolution	0.01 A	0.01 A	0.1 A	0.1 A
	Accuracy <sup>1</sup>	$\pm(0.15\% \text{ of reading} + 0.20\% \text{ of full scale})$ (45 Hz - 65 Hz) $\pm(0.5\% \text{ of reading} + 0.5\% \text{ of full scale})$ (DC, 40 Hz - 999.9 Hz) $\pm(1.2\% \text{ of reading} + 1.2\% \text{ of full scale})$ (1 kHz - 5 kHz)			
Peak current	Resolution	0.01 A	0.01 A	0.1 A	0.1 A
	Accuracy <sup>2</sup>	4% of full scale			
Active power	Resolution	1 W	1 W	10 W	10 W
	Accuracy (L/H) <sup>1,3</sup>	$\pm(0.7\% + 0.7\% \text{ of fs} + 0.001\% \text{ of fs/V}) / \pm(0.7\% + 0.7\% \text{ of fs} + 0.0005\% \text{ of fs/V})$ (45 Hz ~ 100 Hz)			
Apparent power	Resolution	1 VA	1 VA	10 VA	10 VA
	Accuracy (L/H) <sup>1,3</sup>	$\pm(0.3\% + 0.3\% \text{ of fs} + 0.001\% \text{ of fs/V}) / \pm(0.3\% + 0.3\% \text{ of fs} + 0.0005\% \text{ of fs/V})$ (45 Hz ~ 100 Hz)			
Power Factor	Resolution	0.01			
DC voltage	Resolution	0.1 V			
	Accuracy	0.05% of reading + 150 mV			
<b>Output Stability</b>					
Line regulation <sup>4</sup>					$\pm 0.1\%$
Load regulation (L/H) <sup>5,6</sup>	$\leq 100 \text{ Hz}$	$\pm 0.1 \text{ V} / \pm 0.2 \text{ V}$	$\pm 0.1 \text{ V} / \pm 0.2 \text{ V}$	$\pm 0.1 \text{ V} / \pm 0.2 \text{ V}$	$\pm 0.2 \text{ V} / \pm 0.4 \text{ V}$
	$\leq 500 \text{ Hz}$	$\pm 0.3 \text{ V} / \pm 0.6 \text{ V}$	$\pm 0.3 \text{ V} / \pm 0.6 \text{ V}$	$\pm 0.3 \text{ V} / \pm 0.6 \text{ V}$	$\pm 0.3 \text{ V} / \pm 0.6 \text{ V}$
	$\leq 1 \text{ kHz}$	$\pm 1 \text{ V} / \pm 2 \text{ V}$	$\pm 1 \text{ V} / \pm 2 \text{ V}$	$\pm 1 \text{ V} / \pm 2 \text{ V}$	$\pm 1 \text{ V} / \pm 2$
Total harmonics distortion <sup>6</sup>	$\leq 100 \text{ Hz}$	0.3%			
	$\leq 500 \text{ Hz}$	0.5%			
	$\leq 5 \text{ kHz}$	1.5%/kHz			

1. At 10 % to 100 % of maximum rated current, sine wave

2. Pulse height of sine wave

3. At a power factor of 1

4. For input voltage changes within the rated range

5. For output current changes within 0 to 100 % of the rating and when the compensation function is not used.

6. When the output phase voltage is between 80 V and 160 V (L range) or 160 V and 320 V (H range), the load power factor is 1, and the response is FAST at the output terminal block.

## Supplemental Characteristics

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

Input	AC6903H 5 kHz		AC6906H 5 kHz		AC6912H 5 kHz		AC6918H 5 kHz		
	AC6903L 550 Hz		AC6906L 550 Hz		AC6912L 550 Hz		AC6918L 550 Hz		
Apparent Power	≤4 kVA		≤7.8 kVA		≤15.6 kVA		≤23.4 kVA		
Power Factor (typical) <sup>1</sup>	0.93		0.95		0.95		0.95		
Efficiency (typical) <sup>1</sup>	82%		85%		85%		85%		
Hold-up time for power interruption <sup>1</sup>	10 ms								
Frequency (nominal)	50 Hz ~ 60 Hz								
Frequency (variation)	45 Hz ~ 65 Hz								
Voltage (nominal)	100 V input:	100-120 Vrms			200 - 230 Vrms				
	200 V input:	200-240 Vrms			380 - 480 Vrms				
	400 V input:								
Voltage (variation)	100 V input:	85-132 Vrms			170 - 250 Vrms				
	200 V input:	170-250 Vrms			323 - 519 Vrms				
	400 V input:								
Phase	100 V input:	1-phase, 3-wire			3-phase, 4-wire				
	200 V input:				3-phase, 5-wire				
	400 V input:								
Maximum rms input current <sup>2</sup>	100 V input:	48 A							
	200 V input:	24 A		27 A		53 A		80 A	
	400 V input:			14 A		28 A		42 A	
Protective conductor current	200 V input: <sup>3</sup>	≤3.5 mA		≤10 mA		≤15 mA		≤20 mA	
	400 V input:			≤3.5 mA		≤3.5 mA		≤3.5 mA	

1. At output voltage 100 V/200 V, rated output current, sine wave, load power factor 1, output frequency 40 Hz to 1 kHz

2. Current at the minimum voltage (within the allowable variation range)

3. At output voltage 100 V/200 V, rated output current, sine wave, load power factor 1, output frequency 45 Hz to 65 Hz

Output	AC6903H 5 kHz		AC6906H 5 kHz		AC6912H 5 kHz		AC6918H 5 kHz	
	AC6903L 550 Hz		AC6906L 550 Hz		AC6912L 550 Hz		AC6918L 550 Hz	
Maximum peak current <sup>1</sup>	4 times the maximum output current							
Inrush current capacity	Current at 1.4 times the maximum output current for 0.5 s							
Temperature coefficient <sup>2</sup>	100 ppm/°C							
Transient response <sup>3</sup>	40 μs (Fast)							
Response speed Tr/Tf <sup>4</sup>	40 μs (Fast); 100 μs (Medium); 300 μs (Slow)							
Ripple noise <sup>5</sup>	0.25 V rms		0.25 V rms		0.3 V rms		0.4 V rms	
Variation by output frequency <sup>6, 7</sup>								
- with voltage correction enabled	±0.3% (1 Hz ~ 1 kHz); ±10% (1001 Hz ~ 5 kHz)							
- with voltage correction disabled	-3 dB (5 kHz)							

1. Repeated output is possible when the crest factor is 4.

2. For changes within the operating temperature range At output phase voltage 100 V/200 V, no load

3. When the output voltage is 100V or 200V, the load power factor is 1, and the output current changes from 0 A to the rated value and from the rated value to 0 A.

4. At 10 % to 90 % of the output voltage

5. 5 Hz to 1 MHz components in DC mode

6. Voltage variation over 40 Hz to 5 kHz in AC mode with 55 Hz as the reference

7. When the output phase voltage is between 80 V and 160 V (L range) or 160 V and 320 V (H range), the load power factor is 1, and the response is Fast.

## Output Impedance

1 phase		AC6903H 5 kHz AC6903L 550 Hz	AC6906H 5 kHz AC6906L 550 Hz	AC6912H 5 kHz AC6912L 550 Hz	AC6918H 5 kHz AC6918L 550 Hz	
Low Range	Resistance	0 Ω to 667 mΩ	0 Ω to 333 mΩ	0 Ω to 167 mΩ	0 Ω to 111 mΩ	
	Reactance	Fast	15 μH to 667 μH	7 μH to 333 μH	3 μH to 167 μH	2 μH to 111 μH
		Medium	27 μH to 667 μH	13 μH to 333 μH	7 μH to 167 μH	4 μH to 111 μH
	Slow	80 μH to 667 μH	40 μH to 333 μH	20 μH to 167 μH	13 μH to 111 μH	
High Range	Resistance	0 Ω to 2 667 mΩ	0 Ω to 1333 mΩ	0 Ω to 667 mΩ	0 Ω to 444 mΩ	
	Reactance	Fast	55 μH to 2667 μH	27 μH to 1333 μH	13 μH to 667 μH	9 μH to 444 μH
		Medium	107 μH to 2667 μH	53 μH to 1333 μH	27 μH to 667 μH	18 μH to 444 μH
	Slow	320 μH to 2667 μH	160 μH to 1333 μH	80 μH to 667 μH	53 μH to 444 μH	
1 phase 3 wire; and 3 phase						
Low Range	Resistance	0 Ω to 2000 mΩ	0 Ω to 1000 mΩ	0 Ω to 500 mΩ	0 Ω to 333 mΩ	
	Reactance	Fast	40 μH to 2000 μH	20 μH to 1000 μH	10 μH to 500 μH	7 μH to 333 μH
		Medium	80 μH to 2000 μH	40 μH to 1000 μH	20 μH to 500 μH	13 μH to 333 μH
	Slow	240 μH to 2000 μH	120 μH to 1000 μH	60 μH to 500 μH	40 μH to 333 μH	
High Range	Resistance	0 Ω to 8000 mΩ	0 Ω to 4000 mΩ	0 Ω to 2000 mΩ	0 Ω to 1333 mΩ	
	Reactance	Fast	160 μH to 8000 μH	80 μH to 4000 μH	40 μH to 2000 μH	27 μH to 1333 μH
		Medium	320 μH to 8000 μH	160 μH to 4000 μH	80 μH to 2000 μH	53 μH to 1333 μH
	Slow	960 μH to 8000 μH	480 μH to 4000 μH	240 μH to 2000 μH	160 μH to 1333 μH	

## Output On/Off Phase

All Models		
Phase Angle Setting	Setting range	0.0 degrees to 360.0 degrees (0.0 degrees = 360.0 degrees)
	Resolution	0.1 degrees
	Accuracy <sup>1</sup>	±1 degrees (≤1 kHz)

1. Lag due to response speed not included

## Harmonics Measurement

All Models	
Frequency range (fundamental)	10 Hz ~ 1 kHz
Upper limit harmonic analysis	5 <sup>th</sup> ~ 50 <sup>th</sup>
Measurement items	Rms Voltage and Current / Phase angle THD
Current magnitude accuracy <sup>1</sup>	0.15% of reading + 0.20% of full scale (Fundamental 50 Hz or 60 Hz) 1.2% of reading + 1.2% of full scale (Harmonics 2nd ~ 50th)

1.. At an ambient temperature of 23 °C±5 °C

## Protection and Limits

All Models			
Protection Functions		Settings Range	Resolution
Overvoltage (OVP)	RMS	14.0 V to 500.5 V	0.1 V
	Positive peak	+14.0 V to +500.5 V	0.1 V
	Negative peak	- 500.5 V to -14.0 V	0.1 V
Undervoltage (UVP)		0.0 V to 500.5 V	0.1 V
Overcurrent (OCP)	Trip timer	0 s <sup>1</sup> to 10 s	1 s
Watchdog (WDP)	Delay timer	1 s to 3600 s	1 s
Limit Functions		Settings Range	Resolution
Voltage Limit	Upper & Lower AC volt	0.0 V to 322.0 V	0.1 V
	Upper & Lower DC volt	-455.0 V to 455.0 V	0.1 V
Current Limit	Current limit	Maximum current limit $\times 0.1$ to maximum current limit $\times 1.1$	0.01 A (0.35 A to 100.0 A) 0.1 A (100.0 A to 1000 A)
	Positive & Negative limit	Maximum current limit $\times 0.1$ to maximum current limit $\times 4.2$	0.01 A (0.35 A to 100.0 A) 0.1 A (100.0 A to 1000 A)
Frequency Limit		1.00 Hz to 5000 Hz	0.01 Hz (1.00 Hz to 99.99 Hz) 0.1 Hz (100.0 Hz to 999.9 Hz) 1 Hz (1000 Hz to 5000 Hz)

1. Response time is minimized by setting it to 0 seconds. Minimum response time 200 ms or less.

## Communication Interface

All Models	
Software protocol	IEEE Std 488.2-1992
Command Language	Complies with SCPI Specification 1999.0
USB	Complies with the USB 2.0 specifications; data rate: 480 Mbps (high speed), socket B type, self-powered
Message terminator	LF or EOM during reception, LF + EOM during transmission
Device class	Complies with the USBTMC-USB488 device class specifications
LAN	IEEE802.3, 100Base-TX Ethernet LXI Rev.1.5 2016 (Extended Functions: VXI-11, HiSLIP), data rate: 100 Mbps (auto negotiation, Full Speed) AUTO MDIX function IPv4, RJ45 connector, category 5, straight cable
Communication protocol	VXI-11, HiSLIP, SCPI-RAW, SCPI-Telnet
Message terminator	VXI-11 and HiSLIP: LF or END during reception, LF + END during transmission SCPI-RAW: LF
GPIB option	Complies with IEEE Std 488.1-1987 SH1, AH1, T8, L4, SRO, RLO, PPO, DCO, DTO, CO, E1 24-pin connector (receptacle)
Message terminator	LF or EOI during reception, LF + EOI during transmission
Primary address	1 to 30

## Signal I/O

### General

		All Models
Insulation resistance	Primary - terminals signal I/O	500 Vdc, 10 M $\Omega$ or more
	Output - terminals signal I/O	500 Vdc, 10 M $\Omega$ or more
	Input terminals - Output terminals	Non-isolated (shared common circuit)
Withstanding voltage	Primary - terminals pins	1.5 kVac for 1 minute
	Output - terminals pins	1.5 kVac for 1 minute
Isolation voltage		$\pm 42$ V peak

### Analog Input

Analog INPUT (Analog In connector, Ch.A to Ch.C)		All Models
Number of channels		3 channels <sup>1</sup>
Terminal		DSUB 9-pin
Input resistance		10 k $\Omega$ $\pm$ 10% (unbalanced)
Maximum allowable input voltage		$\pm 12$ V
Control system selection	EXTDC Mode	Amplifies the input waveform
	VPROG Mode	Changes the AC voltage, DC voltage, or frequency output using a DC signal
Input voltage range		$\pm 10$ V
Gain Setting range	EXTDC Mode	x5.00 to x220.00
	VPROG Mode	x5.00 to x50.00
Resolution		0.01
Offset adjustment range		$\pm 200$ (equivalent to $\pm 200$ mV through input voltage conversion)
EXTDC mode	Output voltage tr/ta <sup>2</sup>	Main unit specification +50 $\mu$ s (typical)
	Output distortion	Main unit specification +0.2% (0.1% or less, when receiving sine wave) (typical)
Output voltage error		$\pm 3.6$ V (when gain and offset are at default values)
Output voltage temperature coefficient		200 ppm/ $^{\circ}$ C (typical)
Setting delay time		10 $\mu$ s (typical)

1. The common lines of the analog input signals, digital input signals, and selectable I/O signals are not isolated.

2. At 10 % to 90 % of the output voltage.

**Digital I/O**

<b>Input Control (Channels 1, 2, 3, and 4)</b>		<b>All Models</b>
Input	Internal Circuit	pull-up to 5 V by a 1.7 k $\Omega$
	Maximum Voltage Rating	10 Vdc
	Maximum Low-level Input Voltage	0.8 Vdc
	Minimum High-level Input Voltage	4 Vdc
	Low-level Current	1.8 mA (typical)
Selectable input control signals	DISABLE	No enabled functions
	Output On/Off	Output on/off control
	Sequence Run/Stop	Sequence run/stop control
	Protection Clear	Protection clear
	External Alarm	External alarm input
	Wiring Control 1P	Output method change (single-phase)
	Wiring Control 1P3W	Output method change (single-phase, three-wire)
	Wiring Control 3P	Output method change (three-phase)
	Volt Range	Output range change
	Recall Output Preset Slot 1	Preset Slot 1 recall
	Recall Output Preset Slot 2	Preset Slot 2 recall
	Output Inhibit	Output-on inhibit
	Programmable Signal	Programmable signal input
Fixed output signal	Shutdown	Shutdown signal input
Logic polarity		Selectable
<b>Output Status (Channels 5, 6, 7, and 8)</b>		<b>All Models</b>
Output	Internal Circuit	Photocoupler open-collector output
	Maximum Voltage Rating	30 Vdc
	Maximum Current	8 mA
	Minimum Low-level Voltage	0.7 V DC (typical)
Selectable output status signals	DISABLE	No enabled functions
	I <sub>pk</sub> Limit Status	Peak current limit status
	Overload Status	Overload status
	Busy Status	Busy status
	Wiring Control 1P	Output method status (single-phase)
	Wiring Control 1P3W	Output method status (single-phase, three-wire)
	Wiring Control 3P	Output method status (three-phase)
	Voltage Range H Status	Output voltage H range status
	Power ON Status	POWER switch on status
	SEQ Status Out	Sequence/power line abnormality simulation status output
Programmable Signal	Programmable signal status	
Fixed output signal	Alarm status	Alarm status
Logic polarity		Selectable

Configurable I/O (Channels 9 and 10)		All Models
Input	Maximum Voltage Rating	5 Vdc
	Maximum Low-level Input Voltage	0.8 Vdc
	Minimum High-level Input Voltage	2 Vdc
Output	Maximum Low-level Output Voltage	0.55 Vdc
	Minimum High-level output Voltage	3.8 Vdc
	Minimum Low-level Slnk Current	12 mA
Configurable input signals	DISABLE	No enabled functions
	Sync Clock In	Output reference phase input
	SEQ Trigger In	Sequence trigger input
	Output Control	Output on/off
	Sequence Execution Control	Sequence run/stop
	Alarm Clear	Alarm clear
	External Alarm	External alarm input
	Wiring Control 1P	Output method change (single-phase)
	Wiring Control 1P3W	Output method change (single-phase, three-wire)
	Wiring Control 3P	Output method change (three-phase)
	Volt Range	Output range change
	Recall Output Preset Slot 1	Preset Slot 1 recall
	Recall Output Preset Slot 2	Preset Slot 2 recall
	Output Inhibit	Output-on inhibit
Programmable Signal	Programmable signal input	
Configurable output signals	DISABLE	No enabled functions
	Standard Clock Out	Output reference phase output
	SEQ Trigger Out	Sequence trigger output
	Output ON Status	Output on status
	I Pk Limit Status	Limit status
	Overload Status	Overload status
	Busy Status	Busy status
	Wiring 1P Status	Output method status (single-phase)
	Wiring 1P3W Status	Output method status (single-phase, three-wire)
	Wiring 3P Status	Output method status (three-phase)
	Volt Range H Status	Output voltage H range status
	Power ON Status	POWER switch on status
	SEQ Status Out	Sequence/power line abnormality simulation status output
	Programmable Signal	Programmable signal status
Logic polarity	Selectable	

## Parallel Operation

		All Models
Maximum number of units in parallel operation		$N(\text{units in parallel}) \leq 4$
Power capacity <sup>1</sup>		$[\text{Capacity of one unit}] \times N$
Output voltage stability	Load regulation - from 0 to 100% variation within the rating	$\pm 0.5 \text{ V or less } (\leq 100 \text{ Hz})^2$
	Variation according to output frequency - for variation within the rated range	$\pm 1.2\% \text{ or less } (\leq 1 \text{ kHz})^2 \text{ }^3$
Total harmonic distortion		$0.5\% \text{ or less } (\leq 100 \text{ Hz})^2$
Output voltage response speed Tr/Tf		$100\mu\text{s (typical w/response Medium)} / 300\mu\text{s (typical w/response Slow)}^4$
Ammeter, Wattmeter		Displays the total value of parallel operation of parallel operation on the primary unit <sup>5</sup>

1. The maximum rating is limited to 48 kVA for single-phase and 96 kVA for single-phase three-wire, regardless of the number of units in parallel.
2. Value at the OUTPUT terminal block of the master unit for output voltage 80 V to 160 V or 160 V to 320 V, load power factor 1
3. Voltage variation over 40 Hz to 5 kHz in AC mode with 55 Hz as the reference
4. At 10 % to 90 % of the output
5. The resolution varies depending on the output capacity during parallel operation

## General

General		All Models
Insulation resistance	Primary-to-chassis	500 Vdc, 10 MΩ or more
	Output-to-chassis	
	Primary-to-output	
Withstand voltage	Primary-to-chassis	1500 Vac, 2150 Vdc, for 1 minute
	Output-to-chassis	
	Primary-to-output	
Isolation to ground		320 Vrms / 452 Vdc
Electromagnetic compatibility (EMC) <sup>1</sup>		Complies with requirements of the following directive and standards EMC Directive 2014/30/EU EN 61326-1 (Class A <sup>2</sup> ), EN 55011 (Class A <sup>2</sup> , Group 1 <sup>3</sup> ) Applicable under the following conditions: The maximum length of all cabling and wiring connected to the product must be <3 m. (excluding the cable that connects to the LAN)
Safety		Complies with the requirements of the following directive and standards: Low voltage directive 2014/35/EU <sup>2</sup> EN 61010-1 (Class I <sup>4</sup> , Pollution Degree 2 <sup>5</sup> )
Environmental conditions	Operating environment	Indoor use, overvoltage category II
	Operating temperature range	0 - 40°C (32°F - 104°F)
	Operating humidity range	20% rh - 80% rh (no condensation)
	Storage temperature range	-10 - +60°C (14°F - 140°F)
	Storage humidity range	90% rh or less (no condensation)
	Altitude	Up to 2000 m (6561.7 feet)

Mechanical	AC6903H 5 kHz AC6903L 550 Hz	AC6906H 5 kHz AC6906L 550 Hz	AC6912H 5 kHz AC6912L 550 Hz	AC6918H 5 kHz AC6918L 550 Hz
Net Dimensions (W x H x D in mm)	430 x 129.2 x 667.5	430 x 262 x 562	430 x 389 x 562	430 x 563 x 562
Overall dimensions (+ wheels, + covers) (W x H x D in mm)	440 x 160 x 720	445 x 345 x 650	445 x 475 x 650	445 x 660 x 665
Weight (200 V input) (400 V input)	28 kg	47 kg 49 kg	71 kg 72 kg	104 kg 106 kg
Input terminal	M6	M5	M5	M8 (200 V input) M5 (400 V input)
Output terminal	M6	M5	M5	M6

1. Only on models that have the CE marking on the panel.
2. This is a Class A instrument. This product is intended for use in an industrial environment. This product may cause interference if used in residential areas. Such use must be avoided unless the user takes special measures to reduce electromagnetic emissions to prevent interference to the reception of radio and television broadcasts.
3. This is a Group 1 instrument. This product does not generate and/or use intentionally radio-frequency energy, in the form of electromagnetic radiation, inductive and/or capacitive coupling, for the treatment of material or inspection/analysis purpose.
4. This product conforms to Class I. Be sure to ground the protective conductor terminal of this product. If not grounded properly, safety is not guaranteed.
5. Pollution is addition of foreign matter (solid, liquid or gaseous) that may produce a reduction of dielectric strength or surface resistivity. Pollution Degree 2 assumes that only non-conductive pollution will occur except for an occasional temporary conductivity caused by condensation.



# 2

## Installation

**Before Installation or Use**

**Outline Diagrams**

**Rack and Floor Mounting Options**

**Installing an Optional GPIB Board**

**Power Cord Connections**

**Switchboard and Circuit Breakers**

**Interface Connections**

**Quick Start Lesson**

**Output Power Connections**

**Analog and Digital Connections**

**Parallel Connections**

## Before Installation or Use

### Inspect the Unit

When you receive your instrument, inspect it for obvious shipping damage. If there is damage, notify the shipping carrier and nearest Keysight Sales and Support Office immediately. Refer to [www.keysight.com/find/assist](http://www.keysight.com/find/assist). Save all packing and shipping materials in case the unit must be returned or moved. Refer to [Repackaging for Shipment](#) for further information.

### Check for Items Supplied

Verify that you received the following items along with your instrument.

Item	Part Number	Quantity
Packing list	AC6900-90001	1
Digital I/O Connector, D-Subminiature 25-pin plug <sup>1</sup>	AC6900-30001	1
Cap bolts <sup>2</sup> - not included with AC6903 units	AC6900-40001	8
Cable ties - for bundling sense and load wires	AC6900-80001	4
Safety Information booklet	9320-6797	1
Envelope with Certificate of Calibration, China RoHS Addendum, and South Korea EMC Class A Declaration	9230-0333	1

<sup>1</sup> This plug must be installed in the back of the unit to allow the unit to turn on (see item 4 under [Rear Panel at a Glance](#)).

<sup>2</sup> To be installed in the sides of the unit where the shipping brackets were attached.

Refer to the Packing list for any additional items that may be included with your shipment. If anything is missing, please contact your nearest [Keysight Sales and Support Office](#).

### Review Safety Information

This AC source 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 an earth ground. Refer to the [Safety Notices](#) for general safety information. Before installation or operation, check the instrument and review this guide for safety warnings and instructions. Safety warnings for specific procedures are located at appropriate places throughout this guide.

### Location Considerations

The AC6900 Series instruments are Overvoltage Category II instruments that should only be operated in a controlled, indoor environment subject to the following restrictions:

**WARNING** Do not operate the instrument near flammable gases or fumes.

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**Operating:** 0 to 40 °C (32 to 104 °F), 20% to 80% relative humidity, noncondensing

**Storage:** -10 to 60 °C (14 to 140 °F), 90% or less relative humidity, noncondensing

**Altitude:** Up to 2000 m

**Air Flow:** Allow at least 50 cm of free space in front and behind the unit.

**CAUTION** Do not block the air intake at the front of the instrument or the exhaust at the rear.

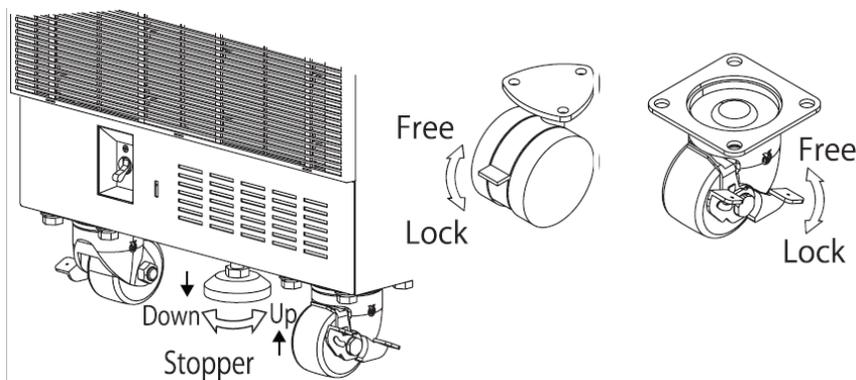
## Moving Considerations for AC6906, AC6912 and AC6918

When moving or transporting this instrument to the installation location, be sure to observe the following precautions:

- Raise the stopper on model AC6918. Turn the stopper counterclockwise to raise it. Moving the unit without raising the stopper may cause injuries if the unit tips over.
- Unlock the four casters under the unit. Be sure to have two or more people move the unit. Exercise special care when moving the unit over a slope or across steps.
- When using a forklift, slide the forks under the bottom of the unit, check that the unit is stable, and then raise the unit. This also applies when using a band or harness to move the unit.
- Do not tip the unit on its side or turn it upside down.

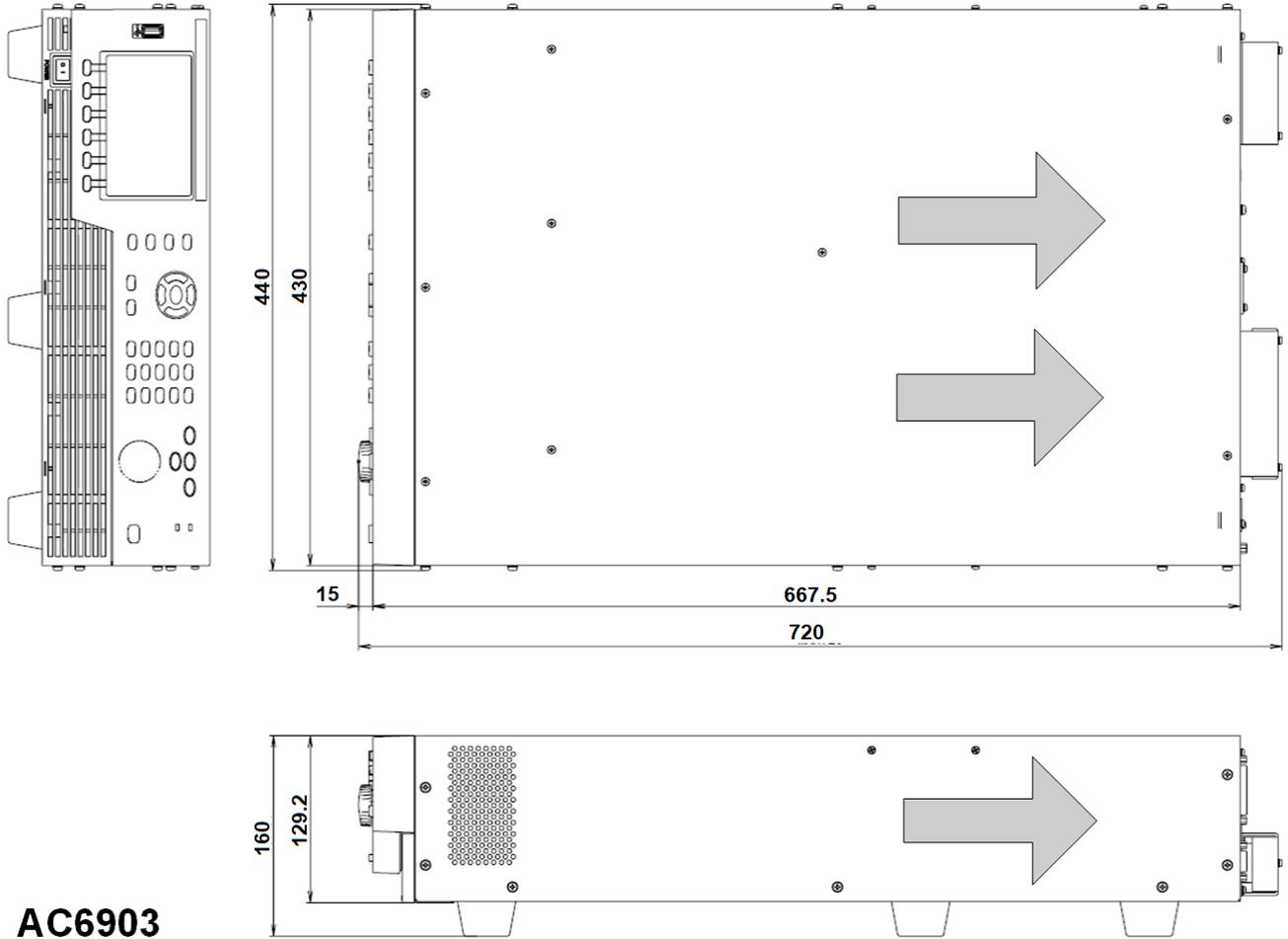
After the instrument is positioned in its installation location, ensure that the unit is not moved accidentally when being operated.

- Lock the four casters under the unit with your foot.
- Lower the stopper on model AC6918. Turn the stopper clockwise to lower it.



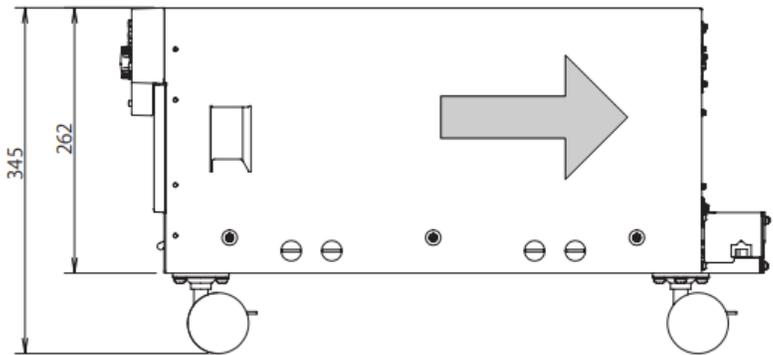
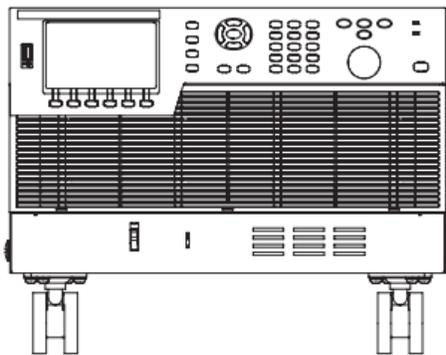
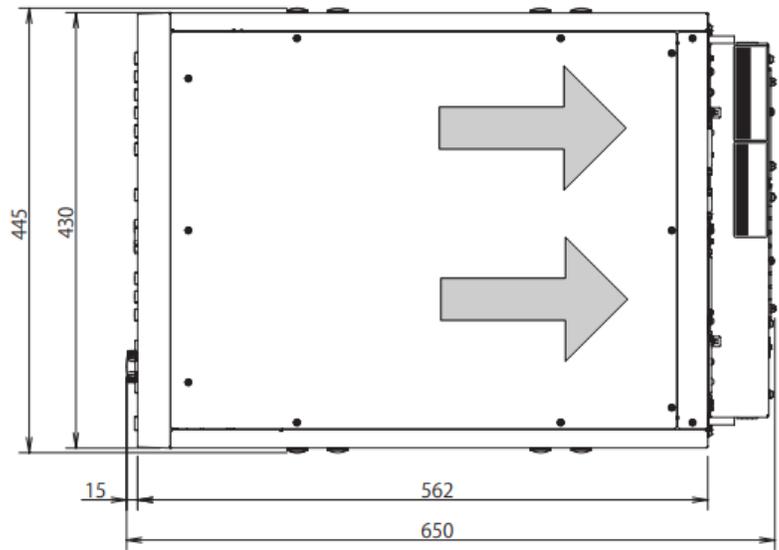
## Outline Diagrams

All dimensions are in millimeters.

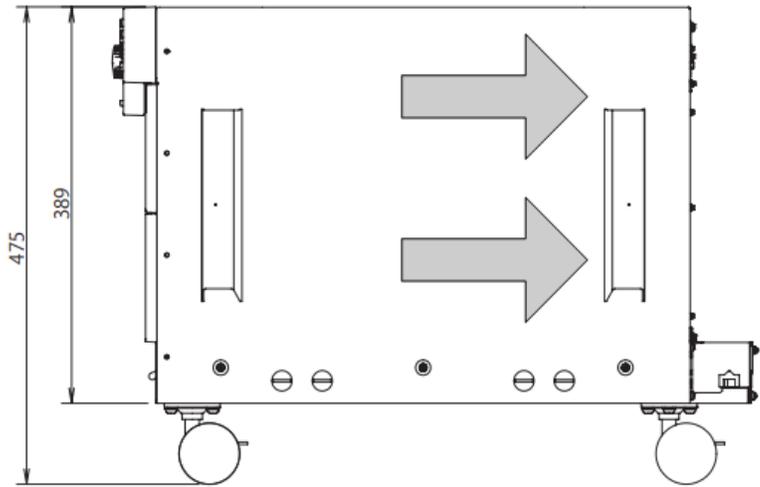
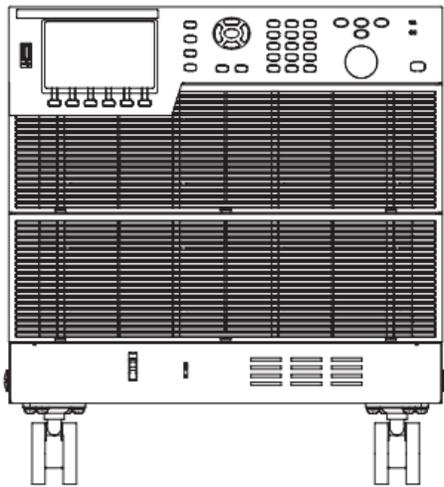
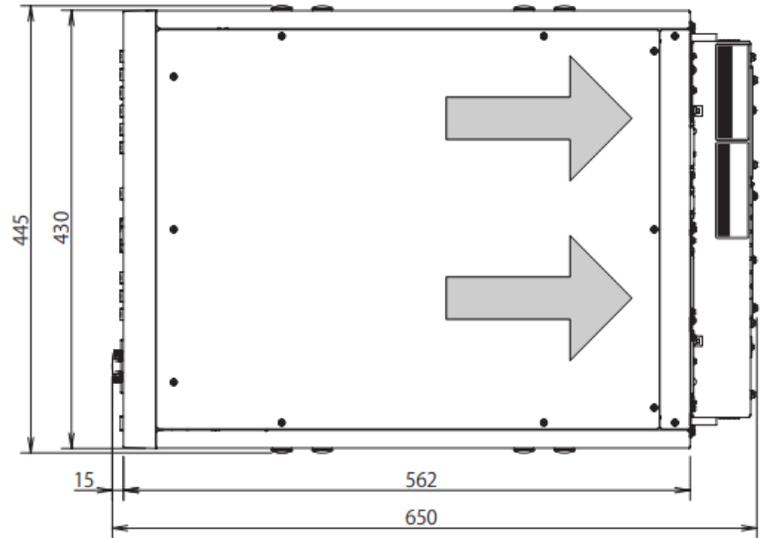


**AC6903**

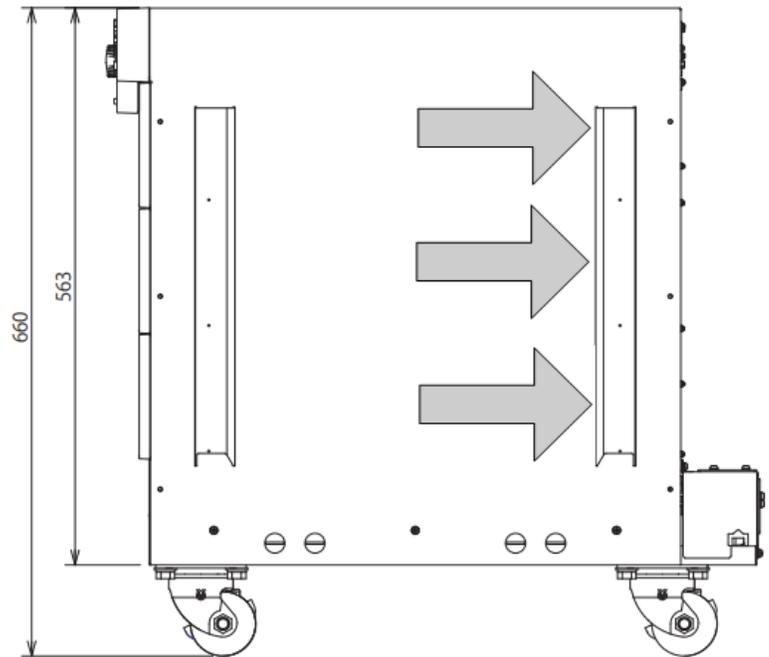
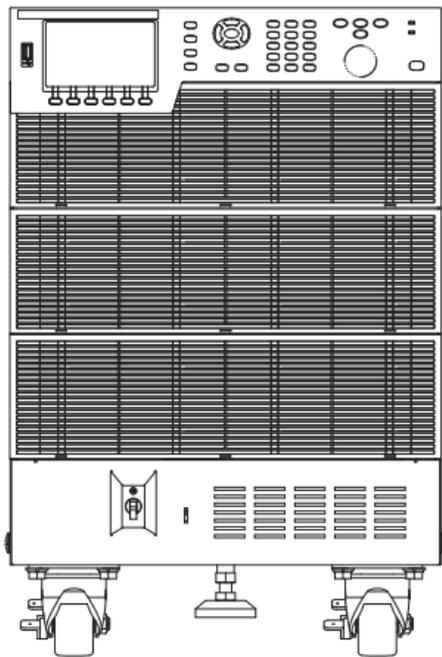
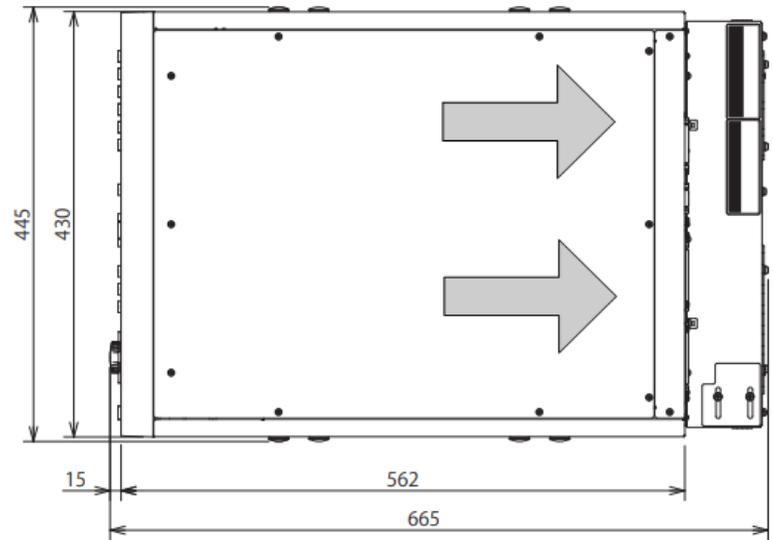
# AC6906



**AC6912**



# AC6918



## Rack and Floor Mounting Options

### Rack Mounting - for Models AC6903, AC6906 and AC6912

Optional Rack mount kits allow the instruments to be installed in a 19-inch EIA rack.

**WARNING**
**Heavy Weight**

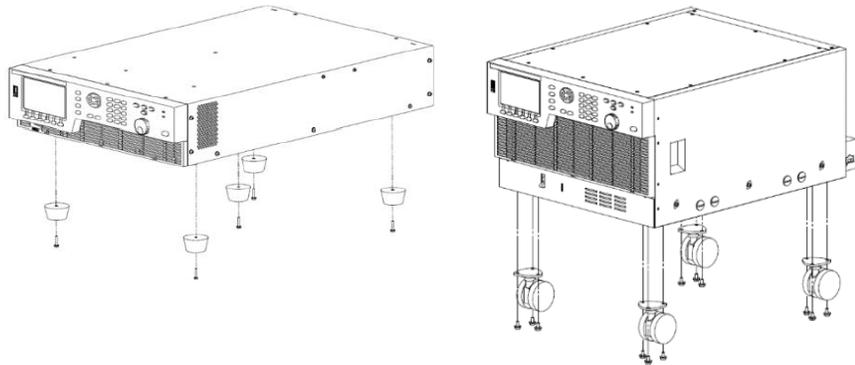
Do not move or lift the instrument by yourself. Be sure to have two or more people move the instrument. If you are using a lift or bands to move the instrument, be sure to slide the lift or bands under the instrument and then raise the instrument.

**CAUTION**

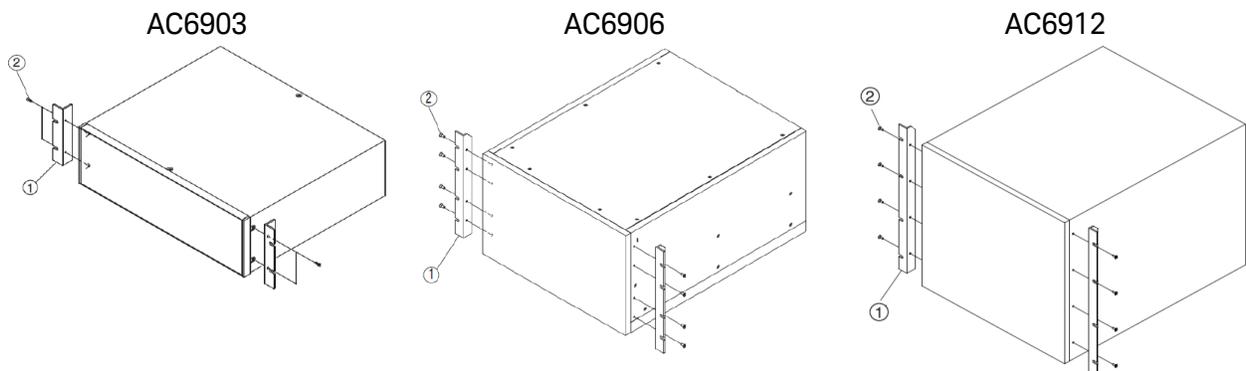
Standard L-shaped rack rails are required to support the instrument in the rack. The brackets cannot support the weight of the instruments by themselves. Do not block the air intake at the front of the instrument or the exhaust at the rear.

Kit Items	Description	AC69RAC3 Qty.	AC69RAC6 Qty.	AC69RAC12 Qty.
1	Brackets	2	2	2
2	Flat Head Screws M4x0.7x10	4	8	8
3	Dress Screws with Nylon Washer	4	8	8
4	Clip Nuts for Rack Frame 10-32 0.5-in	4	8	8

1. Remove the feet or casters from the bottom of the unit. (AC6903 and AC6906 shown)

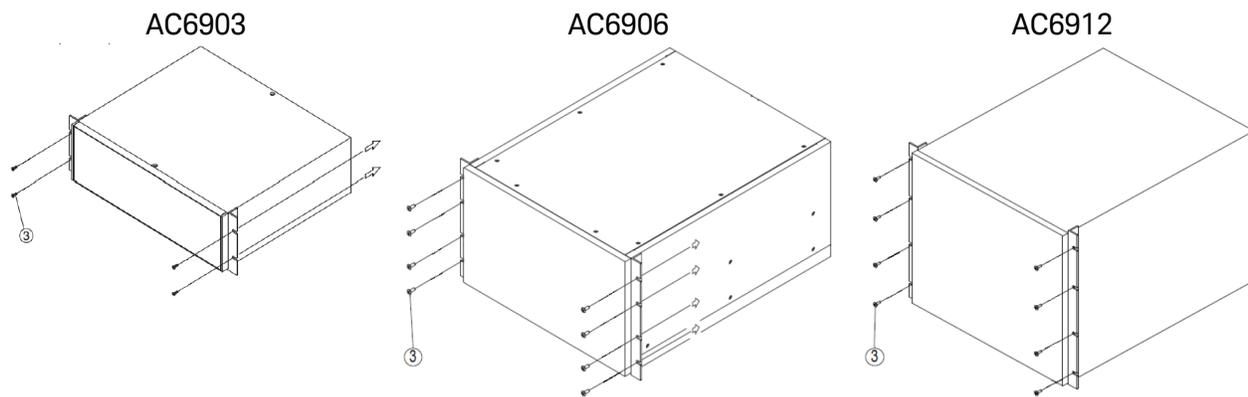


2. Use the supplied flat head screws (M4x10) to attach the brackets to the unit.



3. Install suitable rack rails to support the unit.

Use the supplied dress screws and clip nuts (10-32), to mount the unit in the rack.



### Floor Mounting - for Model AC6918

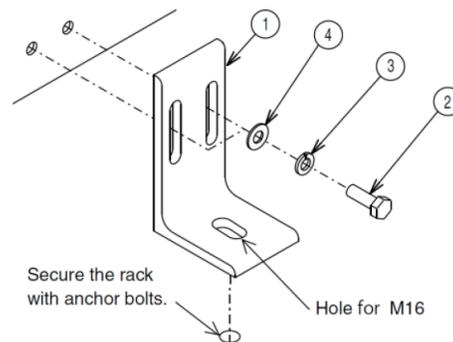
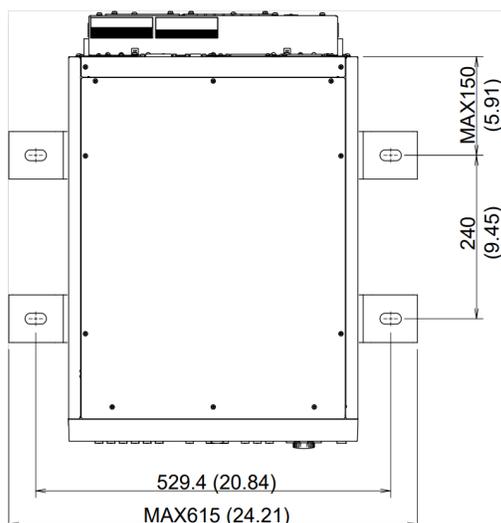
The optional Hold Angle kit allows the instrument to be mounted to the floor.

Kit Items	Description	AC69RAC18 Qty.
1	L-shape anchor	4
2	Bolt M10x35	8
3	Spring washer M10	8
4	Washer M10	8

Four anchor bolts (not provided) are also required to attach the instrument to the floor.

1. Mark and drill the locations on the floor where the anchor bolts will be installed.

2. Install the four L-shape anchors to the right and left sides of the base of the instrument. Then fix the instrument with anchor bolts.

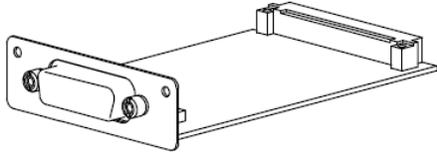


## Installing a GPIB Board Accessory

By using the GPIB interface board accessory, you can control this product through the GPIB.

Refer to [Keysight Sales and Support Office](#) for information about ordering the AC69GPBU GPIB board.

Install the interface board in the single SLOT, or in SLOT 3 on the rear panel. Refer to [Rear Panel at a Glance](#) for the location.



To install a board:

1. Check that the power switch is turned off.
2. Touch the grounded metal to discharge your static electricity.
3. For Model AC6903, unscrew the single SLOT cover screws and remove the cover. For all other Models, unscrew the SLOT 3 cover screws and remove the cover. Keep the cover in case the interface board is ever removed.
4. Hold the board so that the printed circuit board side is facing up.
5. Slide the board all the way into the slot until the board's connector is fully inserted into the slot connector at the back.
6. Use the slot cover screws that you removed in step 3 to secure the board.

## Power Cord Connections

### Connecting the AC6903

### Connecting the AC6906 and AC6912

### Connecting the AC6918

A power cord is not supplied with this product. This product complies with IEC Overvoltage Category II (energy-consuming equipment supplied from a fixed installation).

**WARNING** **Risk of Electric Shock** Turn off the switchboard circuit breaker before connecting the cord. Do not use the terminal block with the terminal cover removed. Always ensure that the power cord ground is connected.

**Risk of Fire.** Have a qualified engineer connect the power cord to the switchboard.

**CAUTION** **Ensure that all input connections are correct.** AC6900 series accept both Wye and Delta 3-phase power input for both the 200 V and 400V models. For the 400 V input models, the Neutral phase **must be connected**. Damage to the instrument may result if the Neutral is not connected.

**NOTE** The AC6900 Series instruments may be hard wired to the utility mains. Refer to **Switchboard and circuit breaker requirements** for guidance on branch circuit and circuit breaker sizing. A switchboard circuit breaker disconnect must be provided.

## Power Cord Requirements

A power cord is not supplied with this product.

**WARNING** The cable cross-section must be suitable for the maximum input current of the instrument. The ground cable must have the same cross-section as the phase cable.

Model	Input	Description	Cross section	Max current	Terminal size
AC6903	100/200 V 1P	Single core, 3 pcs	14 mm <sup>2</sup> or more	48 A	M6
AC6906	200 V 3P	Single core, 4 pcs	5.5 mm <sup>2</sup> or more	27 A	M5
	400 V 3P	Single core, 5 pcs	5.5 mm <sup>2</sup> or more	14 A	M5
AC6912	200 V 3P	Single core, 4 pcs	14 mm <sup>2</sup> or more	53 A	M5
	400 V 3P	Single core, 5 pcs	5.5 mm <sup>2</sup> or more	28 A	M5
AC6918	200 V 3P	Single core, 4 pcs	22 mm <sup>2</sup> or more	80 A	M8
	400 V 3P	Single core, 5 pcs	8 mm <sup>2</sup> or more	42 A	M5

## 2 Installation

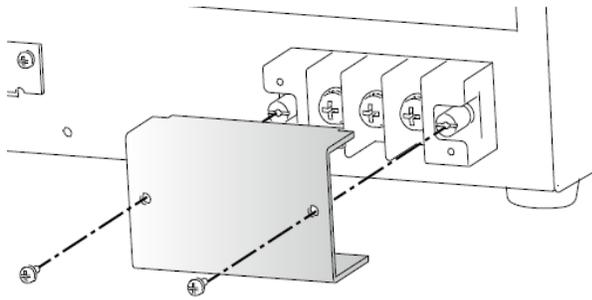
Prepare a power cord that meets the above specifications. The temperature rating of the power cable should be higher than 70 degrees Celsius.

The following table gives the tightening torque of the input terminal screws.

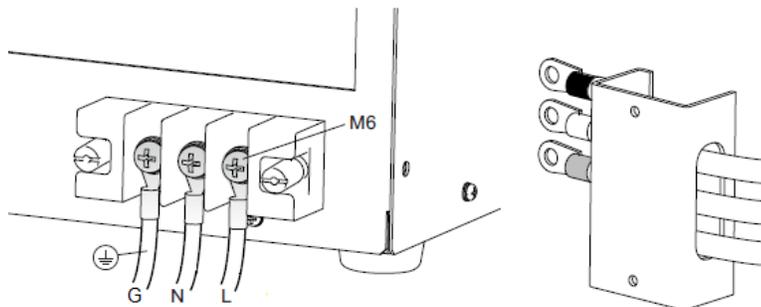
Terminal size	Recommended Nm	Maximum Nm
M5	2.0	2.4
M6	2.5	3.0
M8	5.5	6.6

### Connecting the AC6903

1. Check that the AC power supply meets the instrument's nominal input rating, which is either single-phase 100 VAC to 120 VAC, or single-phase 200 VAC to 240 VAC. The frequency is 50 or 60 Hz.
2. Check that the power switch is turned off.
3. Unfasten the two M4 screws from the AC INPUT terminal block cover and remove the cover.



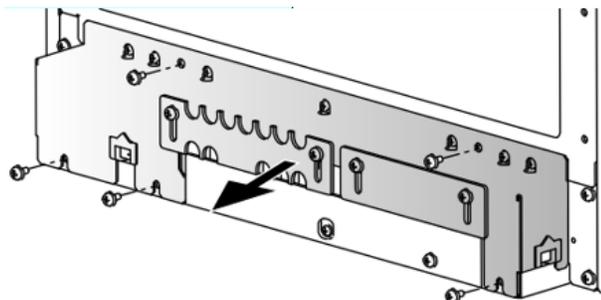
4. Run the power cable through the opening in the input cover as shown. Connect the power cord according to the labeling on the INPUT terminal block. Always connect the ground wire first.



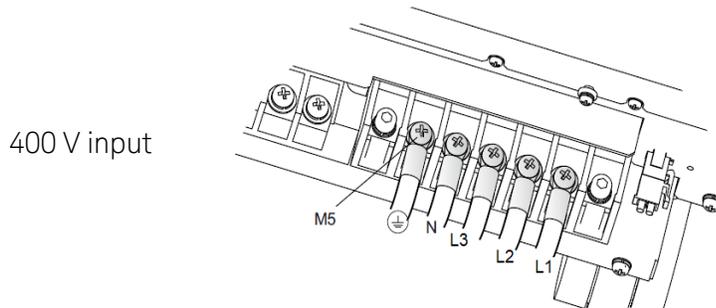
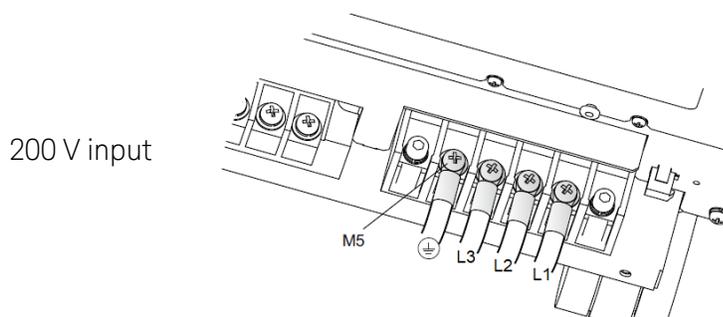
5. Fasten the cover that you removed in step 3 with the two screws.
8. Turn off the switchboard's circuit breaker.
7. Connect the power cord according to the indication on the switchboard.
8. Turn on the switchboard's circuit breaker. This completes the connections.

## Connecting the AC6906 and AC6912

1. Check that the AC power supply meets the instrument's nominal input rating, which is either 200 VAC 3-phase, or 400 VAC 3-phase. The frequency is 50 or 60 Hz.
2. Check that the power switch is turned off.
3. Unfasten the five M4 screws from the terminal block cover and remove the cover.



4. Connect the power cord according to the labeling on the INPUT terminal block. Always connect the ground wire first.

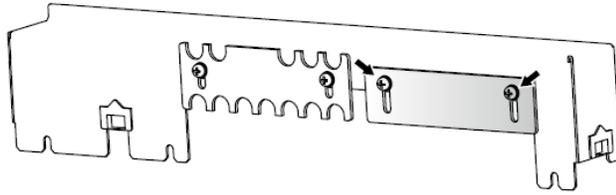


### CAUTION

Damage to the instrument may result if the Neutral is not connected.

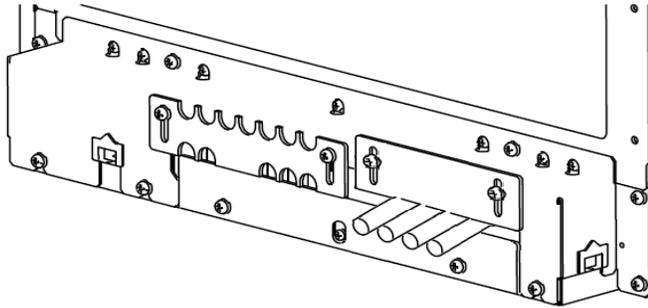
5. Turn off the switchboard's circuit breaker.
6. Connect the power cord according to the indication on the switchboard.
7. Loosen the two screws until the INPUT terminal cover can move.

## 2 Installation



8. Fasten the terminal cover you removed in step 3 with the three screws.

9. Slide the INPUT terminal cover until it just touches the wires, and then fasten the screws.



10. Connect the switchboard end of the power cord to match the switchboard connections.

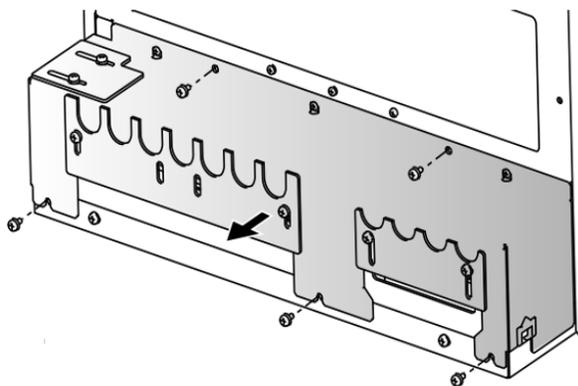
11. Turn on the switchboard's circuit breaker. This completes the connections.

### Connecting the AC6918

1. Check that the AC power supply meets the instrument's nominal input rating, which is either 200 VAC 3-phase, or 400 VAC 3-phase. The frequency is 50 or 60 Hz.

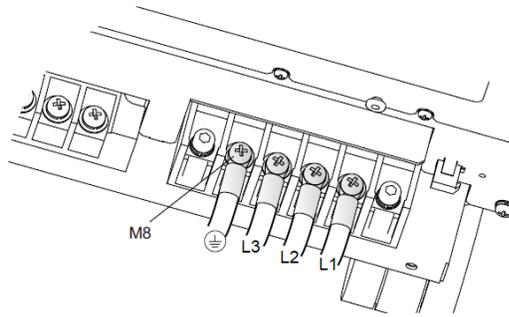
2. Check that the power switch is turned off.

3. Unfasten the five M4 screws from the terminal block cover and remove the cover.

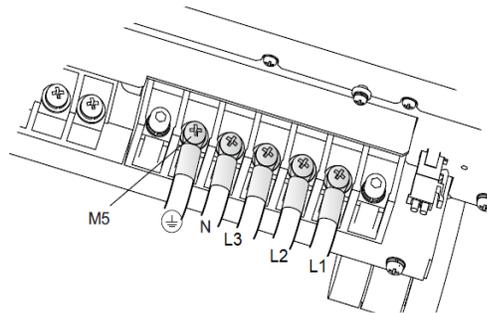


4. Connect the power cord according to the labeling on the INPUT terminal block. Always connect the ground wire first.

200 V input



400 V input

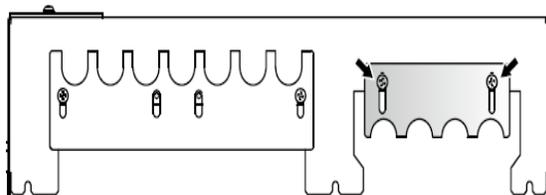
**CAUTION**

Damage to the instrument may result if the Neutral is not connected.

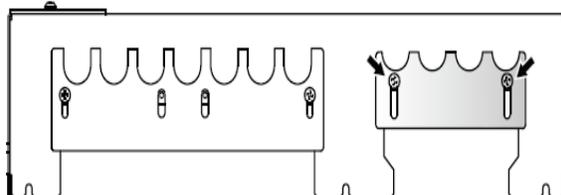
5. Turn off the switchboard's circuit breaker.

6. Connect the power cord according to the indication on the switchboard.

7a. For the 200 V input model, remove the two M4 screws, **change the orientation of the INPUT terminal cover**, and fasten with the screws you just removed. Tighten the screws loosely so that the INPUT terminal cover can still be moved.



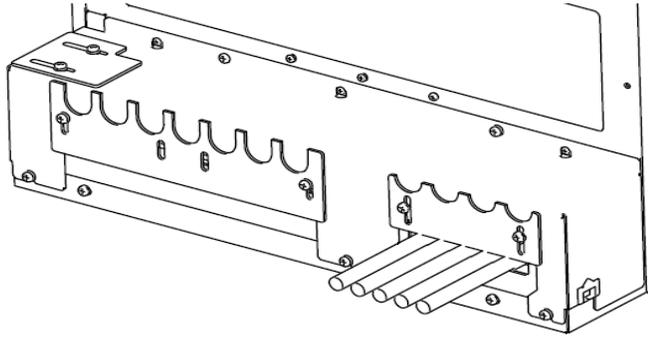
7b. For three-phase 400 V input model, loosen the two M4 screws until the INPUT terminal cover moves.



8. Fasten the terminal cover you removed in step 3 with the five screws..

9. Slide the INPUT terminal cover until it touches the wires, and then fasten the screws.

## 2 Installation



10. Connect the switchboard end of the power cord to match the switchboard connections.
11. Turn on the switchboard's circuit breaker. This completes the connections

## Switchboard and Circuit Breaker Requirements

**WARNING** Have a qualified engineer connect the power cord to the switchboard.

Turn off the switchboard circuit breaker to disconnect the instrument from the AC line in an emergency. The breaker must be suitably located and easily reached, and it must be marked as the disconnecting device for the equipment.

This section is provided for guidance only; consult with local experts to ensure strict compliance with all local electrical code and safety requirements. These requirements take precedence over any guidance provided in this section.

- Each phase requires a separate breaker.
- Dedicate the circuit breaker for models AC6903, AC6906, AC6912, and AC6918.
- Keep the switchboard easily accessible at all times.
- Apply a label to the switchboard, clearly identifying the disconnecting device and its associated model.
- Be sure to connect the wires correctly between the switchboard and the input terminals of the product as shown:

Single-phase 100/200 V input: L, N and  GND.

Three-phase 200 V input: L1, L2, L3, and  GND.

Three-phase 400 V input: L1, L2, L3, N, and  GND.

The following table provides information about worst case current consumption for all AC6900 Series models for two nominal AC mains voltages. Entries are obtained by dividing the worst case power consumption (in VA) by the nominal mains voltage and rounding to the next highest integer value. Line currents for other nominal voltages may be calculated similarly.

### Maximum Input VA and Current

	AC6903	AC6906	AC6912	AC6918
Max Input kVA	4 kVA	7.8 kVA	15.6 kVA	23.4 kVA
Max current @ 100 V line	~48 A	N/A	N/A	N/A
Max current @ 200 V line	~24 A	~27 A	~53 A	~80 A
Max current @ 400 V line	N/A	~14 A	~28 A	~42 A

### Breaker Sizes

Consult with local authorities to ensure full compliance with electrical code and safety requirements before connecting any AC6900 Series instrument.

## 2 Installation

Line Voltage	AC6903	AC6906	AC6912	AC6918
100 V line	75 A	N/A	N/A	N/A
200 V line	40 A	50 A	75 A	125 A
400 V line	N/A	30 A	40 A	60 A

Different regions of the world have different sizing requirements for branch circuit conductors and circuit breakers. In Europe and other regions where IEC standards apply, circuit breakers generally are rated at 100% utilization, meaning that a device connected to a dedicated branch circuit may draw a maximum current up to the circuit breaker rating. In the United States, the NEC generally specifies what is known as the "80% rule" which requires branch circuits to be rated at 1.25 times the maximum nameplate rating of the connected device.

Standard circuit breaker sizes also vary by region. The table below provides guidance for circuit breaker sizing for various nominal mains voltages. The guidance for North American mains voltages includes the 1.25 factor associated with the 80% rule.

### **IEC 60898-1 and European Standard EN 60898-1 Standard Sizes**

6, 10, 13, 16, 20, 25, 32, 40, 50, 63, 80, and 100 A

### **NEMA Standard Sizes (also commonly used in Japan)**

15, 20, 25, 30, 35, 40, 45, 50, 60, 70, 80, 90, and 100 A

## Interface Connections

### GPIB Connection

### USB Connection

### LAN Connection

This section describes how to connect to the instrument's various communication interfaces. For additional information about configuring and using the communications interfaces, refer to **Remote Interface Configuration**.

To begin, please download and install the Keysight IO Libraries Suite from [www.keysight.com/find/IOlibraries](http://www.keysight.com/find/IOlibraries).

**NOTE**

Refer to **Rear Panel at a Glance** for the location of the interface connectors.

### GPIB Connection

1. Connect your computer to your instrument's GPIB interface accessory using a GPIB interface cable. The GPIB card should be installed in the appropriate accessory slot as shown under **Rear Panel at a Glance**.
2. Use the Connection Expert utility of the Keysight IO Libraries Suite to connect to the installed GPIB interface card.
3. You can now use Interactive IO within the Connection Expert to communicate with your instrument, or you can program your instrument using various programming environments.

### USB Connection

1. Connect the instrument's rear-panel USB device port to a USB port on your computer.
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.
3. You can now use Interactive IO within the Connection Expert to communicate with your instrument, or you can program your instrument using various programming environments.

### LAN Connection

1. Connect a LAN cable from the instrument's rear-panel LAN port to the site LAN or your computer. The instrument's factory default LAN settings automatically obtain an IP address from the network using a DHCP server (DHCP is on). The DHCP server will register the instrument's host name with the dynamic DNS server. The host name and IP address can then be used to communicate with the instrument. If you are using a private LAN, you can leave all LAN settings as they are. The instrument will automatically choose an IP address using AutoIP if a DHCP server is not present. The instrument assigns itself an IP address from the block 169.254.nnn. The Lan indicator appears in the lower right corner of the display when the LAN port has been configured.
2. Use the Connection Expert utility of the Keysight IO Libraries Suite to add the instrument 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 host name or IP address.
3. You can now use Interactive IO within the Connection Expert to communicate with your instrument, or you can program your instrument using various programming environments. You can also use your computer's Web browser to communicate with the instrument. See [Using the Web Interface](#).

## Quick Start Lesson

Turn the Unit On and Off

Set the Output Voltage

Set the Output Current Limit

Use Built-in Help System

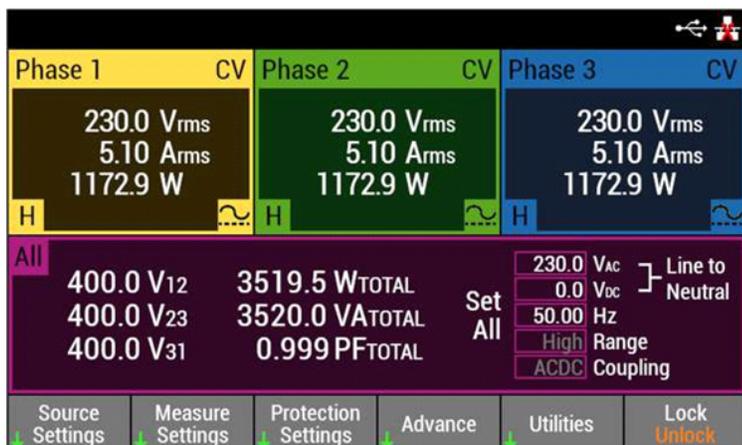
### Turn the Unit On and Off

To turn the instrument on:

1. Check that nothing is connected to any output terminal block on the instrument.
2. Check that the power cord is of the correct type and correctly connected.
3. Check that the supplied AC6900-30001, external Digital I/O Connector (D-Sub 25 Pin Plug) is connected to the DIGITAL I/O port on the rear panel (see item 4 under [Rear Panel at a Glance](#)).
4. Check that the POWER SELECTOR switch on the front panel is set to "Primary".
5. Flip the POWER switch up to turn the instrument on.



The following screen will appear on the display. It shows information about all three output phases and a combined view showing the line information of all outputs.



## 2 Installation

Pressing the **Meter** key will sequence through all of the meter views.

### NOTE

It takes about 10 seconds for the instrument to initialize before it is ready for use.

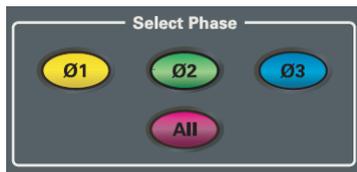
If the instrument does not turn on, verify that the power cord is firmly connected (power-line voltage is automatically sensed at power-on). Also make sure that the instrument is connected to an energized power source.

When the POWER switch is turned on for the very first time, the unit starts in the factory default condition. When the power is turned on the next time, the product starts with the settings that were in use the last time that the POWER switch was turned off. You can set the condition that the unit will be in when the power is turned on. Refer to **Turning the Output On and Off** for more information.

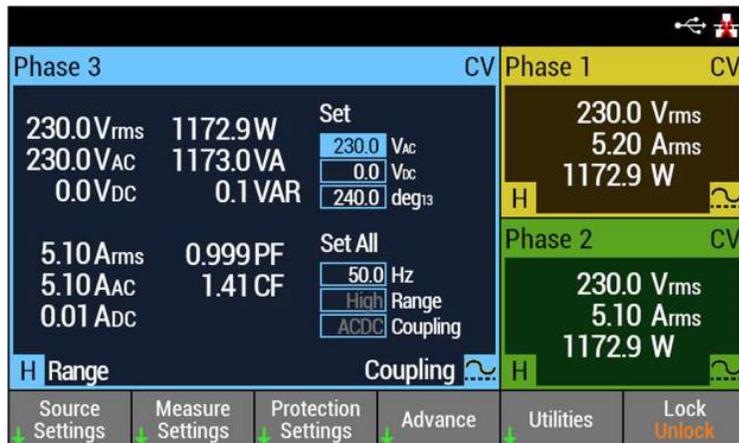
## Set the Output Voltage

### Method 1

Select an output to control. Use the Phase keys to select the output phase.



The selected area of the display will change to allow you to edit the active fields in your selection. In the following example, Phase 3 has been selected.



Use the Navigation keys to select the field you wish to edit. The field can be edited when it appears highlighted.



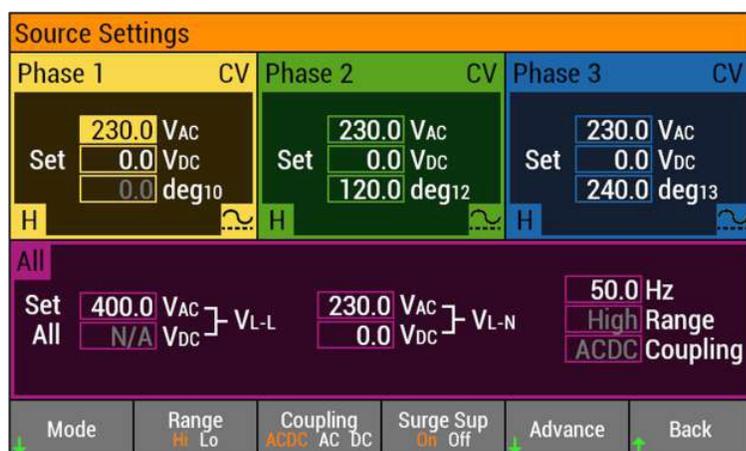
Use the Numeric Entry keys to select a voltage for Phase 3. Press **Enter** to confirm and set the value.



Note: Use the RPG knob to increment or decrement the value that is already in the field.

## Method 2

Alternatively, you can also select the **[Source Settings]** softkey to access the available source settings. Note that the title bar of the display changes to indicate where you are in the front panel menu.



As previously described, use the Phase keys to select the output phase. In the above example Phase 1 has been selected.

As previously described, use the Navigation keys and the Numeric Entry keys to select a voltage for Phase 1. Press **Enter** to confirm and set the value.

Entering a value in the **ALL phases** fields panel will overwrite the values in the corresponding Phase 1 through Phase 3 fields.

## Set the Output Current Limit

To limit the output current, press the **[Protection Settings]** softkey to access the protection and limit settings. Then select the **[Limits]** softkey.

The current limit operates on the rms value of the output current. The default action taken when the current limit is exceeded is that the output will shut down due to an Overcurrent Protection (OCP). If OCP is disabled, the output current will be limited to the maximum current setting and the voltage will

## 2 Installation

be decreased to maintain the current at its limit setting. Refer to [Setting Protection](#) for more information.

Protection & Limit Settings\Limit	
<b>Voltage Limit</b>	<b>Positive Peak Current Limit</b>
AC voltage (max) <input type="text" value="322.0"/> V	All phases <input type="text" value="168.0"/> A
AC voltage (min) <input type="text" value="0.0"/> V	Phase 1 <input type="text" value="168.0"/> A
DC voltage (max) <input type="text" value="455.0"/> V	Phase 2 <input type="text" value="168.0"/> A
DC voltage (min) <input type="text" value="-455.0"/> V	Phase 3 <input type="text" value="168.0"/> A
<b>Max Current Limit</b>	<b>Negative Peak Current Limit</b>
All phases <input type="text" value="44.0"/> A	All phases <input type="text" value="-168.0"/> A
Phase 1 <input type="text" value="44.0"/> A	Phase 1 <input type="text" value="-168.0"/> A
Phase 2 <input type="text" value="44.0"/> A	Phase 2 <input type="text" value="-168.0"/> A
Phase 3 <input type="text" value="44.0"/> A	Phase 3 <input type="text" value="-168.0"/> A
Frequency	Back

As previously described, use the Navigation keys and the Numeric Entry keys to select a maximum current limit value for a specified phase or all phases. Press **Enter** to confirm and set the value.

Entering a value in the **Current ALL phases** field will overwrite the values in the corresponding Phase 1 through Phase 3 fields.

### Use the Built-in Help System

#### View Errors

If a self-test error occurs, a message is displayed on the title bar. For self-test and other error messages, refer to [Error Messages](#) for more information.

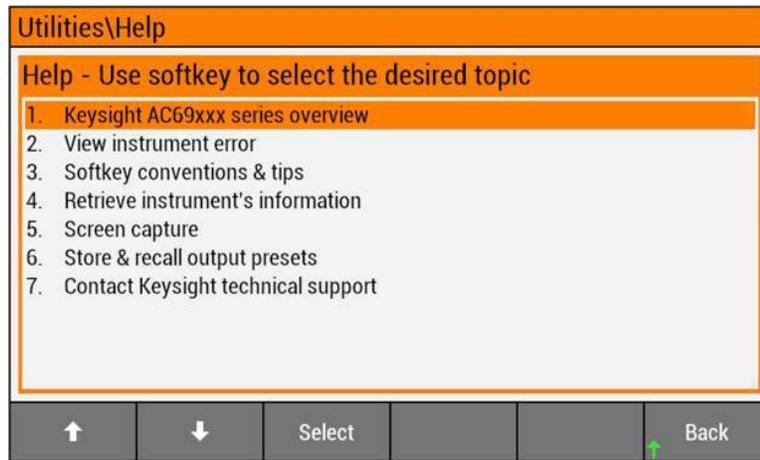


Select the **Utilities > Error** softkeys to display any error messages.

Utilities\Error	
<b>Error Messages</b>	
Error -222, Data out of range	
Clear	Back

## View Help

Select the **Utilities** > **Help** softkeys to view built-in help at any time.



Press the **Meter** key to immediately exit the front panel menu.

Flip the POWER switch down to turn the instrument off.

## Output Power Connections

### Preparation

#### Connecting the Load Cables (AC6903)

#### Connecting the Load Cables (AC6906, and AC6912)

#### Connecting the Load Cables (AC6918)

#### Connecting the Remote Sense Wires

### Preparation

**WARNING** Risk of Electric Shock

Before making any load or sense connections be sure to turn the POWER switch off and turn off the circuit breaker of the switchboard.

Even with power turned off, residual voltage may remain at the output terminals. Do not touch the output terminal block for at least 20 seconds after the power is turned off.

Always attach the OUTPUT terminal cover so that the terminals are not exposed during operation.

Use load cables with a voltage rating that meets or exceeds the product's isolation voltage ( $\pm 452$  V).

Use load cables whose capacity is adequate for the maximum output current and with sturdy, flame-resistant insulation

When using single-phase output, be sure to connect three cables each for L and N. There is a risk of touching the unused terminals through the gap of the OUTPUT terminal cover.

---

**CAUTION** A sudden load variation exceeding the rating may cause a large overshoot.

To avoid risk of heat buildup or spark emission, fasten the wires securely using the recommended torque.

Connecting a voltage source such as a battery to the instrument will result in current flowing from the voltage source to the instrument and may damage the instrument. If you need to connect a voltage source to the instrument, you must provide a switch between the voltage source and the instrument, match the output voltage to the voltage source, and then connect the voltage source.

---

**NOTE** The L and N terminals of the OUTPUT terminal block are isolated from the input power supply. The polarity does not constitute a problem in terms of safety. The polarity matters in synchronous mode (in which the product is synchronized with the input power supply) and DC mode, so check the polarity of the load before you connect it to the product. You can use either L or N to ground the product.

### Wire Requirements

Use noncombustible load wires rated to carry the maximum rated output current.

Nominal cross-sectional area (mm <sup>2</sup> )	AWG	Reference cross-sectional area (mm <sup>2</sup> )	Allowable current (A) (Ta=30 °C)
0.9	18	0.82	17
1.25	16	1.31	19
2	14	2.08	27
3.5	12	3.31	37
5.5	10	5.26	49
8	8	8.37	61
14	6	13.3	88
22	4	21.15	115
30	2	33.62	139
38	1	42.41	162
50	1/0	53.49	190
60	2/0	67.42	217
80	3/0	85.03	257
100	4/0	107.2	298

The values vary depending conditions such as the wire covering (insulator) and material (allowable temperature) and whether they are multi-core cables. For cables other than those specified in the table above, please consult with qualified personnel.

The following table provides the maximum output current that each model can generate.

Model	Output	1 phase output	1 phase 3 wire and 3 phase output
AC6903	Low range	30 A	10 A
	High range	15 A	5 A
AC6906	Low range	60 A	20 A
	High range	30 A	10 A
AC6912	Low range	120 A	40 A
	High range	60 A	20 A
AC6918	Low range	180 A	60 A
	High range	90 A	30 A

## 2 Installation

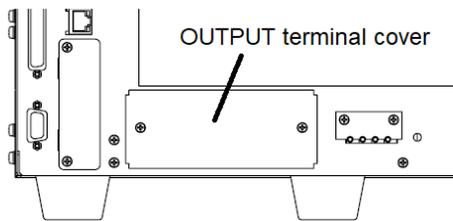
The following table gives the tightening torque of the output terminal screws.

Terminal size	Recommended Nm	Maximum Nm
M5	2.0	2.4
M6	2.5	3.0
M8	5.5	6.6

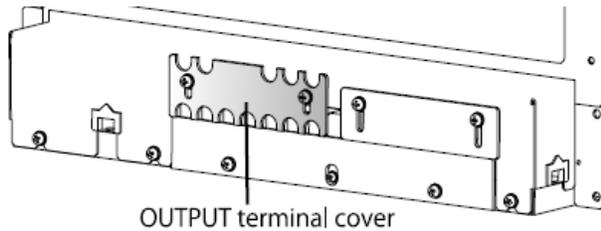
### Output Terminal Covers

When the product is shipped from the factory, an OUTPUT terminal cover is attached to keep the OUTPUT terminals from becoming exposed. If you are not using the OUTPUT terminal block, attach the terminal cover so that the terminals are not exposed.

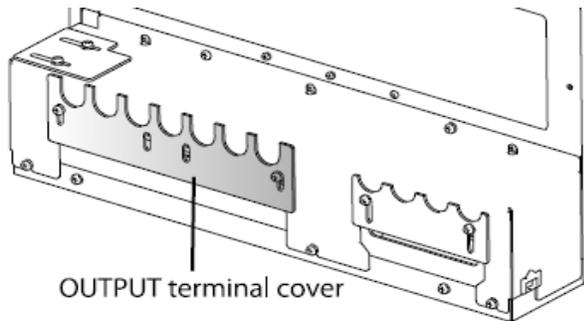
AC6903



AC6906, and AC6912



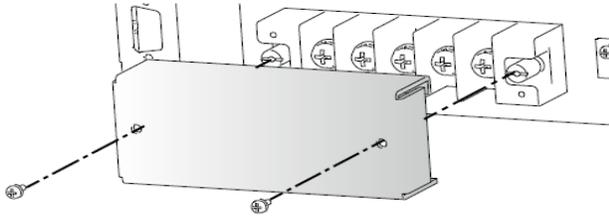
AC6918



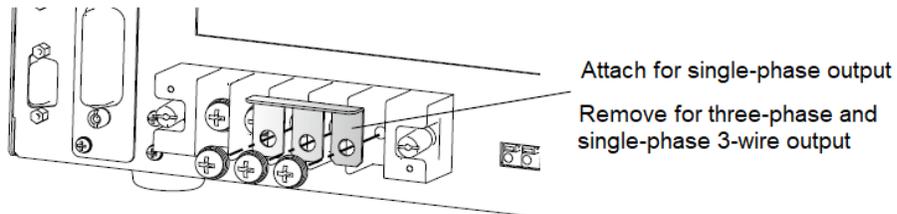
### Connecting the Load Cables (AC6903)

1. Check that the power switch is turned off.
2. Turn off the switchboard's circuit breaker.

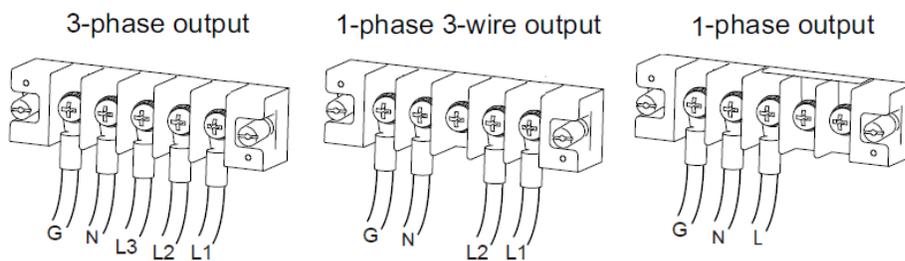
3. Unfasten the two M3 screws from the OUTPUT terminal block cover and remove the cover.



4. Attach the shorting bar for single-phase output only.  
Remove the shorting bar for three-phase output and single-phase 3-wire output.



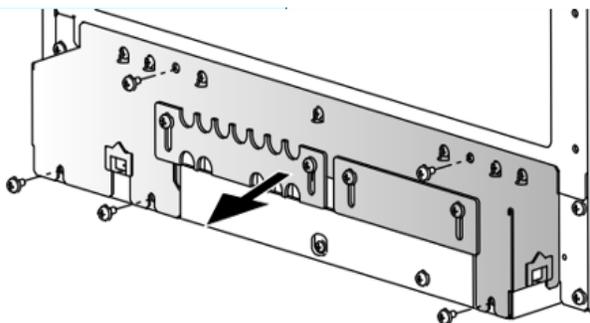
5. Securely connect the load cables to the OUTPUT terminal block. Connect the power cord according to the labeling on the INPUT terminal block. Always connect the ground wire first.



6. Fasten the cover that you removed in step 3 with the two screws. This completes the connections.

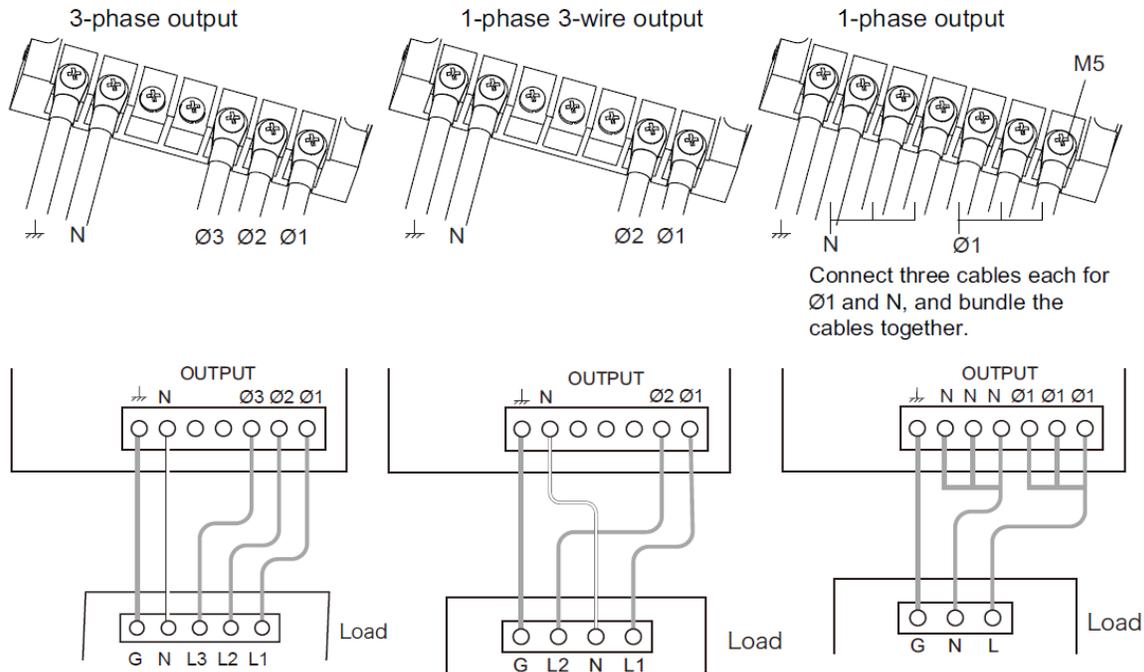
### Connecting the Load Cables (AC6906, and AC6912)

1. Check that the power switch is turned off.
2. Turn off the switchboard's circuit breaker.
3. Remove the five M4 screws from the terminal block cover, and remove the cover.

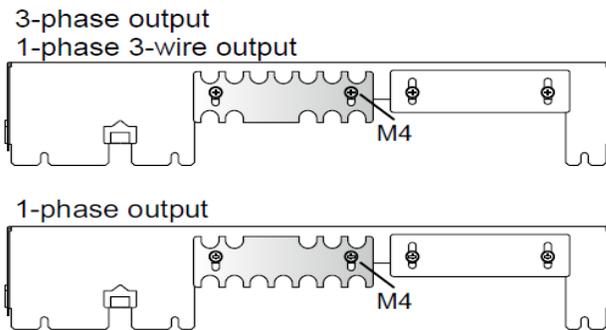


## 2 Installation

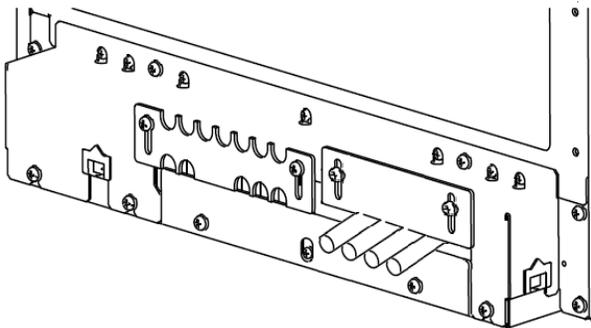
- Securely connect the load wires to the OUTPUT terminal block. The length of the load cables should be less than 30 meters. If the load has a ground (GND) terminal, be sure to connect it to the G terminal of the instrument's OUTPUT terminal block. Be sure to use a wire that is greater than or equal to the diameter of the wires used to connect the load.



- Attach the OUTPUT terminal cover so that the unused terminals are not exposed.

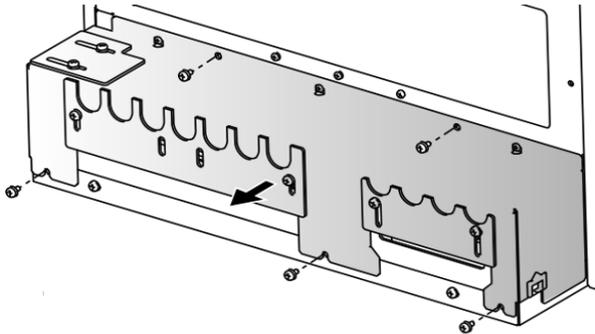


- Fasten the terminal cover you removed in step 3 with the five screws (1-phase shown). This completes the connections.

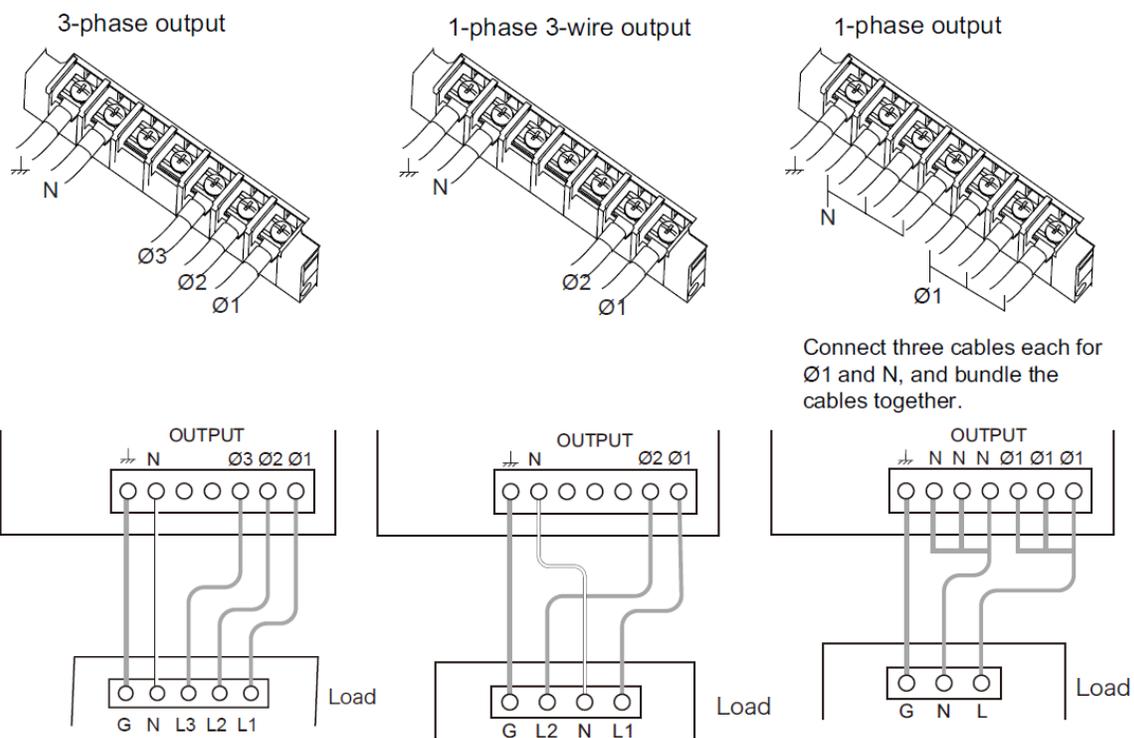


## Connecting the Load Cables (AC6918)

1. Check that the power switch is turned off.
2. Turn off the switchboard's circuit breaker.
3. Remove the five M4 screws from the terminal block cover, and remove the cover.

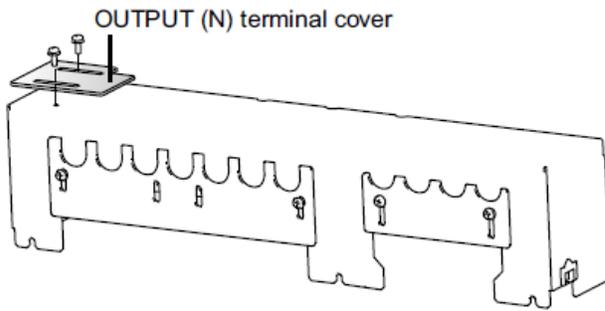


4. Securely connect the load wires to the OUTPUT terminal block. The length of the load cables should be less than 30 meters. If the load has a ground (GND) terminal, be sure to connect it to the G terminal of the instrument's OUTPUT terminal block. Be sure to use a wire that is greater than or equal to the diameter of the wires used to connect the load.

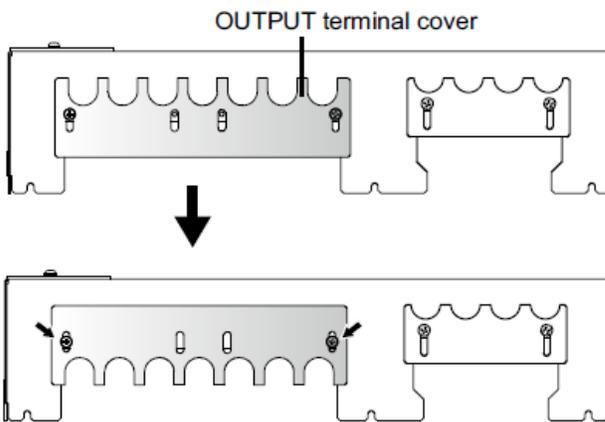


## 2 Installation

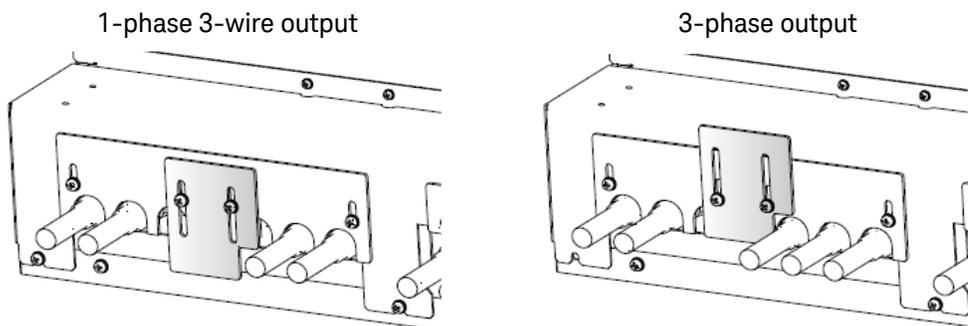
5. To use three-phase output or single-phase three-wire output, remove the OUTPUT (N) terminal cover from the terminal block cover.



6. Remove the two M4 screws, change the orientation of the INPUT terminal cover, and fasten with the screws you just removed. Tighten the screws just enough so that the OUTPUT terminal cover can still be moved.



7. Fasten the terminal cover you removed in step 3 with the three screws.
8. Slide the OUTPUT terminal cover until it touches the wires, and then fasten the screws.
9. To use the three-phase output or single-phase three-wire output, attach the OUTPUT (N) terminal cover so that the unused terminals are not exposed. This completes the connections.

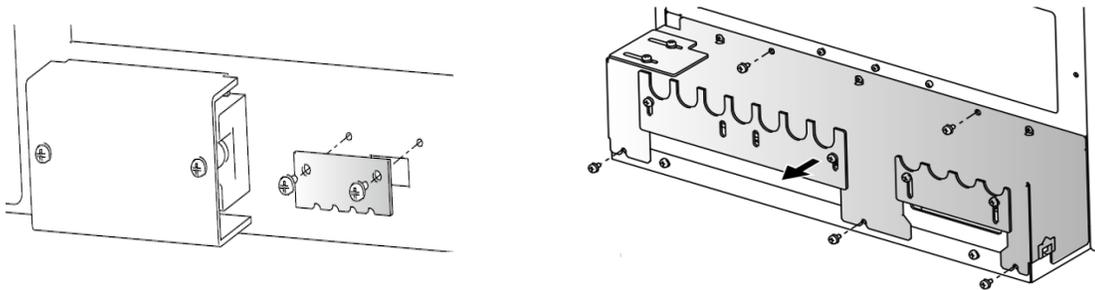


## Connecting the Remote Sense Wires

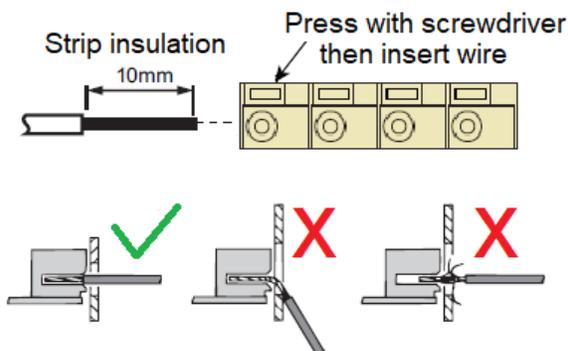
**WARNING** Risk of Electric Shock Before making any load or sense connections be sure to turn the POWER switch off and turn off the circuit breaker of the switchboard. Do not touch the output terminal block for at least 20 seconds after the power is turned off.

Remote sensing compensates for voltage drops in long load cables by monitoring the output voltage directly at the load. The sensing function can compensate up to 1 Vrms for a single load line. Always select a load wire that is thick enough to prevent the voltage drop in the wire from exceeding the compensation voltage.

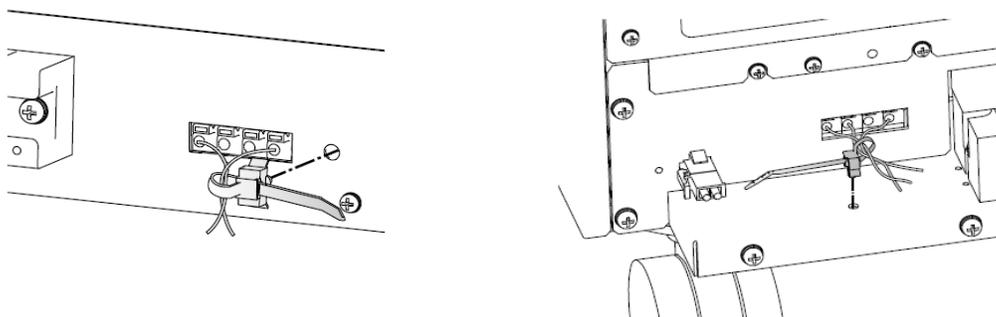
1. Check that the power switch is turned off.
2. Turn off the switchboard's circuit breaker.
3. Remove the five M4 screws from the terminal block cover, and remove the cover..



4. Insert the wires into the sense connector as shown. Observe the illustrated precautions.



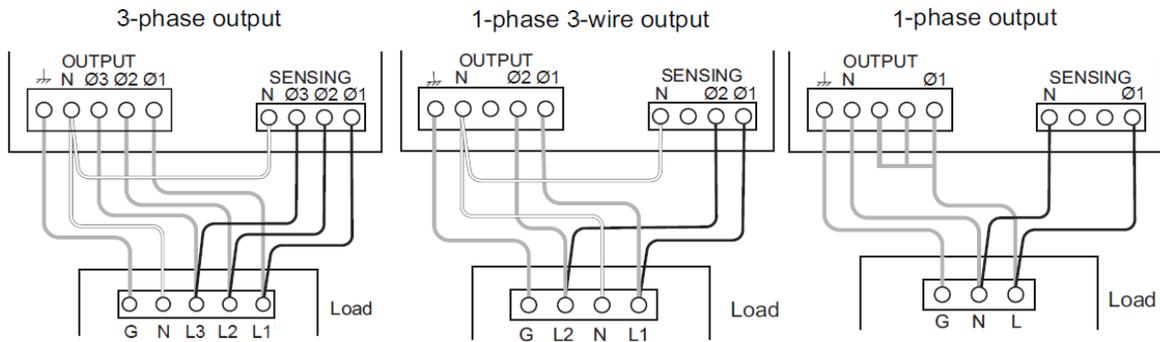
5. Twist the sense wires together. Use the supplied cable ties to bundle the sense wires. Firmly tighten the cable tie so that the sensing cables do not come loose.



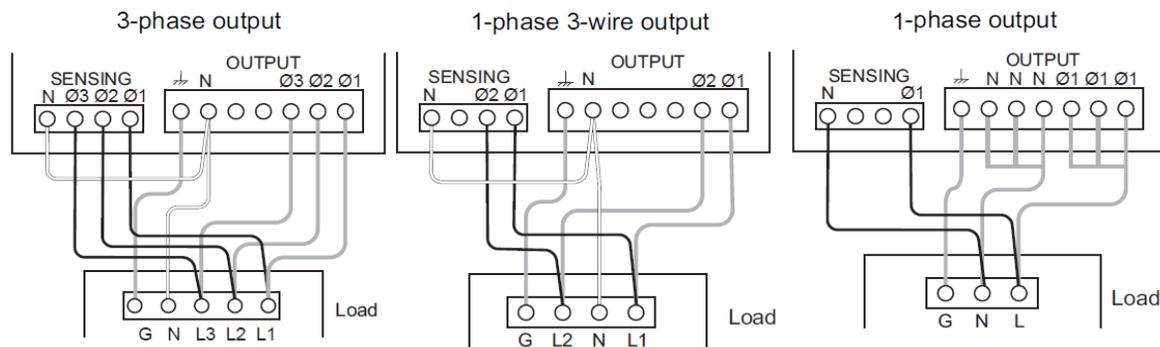
## 2 Installation

- Securely connect the sense wires to the OUTPUT terminal block and the Load terminals as shown in the following wiring diagrams. Twist or bundles the sense wires. Connect the sense wires as close to the load as possible.

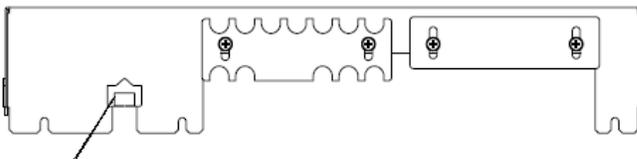
### AC6903



### AC6906 AC6912 AC6918



- Re-attach the terminal cover. For AC6906, and AC6912, run the sensing wires through the gap in the location shown below. For AC6903 and AC6918, run the sensing wires through the gap in the OUTPUT terminal block. This completes the remote sensing connections.



## Analog and Digital Connections

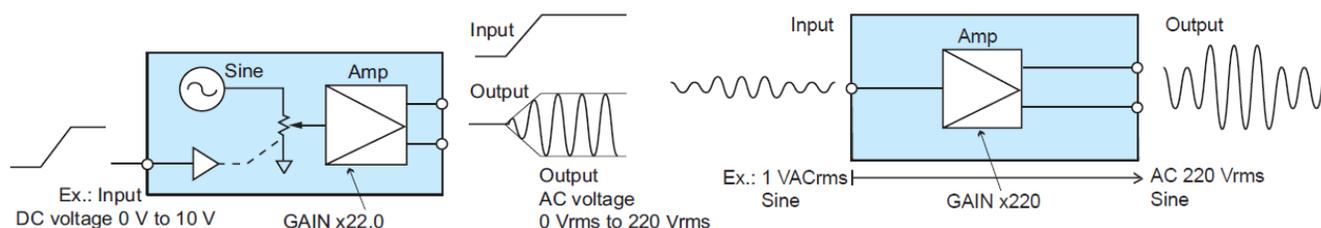
### Analog Connections

### Digital Connections

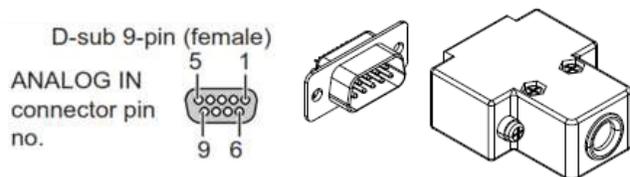
This section describes how to connect to the instrument's analog and digital interfaces. Refer to [Rear Panel at a Glance](#) for the location of the interface connectors.

### Analog Connections

There are two available analog input functions, which are mutually exclusive. You can apply external signals to change the AC voltage, DC voltage, or frequency. You can also amplify input signals that are applied to the connector channels.



The following are the pin assignments for the Analog IN connector. Refer to [Keysight Sales and Support Office](#) for information about ordering the AC69ALGU analog input mating connector.



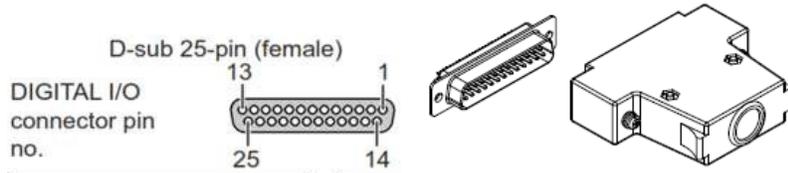
Pin number	Signal
1	CH A
2	CH B
3	CH C
4, 5	not used
6	CH A common
7	CH B common
8	CH C common
9	not used

**CAUTION** When the instrument is being controlled using external analog signals, voltage limits cannot be set. Applying an excessive external voltage by mistake can damage the load.

## Digital Connections

This section describes the wiring considerations of the digital IO signals lines.

The following are the pin assignments for the Digital IN connector. Refer to [Keysight Sales and Support Office](#) for information about ordering the AC69DIGU digital interface connector for making your wiring connections

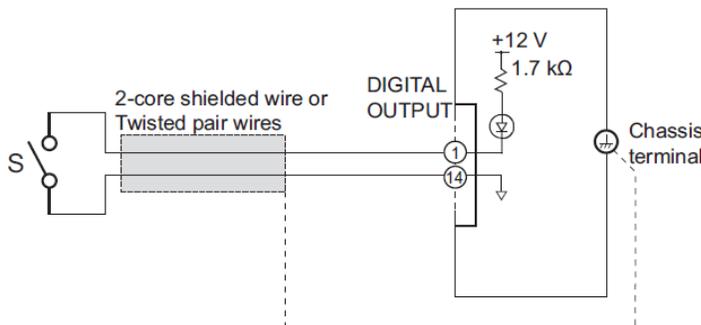


Pin number	Signal	Pin number	Signal
1	CH 1 Input	14	CH 1 common
2	CH 2 input	15	CH 2 common
3	CH 3 input	16	CH 3 common
4	CH 4 input	17	CH 4 common
5	not used	18	not used
6	CH 5 output	19	CH 5 common
7	CH 6 output	20	CH 6 common
8	CH 7 output	21	CH 7 common
9	CH 8 output	22	CH 8 common
10	not used	23	not used
11	CH 9 input/output	24	CH 9 common
12	CH 10 input/output	25	CH 10 common
13	not used		

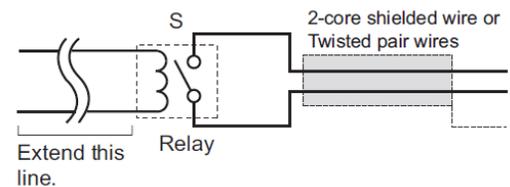
## Input Control Signals

The following illustration show connections for one Input Control channel at pins 1 and 14.

For normal wiring



For long distance wiring,  
replace switch S with a relay



The following recommendations are provided for guidance when connecting to the Digital port.

To reduce the influence of noise on the signal, connect a 2-core shielded wire or a twisted-pair wire, and keep the wire as short as possible. If the wiring is long, it is easy for noise to interfere with the operation of the digital signals. Use the following recommendation for long distance wiring.

The maximum open-circuit voltage across input pins is approximately 12 V, and the maximum short-circuit current is approximately 7.1 mA (the internal circuits are pulled up to 12 V with 1.7 k $\Omega$  resistors).

- Use external contacts that have a contact rating greater than or equal to 7.1 mA at 12 Vdc.
- High-level input voltage: 11 V to 12 V, or open
- Low-level input voltage: 0 V to 1 V
- You can set the active signal polarity for each channel.
- If you are using a shielded cable, connect the shield to the connector shell.

### **Output Status Signals**

The output signal is an open-collector output from a photocoupler (30 Vdc, 8 mA max.). It is isolated from the inside of the product. You can set the active signal polarity for each channel.

- Maximum voltage: 30 V
- Maximum current (sink): 8 mA

## Parallel Connections

### Switch Settings

#### Connecting the Optional Communications Cables

#### Connecting the Optional Synchronization Cables

#### Connecting the Output Cables

#### Connecting the Load

#### Turning the Units On and Checking Operation

#### Disconnecting Parallel Operation

**NOTE** The parallel information in this section does not apply to AC6903 units.

### Switch Settings

#### **WARNING** Risk of Electric Shock

Before making any load or sense connections be sure to turn the POWER switch off and turn off the circuit breaker of the switchboard. Even with power turned off, residual voltage may remain at the output terminals. Do not touch the output terminal block for at least 20 seconds after the power is turned off.

Always attach the OUTPUT terminal cover so that the terminals are not exposed during operation.

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**CAUTION** Use load cables with a thickness (conductor cross-sectional area) equivalent to that of the load cable for each instrument.

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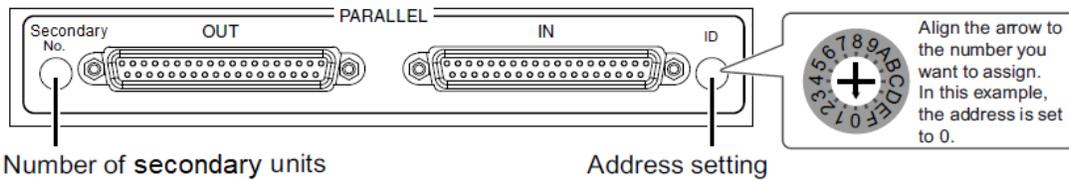
**NOTE** Refer to [Keysight Sales and Support Office](#) for information about ordering the optional AC69PAR1 parallel interface connector for making your wiring connections, and the AC69SYN1 Synchronization cable - for synchronizing the power switches.

Refer to [Rear Panel at a Glance](#) for the location of the parallel connectors.

The power capacity of each phase is limited to 48 kVA, and the maximum current is limited to 480 A.

If the response is set to high-speed (FAST), it is changed to normal speed (MEDIUM) during parallel operation.

The following table describes the switch settings for up to three secondary units connected to one primary unit.



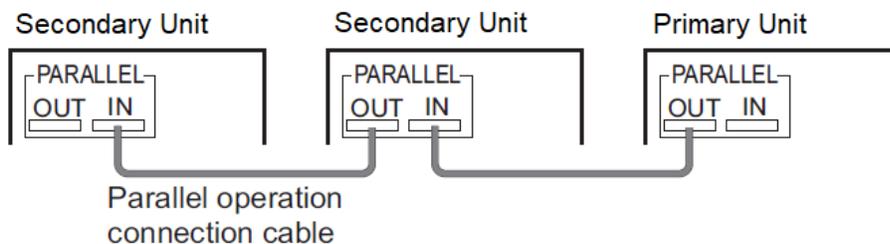
Number of secondary units

Address setting

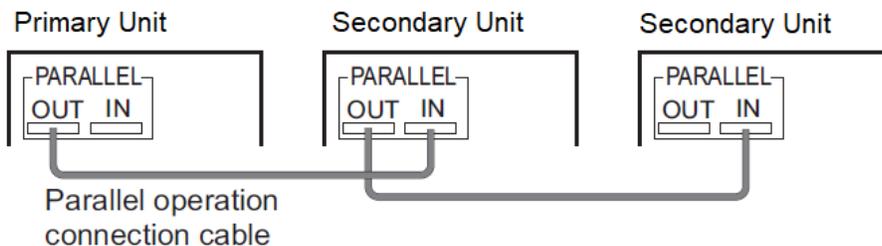
	Primary unit	Secondary 1	Secondary 2	Secondary 3
Address	0	1	2	3
No. of secondary units	1	1		
No. of secondary units	2	2	2	
No. of secondary units	3	3	3	3

### Connecting the Optional Communications Cables

Signals flow from the OUT connector to the IN connector. Make sure the IN and OUT connections are correct. The connector is always installed in the OUT connector of the primary unit.



or

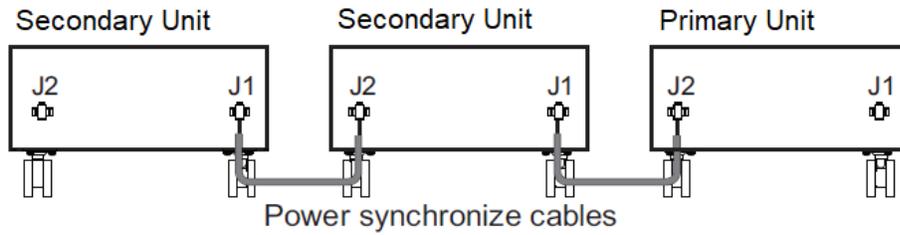


### Connecting the Optional Synchronization Cables

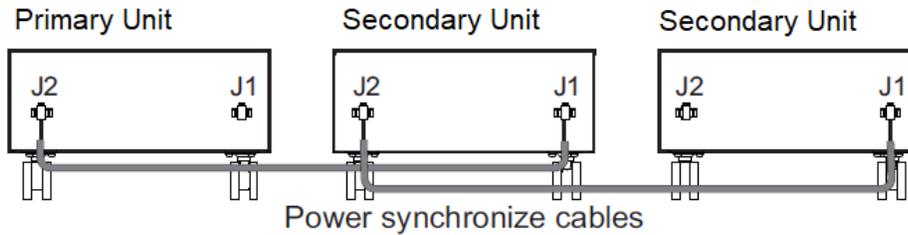
Connect the optional power synchronize cables. With these cables installed, you can configure the paralleled system so that when the primary unit is turned on, all the secondary units also turn on.

Signals flow from the J2 connector to the J1 connector. Make sure the J1 and J2 connections are correct. The connector is always installed in the J2 connector of the primary unit. Push the power synchronize cables in until they are locked in place

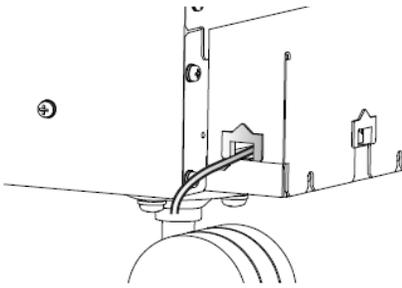
## 2 Installation



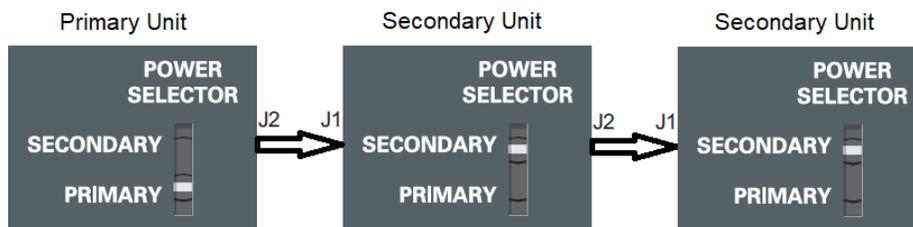
or



Route the synchronization cable out through the openings in the sides of the terminal cover. Do not pinch the synchronization cables by the cover.

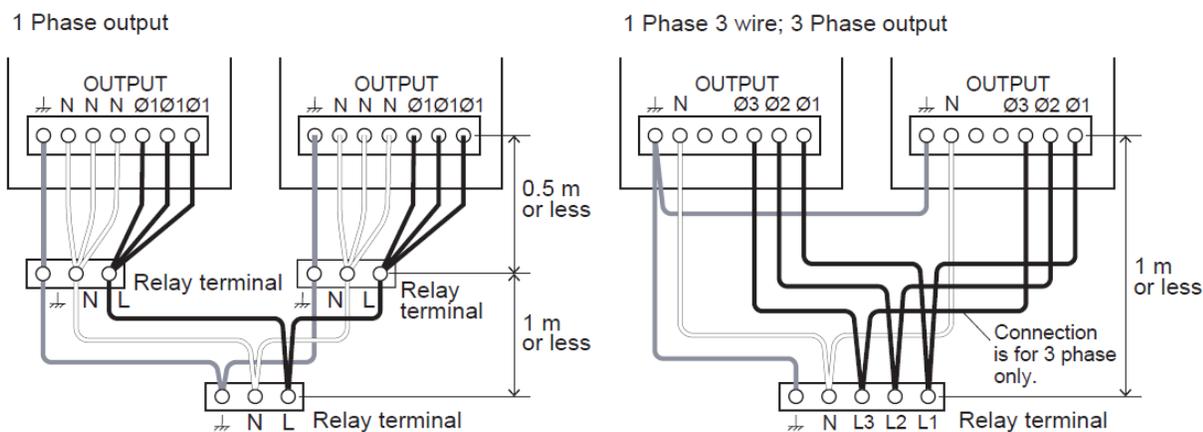


Set the front panel switches to match the rear panel synchronization settings. When you operate the primary unit's POWER switch, the secondary units' power supplies turn on synchronously.

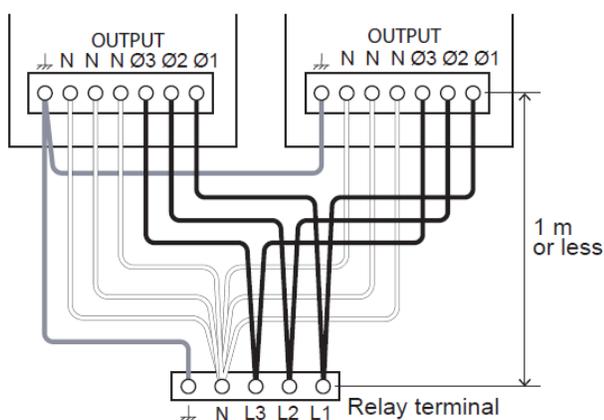


### Connecting the Output Cables

Refer to the following figure, and connect the OUTPUT terminal block and relay terminals.



If the output method to the load changes, connect all terminals.



## Connecting the Load

### **WARNING** Risk of Electric Shock

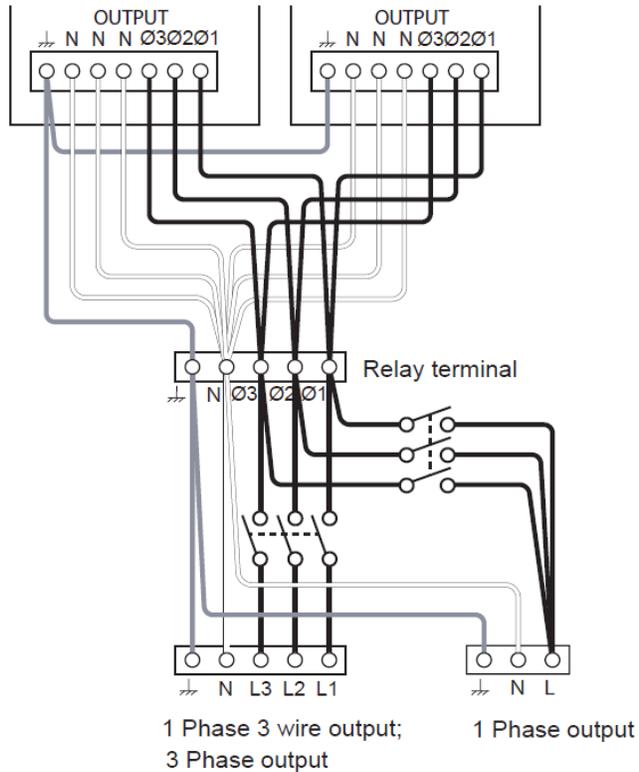
Before making any load or sense connections be sure to turn the POWER switch off and turn off the circuit breaker of the switchboard. Do not touch the output terminal block for at least 20 seconds after the power is turned off.

Always attach the Output terminal cover so that the terminals are not exposed during operation..

### **CAUTION** Do not reverse the L and N polarities.

Use noncombustible cables with a thickness appropriate for the output current to connect from the relay terminal to the load.

## 2 Installation



### Turning the Units On and Checking Operation

Parallel operation is controlled from the primary unit. You cannot control parallel operation from a secondary unit.

If turn-on synchronization is enabled, turn on the primary unit's POWER switch.

If synchronization is disabled, turn on the POWER switches on the primary unit and all secondary units within 10 seconds.

Check the operation of the unit before connecting the load, or open the load's connection relay if the load is connected.

- POWER switch on
- Voltage setting
- OUTPUT on/off
- Voltage range switching

If a problem occurs on even one unit, you will not be able to perform parallel operation.

### Disconnecting Parallel Operation

To end parallel operation, turn off the power, and then remove the connection cables from the PARALLEL connectors and the power synchronize cables from the J1 and J2 connectors. Hold down the lock lever of the power synchronize cable, and pull it free of the unit.

Set the rotary switches of the number of secondary units and addresses to zero.

If the power supplies are synchronized, set the POWER Selector switches to Primary with the POWER switch turned off.

If the current limit setting on the primary unit exceeds the rated current, the current limit will be changed to the maximum value for that instrument's setting only.



# 3

## User Information

**Front Panel Menu Reference**

**Programming the Output**

**Setting Protection and Limits**

**Turning the Output On and Off**

**Displaying Measurements**

**Using Advanced Functions**

**Using Output Controls**

**Using System Utilities**

**Remote Interface Configuration**

**Digital IO Configuration**

## Front Panel Menu Reference

This is an overview of the front-panel menus.

Press any of the softkeys to access the front-panel menus.



The green down arrows are used to indicate that there is a lower level within that menu. If there is no more down arrow, it indicates that you are at the lowest possible level. The Green up arrow is used to move back to the upper level.

On front panel softkeys that act as a toggle, the item highlighted in orange is the active selection. Press the softkey to make the selection.

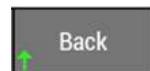


- in this example, the front panel menu is unlocked

Note that the title bar of the front panel display is used to show the current menu level. A backslash symbol is used to indicate the lower level of the menu path.



In the above title bar example, the Advance settings are located under the Source Settings menu.



Use the Back softkey to back out of the menu levels.

### The Menu Tree

Menu Heading	Description
Source Settings >	
Mode > 3 Phase	Configures the terminal wiring for 3-phase
1 Phase 3-wire	Configures the terminal wiring for 1-phase 3-wire
1 Phase	Configures the terminal wiring for 1-phase In 1 phase, all three terminals are combined
Range Hi Lo	Toggles to select the High or Low output voltage
Coupling ACDC AC DC	Toggles to select the output coupling ACDC combines the AC and the DC output signals
Surge Sup On Off	Turns output surge suppression On or Off When Off, the output status shows ~CV

Menu Heading		Description
Advance >	ON Phase On Off	Selects the On phase and specifies On phase angle
	OFF Phase On Off	Selects the Off phase and specifies Off phase angle
	Soft Start On Off	Selects Soft Start and specifies the output rise time
	Soft Stop On Off	Selects Soft Stop and specifies the output fall time
	Sync Dis Line Ext	Specifies the synchronization source of the output Also specifies the delay for the Line phase angle
<b>Measure Settings &gt;</b>		
	Voltage >	Selects Voltage measurements
	Current >	Selects Current measurements
	ACDC	Selects ACDC (rms) measurements
	AC	Selects AC measurements
	DC	Selects DC measurements
	Peak	Selects Peak measurements
	Peak Clear	Clears all Peak measurements
Advance >	Sense >	Sense On Off
		Sense sets measurement averaging and peak hold times Turns the sense controls On or Off
		SNS Type Hard Soft
		Selects Hard or Soft sensing functions
		SNS Point Out Sense
		Selects the sensing point for soft sensing
		SNS Control AC DC
		Selects the output voltage type for soft sensing
<b>Protection Settings &gt;</b>		
	Protection >	Protection configures OVP, OCP, UVP, and WDP
	UVP On Off	UVP turns under voltage protection on or off
	OCP On Off	OCP turns over current protection on or off
	WDP On Off	WDP turns watchdog protection on or off
Limit >	Frequency >	Sets limits for Voltage, Max Current, $\pm$ Peak Current Click Frequency to specify frequency limits
	Protection Clear	Click Protection Clear to clear any protections If the fault persists, the protection will not clear

### 3 User Information

Menu Heading		Description
<b>Advance &gt;</b>		
Simulation >		Simulation configures power line abnormality simulation
SIM On Off		Turn simulation on or off
Polarity Pos Neg		Specifies the polarity of the simulation
T1 Type Time Angle		Specifies the T1 setting in time or phase angle
T5 Type Time Cycle		Specifies the T5 setting in time or cycle
Run SIM		Runs the simulation
Sequence >		Sequence configures a sequence of output steps
Add		Click Add to add a new step to the sequence
Delete		Deletes the selected step from the sequence
Clear All		Removes all sequence steps
Properties >		Properties configures a sequence loop
Continuous On Off		Turns continuous loop on or off
Run SEQ		Runs the sequence if the initiation is manual
Harmonic Analysis >		Performs harmonic analysis on the output
Type Volt Curr		Specifies the harmonic type
Harmonic All Odd Even		Specifies the harmonic to display
↑, ↓		Scroll up or down the harmonic list
Output Control >		Configures the output controls
Impedance Control		Impedance Control specifies resistance and reactance Turns impedance control on or off
Output Response		Speed S M F Sets the response speed Slow, Medium, or Fast
Custom Waveform		Custom Wav On Off Configures a custom waveform Turns the custom waveform on or off
		Type Sine Peak Flat Specify the waveform type to configure
Analog Input		Analog In On Off Configures the analog connector pins Turns the analog control on or off
		CTRL Para All VAC VDC Specifies the channel control parameter
Parallel Output		Shows the address switch and cable connections

Menu Heading		Description			
<b>Utilities &gt;</b>					
Store & Recall >	Store Settings >	Dest Int Ext		Stores settings to internal memory or to the USB drive	
		Store		When external, select the options to store	
		Set to Power On		Sets storage settings to Power on state Not available when Destination + External	
	Recall Settings >	Source Int Ext		Recall settings from internal memory or from the external USB drive	
		Recall		Recall the settings	
	Power On Settings >	Set to Power On		Set the power on settings to the Power on values	
	Output Presets >	Preset (1, 2) Store		Quickly saves the present settings of the unit in Preset location 1 or 2	
		Preset (1, 2) Recall		Quickly recalls the settings of the unit stored in Preset location 1 or 2	
	Set to Default			Sets the units to the default settings	
I/O Config >	USB Status >			Displays the USB connect string	
	LAN Status >	LAN Restart		Displays the LAN status Click LAN Restart to restart the LAN	
		LAN Reset		Resets the LAN to the previous settings	
	LAN Settings >	DHCP On Off		Displays the LAN settings Turns DHCP on or off	
		AutoDNS On Off		Turns AutoDNS on or off	
		mDNS On Off		Turns mDNS on or off	
		Keyboard		Available when a text field is selected	
		Set to Default		Sets the LAN to the factory defaults	
	Digital I/O >	Input Control	Input Control (1, 2, 3)	Input Control On Off	Configures Input Control 1, 2, or 3 Turns input control on or off
				Polarity Pos Neg	Sets polarity for Input Control 1, 2, or 3
				Mode Live Latch	Sets the mode for the Output inhibit signal
		Output Status	Output status (5, 6, 7, 8)	Output Status On Off	Configures Output Status 5, 6, 7, or 8 Turns output status on or off
				Polarity Pos Neg	Sets polarity for Output Status 5, 6, 7, or 8

### 3 User Information

Menu Heading			Description
	Config IO	Config I/O (9, 10)	Config IO On Off Configures Config IO 9, or 10 Turns config IO on or off
			Direction In Out Specifies the IO direction
			Polarity Pos Neg Sets polarity for Config IO 9, or 10
			Mode Live Latch Sets the mode for the Output inhibit signal
	GPIB Status >		Displays and sets the GPIB address Only available with GPIB option.
System Settings >	User Options >	Display On Off	Turns the Display on or off
		Scr Sav On Off	Turns the Screen saver on or off
		Phase Conv 123 ABC UVW	Selects the Phase naming convention The default is Phase 1, Phase 2, Phase 3
		Key Click On Off	Turns key clicks on or off
		Sleep On Off	Turns the Sleep Function on or off
	Date & Time >	Year	Specify the year
		Month	Specify the month
		Day	Specify the day
		Hour	Specify the hour
		Minute	Specify the minute
	Advance >	Offset Adjust	Adjusts the offset for the output and sense terminals
		Power Mgmt	↑, ↓ Selects internal power modules to disable in order to limit power
		Enable All	Enables all selected power modules
		Disable All	Removes power management for all
	About >	Firmware Update >	Update Displays instrument information Also access the firmware update function
	Sanitize		Permanently deletes all data stored in instrument memory
Error >	Clear		Displays errors and clears error display
Help >	↑, ↓		Selects the help topic
Lock Unlock			Locks and unlocks the front panel keys

## Programming the Output

### Programming Mode, Range, Coupling, and Suppression

#### Programming AC Voltage

#### Programming DC Voltage

#### Typical Commands

You can program the output voltage, frequency, frequency limits, and starting phase angle. Before programming the output, select the appropriate output mode and voltage range.

### Programming Mode, Range, Coupling, and Suppression

From the front panel softkeys select **Source Settings**



#### Voltage Range, Coupling, and Suppression

In the **Source Settings** menu, start by specifying the **voltage range**. Toggle the **Range** softkeybutton to select either Hi or Lo range. The output must be off to change the range settings. The instrument checks to ensure that currently active settings are within the new range setting.



Next, specify the coupling. Toggle the **Coupling** softkey to select one of three couplings: ACDC, AC, or DC. AC produces AC output, DC produces DC output, and ACDC produces AC superimposed on the DC output.

Refer to **Turning the Output On or Off** for information about activating voltage **Surge Suppression**, and additional output programming functions available under the **Advance** softkey.

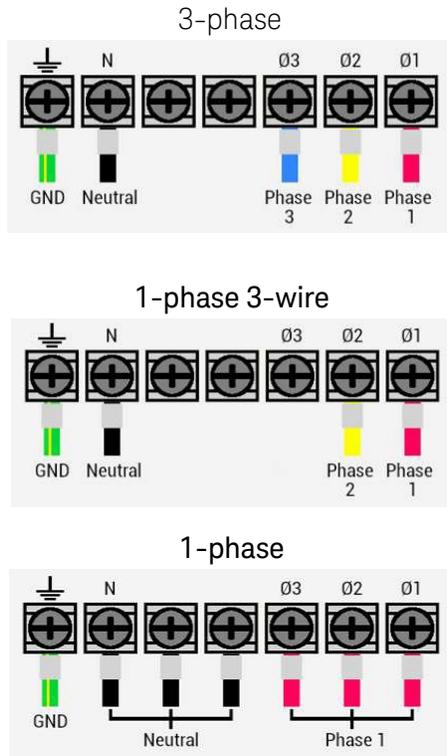
#### Output Mode

Then select the output **Mode** softkey, and select one of three output modes.

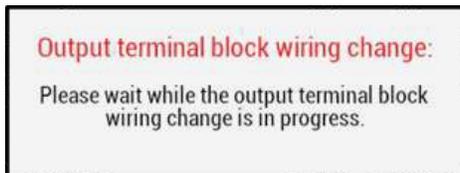


Check to make sure that the wiring on the back of your unit matches your mode selection. A confirmation message will ask you to confirm the wiring. The instrument will then configure the internal relays to match the wiring selection.

### 3 User Information



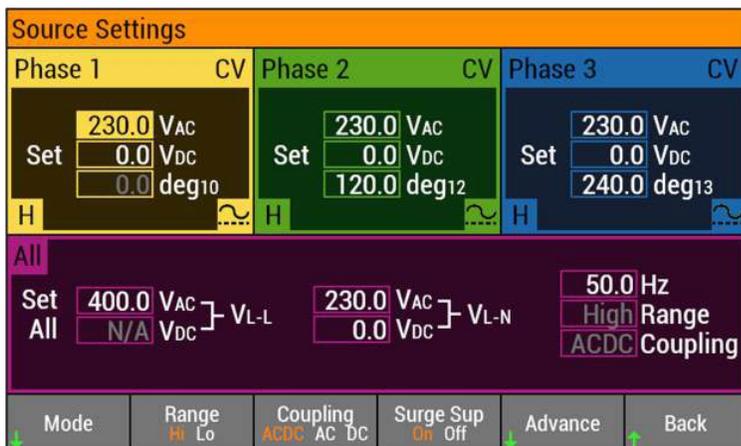
The instrument will then configure the internal relays to match the wiring selection.



## Programming AC Voltage

### Output Voltage, Frequency, and Phase Angle

The following display shows how to set the voltage, frequency, and phase. Note that the display indicates that the High range **H** has been selected for all phases, and the coupling is ACDC **?**



You can specify individual (or independent) settings for each phase (1, 2, or 3), or specify the same value for ALL phases.

Depending on the Coupling selection you can specify an AC voltage + DC voltage. You can also specify the phase angle between phases. Note that phase differences other than  $120^\circ$  between phases will result in an unbalanced output, which will be indicated in the title bar **!UNB**

Settings in the **All** sub frame are global and apply to all phases. Within the All settings, you can opt to set the line-to-line voltage instead of the line-to-neutral voltage. This will overwrite any previous settings in the individual phase setting. The line to neutral voltage setting field will be unavailable as all three phases will be set to the same value. This also applies to the DC voltage settings.

You can set the output frequency from 40 to 5000 Hz for AC mode and ACDC mode, regardless of whether the output is on. The frequency can only be set in the **All** sub frame, and applies to all phases.

The voltage range and coupling can also be set in the **All** sub frame, but are unavailable when the output is enabled as shown in the example above (the CV status indicates that the output is enabled).

### Output Settings in 1 phase 3-wire and 1 phase modes

Not all settings in the **All** sub frame can be changed. It depends on the output mode. For example, in three-phase mode; the line to line DC voltage cannot be set. Hence, N/A is used to indicate this. Below are examples of the source settings pages for two additional different output modes.

#### 1 phase 3-wire

Source Settings					
Phase 1 CV		Phase 2 CV		1P3W Mode	
Set 200.0 V <sub>AC</sub> 10.0 V <sub>DC</sub> 0.0 deg <sub>10</sub>		Set 200.0 V <sub>AC</sub> -10.0 V <sub>DC</sub> 180.0 deg <sub>12</sub>			
All					
Set 400.0 V <sub>AC</sub> V <sub>L-L</sub> 20.0 V <sub>DC</sub>		200.0 V <sub>AC</sub> V <sub>L-N</sub> 10.0 V <sub>DC</sub>		50.0 Hz High Range ACDC Coupling	
Mode	Range Hi Lo	Coupling ACDC AC DC	Surge Sup On Off	Advance	Back

#### 1 phase

Source Settings					
Phase 1 CV		1P Mode		1P Mode	
Set 200.0 V <sub>AC</sub> 0.0 V <sub>DC</sub> 0.0 deg <sub>10</sub>					
All					
Set N/A V <sub>AC</sub> V <sub>L-L</sub> N/A V <sub>DC</sub>		N/A V <sub>AC</sub> V <sub>L-N</sub> N/A V <sub>DC</sub>		50.0 Hz High Range ACDC Coupling	
Mode	Range Hi Lo	Coupling ACDC AC DC	Surge Sup On Off	Advance	Back

## Programming DC Voltage

**WARNING** In DC mode, the Line (P1) terminals are at positive potential and the Neutral terminals are at negative potential when setting the positive value. The opposite is true when setting the negative value.

The AC6900 Series can output DC voltage. When the output is turned on, you cannot change the output mode or voltage range. You must turn the output off first. You can set the voltage regardless of whether the output is on or off.

### Voltage Range, Coupling, and Suppression

In the **Source Settings** menu, start with setting the coupling to **DC** by toggling the **Coupling** softkey.



Toggle the **Range** softkey to select either Hi or Lo range. The output must be off to change the range settings. The instrument checks to ensure that currently active settings are within the new range setting.

Refer to **Turning the Output On or Off** for information about activating voltage **Surge Suppression**, and additional output programming functions available under the **Advance** softkey.

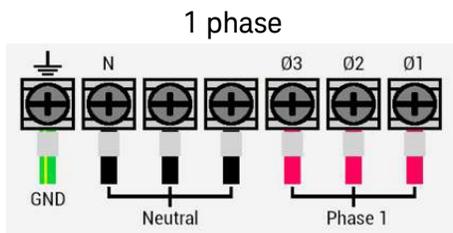
### Output Mode

Select the **Mode** softkey and select **1-Phase**.

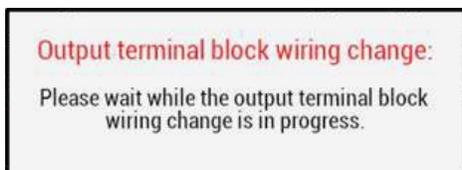
Note that you can also select 1-phase, 3-wire if you wish to output positive and negative DC voltages.



Check to make sure that the wiring on the back of your unit matches your mode selection. A confirmation message will ask you to confirm the wiring. The instrument will then configure the internal relays to match the wiring selection.



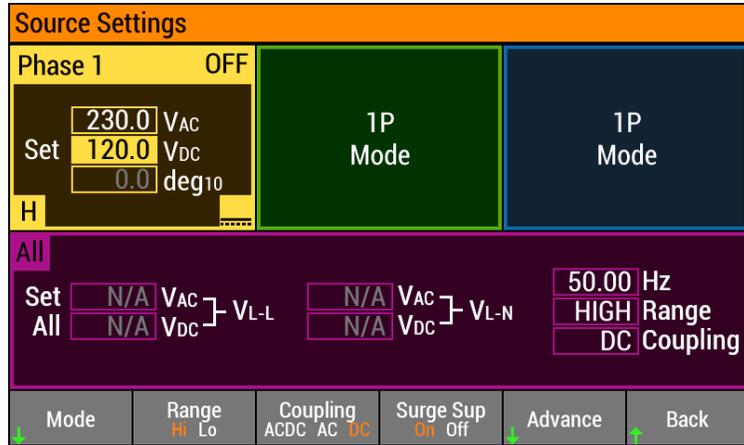
The instrument will then configure the internal relays to match the wiring selection.



### DC Voltage

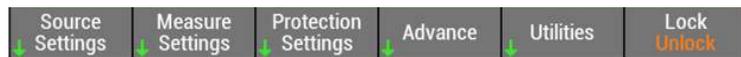
Specify the DC voltage to be output as shown below. In this example the DC voltage will be superimposed on the AC voltage.

Note that you can also output just DC voltage by not programming the AC voltage.

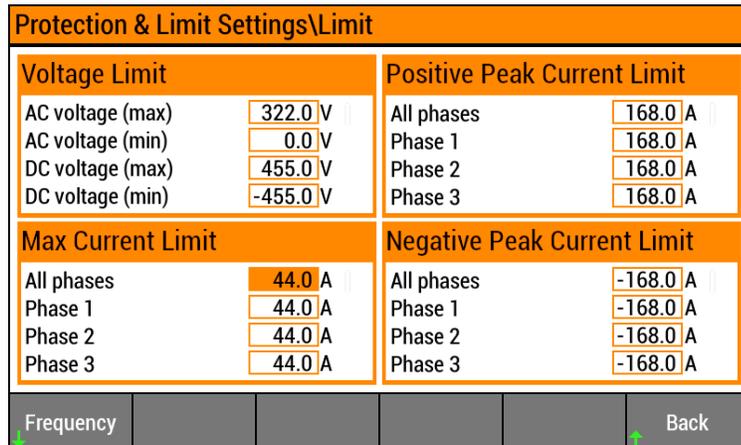


It is always a good idea to check the limits to make sure the value that you program is within the specified limit setting.

Press the [Protection Settings] softkey to access the protection and limit settings.



Then select the [Limits] softkey.



## Typical Commands

To set AC voltage:

<b>SYSTem:CONFigure:WIRing 3</b>	Selects 3-phase mode.
<b>OUTPut:COUPling AC</b>	Select AC mode.
<b>VOLTage:RANGe 160</b>	Select the 160 V range.
<b>VOLTage 110</b>	Specify 110 V.
<b>FREQuency 55</b>	Specify 55 Hz.
<b>OUTPut ON</b>	Turn the output on.

To set DC voltage:

<b>SYSTem:CONFigure:WIRing 1</b>	Selects 3-phase mode.
<b>OUTPut:COUPling DC</b>	Select DC mode.
<b>VOLTage:RANGe 160</b>	Select the 160 V range.
<b>VOLTage:OFFSet 40</b>	Specify 40 V.
<b>OUTPut ON</b>	Turn the output on.

To query maximum and minimum limits:

**VOLTage? MINimum**

**VOLTage? MAXimum**

**FREQuency? MINimum**

**FREQuency? MAXimum**

**VOLTage:OFFSet? MINimum**

**VOLTage:OFFSet? MAXimum**

## Setting Protection and Limits

### Setting Protection

### Setting Limits

### Typical Commands

## Setting Protection

The protection function applies limits when there is a danger of damaging the instrument's internal circuitry or to protect the load. When a protection function is activated, an Error is generated, and the output is turned off.

Press the **Protection Settings** softkey to access the protection settings.



Then select the **Protection** softkey.



Enter the Protection Settings in the following display.

Protection & Limit Settings\Protection	
<b>Over Voltage Protection (OVP)</b> OV <input type="text" value="500.5"/> V Positive peak OV <input type="text" value="500.5"/> V Negative peak OV <input type="text" value="-500.5"/> V	<b>Over Current Protection (OCP)</b> Trip timer <input type="text" value="10"/> s
<b>Under Voltage Protection (UVP)</b> UV <input type="text" value="0.0"/> V	<b>Watchdog Protection (WDP)</b> Delay timer <input type="text" value="60"/> s
UVP On Off	OCP On Off
WDP On Off	Back

### Configure OverVoltage and UnderVoltage Protection

Overvoltage protection cannot be disabled. For overvoltage protections, enter values for OV, Positive Peak OV and Negative Peak OV. By default, these are set to their maximum allowable values.

For undervoltage protection, enter an undervoltage protection that turns the output off when the output goes below the undervoltage value. The default setting is zero. Toggle the UVP softkey to turn undervoltage protection on or off.

If the measured voltage exceeds the OVP value, or is less than the UVP value, an error occurs, and the output turns off.

### Configure OverCurrent Protection

You can turn overcurrent protection on or off. Toggle the **OCP** softkey on or off.

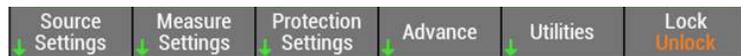
When you turn overcurrent protection on, you can also specify the amount of time that must elapse before the output is turned off when the current limit is exceeded. This is useful when you don't want the output to be turned off due to issues such as inrush current causing short-term overloads. Timer values can be specified from 0 to 10 seconds.

**NOTE** The current detection response is not instantaneous. Depending on the current measurement response speed, there may be a delay of approximately 0.1 seconds.

To specify the current limits, refer to [Setting Limits](#).

### Clear Overcurrent Protection

Press the **Protection Settings** softkey to access the protection settings.



To clear an overcurrent protection condition, select **Protection Clear**.



The current output status condition is displayed in the title bar of the output phase to help you ensure that clearing the protection condition is appropriate and likely to produce expected results. See [Phases 1-3](#).

### Configure Watchdog protection

This function turns off the output when SCPI communication is not performed for a length of time that is equal to or exceeds the watchdog setting. It is disabled by factory default.

The time until the watchdog protection is activated can be set from 1 second to 3600 seconds (default = 60 s)

You can turn watchdog protection on or off. Toggle the **WDP** softkey on or off.

### Setting Limits

The Limits function limits the instrument's output setting to prevent damage to the load caused by operator error. You should specify limits before applying output to the load, but you can set limits with the OUTPUT on. Note that the limit value takes precedence over the setting value for voltage and current. If the current setting value exceeds the limit range when the voltage or frequency limit value is changed, the setting value (voltage or current) is set to a limit value that is close to the limit setting.

Press the **Protection Settings** softkey to access the limits settings.



Then select the **Limit** softkey.



Enter the Limit Settings in the following display.

Protection & Limit Settings\Limit	
<b>Voltage Limit</b>	<b>Positive Peak Current Limit</b>
AC voltage (max) <input type="text" value="322.0"/> V	All phases <input type="text" value="168.0"/> A
AC voltage (min) <input type="text" value="0.0"/> V	Phase 1 <input type="text" value="168.0"/> A
DC voltage (max) <input type="text" value="455.0"/> V	Phase 2 <input type="text" value="168.0"/> A
DC voltage (min) <input type="text" value="-455.0"/> V	Phase 3 <input type="text" value="168.0"/> A
<b>Max Current Limit</b>	<b>Negative Peak Current Limit</b>
All phases <input type="text" value="44.0"/> A	All phases <input type="text" value="-168.0"/> A
Phase 1 <input type="text" value="44.0"/> A	Phase 1 <input type="text" value="-168.0"/> A
Phase 2 <input type="text" value="44.0"/> A	Phase 2 <input type="text" value="-168.0"/> A
Phase 3 <input type="text" value="44.0"/> A	Phase 3 <input type="text" value="-168.0"/> A
Frequency	Back

### Voltage limits and voltage limit operation

The instrument lets you to limit the allowable values for the voltage offset. The following table shows the maximum voltage and current limit settings for all models, which allows the limits to be set to any value within the given range. The factory default lower limit of DC mode is 0.0 V, so remember to change the limit if you need to output a negative DC voltage.

Limit Functions		Settings Range	Resolution
Voltage Limit	Upper & Lower AC volt	0.0 V to 322.0 V	0.1 V
	Upper & Lower DC volt	-455.0 V to 455.0 V	0.1 V
Current Limit	Current limit	Maximum current limit $\times 0.1$	0.01 A (0.35 A to 100.0 A)
		maximum current limit $\times 1.1$	0.1 A (100.0 A to 1000 A)
	Positive & Negative limit	Maximum current limit $\times 0.1$	0.01 A (0.35 A to 100.0 A)
		maximum current limit $\times 4.2$	0.1 A (100.0 A to 1000 A)

### Current limits and current limit operation

Limits can be placed on the allowable current that flows through the load. There are maximum current, positive peak current, and a negative peak current limits. You can set limits according to the load conditions.

The positive and negative peak current limits instantly limit the peak output currents based on the limit settings. The maximum current limit operates on the rms value of the output current.

Under **Protection Settings** you can set the action to perform (whether to turn off the output, or limit the current) when the current exceeds the Max current limit. You can also set the amount of time that must elapse before the output is turned off when the current limit is exceeded.

**NOTE** The current detection response is not instantaneous. Depending on the current measurement response speed, there may be a delay of approximately 0.1 seconds

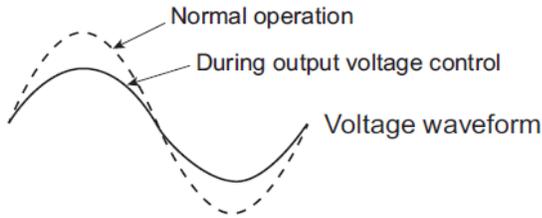
With overcurrent protection ON:

### 3 User Information

If the output current exceeds the current limit for more than the specified time, an error is generated and the output is turned off

With overcurrent protection **OFF**:

If the output current exceeds the current limit, the instrument prevents the output current from exceeding the current limit decreasing the output voltage.



If you select to control the output voltage, the following functions will not be available:

- Soft start and Soft Stop (set output rise and fall time).
- Run power line abnormality simulations.
- Run sequences.
- Soft sensing and regulation adjustments.

#### Frequency limits

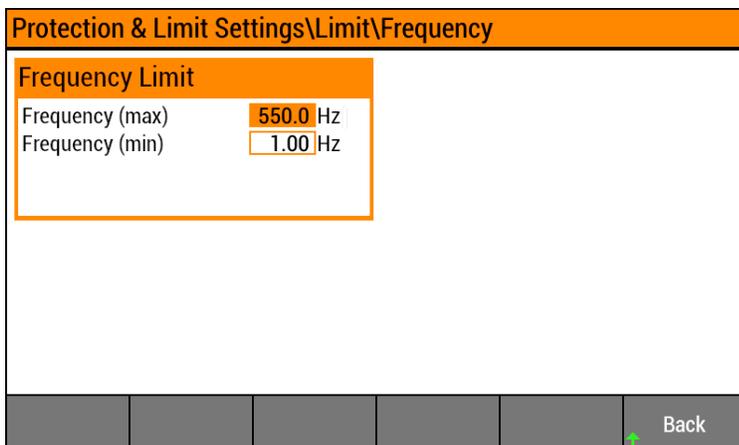
You can set frequency limits regardless of whether the output is on or off.

Select the **Frequency** softkey.



Set the frequency limit to prevent the instrument from generating a frequency that is greater than the limit.

**NOTE** The output frequency is limited to 550 Hz on "L" models in 3-phase mode only.



## Typical Commands

The following lists some typical protection commands:

<code>VOLTage:PROTection:UPPer 150</code>	Sets upper overvoltage limit
<code>VOLTage:PROTection:LOWer 50</code>	Sets lower overvoltage limit
<code>VOLTage:PROTection:LOWer:STATe ON</code>	Enables the lower overvoltage protection
<code>VOLTage:PROTection:PEAK:UPPer 300</code>	Sets positive overvoltage peak protection
<code>VOLTage:PROTection:PEAK:LOWer 300</code>	Sets negative overvoltage peak protection
<code>CURRent:PROTection:STATe 1</code>	Overcurrent protection disables the output
<code>CURRent:PROTection:DElay 5</code>	Delay before before disabling the output
<code>OUTPut:PROTection:WDOG ON</code>	Enables watchdog protection
<code>OUTPut:PROTection:WDOG:DElay 600</code>	Sets the watchdog timer

The following lists some typical output limit commands:

<code>VOLTage:LIMit:UPPer MAX</code>	Sets upper AC voltage limit
<code>VOLTage:LIMit:LOWer MIN</code>	Sets lower AC voltage limit
<code>VOLTage:OFFSet:LIMit:UPPer MAX</code>	Sets upper DC voltage limit
<code>VOLTage:OFFSet:LIMit:LOWer MIN</code>	Sets lower DC voltage limit
<code>CURRent MAX</code>	Sets current limit for all phases
<code>CURRent:PEAK:UPPer MAX</code>	Sets upper peak current limit for all phases
<code>CURRent:PEAK:LOWer MAX</code>	Sets lower peak current limit for all phases
<code>FREQuency:LIMit:UPPer MAX</code>	Sets upper frequency limit
<code>FREQuency:LIMit:LOWer MIN</code>	Sets lower frequency limit

## Turning the Output On and Off

### Enable the Output

### Impedance with Output Off

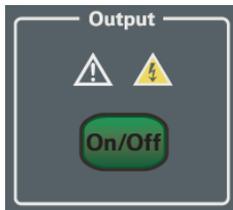
### Voltage Surge Suppression

### Advanced On/Off Functions

### Typical Commands

## Enable the Output

Press **On/Off** key to enable the output. The On/Off key illuminates. 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 shows the output's status.



For a description of the status indicators, refer to [Front Panel Display at a Glance](#).

Press **On/Off** again to disable the output.

OFF: The output voltage turns off (into a high impedance mode). The output is always off at power-on.

If a protection function trips, the output also turns off. However, if the current limit operation is limit control and the overload protection function (current limit) trips, the output is not turned off.

### **WARNING** Risk of Electric Shock

To prevent the possibility of electric shock, do not touch the output terminal block.

If a capacitor, battery, or similar device is connected as a load in DC mode, voltage remains at the section connected to the output terminal block even when the output is off until the load energy is discharged. The discharge time of the internal capacitor when no load is connected is approximately 0.1 seconds. To prevent the possibility of electric shock, do not touch the output terminal block.

---

**CAUTION** When the output is turned on, several volts of undershoot or overshoot may appear for a time period on the order of ten microseconds.

---

## Impedance with Output Off

The AC6900 Series instruments do not disconnect output from the internal circuits mechanically using switches and relays. Instead, when the output is turned off, the instruments electrically increase output impedance to limit the output without chattering.

The approximate resistance in the high-impedance condition is shown below, so if the load is a battery or a similar device, a slight current may flow into the instrument and the load may be discharged.

Model	1 phase output		1 phase 3 wire and 3phase outputs	
	Low range	High range	Low range	High range
AC6903	~55 k $\Omega$	~237 k $\Omega$	~160 k $\Omega$	~643 k $\Omega$
AC6906	~55 k $\Omega$	~237 k $\Omega$	~160 k $\Omega$	~643 k $\Omega$
AC6912	~27 k $\Omega$	~122 k $\Omega$	~81 k $\Omega$	~346 k $\Omega$
AC6918	~18 k $\Omega$	~82 k $\Omega$	~55 k $\Omega$	~237 k $\Omega$

## Voltage Surge Suppression

In the **Source Settings** menu, you can activate voltage surge suppression (**Surge Sup** softkey) when the output is turned off.



Refer to **Programming the Output** for information about programming the output **Mode**, **Range** and **Coupling**.

With voltage surge suppression **ON**:

The output is turned off after the output voltage is set to 0 V (low output impedance), after which the output impedance is changed to high. Initially setting the impedance low prevents large voltage overshooting and undershooting by the load immediately after the output is turned off. It is recommended that you use the instrument with the voltage surge suppression set to on (the default).

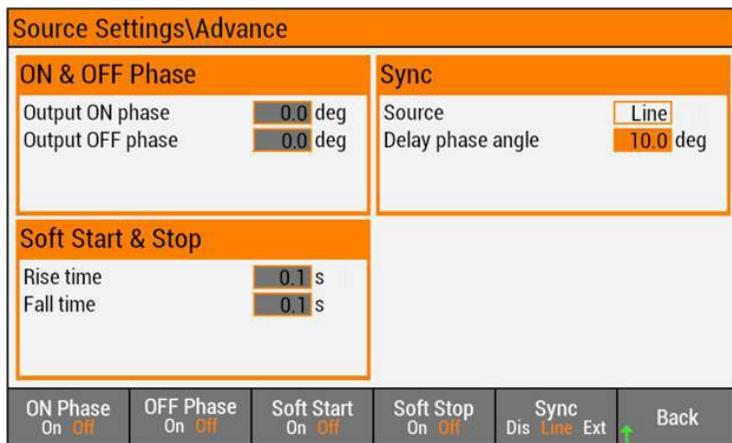
Note that if the voltage surge suppression is on, an unexpected current may flow through the instrument immediately after the output is turned off depending on the connected load (power conditioner, regenerative inverter, battery, etc.). If this is unacceptable, turn voltage surge suppression off.

With voltage surge suppression **OFF**:

When the output is turned off, the output of this product is at high impedance (refer to above chart).

## Advanced On/Off Functions

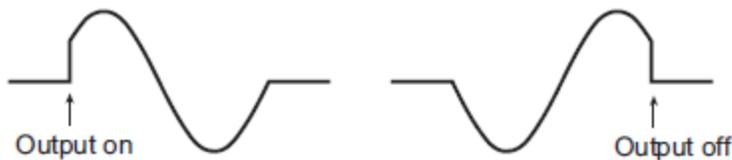
In the **Source Settings** menu, select the **Advance** softkey to enable or disable output phase control, specify soft start and stop, and enable output frequency synchronization.



### Output ON & OFF Phase

Without enabling phase control, the output turn-on will occur at random points in the output waveform.

You can control both output-on and output-off phases by specifying a turn-on and turn-off phase in degrees. The default setting is zero degrees. You can specify values from 0 to 360 degrees. To enable the phase controls, toggle the **On Phase** and **Off Phase** softkeys to ON.



**NOTE** With phase control off, the output always turns off at the zero-crossing phase to ensure the instrument's output capacitor discharges when there is no load.

### Soft Start & Stop

Soft start lets you gradually increased the output voltage when the output is turned on to control the load device's inrush current. Suppressing the inrush current prevents the voltage from dropping and the output from being turned off as a result of an alarm activation

Soft Stop lets you gradually decreased the output voltage when the output is turned off to control the inductive kickback that occurs when the current is cut off.

The default rise and fall time setting is 0.1 seconds. You can specify values from 0.1 to 30.0 seconds. To enable the soft start and soft stop controls, toggle the **Soft Start** and **Soft Stop** softkeys to ON.



Soft start and stop cannot be set when the product is being controlled with an external analog signal and the signal source is set to external signal (EXT) only or when the product is being controlled with an external analog signal and the voltage is being varied using an external DC signal. Soft start and stop are disabled when the current limit is exceeded.

### Frequency Sync

The sync function synchronizes the frequency and phase of the instrument's output voltage to the 50 Hz or 60 Hz input line or to an external sync signal. This function operates when the lower frequency limit is less than 45 Hz and the upper frequency limit is greater than 65 Hz. This is useful in situations when the display of an external measuring instrument is not stable.

To enable the sync function, toggle the **Sync** to LINE or EXT.

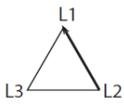
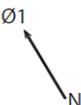
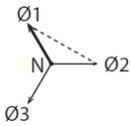
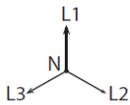
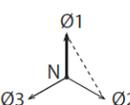
When LINE is selected, sync function synchronizes the frequency and phase of the output to the 50 Hz or 60 Hz input line (refer to the following table).

When EXT is selected, sync function synchronizes the frequency and phase of the output to an external sync input signal (refer to the [Digital IO Configuration](#)).

To finely control the synchronization phase of the input voltage on three-phase input models, set the Delay phase angle to a value from 0 to 360 degrees.

#### NOTE

When turning off frequency synchronization, the output frequency is set to either 50 Hz or 60 Hz.

Input Wiring	1-phase output and 1-phase 3-wire output	3-wire output
 200 V input	 In-phase with input $V_{L1-L2}$	 $V_{\text{Ø1-N}}$ and $V_{L1-L2}$ are in phase
 400 V input	 In-phase with input $V_{L1-N}$	 In-phase with the input

### Typical Commands

The following lists additional output turn-on/turn off configuration commands:

<b>OUTPut ON OFF</b>	Turns the output on or off
<b>OUTPut:SSUPpression:STATe ON</b>	Enables output surge suppression
<b>OUTPut:PHASe:ON</b>	Enables the output-on phase control
<b>OUTPut:PHASe:ON:LEVel 90</b>	Sets the output-on phase
<b>OUTPut:PHASe:OFF</b>	Enables the output-off phase control
<b>OUTPut:PHASe:OFF:LEVel 90</b>	Sets the output-off phase
<b>OUTPut:SStart ON</b>	Enables soft start turn-on

### 3 User Information

<code>OUTPut:SStart:TIME 10</code>	Sets the soft start turn-on
<code>OUTPut:SStart:FALL ON</code>	Enables soft start turn-off
<code>OUTPut:SStart:TIME:FALL 10</code>	Sets the soft start turn-off
<code>FREQuency:SYNChronous ON</code>	Enables frequency synchronous
<code>FREQuency:SYNChronous:MODE LINE</code>	Sets the frequency synchronous source
<code>FREQuency:SYNChronous:PHASe 10</code>	Sets the frequency synchronous phase

## Displaying Measurements

### Measurement Settings

### Advanced Settings

### Sense Terminal Settings

### Typical Commands

All output measurements are shown on the front panel displays. Pressing the **Meter** key lets you sequence through the various measurement displays.

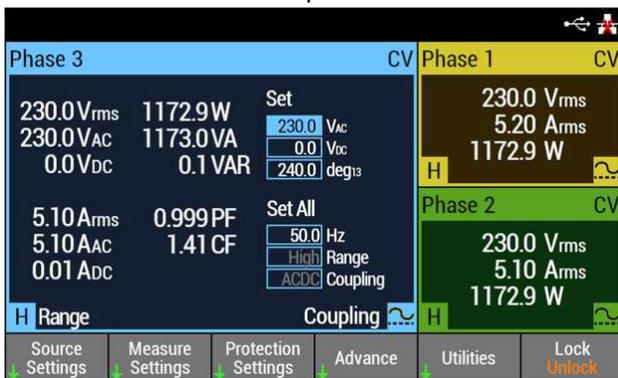
Meter All -- >



Meter 3 phase -->



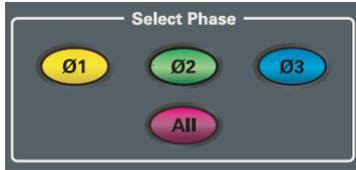
Meter 1 phase -->



### 3 User Information

The default display view is Meter All view. Sequencing through the measurement views provides additional measurement and setting details about the selected phase.

Pressing the [Ø1], [Ø2] or [Ø3] key can be used to select the phase of interest. Pressing the similar key again will also causes it to cycle between the metering view with the selected phase activated.



While in the metering view, pressing the [ALL] key will always change the metering view back to Meter All View with the All phase area selected.



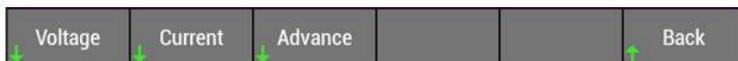
The **All** area of the display shows the measurements that apply to all phases. On the left side, the line-to-line voltage between the indicated phases is shown (phase 1 to 2, 2 to 3, and 1 to 3). The right side of the display shows the line-to-neutral voltage, provided it is the same for all phases. It also displays the total power in Watts, the apparent power in VA, and the power factor.

### Measurement Settings

From the front panel softkeys select **Measure Settings**



The measure settings menu lets you select from the following measurement functions:



Selecting either the **Voltage** or **Current** softkeys brings up the following menu, which provides the same measurement couplings for either measurement.

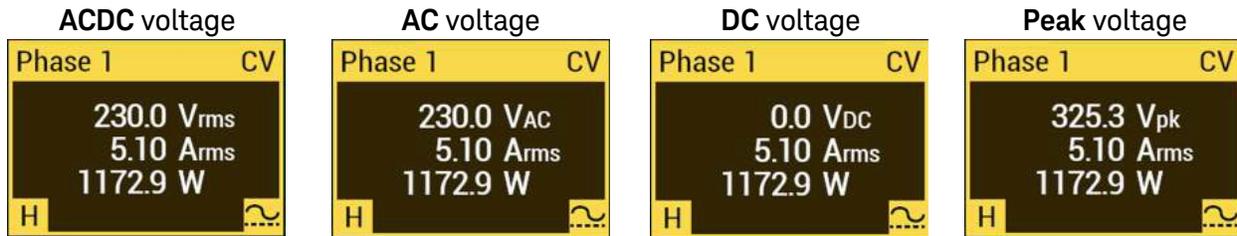


Selecting ACDC, AC, DC, or Peak applies the selected measurement coupling to the voltage or current measurements.

- ACDC** The rms value of the output is presented in the metering displays.
- AC** The AC component of the output is presented in the metering displays.
- DC** The average (DC) component of the output is presented in the metering displays.

**Peak** The peak current is displayed as an absolute value of the maximum instantaneous current measured.

The following shows the voltage coupling selections. Similar couplings apply to the current function.

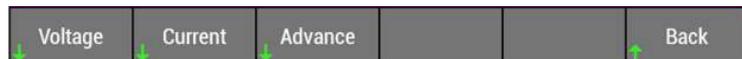


Note that there is no DC voltage measurement in the above example because the instrument coupling is set to ACDC . Also note that even if a negative DC voltage is being generated, the peak current is displayed as a positive value.

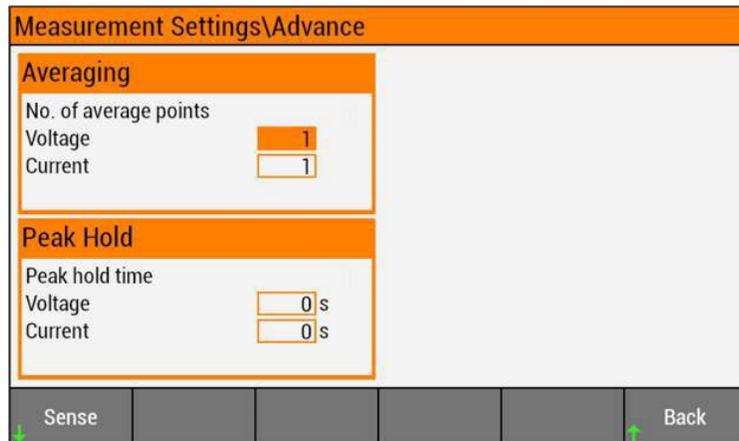
If the selection is set to Peak, the peak measurement can be held. This additional setting associated with the peak measurement coupling, is available under the **Advance** menu. Selecting the **Peak Clear** softkey clears the peak hold measurement.

## Advanced Settings

From the front panel softkeys select **Advance** to access the advanced measurement settings.



The advanced settings menu lets you configure measurement Averaging and Peak Hold



**Averaging** - Enter the number of averaged points in the Voltage and Current fields. The Voltage and current fields let you choose from 1 to 32 points. Use the Data Entry keypad to enter your values, then press Enter.

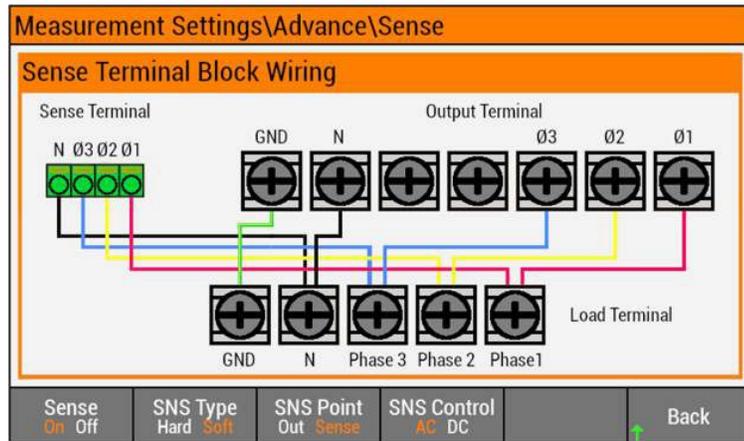
**Peak Hold** - Enter the peak hold time in the Voltage and Current fields. Values are in seconds, from 0 to 10. If a value greater than ten is entered, the peak hold time will be indefinite. Selecting the **Peak Clear** softkey clears the peak hold measurement.

## Sense Terminal Settings

Select **Sense** to access the sense configuration settings.



Note that the sense wiring diagram is also displayed. Refer to Sense Terminal Wiring below.



The **Sense** softkey must be toggled On to access the sense selections.

Toggle the **Sense Type** softkey to select either Hard or Soft sensing.

Hard sensing measures the output voltage compensation point directly across the load. It can compensate the voltage up to approximately 1.5 V for a single load line. Because compensation is performed in real time, the output voltage can be stabilized at a high speed. However, the output may become unstable and oscillate depending on the wiring and the load type. If the output becomes unstable, use soft sensing

Soft sensing is recommended if you are using a load that does not require a fast output voltage response speed. Soft sensing can compensate the voltage up to  $\pm 10\%$  of the product's set voltage. The maximum output voltage during compensation is limited by the rated output voltage. Refer to Voltage Compensation for more information about using remote sensing.

When Soft sense type is selected, two additional softkeys are displayed:

The **SNS Point** softkey toggles between Out and Sense.

Out selects the output terminals as the remote sense point when using Soft sensing.

Sense selects the location where the remote sense wires are connected as the remote sense point when using Soft sensing.

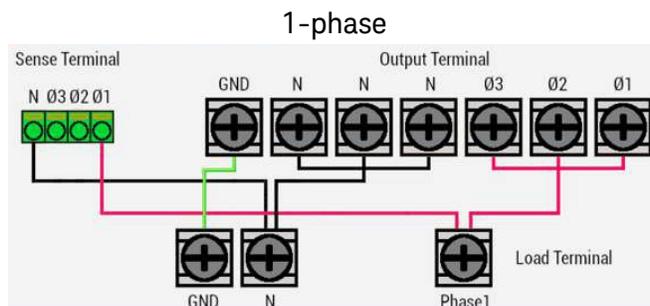
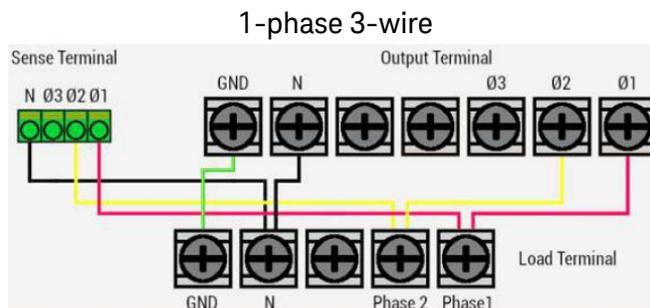
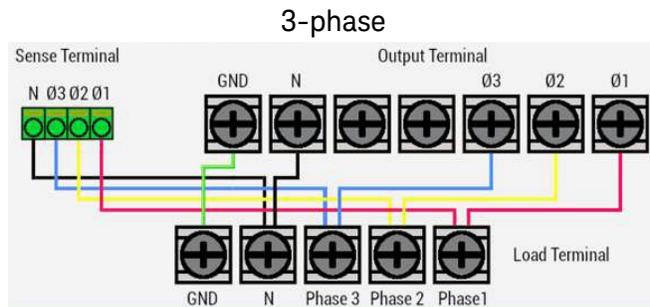
The **SNS Control** softkey toggles between AC and DC.

Specify whether AC or DC measurements are being made when using Soft sensing.

### Sense Terminal Wiring

The Sense display will show one of the following three output terminal settings that you have configured and confirmed in the output **Mode** settings menu.

Now you must also check and confirm that the sense wiring on the back of your unit matches your previous mode selection. A confirmation message will ask you to confirm the sense wiring. The instrument will then configure the internal sense relays to match one of the following wiring selections (3-phase, 1-phase 3-wire, or 1-phase).



The instrument will then configure the internal sense relays to match the wiring selection.



## Typical Commands

### Display commands

<code>DISPlay ON</code>	Turns the front-panel display on or off.
<code>DISPlay:METer:COUPling:CURRent AC</code>	Selects the current measurement unit.
<code>DISPlay:METer:COUPling:VOLTage AC</code>	Selects the voltage measurement unit.
<code>DISPlay:PHASe P123</code>	Selects the phase-naming convention.
<code>DISPlay:VIEW METER_ALL</code>	Selects the phases to display.

### Measurement commands:

<code>FETCh:ALL?</code>	Returns all previous measurements
<code>MEASure:ALL?</code>	Returns all new measurements
<code>FETCh &lt;Measured_Item&gt;?</code>	Returns all previous measurement items
<code>MEASure &lt;Measured_Item&gt;?</code>	Returns all new measurement items

### Sense commands

<code>SENSe:AVERage &lt;value&gt;</code>	Sets the moving averaging count for both voltage and current measurements.
<code>SENSe:CURRent[:PEAK]:HOLD:TIME</code>	Sets the peak current hold time
<code>SENSe:VOLTage[:PEAK]:HOLD:TIME</code>	Sets the peak voltage hold time
<code>SENSe:CURRent[:PEAK]:HOLD:CLEar</code>	Clears the peak current hold value
<code>SENSe:VOLTage[:PEAK]:HOLD:CLEar</code>	Clears the peak voltage hold value

## Using Advanced Functions

### Power Line Abnormality Simulations

#### Programming Output Sequences

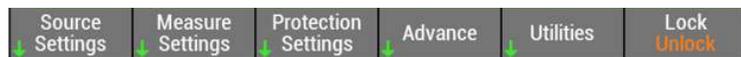
#### Sequence Examples

#### Harmonic Analysis

#### Output Controls

#### Typical Commands

Press the [Advance] softkey to access the advanced functions

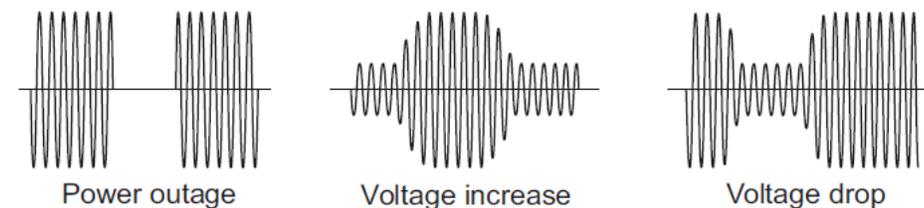


Advance functions include: Simulations, Sequences, Harmonic Analysis, and Power Management

### Power Line Abnormality Simulations

You can simulate power supply line errors by stopping the output (to simulate power failures) and decreasing and increasing the voltage (to simulate voltage dips and pops).

You can use this to test switching power supplies and other electronic devices



A sine wave is generated during the power line abnormality simulations. Even if a special waveform is set with the waveform bank, a sine wave will be generated as soon as you execute the power line abnormality simulation. You can set this function regardless of whether the output is on or off.

Select the **Simulation** softkey to access the Simulation function.

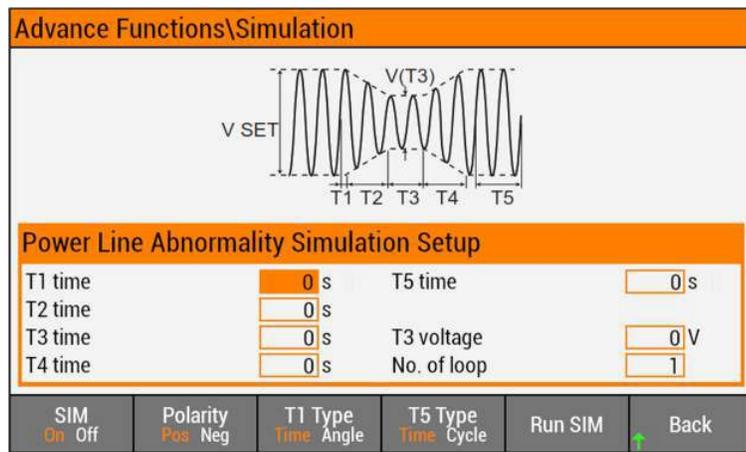


A graphic is displayed that identifies the parameters of the simulated waveform as shown below. The generated waveform created from the front panel applies to all output phases.

#### NOTE

You can create simulations for individual phases as well as from a waveform bank using SCPI **SIMulation** commands.

### 3 User Information



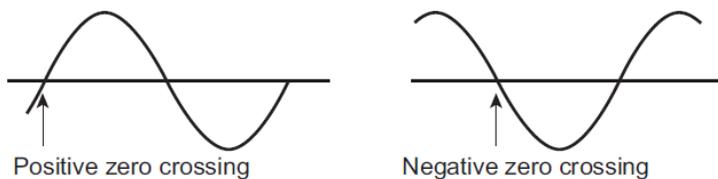
Toggle the **SIM** softkey to turn the simulation function ON.

There are a number of parameters that you can set to configure the simulation waveform.

In the above example the following parameters are shown

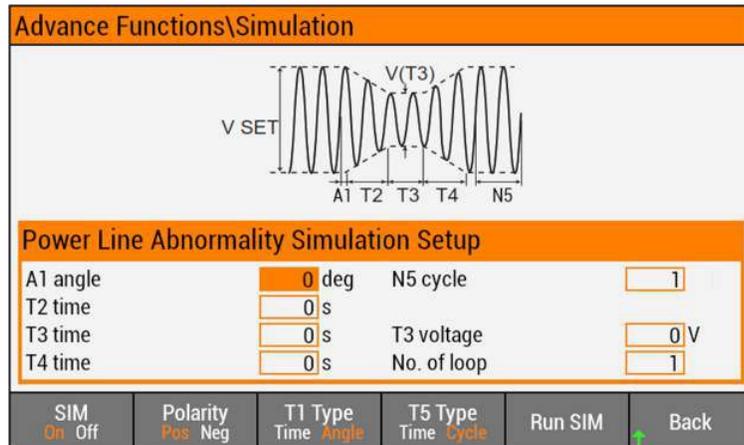
<b>T1 time</b>	Voltage regulation start time in seconds. This is the time or the phase from the waveform's zero crossing (the point where the signal crosses the zero axis) to the point where the voltage regulation – such as increase or decrease – starts to occur. (0.0 s to 0.9999 s)
<b>T2 time</b>	Slope time 1. For Voltage Increase, this indicates how much time is required to raise the voltage to the increase voltage. For Voltage Drops, this indicates how much time is required to lower the voltage to the drop voltage. (0.0 s to 99.99 s)
<b>T3 time</b>	Voltage regulation time. For Voltage Increase, this indicates the length of time that the voltage will be kept at the increase voltage. For Voltage Drops, this indicates the length of time that the voltage will be kept at the drop voltage. (0.1 s to 9.999 s)
<b>T4 time</b>	Slope time 2. For Voltage Increase, this indicates how much time is required to lower the voltage from the increase voltage to the voltage that is in use during the T5 time period. For Voltage Drops, this indicates how much time is required to raise the voltage from the drop voltage to the voltage that is in use during the T5 time period. (0.0 s to 99.99 s)
<b>T5 time</b>	Return time in seconds (or cycles - see below). This indicates how long as a length of time that the voltage will be kept at the level that it returns to after the Voltage Increase or Voltage Drop is completed. (0.0 s to 99.99 s)
<b>T3 voltage</b>	Regulated voltage. For Voltage Increase, this is the voltage level that the voltage will be raised to. For Voltage decrease, this is the voltage level that the voltage will be lowered to. (L range: 0 V to 161.0 V, H range: 0 V to 322.0 V)
<b>No. of loop</b>	Number of times to repeat the T1 to T5 simulation cycle (1 to 9,998; 9999 = infinity).

In addition to the programming the above parameters you can also specify the voltage regulation start polarity. This sets the zero crossing (the time at which the voltage becomes zero) that will be the reference for T1 to either positive zero crossing or negative zero crossing.



Toggle the **Polarity** softkey to indicate either **Positive** or **Negative**.

Furthermore, you can also specify the T1 parameter in degrees, and the T5 parameter in cycles, rather than time, as shown below.



Toggle the **T1 Type** softkey to indicate **Angle**. Toggle the **T5 Type** softkey to indicate **Cycle**

---

**A1 angle** Voltage regulation start angle. This sets the voltage regulation start phase from the waveform's zero crossing (the point where the signal crosses the zero axis) to the point where voltage regulation – such as increase or decrease – starts to occur. (0 to 359.9 degrees)

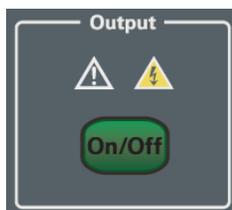
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**N5 cycle** Return cycles. This indicates how long as a number of cycles of the present frequency that the voltage will be kept at the level that it returns to after the Voltage Increase or Voltage Drop is completed. (0 to 999,900)

---

To start the power line abnormality simulation, press the **Run SIM** softkey.

Toggle the **SIM** softkey to OFF to stop the simulation. You can also stop the simulation by turning the output off.



You cannot run a power line abnormality simulation in the following situations:

- The overcurrent protection (OCP) is turned off.
- The regulation adjustment or soft sensing compensation function is in use.
- Low range is selected and the T3 voltage is set to a value outside of its range.
- The T3 voltage is set to a value outside the voltage limits.

## Programming Output Sequences

A sequence is a series of settings—values such as the output voltage, frequency, and time—that are created and saved in advance, and are then recalled and run at a later time.

Sequences are groups of executable units called steps. When a sequence is executed (run), its steps are executed in order, starting with the specified starting step. A single execution of a sequence is completed after the sequence's specified last step has been executed.

You can use the jump function to skip steps and repeatedly execute all the steps in the sequence except for those that have been skipped.

The maximum number of steps is 600

Select the **Sequence** softkey to access the Sequence function.



The sequence steps will be displayed as shown below.

Advance Functions\Sequence									
Step	Freq	ACV	DCV	Time	Outp Stat		Trig		
					On	Out	In	Out	
001	150.0	230.0	100.0	00:00:00.0000	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
002	250.0	100.0	0.0	00:00:01.0010	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	

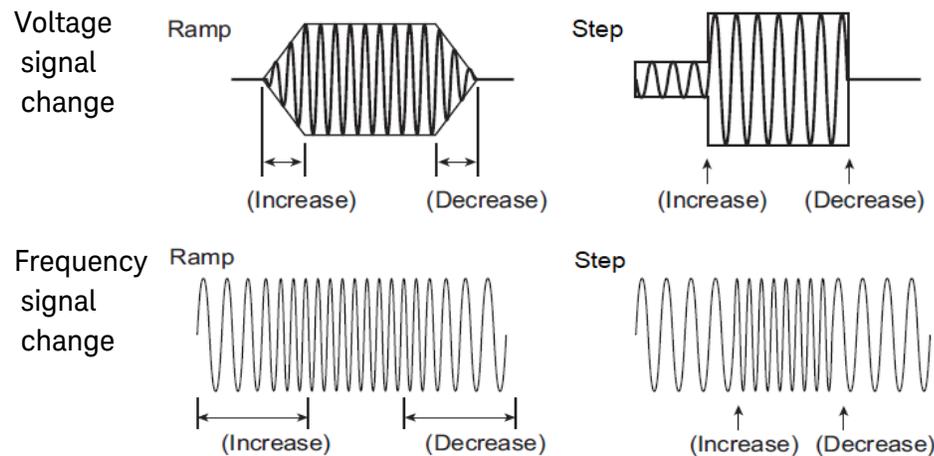
Pressing the **Add** softkey will add a step, either as a first step, or at the end of an existing list. Pressing the **Delete** softkey deletes the active step. Press **Clear All** to delete all steps.

You will notice that each step in the sequence as shown above includes a number of programmable parameters. These are described as follows:

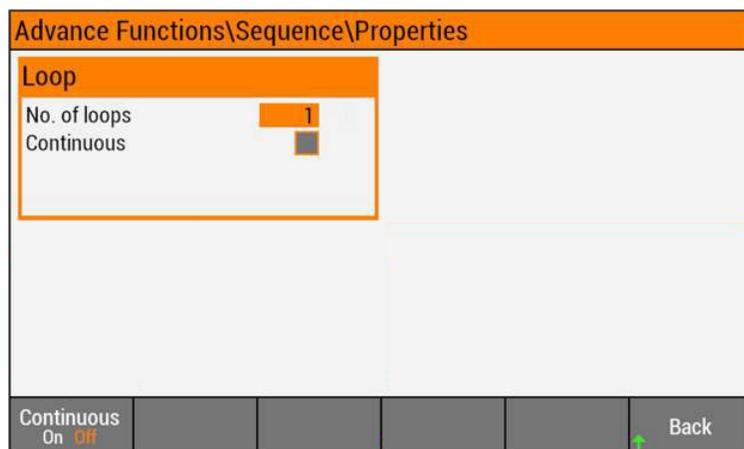
<b>Step</b>	Sets the step that you want to configure (from 1 to 600)
<b>Freq</b>	Sets the step frequency in Hz
<b>ACV</b>	Sets the AC voltage of the step.
<b>DCV</b>	Sets the DC voltage of the step
<b>Time</b>	Sets the time of the sequence execution in hours, minutes, seconds, and milliseconds. Hours = 0 to 23; Minutes = 0 to 59; Seconds = 0 to 59; Milliseconds = 0.1 to 999.9
<b>Outp ON</b>	Turns the output either on (checked) or off (unchecked)

<b>Stat Out</b>	Turns the status signal output either on (checked) or off (unchecked). When the status signal output is turned on, the signal is output only while the step's waveform is being output.
<b>Trig In</b>	Turns the trigger in signal either on (checked) or off (unchecked). When the trigger input is turned on, the sequence is paused after the previous step is finished, and the product enters a trigger input wait state. If a trigger signal (pulse width of at least 10 $\mu$ s) is received through the DIGITAL I/O terminal, the paused is released, and the step is executed.
<b>Trig Out</b>	Turns the trigger in signal either on (checked) or off (unchecked). When the trigger signal output is turned on, the signal is output for several tens of microseconds when a step is executed.

Note that you can select a ramp  or a step  function to change the value linearly over the specified time or change the value as a step. Navigate to the icon and then press the **[Enter]** key to toggle between the two choices. The following illustrates the difference in a ramp or step change:



Press the **Properties** softkey to program additional global parameters for the sequence steps.

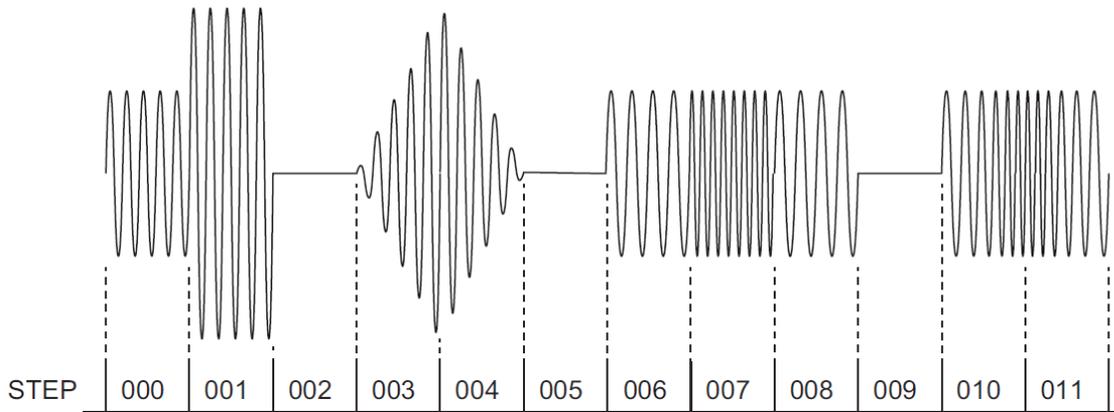


Pressing the **Continuous** softkey toggles the selection between On or Off. When Off, you can specify the number of sequence repetitions in the No. of loops box. You can also check the Continuous box to have the sequence repeat continuously. When set to Off, the sequence runs once.

To run the sequence, press **Back**, then press the **Run SEQ** softkey.

## Sequence Examples

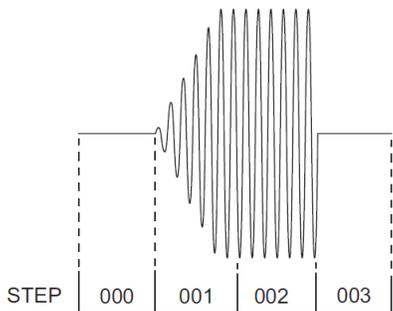
### User-Defined



Step Number	000	001	002	003	004	005	006	007	008	009	010	011
AC Volt V	5	10	0	10	0	0	5	5	5	0	5	5
AC Step/Ramp												
FREQ Hz	50	50	50	50	50	50	40	80	40	40	80	40
FREQ Step/Ramp												
Time ON ms	100	100	100	100	100	100	100	100	100	100	100	100
Output	ON											

In the above example, steps 002, 005, and 009 are used to return the voltage to zero before starting the next step.

### Voltage Ramp

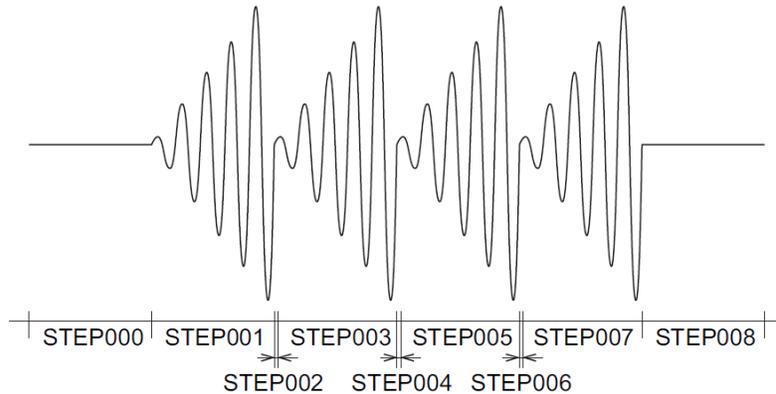


Step Number	000	001	002	003
AC Volt V	0	10	10	0
AC Step/Ramp				
FREQ Hz	50	50	50	50
FREQ Step/Ramp				

Step Number	000	001	002	003
Time ON ms	100	100	100	100
Output	ON	ON	ON	ON

In the above example, step 002 does not generate a ramp because the voltage setting of step 002 is the same as the step 001.

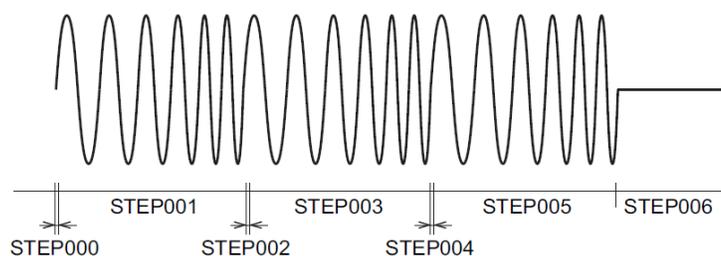
### Voltage Sweeps



Step Number	000	001	002	003	004	005	006	007	008
AC Volt V	0	10	0	10	0	10	0	10	0
AC Step/Ramp									
FREQ Hz	50	50	50	50	50	50	50	50	50
FREQ Step/Ramp									
Time ON ms	100	100	1	100	1	100	1	100	100
Output	ON								

In the above example, small starting steps (steps 000, 002, 004, and 006) are used to set the voltage to zero so that the subsequent ramps will start at the zero before ramping to their 10 V setting.

### Frequency Sweeps



Step Number	000	001	002	003	004	005	006
AC Volt V	0	10	10	10	10	10	0
AC Step/Ramp							
FREQ Hz	40	80	40	80	40	80	40

### 3 User Information

Step Number	000	001	002	003	004	005	006
FREQ Step/Ramp							
Time ON ms	1	100	1	100	1	100	100
Output	ON						

In the above example, steps 000, 002, and 004 set the starting frequency for the each of the frequency ramps.

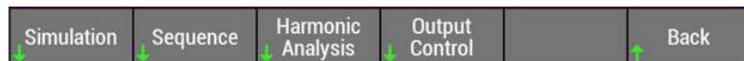
### Harmonic Analysis

You can perform harmonic analysis on the output voltage and output current. A simplified measurement method is used, so this method does not conform to standards such as IEC.

The analyzed harmonic varies depending on the output frequency.

Frequency	Analyzed harmonic	Frequency	Analyzed harmonic
1 Hz to 100 Hz	50th	500.1 Hz to 600 Hz	8th
100.1 Hz to 200 Hz	25th	600.1 Hz to 700 Hz	7th
200.1 Hz to 300 Hz	16th	700.1 Hz to 800 Hz	6th
300.1 Hz to 400 Hz	12th	800.1 Hz to 1000 Hz	5th
400.1 Hz to 500 Hz	10th		

Select the **Harmonic** softkey to access the Harmonic function.



The harmonics list will be displayed as shown below.

Advance Functions\Harmonic Analysis						
Output Type	<input type="radio"/> Volt	THD (Phase 1)		0.01 %		
Harmonic Type	<input type="radio"/> All	THD (Phase 2)		0.01 %		
		THD (Phase 3)		0.01 %		
Order	Ø1 deg	Ø2 deg	Ø3 deg	Ø1 Vrms	Ø2 Vrms	Ø3 Vrms
1	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00
Type	Harmonic			↑	↓	Back
<input type="radio"/> Volt <input type="radio"/> Curr	<input type="radio"/> All <input type="radio"/> Odd <input type="radio"/> Even					

THD is the total harmonic distortion (ratio of the harmonic components up to the 50th harmonic relative to the fundamental component).

Phase degree is the phase difference ( $\pm 180$  deg) from the fundamental voltage waveform.

The measured values of 1st to the 50th harmonic are rms values.

Pressing the **Type** softkey toggles the harmonic list to display either voltage or current harmonics. This is indicated in the Output Type box.

Pressing the **Harmonic** softkey toggles to display either All harmonics, just the Even harmonics, or just the Odd harmonics. This is indicated in the Harmonic Type box. The example below shows the Odd harmonics being displayed.

Because the system is able to show harmonic up to the 50th order and the screen real estate is limited to display only six harmonics at a time, the **↑**, **↓** softkeys are used to scroll through all the harmonic order. When reaching the last page, pressing the Next Page will go back to the first page.

Advance Functions\Harmonic Analysis						
Output Type	Volt		THD (Phase 1)	100 %		
Harmonic Type	Odd		THD (Phase 2)	100 %		
			THD (Phase 3)	100 %		
Order	Ø1 deg	Ø2 deg	Ø3 deg	Ø1 Vrms	Ø2 Vrms	Ø3 Vrms
0	----	----	----	----	----	----
1	0.00	0.00	0.00	0.00	0.00	0.00
2	----	----	----	----	----	----
3	0.00	0.00	0.00	0.00	0.00	0.00
4	----	----	----	----	----	----
5	0.00	0.00	0.00	0.00	0.00	0.00
Type Volt Curr	Harmonic All Odd Even		↑	↓	Back	

## Typical Commands

### Simulation

Configure the simulation parameters.

<b>SIMulation:T1:PHASe:STATe OFF</b>	Sets T1 using time
<b>SIMulation:T5:CYCLe:STATe OFF</b>	Sets T5 using time
<b>SIMulation:T1:TIME 0.5</b>	Sets the voltage regulation starting time
<b>SIMulation:T2:TIME 10</b>	Sets slope time 1
<b>SIMulation:T3:TIME 1</b>	Sets the voltage regulation time
<b>SIMulation:T3:VOLTage 150</b>	Sets the regulated voltage
<b>SIMulation:T4:TIME 10</b>	Sets slope time 2
<b>SIMulation:T5:TIME 10</b>	Sets the return time
<b>SIMulation:REPeat:COUNt 50</b>	Sets the number of repetitions

Execute a power line abnormality simulation

<b>OUTPut ON</b>	Turn the output on.
<b>SIMulation:STATe RUN</b>	Runs the simulation

### 3 User Information

<b>SIMulation:EXECuting?</b>	Queries the simulation status. If running, "RUN" and the repetition number is returned. If stopped, "STOP" is returned.
<b>SIMulation:STATe STOP</b>	Send this command to stop the simulation.

### Sequences

Use the PROG:EDIT command configure each sequence step.

<b>PROGram:Edit 1,50,OFF,100,OFF,0,OFF,0.5,OFF,ON,OFF,ON,0</b>	Step 1
<b>PROGram:Edit 2,60,ON,200,OFF,0,OFF,1,OFF,OFF,OFF,ON,0</b>	Step 2
<b>PROGram:Edit 3,400,ON,230,OFF,0,OFF,2,ON,OFF,OFF,ON.0</b>	Step 3

Configure the sequence conditions.

<b>PROGram:STEP:START 1</b>	Sets the starting step number
<b>PROGram:STEP:END 3</b>	Sets the ending step number
<b>PROGram:LOOP 10</b>	Sets the number of repetitions

Execute a programming sequence.

<b>PROGram:EXEcuting RUN</b>	Runs the sequence
<b>PROGram:EXECuting?</b>	Queries the sequence status.
<b>PROGram:EXECuting STOP</b>	Send this command to stop the sequence

### Harmonic Analysis

<b>FETCh:&lt;Harmonic_Item&gt;?</b>	Returns 50 previous harmonic measurements
<b>MEASure:&lt;Harmonic_Item&gt;?</b>	Returns 50 new harmonic measurements

## Using Output Controls

**Impedance Control**

**Output Response**

**Custom Waveform**

**Analog Input**

**Parallel Output**

**Typical Commands**

Press the **[Advance]** softkey to access the advanced functions



Select the **Output Control** softkey to access the Output controls.



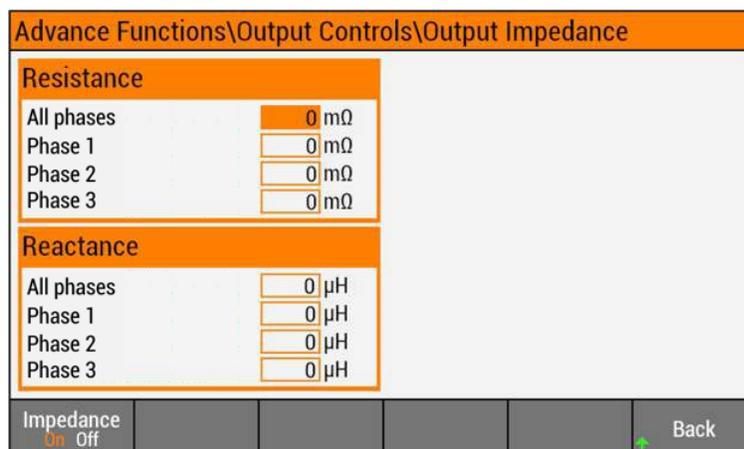
The following output control functions are available



### Impedance Control

This instrument's output impedance is approximately zero ohms. Commercial power sources have an impedance of several milliohms to several ohms. By programming an output impedance, you can simulate the same environment as that provided by commercial power supplies.

The output impedance control can be accessed through the **Impedance Control** softkey. As shown below, the resistance and reactance controls are enabled by toggling the **Impedance** softkey to ON.



### 3 User Information

You can enter a value for All phases, or customize values for each phase. The same applies when programming output reactance values.

Refer to the **Output Impedance** specification for the allowable resistance and reactance values.

If setting value is outside the specifications range, the OUT.Z indicator is displayed in red. If the values exceed the upper limit of the specifications, the largest allowable value will be programmed. If the value is less than the lower limit, the lowest allowable value will be programmed.

Select **Back** to complete the setup.

An **OUT.Z** annunciator will be shown on the title bar to indicate that the output impedance control has been enabled.

### Output Response

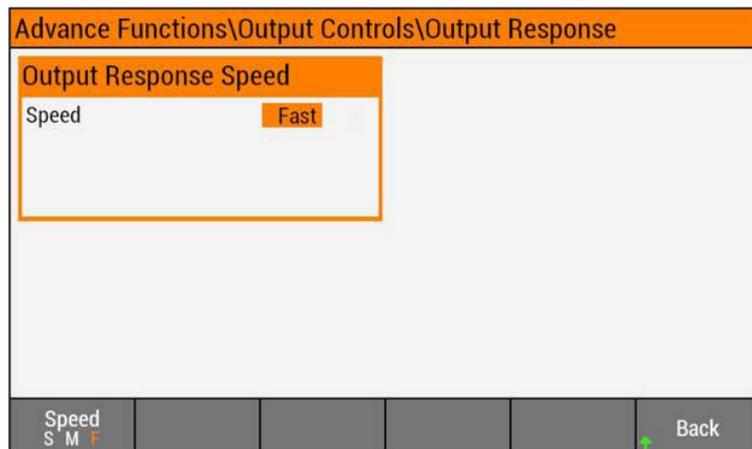
You can set the response speed of the internal amplifier to one of the following three levels according to the load conditions and how you will use the instrument.

**Fast response** - This is used for applications that require fast rise and fall speeds of power supplies. Depending on the load conditions, the output may become unstable or oscillate. Check the output voltage waveform before you actually perform the tests. If the output is unstable, set the response to Medium or Slow.

**Medium response** (the default) - This is used for applications covering a range of frequencies from commercial power line frequencies to the frequencies used by ship and aircraft power supplies.

**Slow response** - This is used to provide stable power to a variety of loads. Note that even if a capacitor that has a large capacitance is connected to the output of the instrument, this setting can be used to provide stable operations. This setting provides a sufficient response speed to generate commercial power line frequencies.

The output response control can be accessed through the **Output Response** softkey. The default response is set to Medium. When set to the default, there is no annunciator on the main display to indicate the output response. If you decide to change the response speed to Slow or Fast, the annunciator will show **S.RESP** for slow response, and **F.RESP** for fast response



Toggle the **Speed** softkey to select the desired output response speed, The selection will appear in the Speed box.

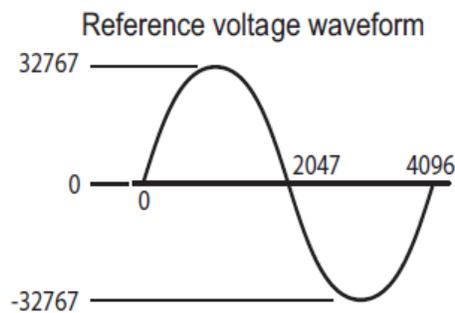
Select **Back** to complete the setup.

## Custom Waveform

You can generate both Peak clipped and Flat curve waveforms. The instrument creates custom voltage waveforms by performing D/A conversion on the waveform data that is stored in its internal waveform bank.

User-defined waveforms stored in other waveform bank locations (from 1 to 256) can be accessed and customized using the information entered in the Custom control.

Waveform bank location zero (0) contains a reference sinewave with a positive peak of 32767 points, a negative peak of -32767, with a cycle of 4096 points. The phase resolution is 0.01 degrees. Waveform bank location zero cannot be overwritten. In the factory default condition, all waveform bank locations contain this reference sinewave.



**Peak clipped waveform** - The peak portion of waveforms is clipped by the specified crest factor value. The sine waveform is adjusted so that the specified rms value and the rms value of the waveform that is actually output are the same. For a sine wave, the crest factor is 1.41. In the voltage waveforms of commercial power lines, the peaks are clipped, so the crest factor is between 1.2 and 1.4.

**Flat curve waveform** - This is a waveform defined in IEC61000-4-13. The peak of the waveform is clipped by the specified clip factor. The waveform peak is defined to be 1. The specified rms value and the rms value of the waveform that is actually output are not the same.

The custom waveform controls can be accessed through the **Custom Waveform** softkey. As shown below, a Sine waveform type has been selected, and you can import custom sinewaves from the waveform bank for each output phase or All output phases.

### 3 User Information

Advance Functions\Output Controls\Custom Waveform

Peak Clipped & Flat Curve Waveform



Custom Waveform Setup		Output Waveform Setting	
Waveform bank no.	1	Wav bank (All phases)	0
Waveform type	Sine	Wav bank (Phase 1)	0
		Wav bank (Phase 2)	0
		Wav bank (Phase 3)	0

Custom Wav  On  Off    Wav Type  Sine  Pk  Flat    Back

As shown below, a Peak waveform type has been selected, and you can import custom sinewaves from the waveform bank for each output phase or All output phases. You can also change the crest factor of the setup.

Advance Functions\Output Controls\Custom Waveform

Peak Clipped & Flat Curve Waveform



Custom Waveform Setup		Output Waveform Setting	
Waveform bank no.	1	Wav bank (All phases)	0
Waveform type	Peak	Wav bank (Phase 1)	0
Crest factor	1.4	Wav bank (Phase 2)	0
		Wav bank (Phase 3)	0

Custom Wav  On  Off    Wav Type  Sine  Pk  Flat    Back

As shown below, a Flat waveform type has been selected, and you can import custom sinewaves from the waveform bank for each output phase or All output phases. You can also change the clip factor of the setup.

Advance Functions\Output Controls\Custom Waveform

Peak Clipped & Flat Curve Waveform



Custom Waveform Setup		Output Waveform Setting	
Waveform bank no.	1	Wav bank (All phases)	0
Waveform type	Flat	Wav bank (Phase 1)	0
Clip factor	1.0	Wav bank (Phase 2)	0
		Wav bank (Phase 3)	0

Custom Wav  On  Off    Wav Type  Sine  Pk  Flat    Back

If you enter a value that is outside the permissible range for the setting; a message box will appear as shown below.



Select **Back** to complete the setup.

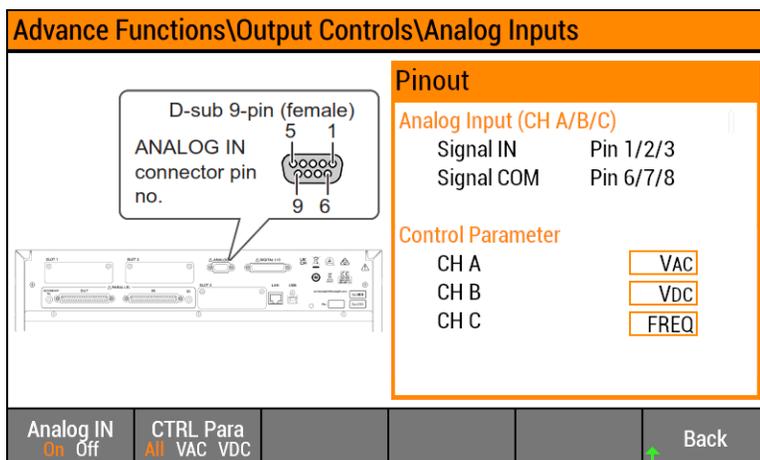
A **WFM** annunciator will be shown on the title bar to indicate that a custom waveform is being generated.

## Analog Input

External analog signals can be used to change the AC voltage, DC voltage, or frequency using a DC signal.

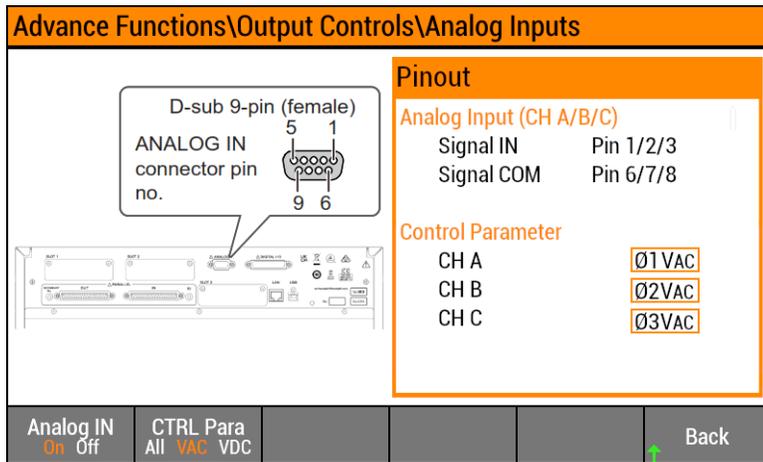
Refer to [Analog and Digital Connections](#) for information on wiring and connections.

As shown below, the Analog Input has been enabled. Note that the additional softkey (**CTRL Para**) for the control parameter will only be available once the Analog Input has been enabled.



This example shows the control parameter is set to ALL. In this setting, CH A is used to control the AC Voltage of all 3 phases, CH B is used to control the DC Voltage of all 3 phases and lastly, CH C is used to control the Frequency setting. The control parameters are shown in the settings boxes.

In the following example, the control parameter is set to VAC. In this setting, each of channels is used to control the corresponding phase AC Voltage as shown in the setting box.



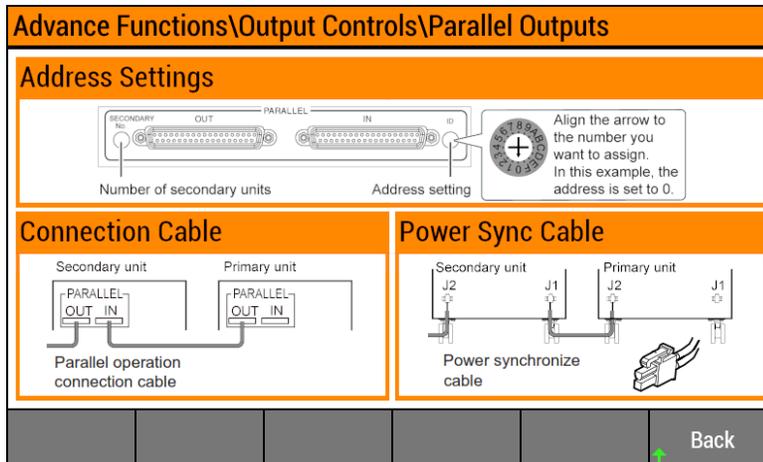
If the control parameter is set to VDC, each of the channels is used to control the corresponding DC Voltage as shown in the settings boxes.

### Parallel Output

**NOTE** The parallel information in this section does not apply to AC6903 units.

Refer to **Parallel Connections** for more information on wiring and connections between instruments.

The following display only illustrates the connections and switch settings for parallel operation. There are controls on this front panel display.



### Typical Commands

#### Impedance Control

- |   |                                       |
|---|---------------------------------------|
| <b>OUTPut:IMPedance ON</b>                                  | Turns the impedance control on or off |
| <b>OUTPut:IMPedance:REACTIVE &lt;value&gt;[(@chanlist)]</b> | Sets the output impedance             |
| <b>OUTPut:IMPedance:REAL &lt;value&gt; [(@chanlist)]</b>    | Sets the output reactance             |

## Output Response

VOLTage:RESPonse FAST

Programs the output response

## Custom Waveform

WAVE:STATe ON

Enables or disables the custom waveform

WAVE:DATA:ARBitrary <bank\_number>, <block>

Sets a waveform with block data at the specified waveform bank

WAVE:DATA:CLIP <bank\_number>, <pclip\_value>, <value>

Sets the crest factor of the peak clipped waveform

WAVE:DATA:IECPclip <bank\_number>, <pclip\_value>, <value>

Sets the clip factor of the flat curve waveform

WAVE:DATA:POINt <bank\_number>, <point>, <data>

Programs the arbitrary waveform data points

WAVE:DATA:SINusoid <bank\_number>

Resets the waveform to a sinusoid

WAVE:DATA:TYPE? <bank\_number>

Queries the type of waveform

## Analog Input

VOLTage:PROGramming:EXTernal:MODE EXTDC

Sets the external analog signal's programming mode.

VOLTage:PROGramming:EXTernal:EXTDC :SIGNal:SOURce EXT

Sets the external analog input programming signal source.

VOLTage:PROGramming:EXTernal:EXTDC :SIGNal:POLarity <channel>, NORM

Sets the external analog input programming signal polarity.

VOLTage:PROGramming:EXTernal:VPRogram :STATe <channel>, ON

Sets the voltage programming output state for each channel.

VOLTage:PROGramming:EXTernal:VPRogram :MAP ALL

Sets the voltage programming output mapping.

## Parallel Output

SYSTem:CONFigure:FORMation:FRAME?

Queries the number of units in parallel.

SYSTem:CONFigure:FORMation:FRAME:INFO? <value>

Queries information about the specified unit operating in parallel.

## Using System Utilities

**Store and Recall**

**System Settings**

**Error Messages**

**Help Menu**

**Typical Commands**

Press the **Utilities** softkey to access the utilities.

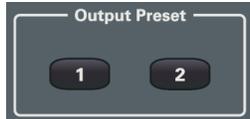


Utilities include: Store and Recall, IO Configuration, System Settings, Error, and Help

### Using Store and Recall

The product has a preset memory, setup memory, and USB storage capability.

**Preset memory** is internal can be recalled by pressing one of two **Output Preset** keys.



The following items can be saved to the two preset memory locations (Preset 1 and Preset 2).

- Frequency
- AC voltage
- DC voltage
- Waveform bank number

For single-phase three-wire output and three-phase output, phase voltages are stored. The line voltages are calculated from the phase voltages

Because you can easily recall saved settings, this feature is useful when you want to switch between two different settings (sudden voltage change or sudden frequency change).

**Setup memory** is also internal and can store up to 10 sets of front panel settings and be accessed from the front panel menu.

**USB storage** is available from the front panel USB port. The following items can be saved to a USB memory device.

- Front Panel settings (same as in setup memory)
- Power line abnormality simulation settings
- Sequence data
- Waveform bank data

You cannot use a USB memory device that has a capacity greater than 16 GB. You may need to use a PC to format the USB memory device into FAT32 format. Note that some USB memory devices may not operate correctly.

## Store Settings

Select the **Store & Recall** softkey to access the Store/Recall controls.



Then select the **Store Settings** softkey



The following store settings are available:

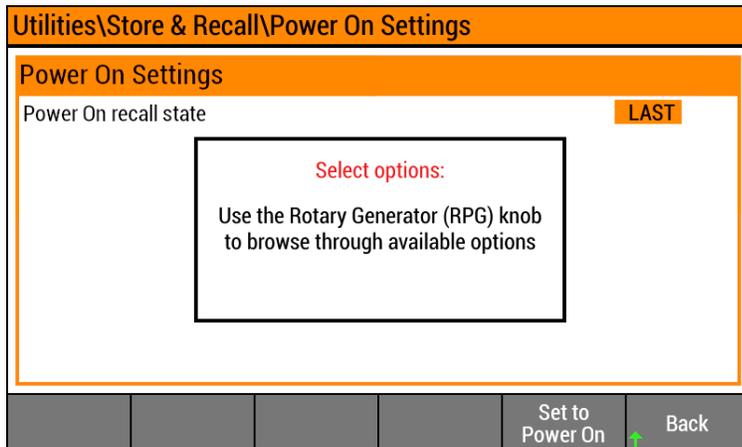


Toggle the **Destination** softkey to select either an Internal or External storage location. When the destination is Internal, you have the option of selecting from 0 to 9 internal storage locations. Specify the location in the Store state box.

Press the **Store** softkey to save the panel settings in the specified location.

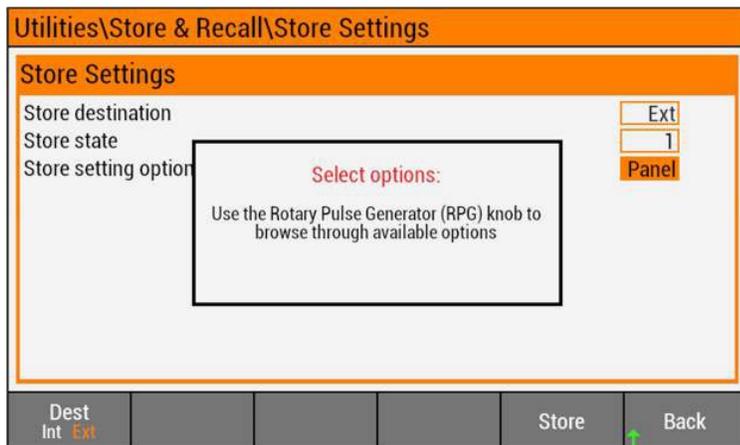
You also have the choice to set a specific store state to the Power On state so that every time the unit is rebooted, it will automatically set all settings according to the settings in the specified store state. However, this is limited to one of the 10 internal memory states. Press the **Set to Power On** softkey.

### 3 User Information



Specify the store state location that you wish to use as the power on recall state. Then press the **Set to Power On** softkey.

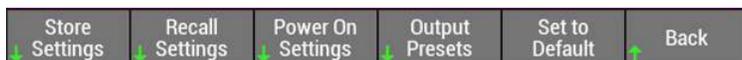
When the **Destination** softkey is set to External, you can choose additional storage setting options like Panel Settings, Simulation Setting, Sequence Data, Waveform Bank or All. Refer to **Default Settings** for further information. Whenever you navigate the setting field that has multiple options to choose, a pop-up message will appear to tell you that the RPG knob can be used to browse through available options.



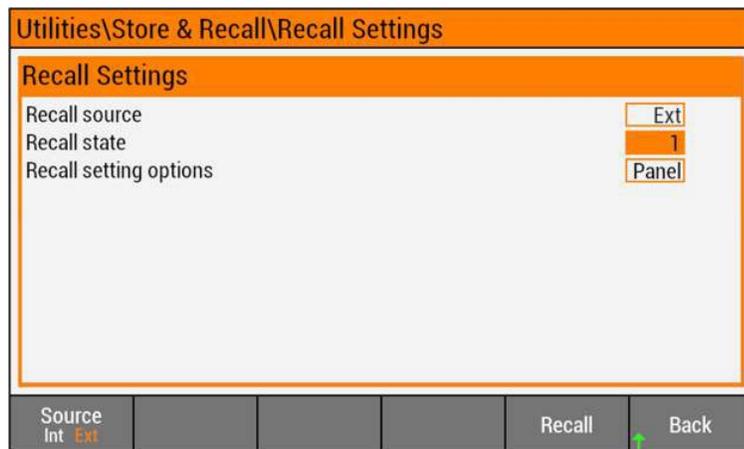
Select **Back** to complete the setup.

### Recall Settings

Recalling settings is similar to storing settings. First, select the **Recall Settings** softkey



The following store settings are available:



When the Source is set to internal, you can only recall settings from the internal storage locations 0 to 9. When the source is set to External, you can also recall Panel Settings, Simulation Setting, Sequence Data, Waveform Bank or All.

The instrument stores the Front Panel settings shown in the table below at five-second intervals. To ensure that settings changes are saved before power-off, wait at least five seconds after changing a setting before turning the instrument off. Otherwise, the last settings may not be stored.

Recalling is not possible in the following situations.

- A power line abnormality simulation is in progress.
- A sequence is running.
- Soft start or soft stop is in progress.
- The settings to be recalled are outside the range of the present limit function or protection function.
- The peak value of the AC+DC waveform is outside the output voltage range.

## Output Preset

Select the **Output Presets** softkey to access the preset functions.



The following function keys are available.



Press the **Preset 1 Store** or **Preset 2 Store** softkey to store the present instrument state in the selected preset memory location.

Press the **Preset 1 Recall** or **Preset 2 Recall** softkey to recall the instrument state in the selected preset memory location. These softkeys perform the same function as the front panel **Output Preset** keys described earlier in this section.

## Set to Default

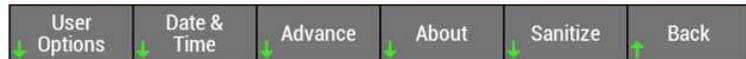
Press the **Set to Default** softkey to return the instrument to the factory default front panel settings as described under **Default Settings**.

## Using System Settings

Select the **System Settings** softkey to access the System Settings controls.



Select the **User Options** softkey to configure the following user options:



Press the **Display** softkey to toggle between turning the display On or Off. When the display is turned off, press any of the softkeys or front panel keys to turn it back on.



Press the **Scr Svr** (screen saver) softkey to toggle between turning the screen saver on or off.

When the screen saver is turned On, the screen saver function blanks the screen after 30 minutes of inactivity. The display is turned on again when power is cycled, after an instrument reset (\*RST), or when you press any of the softkeys or front panel keys.

Press the **Phase Conv** (convention) softkey to toggle between 123, ABC, or UVW

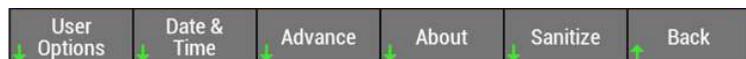
This is meant to change the label or naming convention for the individual phases. Different regions around the world uses different naming convention for the AC line. The default is set to 123. In the above example, it is set to ABC. Hence, the three sub-frames in the main display area will show Phase A, Phase B and Phase C. If you select UVW, it will then change to Phase U, Phase V and Phase W.

Press the **Key Click** softkey to toggle between turning the key click sound On or Off.

Press the **Sleep** softkey to toggle between turning sleep mode On or Off.

You can set the instrument so that it enters sleep mode whenever no output is being generated (because the output is turned off). This turns off the internal power modules, which reduces power consumption. You cannot turn the output on for approximately 1 minute after sleep mode is exited until the internal power modules turn on.

Select the **Date & Time** softkey to configure the date and time.



The following settings are available:

Utilities\System Settings\Date & Time Settings					
Date Settings (DD/MM/YYYY)					10/09/2019
Year					2019
Month					9
Day					10
Time Settings (HH:MM:SS)					11:26:20
Hour					11
Minute					26
Second					20
Year	Month	Day	Hour	Minute	Back

The text boxes on the right side show the current Date and Time in DD/MM/YYYY and HH:MM:SS format respectively.

Click on the appropriate softkey to highlight the text box to change the date or time. Note that the **Second** settings cannot be adjusted. Changing the Hour or Minute settings will automatically causes the Second field to reset to zero 0

Select the **Advance** softkey to configure the advanced system settings.

User Options	Date & Time	Advance	About	Sanitize	Back
--------------	-------------	---------	-------	----------	------

Select the **Offset Adjust** softkey to fine tune the output offset to achieve the zero point.

Offset Adjust	Power Mgmt				Back
---------------	------------	--	--	--	------

The following settings are available:

Utilities\System Settings\Advance\Offset Adjustment					
Output Terminal Voltage Adjustment					
Phase 1					0
Phase 2					0
Phase 3					0
Sense Terminal Voltage Adjustment					
Phase 1					0
Phase 2					0
Phase 3					0
					Back

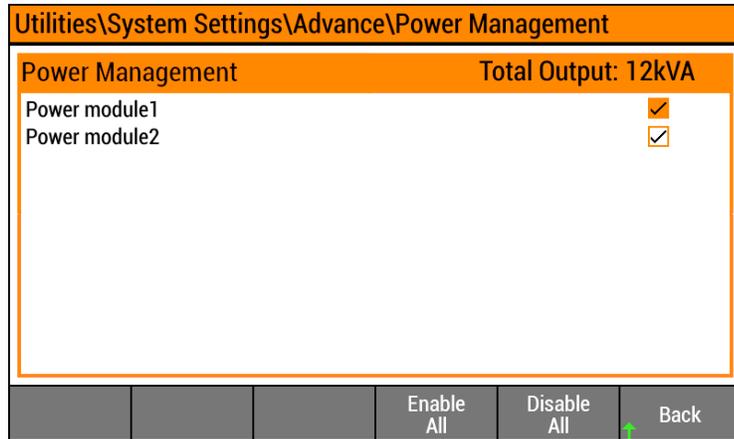
You can provide a voltage offset for both the sense terminals and the output terminals. Enter the offset voltage for each phase. Note that 1-phase-3 wire only uses Phase 1 and Phase 2.

Select the **Power Mgmt** (management) softkey to manage the instrument's internal power modules.

Offset Adjust	Power Mgmt				Back
---------------	------------	--	--	--	------

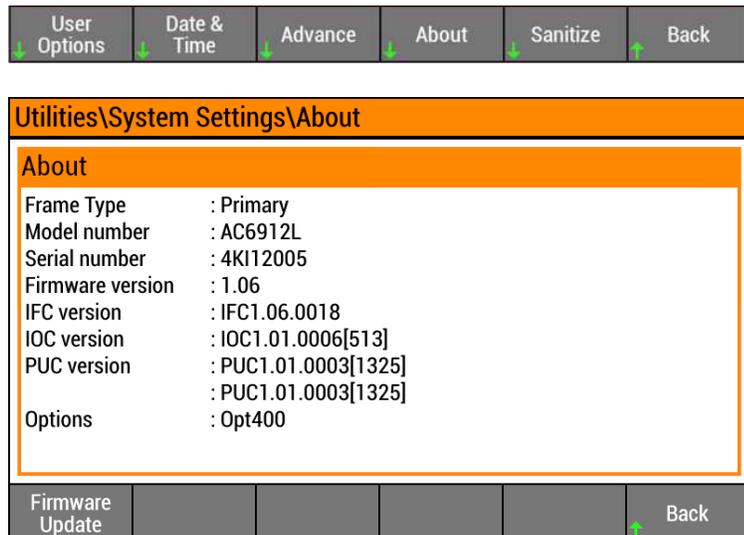
### 3 User Information

The following settings are available:



These selections let you disable one or more power module within the unit to limit the output power or disable the defective power module. Use the up and down arrows to navigate to the power module. Then un-check to disable the selected module. **Enable All** enables all modules. **Disable All** disables all modules.

Select the **About** softkey to view Information such as model number, serial number, options and firmware revision.



Press the Firmware Update softkey to updated the firmware through the front panel USB port. A pop-up message will appear with further instructions.

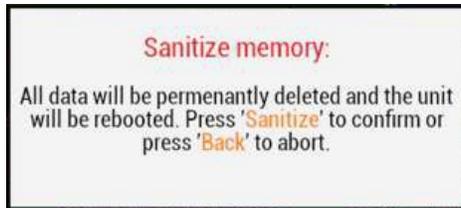


Note that the firmware for a standard unit cannot be installed on an **Option MEM** unit, neither can firmware for an Option MEM unit be installed on a standard unit.

Select the **Sanitize** softkey to delete all user data stored in the instrument's internal memory.



The following message will appear:



Then press the **Sanitize** softkey

Sanitization is per the National Industrial Security Program Operating Manual (NISPOM). Factory 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 typically performed only when you need to remove an instrument from a secure area. The sanitization procedure is not recommended for use in routine applications because of the possibility of unintended loss of data.

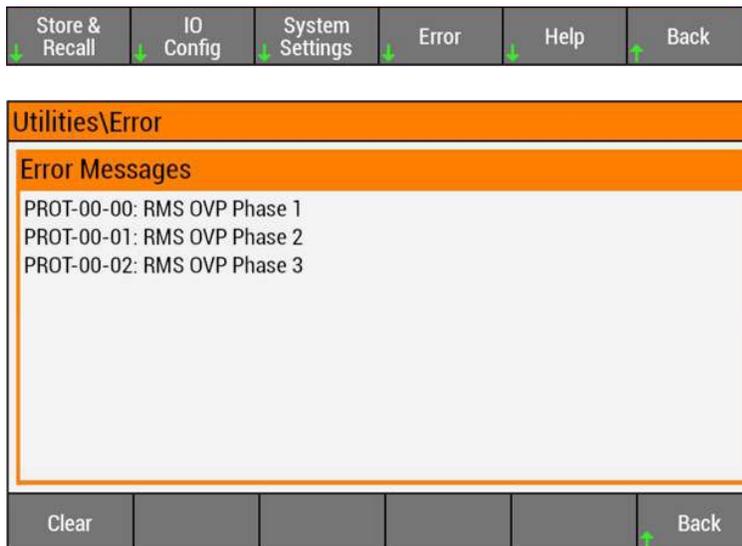
If your unit includes a micro-SD card (Option MEM), you can simply remove the card to sanitize the instrument. Refer to **Removing and Installing an SD Card** for details.

## Error Messages

If a self-test error occurs, a message is displayed on the title bar. For programming errors and other error messages, refer to **Error Messages** for more information.

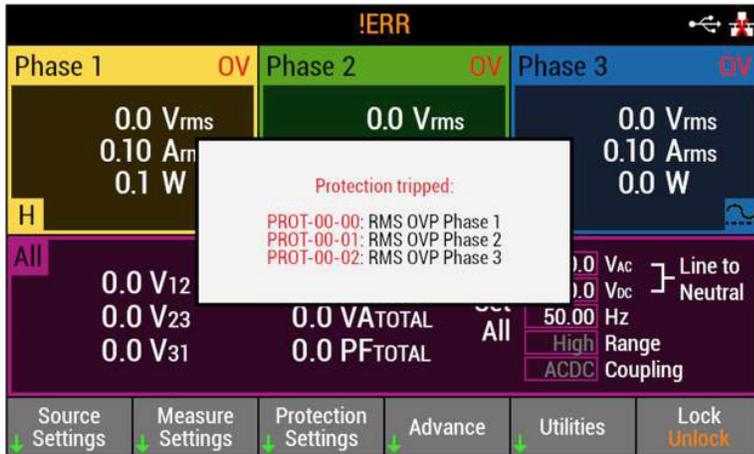


Select the **Utilities > Error** softkeys to display any error messages.



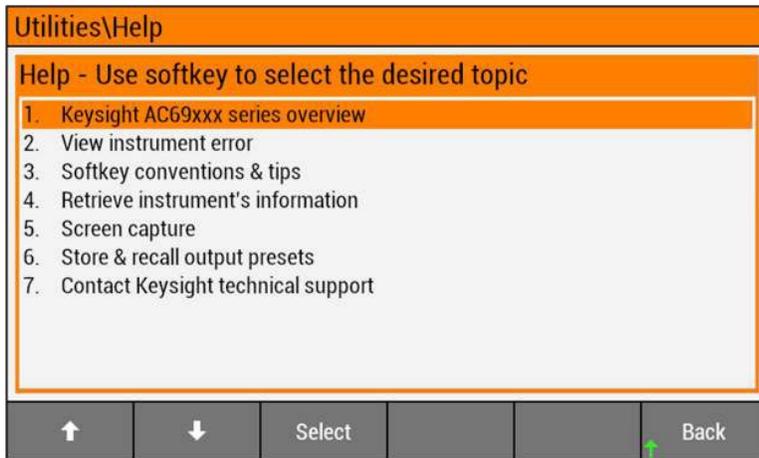
### 3 User Information

For hardware related errors, a pop-up message may appear directly on the display. Refer to [Hardware Error Codes](#) for more information.



### Help Menu

Select the **Utilities > Help** softkeys to view built-in help at any time.



Use the up and down arrows to navigate to the selected topic. Then press the **Select** softkey.

### Typical Commands

#### Store and Recall

<b>*SAV &lt;0 to 10&gt;</b>	Saves the instrument state to a nonvolatile memory location.
<b>*RCL &lt;0 to 10&gt;</b>	Recalls a saved instrument state.
<b>*RST</b>	Resets the instrument to factory default values.
<b>MEMory:SAVE[:IMMEdiate] 1 2</b>	Saves the output settings to memory location 1 or 2.
<b>MEMory:RECall[:IMMEdiate] 1 2</b>	Recalls the memory saved in location 1 or 2
<b>MEMory:RECall:PREView? 1 2</b>	Displays the memory contents saved in location 1 or 2.

## System Settings

<code>SYSTem:DATE &lt;yyyy&gt;,&lt;mm&gt;,&lt;dd&gt;</code>	Sets the local date of the system clock.
<code>SYSTem:TIME &lt;hh&gt;,&lt;mm&gt;,&lt;ss&gt;</code>	Sets the local time of the system clock.
<code>SYSTem:CONFigure:ADJust: VOLTage:FINE &lt;value&gt;</code>	Sets the voltage offset value.
<code>SYSTem:CONFigure:ADJust: VOLTage:TERMinal:MODE OTERM</code>	Applies the voltage offset value to the output terminal.
<code>SYSTem:CONFigure:FORMation: PSAVer:MAXimum &lt;value&gt;</code>	Sets the maximum VA for the power save function.
<code>SYSTem:CONFigure:FORMation: PSAVer:MODules E D {,E D} . . .</code>	Sets the specified power modules to run using the power save function.
<code>SYSTem:CONFigure:FORMation: PSAVer:RESet</code>	Resets the power save settings
<code>*IDN?</code>	Returns the instrument's identification string.

## Error Messages

<code>SYSTem:ERRor[:NEXT]?</code>	Reads and clears one error from the error queue.
<code>SYSTem:ERRor[:NEXT]:COUNT?</code>	Returns the number of errors in the error queue.

## Remote Interface Configuration

**USB Status**

**LAN Status**

**LAN Settings**

**GPIB Status**

**Using the Web Interface**

**Using Telnet**

**Using Sockets**

**Using HiSLIP**

**Typical Commands**

This section describes how to configure each remote interface.

This instrument supports remote interface communication over GPIB (optional), USB, and LAN (default). All three interfaces are "live" at power up, and they may be used simultaneously. To use these interfaces, you must first install the latest Keysight IO Libraries Suite from [www.keysight.com](http://www.keysight.com). Then connect your instrument to your PC.

### USB Status

**NOTE** The Keysight IO Libraries are required to control the instrument through the USB interface.

Use a standard USB cable to connect the instrument to the computer. There are no configurable USB parameters, but you can retrieve the USB connect string from the front panel display by pressing

Utilities >



IO Config >



USB Status



The following information is displayed:

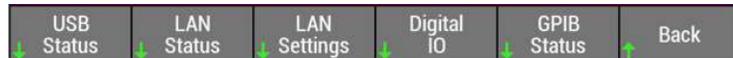


## LAN Status

The front-panel  annunciator indicates that the LAN port is connected and configured. The instrument continually monitors the instrument's LAN port and automatically reconfigures it when the instrument is disconnected and then reconnected to a network.

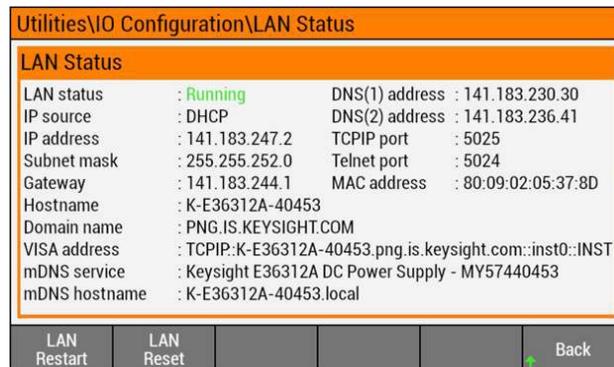
The front panel  annunciator indicates that the USB interface is connected and configured.

To begin configuring the remote interface from the front panel, access the LAN settings by pressing **Utilities > IO Config > LAN Status**.

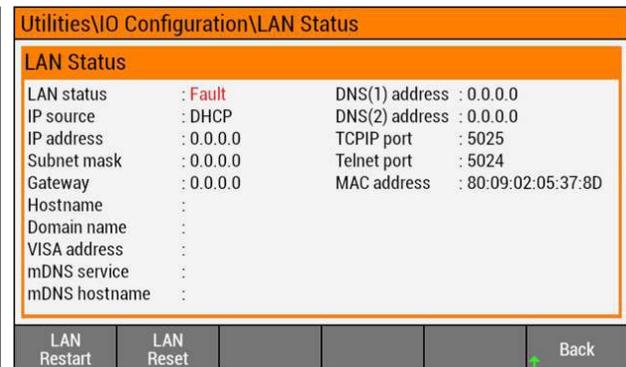


The status will indicate if the LAN is connected (Running), or if it is disconnected (Fault).

### LAN connected



### LAN disconnected



If the LAN is disconnected select **LAN Restart** to restart the LAN. If you need to reset the LAN select **LAN Reset**. If you need to configure the LAN, go back to the previous menu and select **LAN Settings**.

## LAN Settings

The screenshot shows the 'Utilities\IO Configuration\LAN Settings' menu. It is divided into three main sections: IP Configuration, Auto DNS Configuration, and DNS Hostname & mDNS Configuration. At the bottom, there are five softkey options: DHCP, AutoDNS, mDNS, Set to Default, and Back. The DHCP softkey is highlighted in orange, indicating it is the active selection.

IP Configuration		Auto DNS Configuration	
IP source	DHCP	Auto DNS	On
IP address	192 . 168 . 10 . 2	DNS(1) addr	0 . 0 . 0 . 0
Subnet mask	255 . 255 . 255 . 0	DNS(2) addr	0 . 0 . 0 . 0
Gateway	192 . 168 . 10 . 1		

DNS Hostname & mDNS Configuration	
DNS hostname	K-E36312A-40453
mDNS	Off
mDNS service	K-E36312A-40453

DHCP	AutoDNS	mDNS	Set to Default	Back
On Off	On Off	On Off		

From this menu you can configure the LAN. To access any of the three configurable panels, you toggle the corresponding softkey (**DHCP**, **AutoDNS**, or **mDNS**) either ON or Off. The item highlighted in orange is the active selection.

Select **Set to Default** to return the LAN settings to their Default values

The following display shows all three configurable panels with editing enabled. Use the front panel navigation keys or RPG knob to navigate to the numeric field you wish to edit. Then use the front panel numeric entry keys to enter a value.

The screenshot shows the 'Utilities\IO Configuration\LAN Settings' menu with editing enabled. The DHCP softkey is now Off, and the Keyboard softkey is highlighted in orange. The IP address field is set to Manual, and the mDNS is set to On.

IP Configuration		Auto DNS Configuration	
IP source	Manual	Auto DNS	Off
IP address	192 . 168 . 10 . 2	DNS(1) addr	0 . 0 . 0 . 0
Subnet mask	255 . 255 . 255 . 0	DNS(2) addr	0 . 0 . 0 . 0
Gateway	192 . 168 . 10 . 1		

DNS Hostname & mDNS Configuration	
DNS hostname	K-E36312A-40453
mDNS	On
mDNS service	K-E36312A-40453

DHCP	AutoDNS	mDNS	Keyboard	Set to Default	Back
On Off	On Off	On Off			

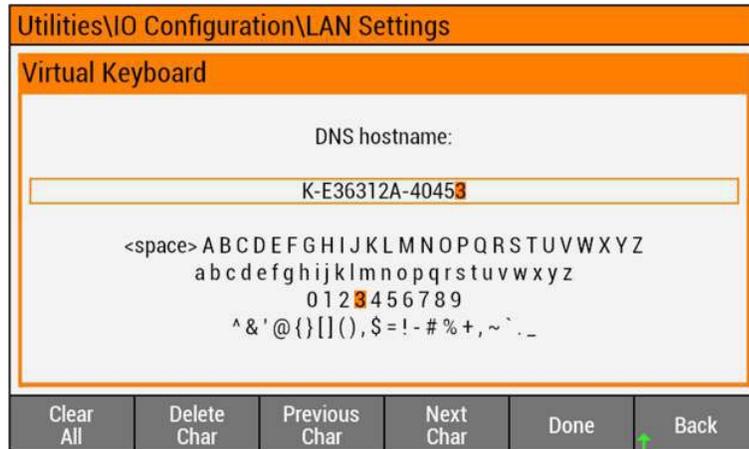
Select the **Keyboard** softkey for alphanumeric entries in the DNS hostname and mDNS service fields.

In the following example, note that the last character in the text box is being highlighted in orange. This indicates that this is the selected character. Pressing **Delete Char** will delete this character only. To navigate between the next and previous character, press **Next Char** or **Previous Char**. Pressing **Clear All** deletes all characters in the text box.

To input new characters, you will need to navigate through the keyboard selections using the navigation keys or RPG knob. Note that the currently selected character is 3 and this is indicated by the orange highlight. Rotating the RPG clockwise, moves the highlight to the right. Rotating the RPG

counter clockwise; move the highlight to the left. In this way you can navigate to any character on the keyboard.

When you have highlighted the desired character, either press **Enter** or press **Next Char**. This confirms your selection and enters it into the oftkey if it is the last character that is currently being selected in the text box.



Select **Done** when complete.

## IP Configuration Description

The IP Configuration parameters include:

<b>IP source: DHCP</b>	Automatically configures instrument addressing. 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.
<b>IP source: :Manual</b>	Manually configures instrument addressing by entering values in the three fields (listed below) that only appear when DHCP is turned off and <b>Manual</b> appears in the IP source box.
<b>IP Address</b>	Specifies the instrument's Internet Protocol (IP) address, which is required for all IP and TCP/IP communications with the instrument. An IP Address is of the form nnn.nnn.nnn.nnn, where each nnn is a decimal number from 0 to 255 with no leading zeros (for example, 169.254.2.20).
<b>Subnet Mask</b>	Allows the instrument to determine whether 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.
<b>DEF Gateway</b>	Specifies the IP Address of the default gateway that allows the instrument to communicate with systems 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 addressing

Dot-notation addresses ("nnn.nnn.nnn.nnn" where "nnn" is a 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 decimal values from 0 to 255, without leading zeros.

## Auto DNS Configuration Description

DNS is an internet service that translates domain names into IP addresses. It is also needed for the instrument to find and display its host name assigned by the network. Normally, DHCP discovers the DNS address information; you only need to change this if DHCP is unused or not functional.

<b>AutoDNS ON</b>	Automatically configures instrument addressing. When selected, the instrument will first try to obtain an IP address from a DHCP server as previously described..
<b>AutoDNS OFF</b>	Manually configures instrument addressing by entering values in the two fields (listed below) that only appear when <b>AutoDNS OFF</b> is selected.
<b>DNS(1) address</b>	Specifies the primary address of the server. Contact your LAN administrator for 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.
<b>DNS(2) address</b>	Specifies the secondary address of the server. Contact your LAN administrator for 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.

## DNS Hostname and mDNS Configuration Description

A host name is the host portion of the domain name, which is translated into an IP address.

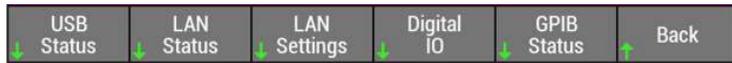
Each instrument is shipped with a default host name with the format: K-modelnumber-serialnumber, where modelnumber is the unit's 7-character model number (e.g. AC6803B), and serialnumber is the last five characters of the 10-character serial number located on the label on the top of the unit, for example 45678.

<b>DNS hostname</b>	This field displays the DNS host name.. The name may contain upper and lower case letters, numbers, and dashes (-).If the field is left blank, no name is registered. The maximum length is 15 characters.
<b>mDNS ON</b>	With mDNS on, you can enter the DNS hostname into the mDNS service box
<b>mDNS service</b>	This field registers the supplied name with the selected naming service. Applies when <b>mDNS ON</b> is selected. With mDNS off, no name is registered.

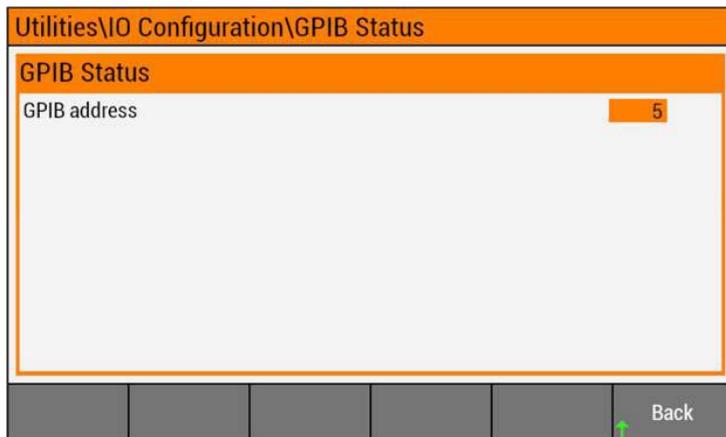
## GPIB Status

The GPIB interface requires the optional GPIB interface board and uses a standard IEEE-488 cable to connect to the computer.

Each device on the GPIB (IEEE-488) interface must have a unique whole number address between 0 and 30 (default 5). Your computer's GPIB interface card address must not conflict with any instrument on the interface bus. View or change the GPIB address by pressing **Utilities > IO Config > GPIB Status**.



The following information is displayed:



Use the front panel numeric entry keys to enter a different GPIB address.

## Using the Web Interface

Your instrument 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 additional connections, performance will be reduced.

### NOTE

The built-in Web interface only operates over the LAN. It requires Internet Explorer 11, Firefox, Chrome, or Microsoft Edge.

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

1. Open your computer's Web browser.
2. Enter the instrument's host name or IP address into the browser's Address field. The following welcome page will appear.

### 3 User Information

KEYSIGHT TECHNOLOGIES AC6912L AC Power Source Serial number: 4KI12005 Log in

---

Home Control Instrument Configure LAN



Connected to AC6912L AC Power Source

at IP address 141.183.247.166

Enable front panel identification indicator

---

Description

Model number	AC6912L
Manufacturer	Keysight Technologies
Serial number	4KI12005
Firmware revision	1.03a IFC1.03.0016b IOC1.01.0006[513]
Description	KEYSIGHT AC6912L AC Power Source - 4KI12005

VISA instrument addresses

VXI-11 LAN protocol	TCPIP::141.183.247.166::inst0::INSTR
TCP/IP SOCKET protocol	TCPIP::141.183.247.166::5025::SOCKET
USB (USBTMC/488)	USB::0x0b3e::0x5102::4KI12005::INSTR
GPIB	N/A

▼ More Information

3. Click on the Browser Web Control tab in the navigation bar on the left to begin controlling your instrument. The front panel of the Web interface works much the same way as the actual front panel of the instrument.

**NOTE** A password is required to control the instrument using the Web interface. The password is set to "Keysight" from the factory. To set a different password, click **View & Modify Configuration**. Refer to the online help for details.

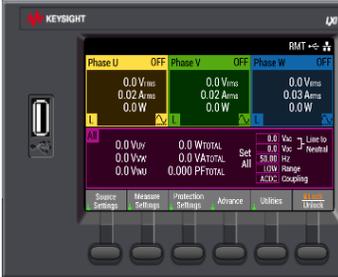
KEYSIGHT TECHNOLOGIES AC6912L AC Power Source Serial number: 4KI12005 Log out

---

Home **Control Instrument** Configure LAN

Control Instrument > Soft Front Panel

Warning: Should network communication issues occur, the reported readings and instrument configuration settings shown in the Soft Front Panel may not represent the actual readings or instrument state. Do not rely on the reported readings from the Soft Front Panel to determine if a circuit that may have hazardous voltages present is safely de-energized.  
 Note: Please allow some time for the page to be reloaded after pressing any key. Press F5 for immediate page reload.




Screen Capture

**WARNING** Should network communication issues occur, the instrument settings shown in the Browser Web Control page may not represent the actual state of the instrument. This may result in unexpected hazardous voltages on the output and sense connections that could result in personal injury, death, or damage to a device under test. Before touching the output or sense connections or connecting to a device under test, always verify the state of the instrument.

4. Click the Configure LAN tab to edit the LAN configuration.

KEYSIGHT TECHNOLOGIES AC6912L AC Power Source  
Serial number: 4K12005

Log out

Home Control Instrument **Configure LAN**

### Configure LAN

Current LAN configuration of the instrument

IP address configuration	Automatic
IP address	141.183.247.166
Subnet mask	255.255.252.0
Default gateway	141.183.244.1
DNS server(s)	141.183.230.30, 141.183.236.41
Hostname	K-AC6912L-12005
Domain	png.is.keysight.com
Description Desired mDNS service name	KEYSIGHT AC6912L AC Power Source - 4K12005

[Edit](#)

[Advanced options](#)

5. For additional help about any of the pages, click the **Help with this Page** tab.

## Using Telnet

In a DOS command window, enter the command **telnet host name 5024** where host name is the instrument's host name 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 instrument. Type the SCPI commands at the prompt.

## Using Sockets

**NOTE**

The instrument allows any combination of up to six simultaneous data socket, control socket, and telnet connections to be made.

The instrument uses 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.

## Using HiSLIP

The High-Speed LAN Instrument Protocol (HiSLIP) is a protocol for TCP-based instrument control. It includes conventional test and measurement protocol capabilities with minimal performance impact.

For technical details regarding HiSLIP, see [www.ivifoundation.org](http://www.ivifoundation.org).

## Typical Commands

`SYSTem:COMMunicate:LAN:CONTRol?`

Returns the TCP port number for SCPI-RAW.

`SYSTem:COMMunicate:RLSTate LOCAL`

Configures the remote/local state of the instrument.

`SYSTem :COMMunicate:RLSTate?`

Queries the remote/local state of the instrument.

## Digital IO Configuration

### Input Control

### Output Status

### Configure IO

### Typical Commands

External digital signals can be used to perform the following controls.

- Controlling the instrument through external contacts
- Monitoring the operation status

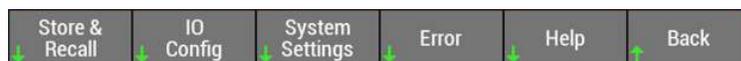
There are four channels (1 to 4) that are controlled using external contacts, four channels (5 to 8) that monitor the operating status, and two channels (9 to 10) that you can select whether to control using external contacts or monitor the operating status (Selectable I/O). These channels are accessible through the Digital I/O connector. Refer to [Analog and Digital Connections](#) for information on wiring and connections.

This section describes how to configure the Digital IO. Access the Digital IO controls by pressing

Advance >.



IO Config >



Digital IO



The following information is displayed:

**Utilities\IO Configuration\Digital IO**

D-sub 25-pin (female)  
DIGITAL I/O  
connector pin no.

**Pinout**

**Input Control (CH 1/2/3/4)**

Signal IN	Pin 1/2/3/4
Signal COM	Pin 14/15/16/17

**Output Status (CH 5/6/7/8)**

Signal OUT	Pin 6/7/8/9
Signal COM	Pin 19/20/21/22

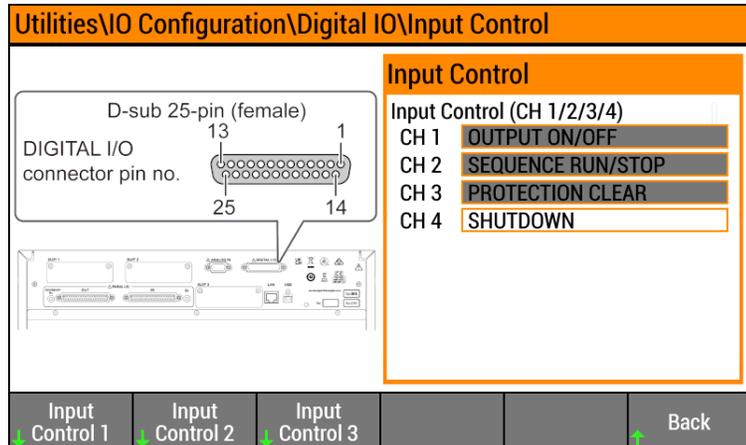
**Configurable IO (CH 9/10)**

Signal IN/OUT	Pin 11/12
Signal COM	Pin 24/25

Input Control	Output Status	Config IO			Back
---------------	---------------	-----------	--	--	------

This display shows the digital IO pinouts for the three different types of signals. An illustration of the Digital connector is also shown. Each of these signal types can be further configured by pressing the **Input Control**, **Output Status** or **Config. IO** softkeys.

### Input Control



Select an input channel by selection the **Input Control 1**, **Input Control 2**, or **Input Control 3** softkey.



You can enable or disable each of the channels by toggling the **Input Ctrl** softkey. Toggle the **Polarity** softkey to assign the signal polarity. When configured, the Inhibit Control signal can be latched to stay on by toggling the **Mode** softkey.

For Channels 1–3, you can select (or map) to any of the control signals listed as follows. Note that Channel 4 is reserved for the shutdown signal and is turned on by default and cannot be changed.

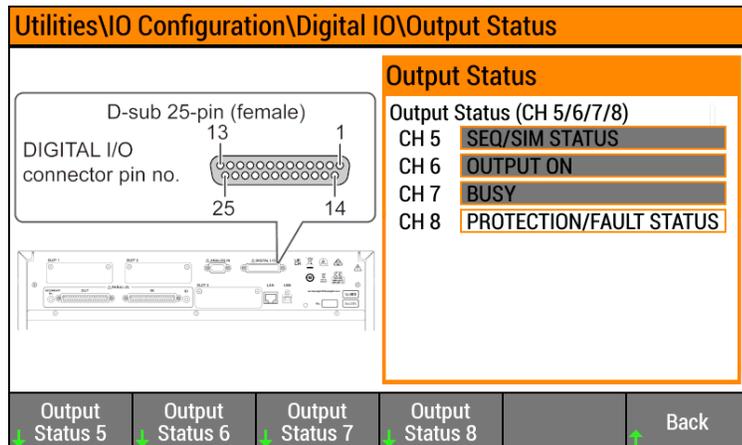
There are two additional channels (Channel 9 and Channel 10) that you can configure as Input Controls or as Output Status signals. These two channels can also be assigned to the following control signals.

However, you cannot assign a control signal to more than one channel. Therefore, excluding the Shutdown function (Channel 4), you can only assign five control signals to the maximum available channels (Channels 1–3 and Channels 9 and 10 if configured as control signals.) Note that the last two control signals in the list can only be assigned to channels 9 and 10.

When the control signal is true, the selected function is enabled.

Refer to **Digital IO** for a list of all the selectable Input Control signals.

## Output Status



Select an input channel by selection the **Output Status 5**, **Output Status 6**, **Output Status 7**, or **Output Status 8** softkey.



You can enable or disable each of the channels by toggling the **Out Status** softkey, Toggle the **Polarity** softkey to assign the signal polarity

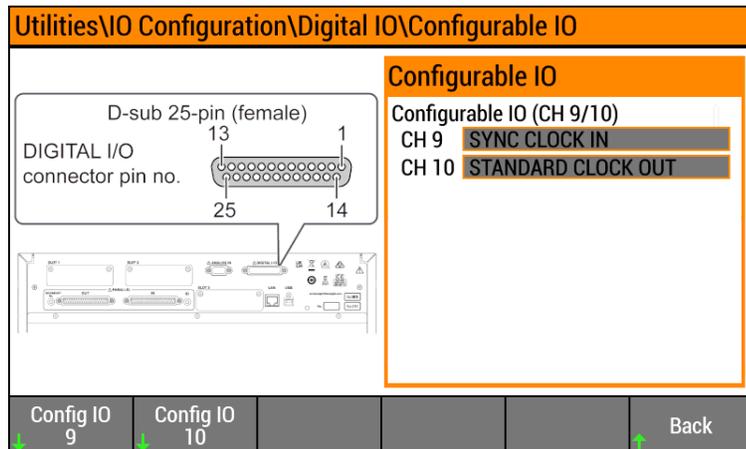
For Channels 5–7, you can select (or map) to any of the status signals listed as follows. Note that Channel 8 is reserved for the Protection status. As mentioned above, there are two additional channels (Channel 9 and Channel 10) that you can configure as Output Status signals.

However, in contrast to the Input Control signal, the Output Status signal CAN be assigned to more than one channel. However you can still only assign five status signals total to the maximum available channels (Channels 5–7 and Channels 9 and 10 if configured as status signals.) Note that the last two status signals in the list can only be assigned to channels 9 and 10.

When the status signal is true, the selected status is true.

Refer to **Digital IO** for a list of all the selectable Output Status signals.

## Configure IO



Channels 9 and 10 can be configured to be either Input Control, or Output Status signals.



You can enable or disable each of the channels by toggling the **Config IO** softkey, Toggle the **Direction** softkey to designate the signal as either Input Control or Output Status. Toggle the **Polarity** softkey to assign the signal polarity. When configured either way, any of the Input Control or Output Status signals can be mapped to the two Configurable IO channels. When configured, the Inhibit Control signal can be latched to stay on by toggling the **Mode** softkey.

Note that there are two additional Clock In/Out signals and two additional SEQ Trigger IN/Out signals that can only be assigned to the Configurable IO channels.

Refer to **Digital IO** for a list of all the Configurable IO signals.

## Typical Commands

- |  |  |
|--|--|
| <b>DIGital:INPut:DATA?</b>                                       | Queries the state of the digital input port.                             |
| <b>DIGital:OUTPut:DATA &lt;value&gt;</b>                         | Sets the state of the digital output port.                               |
| <b>DIGital:PIN&lt;1-3,5-7,9,10&gt;:FUNctIon &lt;map_item&gt;</b> | Maps the designated digital IO pin to a specific in/out function signal. |
| <b>DIGital:PIN&lt;1-3,5-10&gt;:POLarity POSitive NEGative</b>    | Sets the polarity of the designated digital IO pin.                      |

# 4

## SCPI Programming

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# Introduction to SCPI

## Introduction

## Keywords

## Queries

## Command Separators and Terminators

## Syntax Conventions

## Parameter Types

## Device Clear

## Typical Command Processing Times

### NOTE

In addition to using SCPI commands, you can also control the instrument using the IVI driver, available at [ivifoundation.org](http://ivifoundation.org).

## Introduction

This manual describes instrument programming using Standard Commands for Programmable Instruments (SCPI) over LAN, USB, and GPIB (optional). Select the interface type from the front panel, and be sure to understand the SCPI syntax and functions before you send SCPI commands and queries. In addition to using SCPI commands, you can also control the instrument using the IVI driver, available at [ivifoundation.org](http://ivifoundation.org).

The SCPI language is an ASCII-based programming language for test and measurement instruments. SCPI has two types of commands, common and subsystem.

### IEEE-488.2 Common Commands

The IEEE-488.2 standard defines common commands that perform functions such as reset, self-test, and status. Common commands always begin with an asterisk (\*), are three characters long, and may include parameters. The command keyword is separated from the first parameter by a space.

### Subsystem Commands

Subsystem commands perform specific instrument functions. They extend one or more levels below the root in a hierarchical structure. Associated commands are grouped under a common node, thus forming subsystems. A portion of the OUTPut subsystem is shown below to illustrate the tree system. Note that the brackets around a keyword, such as in [:STATe], indicate an optional keyword.

```
:OUTPut
  [:STATe] ON|1|OFF|0
  :COUPling AC|DC|ACDC
  :PROTection
    :CLEAr
```

## Keywords

Keywords, also referred to as headers, are instructions recognized by the instrument. Common commands are also keywords.

OUTPut is a root keyword, STATe, COUPling, and PROTection are second-level keywords, and CLear are third-level keywords. 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 readability, send the long form.

In the above examples, OUTP and OUTPUT are both acceptable. You can use upper- or lower-case letters. Therefore, OUTPUT, outp, and OuTp are all acceptable. Other forms, such as OUT, 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 question mark after the last keyword, before the parameters. Insert a space between the question mark and the first parameter.

You can query the value of most parameters. For example, to query the output voltage, send:

```
VOLTage?
```

You can also query the minimum or maximum allowable voltage:

```
VOLTage? MIN
VOLTage? MAX
```

Wait for all of the results of a query to be returned before sending another command or query. Otherwise, a *Query Interrupted* error will occur and the unreturned data will be lost.

## Command Separators and Terminators

### Separators

Colons (:) separate keyword levels. Blank spaces separate command parameters from their corresponding keyword. If a command requires more than one parameter, a comma separates parameters. In the following example, the frequency (100), low frequency limit (90), and high frequency limit (110) are separated by commas. Note the space after the word FREQuency.

```
FREQuency 100,90,110
```

Semicolons (;) separate commands within the same subsystem. This lets you send several subsystem commands within the same message string. For example, the following command:

```
FREQuency 100,90,110;MODE FIXed
```

## 4 SCPI Programming

is the same as sending the following commands:

```
FREQuency 100,90,110  
FREQuency:MODE FIXEd
```

You can also combine commands of different subsystems within a 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 specify the frequency and turn on the output as follows:

```
FREQuency 100,90,110;:OUTPut ON
```

The colon after the semicolon returns the command parser to the root.

### Terminators

A command string 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 always resets the SCPI command path to the root level.

### Syntax Conventions

Triangle brackets ( < > ) indicate that a parameter. For example, in the command syntax DISPlay[:WINDow]:TEXT "<string>", the <string> parameter is inside triangle brackets. These brackets are not sent with the command string. For example, you could send DISPlay:WINDow:TEXT "Test in progress".

A vertical bar ( | ) separates multiple parameter choices for a given command string. For example, AC|DC|ACDC in the OUTPut:COUPling command indicates that you can specify AC, DC, or ACDC. The bar is not sent with the command string.

Square brackets ( [ ] ) indicate that a keyword or parameter is optional. These brackets are not sent with the command string. If you do not specify a value for an optional parameter, the instrument ignores the parameter. In the DISPlay[:WINDow]:TEXT example above, the optional [:WINDow] level means that DISPlay:TEXT is the same as DISPlay:WINDow:TEXT.

### Parameter Types

The SCPI language defines several data formats to be used in commands and queries.

#### 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:]CURRent <value>|MINimum|MAXimum
```

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, or MAX to set it to its maximum allowable value.

You can also optionally include the following engineering unit suffixes with numeric parameters:

Parameter	Default Unit	Parameter	Default Unit
Voltage	V	Reactance	H
Current	A	Hours	HR
Wattage	W	Minutes	MIN
Apparent Power	VA	Seconds	S
Reactive Power	VAR	Percent	PCT
Degrees	DEG	Resistance	OHM
Frequency	HZ		

You may also put the following prefixes before a unit of measure:

Prefix	Meaning	Number
U	micro	1/1,000,000
M	milli	1/1,000
K	kilo	1,000

As with other SCPI keywords, both units and prefixes are case-insensitive. Thus, you could indicate millivolts as mv, mV, Mv, or MV.

### Discrete Parameters

Discrete parameters specify settings that have a limited number of values (like IMMEDIATE, EXTERNAL, or BUS). Like command keywords, they may have short and long forms. You can mix upper- and lower-case letters. Query responses always return the short form in upper-case letters. The following command requires a discrete parameter:

```
DISPlay:VIEW METER_VI|METER_VP|METER VIP
```

### Boolean Parameters

Boolean parameters represent a single binary condition that is either true (1 or ON) or false (0 or OFF). A boolean query always returns 0 or 1. The following command requires a boolean parameter:

```
DISPlay ON|1|OFF|0
```

### ASCII String Parameters

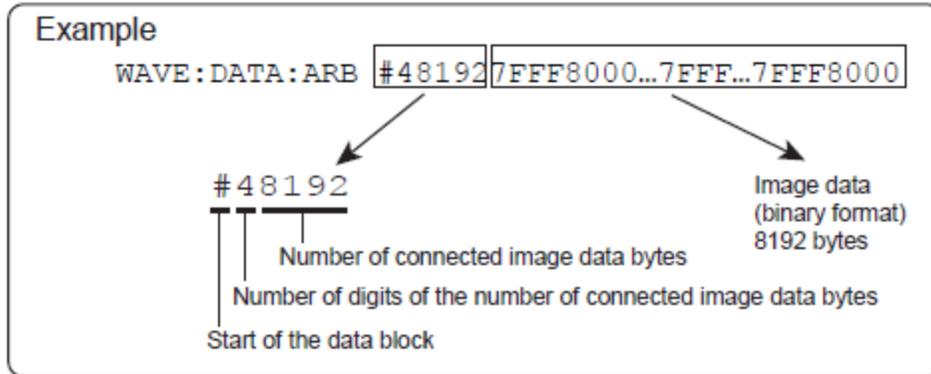
String parameters can contain virtually any ASCII characters. A string must begin and end with matching single (') or double (") quotation marks. To include the quote delimiter as part of the string, enter it twice without any characters in between. The following command uses a string parameter:

```
DISPlay:TEXT "Test in progress . . ."
```

### Arbitrary Block Program or Response Data

Definite-length block data <Block> allows any type of device-dependent data to be programmed or returned as a series of 8-bit binary data bytes. This is particularly useful for transferring large quantities of data or 8-bit extended ASCII codes.

Arbitrary block data that starts with #.



### Phase Designations

When the parameter is numeric, this product allows you to designate the phases you want to set using the syntax (@chanlist). The INSTRument command settings do not apply to phase-designated commands.

Phase 1 is (@1), Phase 2 is (@2), and Phase 3 is (@3).

In the following example, the Phase 2 is set to 130 V.

```
VOLT 130, (@2)
```

Multiple phases can be designated at once. To designate Phase 1 (@1) and Phase 3 (@3)

```
VOLT 130, (@1, 3)
```

To designate all phases (@1 to @3)

```
VOLT 130, (@1:3)
```

### 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.

### Typical Command Processing Times

The table below documents some typical, average command processing times (milliseconds) for various commands and queries. This can help you determine the impact of some common SCPI commands on total test time.

The command processing time is the time until the next command is accepted. It does not include hardware response time.

Command	GPIB <sup>[1]</sup>	USB	Description
*CLS	5	6	Clear the status data.
*RCL	233	230	Recall the contents of a state storage location.
*RST	233	230	Perform a device reset.
*SAV	13	14	Save the current settings.
FREQuency	15	17	Set the AC output frequency.
MEASure:CURRent:AC?	333	333	Query the AC current.
MEASure:VOLTage:AC?	333	333	Query the AC voltage.
OUTPut OFF	19	23	Turn the output OFF.
OUTPut ON	9	11	Turn the output on.
VOLTage	16	18	Set the AC voltage.

<sup>[1]</sup>Using Keysight IO Libraries.

## Command Quick Reference

### ABORt Subsystem

Command/Query	Description
ABORt[:ALL]	Aborts all operations.
ABORt:ACQuire	Aborts all ACQuire operations.
ABORt:PROGram	Aborts all PROGram operations.
ABORt:SIMulation	Aborts all SIMulation operations.
ABORt:TRANsient	Aborts all TRANsient actions.

### CURRent Subsystem

Command/Query	Description
[SOURce:]CURRent[:LEVel][:IMMediate][:AMPLitude] <value> MINimum MAXimum[, <lower_limit>, <upper_limit>] [,@chanlist]	Sets the immediate AC current limit in amps (rms). Specifies optional lower and upper peak limits.
[SOURce:]CURRent[:LEVel][:IMMediate][:AMPLitude]? [MINimum MAXimum] [,@chanlist]	
[SOURce:]CURRent:PEAK:LOWer <value> MINimum MAXimum [,@chanlist]	Specifies the lower peak current limit in amps.
[SOURce:]CURRent:PEAK:LOWer? [MINimum MAXimum] [,@chanlist]	
[SOURce:]CURRent:PEAK:UPPer <value> MINimum MAXimum [,@chanlist]	Specifies the upper peak current limit in amps.
[SOURce:]CURRent:PEAK:UPPer? [MINimum MAXimum] [,@chanlist]	
[SOURce:]CURRent:PROTection:STATe ON 1 OFF 0	Enables or disables current protection.
[SOURce:]CURRent:PROTection:STATe?	
[SOURce:]CURRent:PROTection:TRIP:DELay <value>	Sets the protection trip delay in seconds.
[SOURce:]CURRent:PROTection:TRIP:DELay?	

### DIGital Subsystem

Command/Query	Description
DIGital:INPut:DATA?	Queries the state of the digital input port.
DIGital:OUTPut:DATA <value>	Sets the state of the digital output port.
DIGital:OUTPut:DATA?	
DIGital:PIN<1-3,5-7,9,10>:FUNctIon <map_item>	Maps the designated digital IO pin to a specific in/out function signal.
DIGital:PIN<1 - 10>:FUNctIon?	
DIGital:PIN<1-3,5-10>:POLarity POSitive NEGative	Sets the polarity of the designated digital IO pin.
DIGital:PIN<1-10>:POLarity?	

## DISPlay Subsystem

Command/Query	Description
DISPlay[:WINDow][:STATe] ON 1 OFF 0 DISPlay[:WINDow][:STATe]?	Turns the front-panel display on or off.
DISPlay[:WINDow]:METer:COUPling AC DC ACDC PEAK, AC DC ACDC PEAK DISPlay[:WINDow]:METer:COUPling?	Selects both the voltage and current measurement unit.
DISPlay[:WINDow]:METer:COUPling:CURRent AC DC ACDC PEAK DISPlay[:WINDow]:METer:COUPling:CURRent?	Selects the current measurement unit.
DISPlay[:WINDow]:METer:COUPling:VOLTagE AC DC ACDC PEAK DISPlay[:WINDow]:METer:COUPling:VOLTagE?	Selects the voltage measurement unit.
DISPlay[:WINDow]:PHASe P123 ABC UVW DISPlay[:WINDow]:PHASe?	Selects the phase-naming convention.
DISPlay[:WINDow]:VIEW METER_ALL METER_3P METER_1P DISPlay[:WINDow]:VIEW?	Selects the phases to display.

## FETCh and MEASure Subsystems

Command/Query	Description
FETCh[:SCALar]:ALL? [(@chanlist)] MEASure[:SCALar]:ALL? [(@chanlist)]	Returns all measurements, except TOTal measurements, as a comma-separated list.
FETCh[:SCALar]:CURRent:AC? [(@chanlist)] MEASure[:SCALar]:CURRent:AC? [(@chanlist)]	AC current (Arms)
FETCh[:SCALar]:CURRent:ACDC? [(@chanlist)] MEASure[:SCALar]:CURRent:ACDC? [(@chanlist)]	Current, AC+DC (Arms)
FETCh[:SCALar]:CURRent:AMPLitude:MAXimum? [(@chanlist)] MEASure[:SCALar]:CURRent:AMPLitude:MAXimum? [(@chanlist)]	Instantaneous peak current (A)
FETCh[:SCALar]:CURRent:AMPLitude:MAXimum:HOLD? [(@chanlist)] MEASure[:SCALar]:CURRent:AMPLitude:MAXimum:HOLD? [(@chanlist)]	Peak AC current held value (A)
FETCh[:SCALar]:CURRent:CREStfactor? [(@chanlist)] MEASure[:SCALar]:CURRent:CREStfactor? [(@chanlist)]	Current crest factor
FETCh[:SCALar]:CURRent[:DC]? [(@chanlist)] MEASure[:SCALar]:CURRent[:DC]? [(@chanlist)]	Average DC current (A)
FETCh[:SCALar]:FREQuency? [(@chanlist)] MEASure[:SCALar]:FREQuency? [(@chanlist)]	AC output frequency (Hz)
FETCh[:SCALar]:POWer[:DC]? [(@chanlist)] MEASure[:SCALar]:POWer[:DC]? [(@chanlist)]	Average DC power (W)
FETCh[:SCALar]:POWer:AC:REAL? [(@chanlist)] MEASure[:SCALar]:POWer:AC:REAL? [(@chanlist)]	AC active power (W)
FETCh[:SCALar]:POWer:AC:APParent? [(@chanlist)] MEASure[:SCALar]:POWer:AC:APParent? [(@chanlist)]	AC apparent power (VA)

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Command/Query	Description
FETCH[:SCALar]:POWer:AC:REACTive? [(@chanlist)] MEASure[:SCALar]:POWer:AC:REACTive? [(@chanlist)]	AC reactive power (VAR)
FETCH[:SCALar]:POWer:AC:PFACTor? [(@chanlist)] MEASure[:SCALar]:POWer:AC:PFACTor? [(@chanlist)]	AC power factor
FETCH[:SCALar]:POWer:ACDC:REAL? [(@chanlist)] MEASure[:SCALar]:POWer:ACDC:REAL? [(@chanlist)]	AC active power (W)
FETCH[:SCALar]:POWer:ACDC:APParent? [(@chanlist)] MEASure[:SCALar]:POWer:ACDC:APParent? [(@chanlist)]	AC+DC apparent power (VA)
FETCH[:SCALar]:POWer:ACDC:REACTive? [(@chanlist)] MEASure[:SCALar]:POWer:ACDC:REACTive? [(@chanlist)]	AC+DC reactive power (VAR)
FETCH[:SCALar]:POWer:ACDC:PFACTor? [(@chanlist)] MEASure[:SCALar]:POWer:ACDC:PFACTor? [(@chanlist)]	AC+DC power factor
FETCH[:SCALar]:VOLTagE:DC? [(@chanlist)] MEASure[:SCALar]:VOLTagE:DC? [(@chanlist)]	Average DC voltage (V)
FETCH[:SCALar]:VOLTagE:AC? [(@chanlist)] MEASure[:SCALar]:VOLTagE:AC? [(@chanlist)]	AC voltage (Vrms)
FETCH[:SCALar]:VOLTagE:ACDC? [(@chanlist)] MEASure[:SCALar]:VOLTagE:ACDC? [(@chanlist)]	Voltage, AC+DC (Vrms)
FETCH[:SCALar]:VOLTagE:AMPLitude:MAXimum? [(@chanlist)] MEASure[:SCALar]:VOLTagE:AMPLitude:MAXimum? [(@chanlist)]	Instantaneous peak voltage (V)
FETCH[:SCALar]:VOLTagE:AMPLitude:MAXimum:HOLD? [(@chanlist)] MEASure[:SCALar]:VOLTagE:AMPLitude:MAXimum:HOLD? [(@chanlist)]	Peak AC voltage held value (V)
FETCH[:SCALar]:LTLVoltage:DC? [(@chanlist)] MEASure[:SCALar]:LTLVoltage:DC? [(@chanlist)]	Line-to-line average DC voltage (V)
FETCH[:SCALar]:LTLVoltage:AC? [(@chanlist)] MEASure[:SCALar]:LTLVoltage:AC? [(@chanlist)]	Line-to-line AC voltage (Vrms)
FETCH[:SCALar]:LTLVoltage:ACDC? [(@chanlist)] MEASure[:SCALar]:LTLVoltage:ACDC? [(@chanlist)]	Line-to-line voltage AC+DC voltage (Vrms)
FETCH[:SCALar]:LTLVoltage:AMPLitude:MAXimum? [(@chanlist)] MEASure[:SCALar]:LTLVoltage:AMPLitude:MAXimum? [(@chanlist)]	Line-to-line peak voltage (V)
The following returns the total from all phases	
FETCH[:SCALar]:POWer[:DC]:TOTal? MEASure[:SCALar]:POWer[:DC]:TOTal?	Total DC power (W)
FETCH[:SCALar]:POWer:ACDC:REAL:TOTal? MEASure[:SCALar]:POWer:ACDC:REAL:TOTal?	Total AC active power (W)
FETCH[:SCALar]:POWer:AC:APParent:TOTal? MEASure[:SCALar]:POWer:AC:APParent:TOTal?	Total AC apparent power (VA)
FETCH[:SCALar]:POWer:AC:REACTive:TOTal? MEASure[:SCALar]:POWer:AC:REACTive:TOTal?	Total AC reactive power (VAR)
FETCH[:SCALar]:POWer:AC:PFACTor:TOTal? MEASure[:SCALar]:POWer:AC:PFACTor:TOTal?	Total AC power factor

Command/Query	Description
FETCh[:SCALar]:POWer:ACDC[:REAL]:TOTal? MEASure[:SCALar]:POWer:ACDC[:REAL]:TOTal?	Total AC active power (W)
FETCh[:SCALar]:POWer:ACDC:APParent:TOTal? MEASure[:SCALar]:POWer:ACDC:APParent:TOTal?	Total AC+DC apparent power (VA)
FETCh[:SCALar]:POWer:ACDC:REActive:TOTal? MEASure[:SCALar]:POWer:ACDC:REActive:TOTal?	Total AC+DC reactive power (VAR)
FETCh[:SCALar]:POWer:ACDC:PFActor:TOTal? MEASure[:SCALar]:POWer:ACDC:PFActor:TOTal?	Total AC+DC power factor
The following returns harmonic data	
FETCh:CURRent:HARMonic[AMPLitude]? [[:@chanlist]] MEASure:CURRent:HARMonic[AMPLitude]? [[:@chanlist]]	Harmonic current amplitude
FETCh:CURRent:HARMonic:PHASe? [[:@chanlist]] MEASure:CURRent:HARMonic:PHASe? [[:@chanlist]]	Harmonic current phase
FETCh:CURRent:HARMonic:THD? [[:@chanlist]] MEASure:CURRent:HARMonic:THD? [[:@chanlist]]	Total harmonic distortion (THD)
FETCh:VOLTage:HARMonic[AMPLitude]? [[:@chanlist]] MEASure:VOLTage:HARMonic[AMPLitude]? [[:@chanlist]]	Harmonic voltage amplitude
FETCh:VOLTage:HARMonic:PHASe? [[:@chanlist]] MEASure:VOLTage:HARMonic:PHASe? [[:@chanlist]]	Harmonic voltage phase
FETCh:VOLTage:HARMonic:THD? [[:@chanlist]] MEASure:VOLTage:HARMonic:THD? [[:@chanlist]]	Total harmonic distortion (THD)

## FREQUENCY Subsystem

Command/Query	Description
[SOURce:]FREQuency[:CW] <value> MINimum MAXimum[, <lower_limit>, <upper_limit>] [SOURce:]FREQuency[:CW]? [MINimum MAXimum] [SOURce:]FREQuency[:IMMediate] <value> MINimum MAXimum[, <lower_limit>, <upper_limit>] [SOURce:]FREQuency[:IMMediate]? [MINimum MAXimum]	Sets the immediate AC frequency and optionally the lower and upper frequency soft limits.
[SOURce:]FREQuency:LIMit:LOWer <value> [SOURce:]FREQuency:LIMit:LOWer? [MINimum MAXimum]	Sets the lower AC frequency soft limit.
[SOURce:]FREQuency:LIMit:UPPer <value> [SOURce:]FREQuency:LIMit:UPPer? [MINimum MAXimum]	Sets the upper AC frequency soft limit.
[SOURce:]FREQuency:TRIGgered <value> MINimum MAXimum [SOURce:]FREQuency:TRIGgered? [MINimum MAXimum]	Sets the triggered AC output frequency in Hertz.
[SOURce:]FREQuency:SYNCronous[:STATe] ON 1 OFF 0 [SOURce:]FREQuency:SYNCronous[:STATe]?	Enables or disables frequency synchronous operation.
[SOURce:]FREQuency:SYNCronous:MODE LINE EXTernal [SOURce:]FREQuency:SYNCronous:MODE?	Sets the synchronization signal source.
[SOURce:]FREQuency:SYNCronous:PHASe:DELay <value> MINimum MAXimum [SOURce:]FREQuency:SYNCronous:PHASe:DELay? [MINimum MAXimum]	Sets the synchronization offset angle in degrees.

## FUNction Subsystem

Command/Query	Description
[SOURce:]FUNctIon[:SHApe]:BANK[:INDeX] <index> [,@chanlist] [SOURce:]FUNctIon[:SHApe]:BANK[:INDeX]? [(@chanlist)]	Selects a waveform shape by bank index.

## HCOPy Subsystem

Command/Query	Description
HCOPy:SDUMp:DATA?	Returns the display image in .png format.

## IEEE-488 Subsystem

Command/Query	Description
*CLS	Clear status command.
*ESE <value> *ESE?	Event status enable command and query.
*ESR?	Event status event query.
*IDN?	Identification Query. Returns the instrument's identification string.
*OPC	Sets the OPC (operation complete) bit in the standard event register.
*OPC?	Returns a 1 to the output buffer when all pending operations complete.
*OPT?	Returns a string identifying any installed options.
*PSC 0 1 *PSC?	Enables (1) or disables (0) the clearing of certain enable registers at power on.
*RCL <0 to 10>	Recalls a saved instrument state.
*RST	Resets the instrument to default values.
*SAV <0 to 10>	Saves the instrument state to a nonvolatile memory location.
*SRE <value> *SRE?	Service request enable command and query.
*STB?	Status byte query. Reads the Status Byte Register, which contains the status summary bits and the Output Queue MAV bit.
*TRG	Trigger command. Applies a software trigger (equivalent to IEEE 488.1 Device Trigger) for both TRANsient and ACQuire trigger groups.
*TST?	Self-test. Returns the errors found during the most recent power-on self-test.

## INITiate Subsystem

Command/Query	Description
INITiate[:IMMEDIATE]:ACQUIRE	Initiates the ACQUIRE (measurement) operation.
INITiate[:IMMEDIATE]:PROGRAM	Initiates the PROGRAM operation.
INITiate[:IMMEDIATE]:SIMULATION	Initiates the SIMULATION operation.
INITiate[:IMMEDIATE]:TRANSIENT	Initiates the TRANSIENT operation.

## INSTrument Subsystem

Command/Query	Description
INSTrument[:SElect] OUTPUT0 OUTPUT1 OUTPUT2 OUTPUT3 INSTrument[:SElect]?	Selects the phase to be controlled by output phase name.
INSTrument:NSElect 0 1 2 3 INSTrument:NSElect?	Selects the phase to be controlled by output phase number.

## LXI Subsystem

Command/Query	Description
LXI:IDENTify[:STATe] ON 1 OFF 0 LXI:IDENTify[:STATe]?	Turns the front-panel LXI identify indicator (blinking "Lan" annunciator) on or off.
LXI:MDNS[:STATe] ON 1 OFF 0 LXI:MDNS[:STATe]?	Turns the LAN mDNS service on or off.

## MEMory Subsystem

Command/Query	Description
MEMory:RECall[:IMMEDIATE] 1 2	Recalls the memory saved in location 1 or 2
MEMory:RECall:PREView? 1 2	Displays the memory contents saved in location 1 or 2
MEMory:SAVE[:IMMEDIATE] 1 2	Saves the output settings to memory location 1 or 2

## OUTPut Subsystem

Command/Query	Description
OUTPut[:STATe] ON 1 OFF 0 OUTPut[:STATe]?	Enables or disables the instrument's output.
OUTPut:COUPLing AC DC ACDC OUTPut:COUPLing?	Sets the output coupling mode.
OUTPut:IMPedance[:STATe] ON 1 OFF 0 OUTPut:IMPedance[:STATe]?	Enables or disables the output impedance control.

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Command/Query	Description
OUTPut:IMPedance:REACtive <value> MINimum MAXimum [,@chanlist] OUTPut:IMPedance:REACtive? [MINimum MAXimum] [,@chanlist]	Sets the reactive part of the output impedance in Henries.
OUTPut:IMPedance:REAL <value> MINimum MAXimum [,@chanlist] OUTPut:IMPedance:REAL? [MINimum MAXimum] [,@chanlist]	Sets the resistance part of the output impedance in ohms.
OUTPut:INHibit:MODE LATCHing LIVE OUTPut:INHibit:MODE?	Sets the operating mode of the remote inhibit digital pin.
OUTPut:PHASe:OFF[:STATe] ON Free OFF Fixed OUTPut:PHASe:OFF[:STATe]?	Enables or disables the output-off phase control when OUTPut OFF is sent.
OUTPut:PHASe:OFF:LEVel <value> OUTPut:PHASe:OFF:LEVel?	Sets the output-off phase angle when OUTPut OFF is sent in degrees.
OUTPut:PHASe:ON[:STATe] ON Free OFF Fixed OUTPut:PHASe:ON[:STATe]?	Enables or disables the output-on phase control when OUTPut ON is sent.
OUTPut:PHASe:ON:LEVel <value> OUTPut:PHASe:ON:LEVel?	Sets the output-on phase angle when OUTPut ON is sent in degrees.
OUTPut:PHASe:P1Offset <value> MINimum MAXimum OUTPut:PHASe:P1Offset? [MINimum MAXimum]	Sets the absolute phase 1 offset angle to the specified reference in degrees.
OUTPut:PHASe:P12 <value> MINimum MAXimum OUTPut:PHASe:P12? [MINimum MAXimum]	Sets the difference between the phase 1 angle and the phase 2 angle in degrees.
OUTPut:PHASe:P13 <value> MINimum MAXimum OUTPut:PHASe:P13? [MINimum MAXimum]	Sets the difference between the phase 1 angle and the phase 3 angle in degrees.
OUTPut:PON:SAFE ON 1 OFF 0 OUTPut:PON:SAFE?	Enables or disables the power-on output state.
OUTPut:PON:STATe RST RCL<0-9> AUTO OUTPut:PON:STATe?	Specifies the output power-on state.
OUTPut:PROTection:CLEar	Resets the latched protection.
OUTPut:PROTection:WDOG[:STATe] ON 1 OFF 0 OUTPut:PROTection:WDOG[:STATe]?	Enables or disables the I/O watchdog timer.
OUTPut:PROTection:WDOG:DElay <value> MINimum MAXimum OUTPut:PROTection:WDOG:DElay? [MINimum MAXimum]	Sets the watchdog delay time.
OUTPut:SStart[:STATe][:RISE] ON 1 OFF 0 OUTPut:SStart[:STATe][:RISE]?	Enables or disables the soft-start rise.
OUTPut:SStart[:STATe]:FALL ON 1 OFF 0 OUTPut:SStart[:STATe]:FALL?	Enables or disables the soft-start fall.
OUTPut:SStart:TIME[:RISE] <value> MINimum MAXimum OUTPut:SStart:TIME[:RISE]? [MINimum MAXimum]	Sets the soft-start rise time in seconds.
OUTPut:SStart:TIME:FALL <value> MINimum MAXimum OUTPut:SStart:TIME:FALL? [MINimum MAXimum]	Sets the soft-start fall time in seconds.
OUTPut:ssUPpression:STATe ON 1 OFF 0 OUTPut:ssUPpression:STATe?	Enables or disables the voltage surge suppression feature.

## PROGram Subsystem

Command/Query	Description
PROG:CLEAR	Sets all sequence steps to their default values.
PROG:EDIT <step>, <freq>, <ramp-bool>, <ac-volt>, <ramp-bool>, <dc-volt>, <ramp-bool>, <step-time>, <output-bool>, <status-bool>, <trigin-bool>, <trigout-bool>, <bank-number> PROG:EDIT? <step>	Programs the sequence step.
PROG:EDIT:FUNCTION[:SHAPE]:BANK[:INDEX] <step>, <bank-number> [,@chanlist] PROG:EDIT:FUNCTION[:SHAPE]:BANK[:INDEX]? <step> [,@chanlist]	Sets the waveform bank number of the sequence step.
PROG:EDIT:IMPEDANCE[:STATE] <step>, ON 1 OFF 0 PROG:EDIT:IMPEDANCE[:STATE]? <step>	Enables or disables the output impedance of the step.
PROG:EDIT:IMPEDANCE:REACTIVE <step>, <value> [,@chanlist] PROG:EDIT:IMPEDANCE:REACTIVE? <step> [,@chanlist]	Sets the reactive component of the output impedance of the step.
PROG:EDIT:IMPEDANCE:REAL <step>, <value> [,@chanlist] PROG:EDIT:IMPEDANCE:REAL? <step> [,@chanlist]	Sets the resistive component of the output impedance of the step.
PROG:EDIT:JUMP <step>, <jump-bool>, <jump-step>, <jump-count> PROG:EDIT:JUMP? <step>	Configures the jump settings of the sequence step.
PROG:EDIT:PHASE:P1Offset <step>, <enable-bool>, <value> PROG:EDIT:PHASE:P1Offset? <step>	Sets the phase 1 offset angle of the sequence step.
PROG:EDIT:PHASE:P12 <step>, <enable-bool>, <value> PROG:EDIT:PHASE:P12? <step>	Sets the phase 1 and phase 2 angle difference of the sequence step.
PROG:EDIT:PHASE:P13 <step>, <enable-bool>, <value> PROG:EDIT:PHASE:P13? <step>	Sets the phase 1 and phase 3 angle difference of the sequence step.
PROG:EDIT:PHASE:RAMP <step>, <OFF LEAD LAG>, <OFF LEAD LAG>, <OFF LEAD LAG> PROG:EDIT:PHASE:RAMP? <step>	Sets the phase signal change characteristics of the sequence step.
PROG:EDIT:PHASE:START <step>, <value> PROG:EDIT:PHASE:START? <step>	Sets the starting phase angle of the sequence step.
PROG:EDIT:PHASE:STOP <step>, <value> PROG:EDIT:PHASE:STOP? <step>	Sets the stopping phase angle of the sequence step.
PROG:EDIT:VOLTAGE <step>, <value> [,@chanlist] PROG:EDIT:VOLTAGE? <step>	Sets the unbalanced ac voltage of the sequence step.
PROG:EDIT:VOLTAGE:OFFSet <step>, <value> [,@chanlist] PROG:EDIT:VOLTAGE:OFFSet? <step>	Sets the unbalanced dc voltage of the sequence step.
PROG:EXECuting STOP RUN PAUSE <time>, <loop>, <step> PROG:EXECuting?	Changes the execution state of the sequence program.
PROG:LOOP <value> PROG:LOOP?	Sets the number of program loops.
PROG:STEP:ADD <step>	Adds a new program step.
PROG:STEP:CLEAR <step>	Removes the specified program step.

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Command/Query	Description
PROGram:STEP:END <step> PROGram:STEP:END?	Sets the sequence ending step.
PROGram:STEP:START <step> PROGram:STEP:START?	Sets the sequence starting step.

### SENSe Subsystem

Command/Query	Description
SENSe:AVERage <value> SENSe:AVERage?	Sets the moving averaging count for both voltage and current measurements.
SENSe:CURREnt:AVERage <value> SENSe:CURREnt:AVERage?	Sets the moving averaging count for current measurements.
SENSe:CURREnt[:PEAK]:HOLD:CLEar	Clears the peak held current measurement.
SENSe:CURREnt[:PEAK]:HOLD:TIME <value> MINimum MAXimum SENSe:CURREnt[:PEAK]:HOLD:TIME? [MINimum MAXimum]	Sets the peak hold time for current measurements in seconds.
SENSe:VOLTage:AVERage <value> SENSe:VOLTage:AVERage?	Sets the moving averaging count for voltage measurements.
SENSe:VOLTage[:PEAK]:HOLD:CLEar	Clears the peak held voltage measurement.
SENSe:VOLTage[:PEAK]:HOLD:TIME <value> MINimum MAXimum SENSe:VOLTage[:PEAK]:HOLD:TIME? [MINimum MAXimum]	Sets the peak hold time for voltage measurements in seconds.

### SIMulation Subsystem

Command/Query	Description
SIMulation:EXECuting RUN STOP, <repeat-count> SIMulation:EXECuting?	Runs or stops the power failure simulation.
SIMulation:POLarity POSitive NEGative SIMulation:POLarity?	Sets the voltage polarity of the power line simulation.
SIMulation:REPeat:COUNT <value> SIMulation:REPeat:COUNT?	Sets the repeat count of the power line simulation.
SIMulation:STATe ON 1 OFF 0	Enables or disables a power line simulation sequence.
SIMulation:T1:PHASe[:LEVel] <value> MINimum MAXimum SIMulation:T1:PHASe[:LEVel]? [MINimum MAXimum]	Sets the starting phase angle of the simulation in degrees.
SIMulation:T1:PHASe:STATe ON 1 OFF 0 SIMulation:T1:PHASe:STATe?	Selects whether the simulation start will be set in terms of time or phase.
SIMulation:T1:TIME[:LEVel] <value> MINimum MAXimum SIMulation:T1:TIME[:LEVel]? [MINimum MAXimum]	Sets the starting time of the simulation.

Command/Query	Description
SIMulation:T2:TIME[:LEVel] <value> MINimum MAXimum SIMulation:T2:TIME[:LEVel]? [MINimum MAXimum]	Sets the first slope time of the simulation.
SIMulation:T3:TIME[:LEVel] <value> MINimum MAXimum SIMulation:T3:TIME[:LEVel]? [MINimum MAXimum]	Sets the time of the simulation.
SIMulation:T3:VOLTage[:LEVel] <value> MINimum MAXimum SIMulation:T3:VOLTage[:LEVel]? [MINimum MAXimum]	Sets the regulated voltage of the simulation.
SIMulation:T4:TIME[:LEVel] <value> MINimum MAXimum SIMulation:T4:TIME[:LEVel]? [MINimum MAXimum]	Sets the second slope time of the simulation.
SIMulation:T5:CYCLe[:LEVel] <value> SIMulation:T5:CYCLe[:LEVel]?	Sets the number of return cycles of the simulation.
SIMulation:T5:CYCLe:STATe ON 1 OFF 0 SIMulation:T5:CYCLe:STATe?	Selects whether the simulation remaining in the returned state will be set in terms of time or cycles.
SIMulation:T5:TIME[:LEVel] <value> MINimum MAXimum SIMulation:T5:TIME[:LEVel]? [MINimum MAXimum]	Sets the return time of the simulation.

## STATus Subsystem

Command/Query	Description
STATus:PRESet	Initializes the transition and enable filters for both OPERATION and QUESTIONable register groups.
STATus:OPERation[:EVENT]?	Queries the event of the Operation status group.
STATus:OPERation:CONDition?	Queries the condition of the Operation status group.
STATus:OPERation:ENABle <value> STATus:OPERation:ENABle?	Sets the value of the enable register of the Operation status group.
STATus:OPERation:NTRansition <value> STATus:OPERation:NTRansition? STATus:OPERation:PTRansition <value> STATus:OPERation:PTRansition?	Sets and queries the value of negative and positive transition filters of the Questionable status group.
STATus:OPERation:INSTrument[:EVENT]?	Queries the event of the Operation Instrument status group.
STATus:OPERation:INSTrument:CONDition?	Queries the condition of the Operation Instrument status group.
STATus:OPERation:INSTrument:ENABle <value> STATus:OPERation:INSTrument:ENABle?	Sets the value of the enable register of the Operation Instrument status group.
STATus:OPERation:INSTrument:NTRansition <value> STATus:OPERation:INSTrument:NTRansition? STATus:OPERation:INSTrument:PTRansition <value> STATus:OPERation:INSTrument:PTRansition?	Sets and queries the value of negative and positive transition filters of the Operation Instrument status group.
STATus:OPERation:INSTrument:ISUMmary<1 2 3>[:EVENT]?	Queries the event of the Operation Instrument Isummary status group.
STATus:OPERation:INSTrument:ISUMmary<1 2 3>:CONDition?	Queries the condition of the Operation Instrument Isummary status group.

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Command/Query	Description
STATus:OPERation:INSTRument:ISUMmary<1 2 3>:ENABLE <value> STATus:OPERation:INSTRument:ISUMmary<1 2 3>:ENABLE?	Sets the value of the enable register of the Operation Instrument Isummary status group.
STATus:OPERation:INSTRument:ISUMmary<1 2 3>:NTRansition <value> STATus:OPERation:INSTRument:ISUMmary<1 2 3>:NTRansition? STATus:OPERation:INSTRument:ISUMmary<1 2 3>:PTRansition <value> STATus:OPERation:INSTRument:ISUMmary<1 2 3>:PTRansition?	Sets and queries the value of negative and positive transition filters of the Operation Instrument Isummary status group.
STATus:QUESTionable[:EVENT]?	Queries the event of the Questionable status group.
STATus:QUESTionable:CONDition?	Queries the condition of the Questionable status group.
STATus:QUESTionable:ENABLE <value> STATus:QUESTionable:ENABLE?	Sets the value of the enable register of the Questionable status group.
STATus:QUESTionable:NTRansition <value> STATus:QUESTionable:NTRansition? STATus:QUESTionable:PTRansition <value> STATus:QUESTionable:PTRansition?	Sets and queries the value of negative and positive transition filters of the Questionable status group.
STATus:QUESTionable:INSTRument[:EVENT]?	Queries the event of the Questionable Instrument status group.
STATus:QUESTionable:INSTRument:CONDition?	Queries the condition of the Questionable Instrument status group.
STATus:QUESTionable:INSTRument:ENABLE <value> STATus:QUESTionable:INSTRument:ENABLE?	Sets the value of the enable register of the Questionable Instrument status group.
STATus:QUESTionable:INSTRument:NTRansition <value> STATus:QUESTionable:INSTRument:NTRansition? STATus:QUESTionable:INSTRument:PTRansition <value> STATus:QUESTionable:INSTRument:PTRansition?	Sets and queries the value of negative and positive transition filters of the Questionable Instrument status group.
STATus:QUESTionable:INSTRument:ISUMmary<1 2 3>[:EVENT]?	Queries the event of the Questionable Instrument Isummary status group.
STATus:QUESTionable:INSTRument:ISUMmary<1 2 3>:CONDition?	Queries the condition of the Questionable Instrument Isummary status group.
STATus:QUESTionable:INSTRument:ISUMmary<1 2 3>:ENABLE <value> STATus:QUESTionable:INSTRument:ISUMmary<1 2 3>:ENABLE?	Sets the value of the enable register of the Questionable Instrument Isummary status group.
STATus:QUESTionable:INSTRument:ISUMmary<1 2 3>:NTRansition <value> STATus:QUESTionable:INSTRument:ISUMmary<1 2 3>:NTRansition? STATus:QUESTionable:INSTRument:ISUMmary<1 2 3>:PTRansition <value> STATus:QUESTionable:INSTRument:ISUMmary<1 2 3>:PTRansition?	Sets and queries the value of negative and positive transition filters of the Questionable Instrument Isummary status group.

## SYSTem Subsystem

Command/Query	Description
SYSTem:BEEPer[:IMMEDIATE]	Issues a single beep.
SYSTem:BEEPer:KCLick ON 1 OFF 0 SYSTem:BEEPer:KCLick?	Disables or enables the click tone heard when you press a front-panel key.
SYSTem:BEEPer:STATe ON 1 OFF 0 SYSTem:BEEPer:STATe?	Disables or enables the beep heard when an error is generated.
SYSTem:COMMunicate:LAN:CONTRol?	Returns the TCP port number for SCPI-RAW.
SYSTem:COMMunicate:RLState LOCAL REMOTE RWLOCK SYSTem:COMMunicate:RLState?	Configures the remote/local/lockout state of the instrument.
SYSTem:CONFigure:ADJust:VOLTage:FINE <value> MINimum MAXimum [,(@chanlist)] SYSTem:CONFigure:ADJust:VOLTage:FINE? [MINimum MAXimum] [,(@chanlist)]	Sets the voltage offset value.
SYSTem:CONFigure:ADJust:VOLTage:TERMinal:MODE OUTPut SENSE SYSTem:CONFigure:ADJust:VOLTage:TERMinal:MODE?	Applies the voltage offset value either to the output terminal or the sense terminal.
SYSTem:CONFigure:FORMation:FRAME[:COUNT]?	Queries the number of units operating in parallel.
SYSTem:CONFigure:FORMation:FRAME:INFO? <value>	Queries information about the specified unit operating in parallel.
SYSTem:CONFigure:FORMation:PMODule[:COUNT]? <value>	Queries the number of power modules in the specified frame.
SYSTem:CONFigure:FORMation:PMODule:INFO? <frame>, <module>	Queries information about the specified module operating in a frame.
SYSTem:CONFigure:FORMation:PSAVer:MAXimum <value> MINimum MAXimum SYSTem:CONFigure:FORMation:PSAVer:MAXimum? [MINimum MAXimum]	Sets the maximum VA for the power save function in Watts.
SYSTem:CONFigure:FORMation:PSAVer:MODules E D {,E D} . . . SYSTem:CONFigure:FORMation:PSAVer:MODules?	Sets the specified power modules to run using the power save function.
SYSTem:CONFigure:FORMation:PSAVer:RESet	Resets the power save settings.
SYSTem:CONFigure:NOUtputs 1 2 3 SYSTem:CONFigure:NOUtputs? SYSTem:CONFigure:WIRing 1 2 3 SYSTem:CONFigure:WIRing?	Specifies the number of output phases. The two commands are equivalent.
SYSTem:DATE <yyyy>,<mm>,<dd> SYSTem:DATE?	Sets the local date of the system clock.
SYSTem:ERRor[:NEXT]? SYSTem:ERRor[:NEXT]:COUNT?	Reads and clears one error from the error queue. Returns the number of errors in the error queue.
SYSTem:LOCAL SYSTem:REMOTE SYSTem:RWLOCK	These three commands are equivalent to SYSTem:COMMunicate:RLState
SYSTem:PASSword[:CENable] "<password>" SYSTem:PASSword[:CENable]?	Enables password protection by entering the password.

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Command/Query	Description
SYSTem:PASSword[:CENable]:STATe?	Queries if password protection is enabled.
SYSTem:PASSword:CDISable "<password>"	Disables password protection.
SYSTem:PASSword:NEW "<existing_password>","<new_password>"	Sets a new password.
SYSTem:SLEEp:EXECute	Immediately activates sleep mode.
SYSTem:SECurity:IMMEDIATE	Clears all user memory (including stored states) and reboots the instrument in the *RST state.
SYSTem:TIME <hh>,<mm>,<ss> SYSTem:TIME?	Sets the local time of the system clock.
SYSTem:VERSion?	Returns the version of SCPI that the instrument uses.

### TRIGger Subsystem

Command/Query	Description
TRIGger:ACQuire[:IMMEDIATE]	Sends a software trigger to the ACQuire subsystem.
TRIGger:ACQuire:SOURce IMMEDIATE BUS TRIGger:ACQuire:SOURce?	Sets the trigger source that starts the measurement after INIT:ACQ.
TRIGger:PROGram[:IMMEDIATE]	Sends a software trigger to the PROGram subsystem.
TRIGger:PROGram:SOURce IMMEDIATE BUS TRIGger:PROGram:SOURce?	Sets the trigger source that starts the program.
TRIGger:SIMulation[:IMMEDIATE]	Sends a software trigger to the SIMulation subsystem.
TRIGger:SIMulation:SOURce IMMEDIATE BUS TRIGger:SIMulation:SOURce?	Sets the trigger source that starts the simulation.
TRIGger:TRANsient[:IMMEDIATE]	Triggers the TRANsient subsystem.
TRIGger:TRANsient:SOURce IMMEDIATE BUS TRIGger:TRANsient:SOURce?	Sets the trigger source for changing the output value after INIT:TRAN.

## VOLTage Subsystem

Command/Query	Description
[SOURce:]VOLTage[:LEVel][:IMMediate][:AMPLitude] <value> MINimum MAXimum[, <low_limit>, <high_limit>] [,@chanlist] [SOURce:]VOLTage[:LEVel][:IMMediate][:AMPLitude]? [MINimum MAXimum] [,@chanlist]	Sets the immediate AC voltage level, and optionally the lower and upper soft limits.
[SOURce:]VOLTage[:LEVel]:LIMit:LOWer <value> MINimum MAXimum [SOURce:]VOLTage[:LEVel]:LIMit:LOWer? [MINimum MAXimum] [SOURce:]VOLTage[:LEVel]:LIMit:UPPer <value> MINimum MAXimum [SOURce:]VOLTage[:LEVel]:LIMit:UPPer? [MINimum MAXimum]	Sets the the lower and upper AC voltage limits.
[SOURce:]VOLTage[:LEVel]:TRIGgered[:AMPLitude] <value> MINimum MAXimum [,@chanlist] [SOURce:]VOLTage[:LEVel]:TRIGgered[:AMPLitude]? [MINimum MAXimum] [,@chanlist]	Sets the triggered AC voltage level.
[SOURce:]VOLTage:COMPensate:MODE DISabled HARD SOFT [SOURce:]VOLTage:COMPensate:MODE?	Sets the compensation mode.
[SOURce:]VOLTage:COMPensate:SOFT:CONTRol[:STATus] AC DC [SOURce:]VOLTage:COMPensate:SOFT:CONTRol[:STATus]?	Sets the compensated voltage mode.
[SOURce:]VOLTage:COMPensate:SOFT:TERMinal OUTPut SENSe [SOURce:]VOLTage:COMPensate:SOFT:TERMinal?	Sets the compensation sensing point.
[SOURce:]VOLTage:LTLIne <value> MINimum MAXimum [SOURce:]VOLTage:LTLIne? [MINimum MAXimum]	Sets the line-to-line AC voltage.
[SOURce:]VOLTage:OFFSet[:IMMediate] <value> MINimum MAXimum [, <low_limit>, <high_limit>] [,@chanlist] [SOURce:]VOLTage:OFFSet[:IMMediate]? [MINimum MAXimum] [,@chanlist]	Sets the immediate DC voltage in VDC, and also optionally sets the soft limits.
[SOURce:]VOLTage:OFFSet:LIMit:LOWer? [SOURce:]VOLTage:OFFSet:LIMit:UPPer?	Queries the lower and upper DC voltage limits.
[SOURce:]VOLTage:OFFSet:TRIGgered <value> MINimum MAXimum [SOURce:]VOLTage:OFFSet:TRIGgered? [MINimum MAXimum]	Sets the triggered DC voltage in VDC.
[SOURce:]VOLTage:OFFSet:LTLIne <value> MINimum MAXimum [SOURce:]VOLTage:OFFSet:LTLIne? [MINimum MAXimum]	Sets the line-to-line DC voltage.
[SOURce:]VOLTage:PROGramming:EXTernal:EXTDC:ADJust:GAIN <channel>, <value> [SOURce:]VOLTage:PROGramming:EXTernal:EXTDC:ADJust:GAIN? <channel>	Sets the voltage gain of the external analog input EXTDC.
[SOURce:]VOLTage:PROGramming:EXTernal:EXTDC:ADJust:OFFSet <channel>, <value> [SOURce:]VOLTage:PROGramming:EXTernal:EXTDC:ADJust:OFFSet? <channel>	Sets the voltage offset of the external analog input EXTDC.
[SOURce:]VOLTage:PROGramming:EXTernal:EXTDC:APERture <value> MINimum MAXimum [SOURce:]VOLTage:PROGramming:EXTernal:EXTDC:APERture? [MINimum MAXimum]	Sets the external analog input signal's aperture time.
[SOURce:]VOLTage:PROGramming:EXTernal:EXTDC:SIGNal:POLarity <channel>, NORMal INVerted [SOURce:]VOLTage:PROGramming:EXTernal:EXTDC:SIGNal:POLarity? <channel>	Sets the external analog input programming signal polarity.
[SOURce:]VOLTage:PROGramming:EXTernal:EXTDC:SIGNal:SOURce EXTernal INT_EXT [SOURce:]VOLTage:PROGramming:EXTernal:EXTDC:SIGNal:SOURce?	Sets the external analog input programming signal source.
[SOURce:]VOLTage:PROGramming:EXTernal:MODE EXTDC VPRogram OFF [SOURce:]VOLTage:PROGramming:EXTernal:MODE?	Sets the external analog signal's programming mode.
[SOURce:]VOLTage:PROGramming:EXTernal:VPRogram:ADJust:GAIN <channel>, <value> [SOURce:]VOLTage:PROGramming:EXTernal:VPRogram:ADJust:GAIN? <channel>	Sets the voltage gain of external analog input VPR.

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Command/Query	Description
[SOURce:]VOLTage:PROGramming:EXTernal:VPRogram:ADJust:OFFSet <channel>, <value> [SOURce:]VOLTage:PROGramming:EXTernal:VPRogram:ADJust:OFFSet? <channel>	Sets the voltage offset of the external analog input VPR.
[SOURce:]VOLTage:PROGramming:EXTernal:VPRogram:MAP ALL ACVoltage DCVoltage [SOURce:]VOLTage:PROGramming:EXTernal:VPRogram:MAP?	Sets the voltage programming output mapping.
[SOURce:]VOLTage:PROGramming:EXTernal:VPRogram:STATe <channel>, ON 1 OFF 0 [SOURce:]VOLTage:PROGramming:EXTernal:VPRogram:STATe? <channel>	Sets the voltage programming output state for each channel.
[SOURce:]VOLTage:PROGramming:SOURce INTERNAL EXTERNAL [SOURce:]VOLTage:PROGramming:SOURce?	Sets the voltage programming source.
[SOURce:]VOLTage:PROTection:LOWer <value> MINimum MAXimum [SOURce:]VOLTage:PROTection:LOWer? [MINimum MAXimum]	Sets the under-voltage protection value.
[SOURce:]VOLTage:PROTection:LOWer:STATe ON 1 OFF 0 [SOURce:]VOLTage:PROTection:LOWer:STATe?	Enables or disables the under-voltage protection
[SOURce:]VOLTage:PROTection:UPPer <value> MINimum MAXimum [, <neg_limit>, <pos_limit>] [SOURce:]VOLTage:PROTection:UPPer? [MINimum MAXimum]	Sets the over-voltage protection value.
[SOURce:]VOLTage:PROTection:PEAK:LOWer <value> MINimum MAXimum [SOURce:]VOLTage:PROTection:PEAK:LOWer? [MINimum MAXimum]	Sets the negative peak OVP limit.
[SOURce:]VOLTage:PROTection:PEAK:UPPer <value> MINimum MAXimum [SOURce:]VOLTage:PROTection:PEAK:UPPer? [MINimum MAXimum]	Sets the positive peak OVP limit.
[SOURce:]VOLTage:RANGe[:UPPer] <value> MINimum MAXimum [SOURce:]VOLTage:RANGe[:UPPer]? [MINimum MAXimum]	Sets the voltage range.
[SOURce:]VOLTage:RESPonse SLOW MEDIum FAST [SOURce:]VOLTage:RESPonse?	Sets the output response.

## WAVE Subsystem

Command/Query	Description
WAVE:DATA:ARBITrary <bank_number>, <block> WAVE:DATA:ARBITrary? <bank_number>	Sets a waveform with block data at the specified waveform bank.
WAVE:DATA:CLIP <bank_number>, <value> MINimum MAXimum WAVE:DATA:CLIP? <bank_number> [MINimum MAXimum]	Sets the crest factor of the peak clipped waveform.
WAVE:DATA:IECPclip <bank_number>, <value> MINimum MAXimum WAVE:DATA:IECPclip? <bank_number> [MINimum MAXimum]	Sets the clip factor of the flat curve waveform.
WAVE:DATA:POINT <bank_number>, <point>, <data> WAVE:DATA:POINT? <bank_number>, <point>	Programs the arbitrary waveform data points.
WAVE:DATA:SINusoid <bank_number>	Resets the waveform to a sinusoid.
WAVE:DATA:TYPE? <bank_number>	Queries the type of waveform.
WAVE:STATe ON 1 OFF 0	Enables or disables the custom waveform.

## ABORt Subsystem

ABORt commands cancel any triggered actions and returns the trigger system back to the Idle state. ABORt commands are also executed with the **\*RST** command.

### ABORt[:ALL]

Aborts all operations.

Parameter	Typical Return
(none)	(none)
Abort all operations: ABOR:ALL	

You cannot specify a trigger subsystem with this command. It aborts all four trigger operations.

The trigger status at power-on is the same as that after an ABORt.

If an ABORt is sent during a measurement, the measured data is discarded. If an INIT:ACQ has not been sent, the acquired data is retained.

### ABORt:ACQuire

Aborts all ACQuire operations.

Parameter	Typical Return
(none)	(none)
Abort the triggered measurement: ABOR:ACQ	

This command resets the WTG-meas and MEAS-active bits in the Operation Status registers.

If you send an ABOR command without having sent INIT:ACQ, the measurement data is not discarded.

### ABORt:PROGram

Aborts all PROGram operations.

Parameter	Typical Return
(none)	(none)
Abort the triggered measurement: ABOR:PROG	

This command stops the triggered function of the sequence operation.

### **ABORt:SIMulation**

Aborts all SIMulation operations.

Parameter	Typical Return
(none)	(none)
Abort the simulation operation: ABOR:SIM	

This command stops the triggered function of the power line abnormality simulation.

### **ABORt:TRANsient**

Aborts all TRANsient actions.

Parameter	Typical Return
(none)	(none)
Abort any TRANsient actions: ABOR:TRAN	

This command stops the triggered function for any output changes.

## CURRent Subsystem

The CURRent subsystem limits the instrument's output current.

**[SOURce:]CURRent[:LEVel][:IMMediate][:AMPLitude] <value>|MINimum|MAXimum  
[,<lower\_limit>,<upper\_limit>] [,@chanlist]]**

**[SOURce:]CURRent[:LEVel][:IMMediate][:AMPLitude]? [MINimum|MAXimum] [,@chanlist]]**

Sets the immediate AC current limit in amps (rms). Optionally sets the lower and upper limit values. If no optional limit values are set, the optional limits are set to the maximum current values. The optional (@chanlist) parameter lets you designate specific output phases.

Parameter	Typical Return
10 % to 110% of the of the rated current in A	MAX MIN
Sets the current limit to 90 A: CURR 90	
Query the maximum current limit: CURR? MAX	

Current units (UA, MA, A) are allowed.

Values exceeding the instrument's maximum value will be set to the instrument's maximum value.

The \*RST default is the instrument's MAXimum value.

**[SOURce:]CURRent:PEAK:LOWer <value>|MINimum|MAXimum [,@chanlist]]**

**[SOURce:]CURRent:PEAK:LOWer? [MINimum|MAXimum] [,@chanlist]]**

**[SOURce:]CURRent:PEAK:UPPer <value>|MINimum|MAXimum [,@chanlist]]**

**[SOURce:]CURRent:PEAK:UPPer? [MINimum|MAXimum] [,@chanlist]]**

Sets the negative (lower) and positive (upper peak current limits. Values are in amps. The optional (@chanlist) parameter lets you designate specific output phases.

Parameter	Typical Return
10 % to 420% of the of the positive rated current in A	MAX MIN
10 % to 420% of the of the negative rated current in A	
Sets the positive peak current limit to 120 A: CURR:PEAK UPP 120	
Query the negative peak current limit: CURR:PEAK LOW?	

Values exceeding the instrument's maximum value will be set to the instrument's maximum value.

The \*RST default is the instrument's MAXimum value.

**[SOURce:]CURRent:PROTection:STATe ON|1|OFF|0**  
**[SOURce:]CURRent:PROTection:STATe?**

Enables or disables current protection.

Parameter	Typical Return
ON 1 OFF 0	0 (OFF) or 1 (ON)
Enable limit control operation: CURR:PROT:STATe OFF	

ON (TRIP): Turns OUTPUT off and activates the alarm for overload conditions longer than three seconds.

OFF (LIMIT CONTROL): Decreases output voltage to keep current at or below the limit when an overload occurs.

To clear an overcurrent condition, remove the condition's cause and send **OUTPut:PROTection:CLEar**.

If overcurrent protection is enabled and the output goes into current limit, the output is disabled and the Questionable Condition status register OCP bit is set.

The **\*RST** command sets this parameter to ON.

**[SOURce:]CURRent:PROTection:TRIP:DELay <value>**  
**[SOURce:]CURRent:PROTection:TRIP:DELay?**

Sets the protection trip delay in seconds.

Parameter	Typical Return
0.0 - 10.0 seconds	3.5
Sets the protection trip delay to 3.5 seconds: CURR:PROT:TRIP:DEL 3.5	

This command sets the time that must elapse before the output is turned off when the current limit is exceeded.

The **\*RST** command sets this parameter to 10 seconds.

## DIGital Subsystem

Digital commands program the digital control port on the rear panel of the instrument

### DIGital:INPut:DATA?

Queries the state of the digital input port.

Parameter	Typical Return
(none)	<0-63>
Query the digital input port: DIG:INP:DATA?	

### DIGital:OUTPut:DATA <value>

### DIGital:OUTPut:DATA?

Sets the state of the digital output port.

Parameter	Typical Return
<0 - 63>	<0-63>
Set the state of the digital port: DIG:OUTP:DATA 63	

### DIGital:PIN<1-3,5-7,9,10>:FUNcTION <map\_item>

### DIGital:PIN<1 - 10>:FUNcTION?

**NOTE** Refer to [Digital Connections](#) for the designated connector pins for channels 1-10.

Maps the designated digital IO pin to a specific in/out function signal.

Parameter	Typical Return
1-3,5-7,9,10	<map_item>
<map_item> - see table	
Sets the digital channel #1 to negative polarity: DIG:PIN1:POL NEG	

The following functions can be assigned (mapped) to the specified channels.

## 4 SCPI Programming

Mappable Functions for Channels 1-3	Mappable Functions for Channels 5-7	Mappable Functions for Channels 9-10
DIS: Disable	DIS: Disable	DIS: Disable
OUTCTL: Output control	OUTSTAT: Output ON Status	CLKIN: Sync clock input
SEQEXEC: Sequence execution control	IPKLIM: Current Pk Limit Status	SEQTRIGIN: SEQ trigger input
PROTCLR: Protection clear	ILIM: Overload Status	CLKOUT: Standard clock output
EXTPROT: External protection	BUSY: Busy Status	SEQTRIGOUT: SEQ trigger output
WIRCTL_1P: Wiring method control 1P	WIRCHK_1P: Wiring Method 1P Status	
WIRCTL_1P3W: Wiring method control 1P3W	WIRCHK_1P3W: Wiring Method 1P3W Status	
WIRCTL_3P: Wiring method control 3P	WIRCHK_3P: Wiring Method 3P Status	
VRANGE: Voltage range	VRANGE_H: Voltage Range H Status	
RCL_1: Recall preset 1	PON: Power ON Status	
RCL_2: Recall preset 2	SEQSTAT: Sequence Status Out	
INH: Output inhibit	DOUT: User programmable output signal	
DINP: User programmable input signal		

Channels 1-3, 5-7, and 9-10 are disabled by default.

Channels 4 and 8 are fixed to the Shutdown and Protection functions respectively, and cannot be mapped.

### DIGital:PIN<1-3,5-10>:POLarity POSitive|NEGative DIGital:PIN<1-10>:POLarity?

**NOTE** Refer to [Digital Connections](#) for the designated connector pins for channels 1-10.

Sets the polarity of the remote inhibit digital channels. **POSitive** means a logical true signal is a voltage high at the channel. **NEGative** means a logical true signal is a voltage low at the channel.

Parameter	Typical Return
1-3, 5-10 POSitive NEGative	POS or NEG
Sets the digital pin to negative polarity: DIG:PIN:POL NEG	

The polarity of channel 4 is fixed and cannot be changed.

The channel polarities are saved in non-volatile memory.

## DISPlay Subsystem

The DISPlay subsystem controls the front-panel display.

### DISPlay[:WINDow][:STATe]ON|1|OFF|0

Turns the front-panel display on or off.

Parameter	Typical Return
ON 1 OFF 0	(none)
Turn the front-panel display off: <code>DISP:STAT OFF</code>	

Setting this OFF stops refreshing the display, turns off the display's backlight, changes the LINE LED to orange, and disables all front-panel key operations.

The **\*RST** command sets this parameter to ON.

### DISPlay[:WINDow]:METer:COUPling AC|DC|ACDC|PEAK, AC|DC|ACDC|PEAK DISPlay[:WINDow]:METer:COUPling?

Selects both the voltage and current measurement unit on the front panel. The first argument sets the voltage measurement, the second argument sets the current measurement.

Parameter	Typical Return
AC DC ACDC PEAK	AC, DC, ACDC, or PEAK
Set the meter to voltage and current DC measurements: <code>DISP:MET:COUP DC, DC</code>	

AC shows pure AC measurements, DC shows DC measurements, ACDC shows AC and DC measurements, and PEAK shows the peak measurement.

The **\*RST** command sets both this parameter to ACDC.

### DISPlay[:WINDow]:METer:COUPling:VOLTage AC|DC|ACDC|PEAK DISPlay[:WINDow]:METer:COUPling:VOLTage?

Selects the voltage measurement unit on the front panel.

Parameter	Typical Return
AC DC ACDC PEAK	AC, DC, ACDC, or PEAK
Set the meter to voltage DC measurements: <code>DISP:MET:COUP:VOLT DC</code>	

AC shows pure AC measurements, DC shows DC measurements, ACDC shows AC and DC measurements, and PEAK shows the peak measurement.

The **\*RST** command sets this parameter to ACDC.

### **DISPlay[:WINDow]:METer:COUPling:CURRentAC|DC|ACDC|PEAK DISPlay[:WINDow]:METer:COUPling:CURRent?**

Selects the current measurement unit on the front panel.

Parameter	Typical Return
AC DC ACDC PEAK	AC, DC, ACDC, or PEAK
Set the meter to current DC measurements: <code>DISP:MET:COUP:CURR DC</code>	

AC shows pure AC measurements, DC shows DC measurements, ACDC shows AC and DC measurements, and PEAK shows the peak measurement.

The **\*RST** command sets this parameter to ACDC.

### **DISPlay[:WINDow]:PHASe P123|ABC|UVW DISPlay[:WINDow]:PHASe?**

Selects the phase-naming convention.

Parameter	Typical Return
P123 ABC UVW	P123 ABC UVW
Selects ABC as the phase naming convention: <code>DISP:PHAS ABC</code>	

The **\*RST** command sets this parameter to P123.

### **DISPlay[:WINDow]:VIEW METER\_ALL|METER\_3P|METER\_1P**

Selects the phases to display.

Parameter	Typical Return
METER_ALL METER_3P METER_1P	(none)
Display only the three output phases: <code>DISP:VIEW METER_3P</code>	

The **\*RST** command sets this parameter to METER\_ALL.

## FETCH and MEASure Subsystems

The FETCH and MEASure subsystems return measured data. The FETCH and MEASure queries do not take any parameters, and they have the identical syntax (such as FETCH:VOLTage:AC? and MEASure:VOLTage:AC?).

### MEASure Subsystem

A MEASure query or an IMMEDIATE or BUS trigger generates a new measurement that is stored in a buffer and then returned to the user.

Before the instrument can accept an IMMEDIATE or BUS trigger, you must first send INITiate:ACQuire. Otherwise, the instrument will generate SCPI error -211, "Trigger ignored". The buffer retains the measured data until cleared by another MEASure query, an accepted IMMEDIATE or BUS trigger, a \*RST or INITiate:ACQuire command, or a power cycle.

### FETCH Subsystem

A FETCH query immediately returns the previously acquired measurement from this buffer. If no measurement is in the buffer, the instrument generates SCPI error -230, "Data corrupt or stale".

### General Measurement Operation

Normally, it takes approximately 110 ms for a measurement to complete. If there are no MEASure queries or triggers, the data is discarded.

When a MEASure query or IMMEDIATE or BUS trigger is received, the instrument waits for the current digitization to finish, discards the data, and waits for the next measurement interval to finish. The instrument then stores the next measurement into the buffer to ensure that the entire measurement was sampled after the MEASure query or IMMEDIATE or BUS trigger. Therefore, with multiple parameters, a measurement will take much longer to complete.

The acquired measurement includes both the instantaneous voltage and current. The FETCH query may subsequently be used to return any calculated measurement item derived from this data, including FETC:CURR:DC?, FETC:VOLT:AC?, and FETC:POW:ACDC?.

Refer to [Measurement Details](#) for additional information.

## FETCh[:SCALar]:ALL? [(@chanlist)]

### MEASure[:SCALar]:ALL? [(@chanlist)]

Returns all measurements, except TOTal measurements, as a comma-separated list. The optional (@chanlist) parameter lets you designate specific output phases.

Parameter	Typical Return
(none)	<value>[.<value>...]
Triggers and returns all measurements: MEAS:ALL?	
Fetches all measurements: FETC:ALL?	
Fetches all measurements from 3 phases: FETC:ALL? (@1:3)	

The measurements are returned in the order shown in the following table. TOTal measurements are not returned and are listed last.

Measurements are returned in comma-separated NR3 format, using the format 1.23456E+00.

If a phase is not specified, the phase designated by the INSTRument[:SElect] command is returned. If several phases are specified, all measured values of the first specified phase are returned in the Measured Item list order. Then, the measured values of the next specified phase are returned in the Measured Item list order, and so on for the third.

A zero (0) is returned in response to a line-to-line query during single-phase operation.

Measured Item - optional phase designation [(@chanlist)] allowed	Description
CURRent[:DC]	Average DC current (A) Set the averaging period using <b>SENS:AVER</b> .
CURRent:AC	AC current (Arms)
CURRent:ACDC	Current, AC+DC (Arms)
CURRent:AMPLitude:MAXimum	Instantaneous peak current (A)
CURRent:AMPLitude:MAXimum:HOLD	Peak AC current held value (A) This returns the maximum peak current since the power-on or since it was explicitly cleared by <b>SENS:CURR:PEAK:CLE</b> . The peak current (held value) is not cleared by <b>*RST</b> or <b>*RCL</b> .
CURRent:CREStfactor	Current crest factor The crest factor is the AC current divided by the AC peak current.
FREQuency	AC output frequency (Hz) This returns the frequency setting for AC, ACDC, and EXT-AC coupling, or +9.91000E+37 for DC and EXT-DC coupling. The instrument does not measure frequency.
POWer[:DC]	Average DC power (W) Set the averaging period using <b>SENS:AVER</b> .
POWer:AC[:REAL]	AC active power (W)
POWer:AC:APParent	AC apparent power (VA)

Measured Item - optional phase designation [(@chanlist)] allowed	Description
POWer:AC:REACTive	AC reactive power (VAR)
POWer:AC:PFACtor	AC power factor The power factor indicates the efficiency degradation caused by the phase difference between the AC voltage and AC current.
POWer:ACDC[:REAL]	AC active power (W)
POWer:ACDC:APParent	AC+DC apparent power (VA)
POWer:ACDC:REACTive	AC+DC reactive power (VAR)
POWer:ACDC:PFACtor	AC+DC power factor The power factor indicates the efficiency degradation caused by the phase difference between the AC voltage and AC current.
VOLTage[:DC]	Average DC voltage (V)  Set the averaging period using <b>SENS:AVER</b> .
VOLTage:AC	AC voltage (Vrms)
VOLTage:ACDC	Voltage, AC+DC (Vrms)
VOLTage:AMPLitude:MAXimum	Instantaneous peak voltage (V)
VOLTage:AMPLitude:MAXimum:HOLD	Peak AC voltage held value (V) This returns the maximum peak voltage since the power-on or since it was explicitly cleared by <b>SENS:VOLT:PEAK:CLE</b> . The peak voltage (held value) is not cleared by <b>*RST</b> or <b>*RCL</b> .
LTLVoltage:DC	Line-to-line Average DC voltage (V)
LTLVoltage:AC	Line-to-line AC voltage (Vrms)
LTLVoltage:ACDC	Line-to-line ACDC voltage (Vrms)
LTLVoltage:AMPLitude:MAXimum	Line-to-line Instantaneous peak voltage (V)
Measured Item - optional phase designation [(@chanlist)] not allowed	Description
POWer[:DC]:TOTal	Total Average DC power (W)
POWer:ACDC[:REAL]:TOTal	Total AC active power (W)
POWer:AC:APParent:TOTal	Total AC apparent power (VA)
POWer:AC:REACTive:TOTal	Total AC reactive power (VAR)
POWer:AC:PFACtor:TOTal	Total AC power factor
POWer:ACDC[:REAL]:TOTal	Total AC active power (W)
POWer:ACDC:APParent:TOTal	Total AC+DC apparent power (VA)
POWer:ACDC:REACTive:TOTal	Total AC+DC reactive power (VAR)
POWer:ACDC:PFACtor:TOTal	Total AC+DC power factor

**FETCh[:SCALar]:<Measured\_Item>? [(@chanlist)]**  
**MEASure[:SCALar]:<Measured\_Item>? [(@chanlist)]**

Returns the <Measured\_Item> in the form 1.23456E+00. The <Measured\_Item> may be any of the queries listed in previous table, such as VOLTage:AC? or VOLTage:ACDC?. The optional (@chanlist) parameter lets you designate specific output phases.

Parameter	Typical Return
(none)	<value>
Triggers and returns AC voltage: MEAS:VOLT:AC?	
Fetches ACDC voltage: FETC:VOLT:ACDC?	
Fetches average current from phase 2: FETC:CURR:? (@2)	
Fetches ACDC current from all phases: FETC:CURR:ACDC? (@1:3)	

If a phase is not specified, the phase designated by the INSTRument[:SElect] command is returned. If several phases are specified, the measured value of the first specified phase is returned. Then, the measured value of the next specified phase is returned in the same manner, and so on for the third.

**FETCh:<Harmonic\_Item>? [(@chanlist)]**  
**MEASure:<Harmonic\_Item>? [(@chanlist)]**

Returns the harmonic data specified by <Harmonic\_Item>, as shown in the next table. The optional (@chanlist) parameter lets you designate specific output phases.

Parameter	Typical Return
(none)	<value>[.<value>...]
Triggers and returns harmonic voltage amplitude: MEAS:VOLT:HARM?	
Fetches harmonic voltage phase: FETC:VOLT:HARM:PHAS?	
Fetches harmonic current phase from phase 2: FETC:CURR:HARM:PHAS? (@2)	
Fetches harmonic current THD from all phases: FETC:CURR:HARM:THD? (@1:3)	

Harmonic measurements (0th to 50th harmonic) are returned in a comma-separated NR3 format.

If a phase is not specified, the phase designated by the INSTRument[:SElect] command is returned. If several phases are specified, all measured values of the first specified phase are returned. Then, the measured values of the next specified phase are returned in the same manner, and so on for the third.

Harmonic Item - optional phase designation [(@chanlist)] allowed	Description
CURRent:HARMonic[AMPLitude]	Harmonic current amplitude
CURRent:HARMonic:PHASe	Harmonic current phase
CURRent:HARMonic:THD	Total harmonic distortion (THD)
VOLTage:HARMonic[AMPLitude]	Harmonic voltage amplitude
VOLTage:HARMonic:PHASe	Harmonic voltage phase
VOLTage:HARMonic:THD	Total harmonic distortion (THD)

## FREQuency Subsystem

FREQuency commands configure the instrument's output frequency.

```
[SOURce:]FREQuency[:CW] <value>|MINimum|MAXimum[,<lower_limit>,<upper_limit>]
[SOURce:]FREQuency[:CW]? [MINimum|MAXimum]
[SOURce:]FREQuency[:IMMEDIATE] <value>|MINimum|MAXimum[,<lower_limit>,<upper_
limit>]
[SOURce:]FREQuency[:IMMEDIATE]? [MINimum|MAXimum]
```

Sets the immediate AC frequency and optionally the lower and upper frequency soft limits.

Parameter	Typical Return
1.00 to 550 Hz for "L" models in 3 phase mode 1.00 to 5,000 Hz for "H" models	+5.00000E+01
Set the output frequency to 50 Hz: <code>FREQ 50</code>	

This command takes one or three arguments. You cannot have a low or high limit without the other.

This command applies to AC, AC+DC, EXT-DC, and EXT-AC.

The **\*RST** default is 50 Hz.

You should set this value between the lower and upper frequency soft limits.

Frequency suffixes (HZ and KHZ) are allowed.

```
[SOURce:]FREQuency:LIMit:LOWer <value>
[SOURce:]FREQuency:LIMit:LOWer? [MINimum|MAXimum]
```

```
[SOURce:]FREQuency:LIMit:UPPer <value>
[SOURce:]FREQuency:LIMit:UPPer? [MINimum|MAXimum]
```

Sets the lower or upper AC frequency soft limit.

Parameter	Typical Return
1.00 to 550 Hz for "L" models in 3 phase mode 1.00 to 5,000 Hz for "H" models	+1.25000E+02
Query the low frequency limit: <code>FREQ:LIM:LOW?</code>	
Query the upper frequency limit: <code>FREQ:LIM:UPP?</code>	

The following relationship must be met:  $FREQ:LIM:LOW \leq FREQ$  or  $FREQ:TRIG \leq FREQ:LIM:UPP$

This command is invalid if the signal source is an external signal source.

The **\*RST** default is 1.00 Hz.

**[SOURce:]FREQuency:SYNCronous[:STATe]ON|1|OFF|0  
[SOURce:]FREQuency:LIMit[:STATe]?**

Enables or disables frequency synchronous operation.

Parameter	Typical Return
ON 1 OFF 0	0 (OFF) or 1 (ON)
Enable the frequency synchronous operation: <code>FREQ:SYNC ON</code>	

This command applies to AC, AC+DC, EXT-DC, and EXT-AC.

The **\*RST** command sets this parameter to OFF.

**[SOURce:]FREQuency:SYNCronous:MODE LINE|EXTernal  
[SOURce:]FREQuency:SYNCronous:MODE?**

Sets the synchronization signal source.

Parameter	Typical Return
LINE EXTernal	LINE EXT
Set the synchronous signal to External: <code>FREQ:SYNC:MODE EXT</code>	

LINE - synchronizes the frequency synchronization signal to the input line.

EXTernal - synchronizes the frequency synchronization signal to an external Digital IO input signal

The **\*RST** command sets this parameter to LINE.

**[SOURce:]FREQuency:SYNCronous:PHASe:DELay <value>|MINimum|MAXimum  
[SOURce:]FREQuency:SYNCronous:PHASe:DELay? [MINimum|MAXimum]**

Sets the synchronization offset angle in degrees.

Parameter	Typical Return
0 to 360	+9.00000E+01
Set the frequency phase delay to 90: <code>FREQ:SYNC:PHAS:DEL 90</code>	

This command is valid when the sync function is on (FREQ:SYNC ON).

The **\*RST** command sets this parameter to FIXed.

**[SOURce:]FREQuency:TRIGgered <value>|MINimum|MAXimum**  
**[SOURce:]FREQuency:TRIGgered? [MINimum|MAXimum]**

Sets the triggered AC output frequency in Hertz.

Parameter	Typical Return
1.00 to 550 Hz for "L" models	+9.00000E+01
1.00 to 5,000 Hz for "H" models	

---

Set the triggered frequency to 90 Hz: `FREQ:TRIG 90`

This command applies to AC, AC+DC, EXT-DC, and EXT-AC.

The **\*RST** default is 50 Hz.

Frequency suffixes (HZ and KHZ) are allowed.

## FUNction Subsystem

The FUNction subsystem has just one command.

**[SOURce:]FUNction[:SHAPE]:BANK[:INDEX] <index> [,@chanlist]**  
**[SOURce:]FUNction[:SHAPE]:BANK[:INDEX]? [(@chanlist)]**

Selects a waveform shape by bank index.

The optional (@chanlist) parameter lets you designate specific output phases.

Parameter	Typical Return
0 - 256	<bank index>
Specifies a bank index: FUNC:BANK 5	

This command is invalid when the Synchronous function is enabled.

This command is invalid if the signal source is an external signal source.

This command is invalid if the voltage compensation mode has been set to SOFT.

The **\*RST** command sets this parameter to 0.

## HCOPy Subsystem

The HCOPy subsystem has just one command.

### HCOPy:SDUMp:DATA?

Returns the display image in .png format.

Parameter	Typical Return
(none)	<Block>
Return the image in png format: HCOP:SDUM:DATA?	

The response Block length is 3 kB to 3.5 kB.

## IEEE-488 Common Commands

IEEE-488 Common commands generally control overall instrument functions, such as reset, status, and synchronization. All common commands consist of a three-letter mnemonic preceded by an asterisk: \*RST \*IDN? \*SRE 8.

### \*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 Overview** for more information.

Parameter	Typical Return
(none)	(none)
Clear event registers, status byte, and error queue: *CLS	

### \*ESE <value>

#### \*ESE?

Event status enable command and query. Sets the value in the **enable register** for the **Standard Event Status** group. Each set bit of the register enables a corresponding event. All enabled events are logically OR-ed into the ESB bit of the status byte. The query reads the enable register. Refer to **Status Overview** for more information.

Parameter	Typical Return
Decimal sum of the bits in the register, default 0. For example, to enable bit 2 (value 4), bit 3 (value 8), and bit 7 (value 128), use decimal sum 140 (4 + 8 + 128).	<bit value>
Enable bits 3 and 4 in the enable register: *ESE 24	

The value returned is the binary-weighted sum of all bits set in the register.

Any or all conditions can be reported to the ESB bit through the enable register. To set the enable register mask, write a decimal value to the register using **\*ESE**.

A **\*CLS** does not clear the enable register, but does clear the **event register**.

This parameter is not affected by **\*RST** or **\*RCL**.

**\*ESR?**

Event status event query. Reads and clears the **event register** for the **Standard Event Status** group. The event register is a read-only register that latches all standard events. Refer to **Status Overview** for more information.

Parameter	Typical Return
(none)	<bit value>
Read event status enable register: *ESR?	

The value returned is the binary-weighted sum of all bits set in the register.

Any or all conditions can be reported to the ESB bit through the enable register. To set the enable register mask, write a decimal value to the register using **\*ESE**.

Once a bit is set, it remains set until cleared by this query or **\*CLS**.

**\*IDN?**

Identification Query. Returns the instrument's identification string.

Parameter	Typical Return
(none)	KEYSIGHT TECHNOLOGIES,AC6906H,JPUB002121, 1.03 IFC11.03.0016 IOC1.00.0005[512]
Return the instrument's identification string: *IDN?	

The fields are in the following order:

manufacturer name, model number, serial number, and firmware revision.

**\*OPC**

Sets the OPC (operation complete) bit in the standard event register. This occurs at the completion of the pending operation. Refer to [Status Overview](#) for more information.

Parameter	Typical Return
(none)	(none)
Set the Operation Complete bit: <code>*OPC</code>	

The purpose of this command is to synchronize your application with the instrument. It is used in conjunction with initiated acquisitions, initiated transients, output state changes, and output to 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. No further commands can be sent after an `*OPC?` until it has responded. In this way an explicit polling loop can be avoided. That is, the IO driver will wait for the response.

**\*OPC?**

Returns a 1 to the output buffer when all pending operations complete.

Parameter	Typical Return
(none)	+1
Return a 1 when commands complete: <code>*OPC?</code>	

The purpose of this command is to synchronize your application with the instrument.

Other commands cannot be executed until this command completes.

**\*OPT?**

Returns a string identifying any installed options.

Parameter	Typical Return
(none)	OPT200   OPT400
Return installed options: <code>*OPT?</code>	

OPT200 and OPT400 refer to the nominal input AC line.

## \*PSC 0|1

### \*PSC?

Enables (1) or disables (0) the clearing of certain enable registers at power on. These include:  
 Questionable Data Register (STATus:QUEStionable:ENABLE)  
 Standard Operation Register (STATus:OPERation:ENABLE)  
 Status Byte Condition Register (\*SRE)  
 Standard Event Enable Register (\*ESE)

#### NOTE

The \*PSC command does not affect the clearing of the condition or event registers, just the enable registers. For more information on the SCPI Status System, see Status Subsystem Introduction.

Parameter	Typical Return
0 1, default 1	0 or 1
Disable power-on clearing of affected registers: *PSC 0	

## \*RCL <0 to 10>

Recalls a saved instrument state. This restores the instrument to a state that was previously stored with the \*SAV command.

Parameter	Typical Return
0 to 10	(none)
Recall state from location 1: *RCL 1	

All instrument settings are recalled except: (1) trigger systems are set to the Idle state, (2) calibration is disabled, (3) nonvolatile settings are not affected.

Location 0 is recalled at power-on when the Output Power-On state is RCL0.

This command also aborts TRANSient and ACQuire operations.

## \*RST

Resets the instrument to default values. These settings are described in [Default Settings](#).

\*RST forces the ABORT commands. This cancels any measurement or transient actions in process. It resets the WTG-meas, MEAS-active, WTG-tran, and TRAN-active bits in the Operation Status registers. Stored instrument states are not affected by \*RST.

Parameter	Typical Return
(none)	(none)
Reset the instrument: *RST	

This command also aborts TRANSient and ACQuire operations.

**\*SAV <0 to 10>**

Saves the instrument state to a nonvolatile memory location.

Parameter	Typical Return
0 to 10	(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 recalled at power-on when the Output Power-On state is RCL0.

The calibration state are NOT saved as part of the \*SAV operation.

When shipped, state storage locations 1 through 10 are empty.

**\*SRE <value>****\*SRE?**

Service request enable command and query. This 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 Overview** for more information.

Parameter	Typical Return
Decimal sum of the bits in the register, default 0. For example, to enable bit 2 (value 4), bit 3 (value 8), and bit 7 (value 128), use decimal sum 140 (4 + 8 + 128).	<bit value>
Enable bits 3 and 4 in the enable register: *SRE 24	

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

The register contents are not affected by \*RST or \*RCL.

**\*STB?**

Status byte query. Reads the Status Byte Register, which contains the status summary bits and the Output Queue MAV bit.

Parameter	Typical Return
(none)	<bit value>
Read status byte: *STB?	

The Status Byte is a read-only register and the bits are not cleared when it is read. Refer to [Status Overview](#) for more information.

**\*TRG**

Trigger command. Applies a software trigger (equivalent to IEEE 488.1 Device Trigger) for both TRANSient and ACQuire trigger groups.

Parameter	Typical Return
(none)	(none)
Generate an immediate trigger: INIT:ACQ *TRG	

**\*TST?**

Self-test. Returns the errors found during the most recent power-on self-test.

Parameter	Typical Return
(none)	0 (pass) or +1 (failed)
Perform self-test: *TST?	

The instrument's self-test function is performed when the instrument starts up. If a failure is detected, the corresponding SCPI error is generated, and bit 2 of the STATus:QUEStionable register will be set.

When no failure is found the response will be +0. When one or more failures are found the response value will be -330. In this case, SYST:ERR? will return specific failure messages (at first -330, "Self-test error", and then the self-test error codes). See [SCPI Error Messages](#) for more information.

The \*TST? command does not execute an actual self-test.

## INITiate Subsystem

The INITiate commands initialize the trigger system. This moves the trigger system from the "idle" state to the "wait-for-trigger" state, which enables the instrument to receive triggers. An event on the selected trigger source causes the trigger to occur.

### INITiate[:IMMEDIATE]:ACQUIRE

Initiates the ACQUIRE (measurement) operation.

Parameter	Typical Return
(none)	(none)
Initiate a measurement: INIT:ACQ	

If the ACQUIRE operation is already initiated, this command will produce error -213, "Init ignored".

### INITiate[:IMMEDIATE]:PROGRAM

Initiates the PROGRAM operation.

Parameter	Typical Return
(none)	(none)
Initiate a program: INIT:PROG	

If the PROGRAM operation is already initiated, this command will produce error -213, "Init ignored".

### INITiate[:IMMEDIATE]:SIMULATION

Initiates the SIMULATION operation.

Parameter	Typical Return
(none)	(none)
Initiate a simulation: INIT:SIM	

If the SIMULATION operation is already initiated, this command will produce error -213, "Init ignored".

### INITiate[:IMMEDIATE]:TRANSIENT

Initiates the TRANSIENT operation.

Parameter	Typical Return
(none)	(none)
Initiate a TRANSIENT operation: INIT:TRAN	

If the TRANSIENT operation is already initiated, this command will produce error -213, "Init ignored".

## INSTrument Subsystem

The INSTrument subsystem selects the phase that to be controlled.

### INSTrument[:SElect] OUTPut0|OUTPut1|OUTPut2|OUTPut3 INSTrument[:SElect]?

Selects the phase to be controlled by output phase name. OUTPut0 selects all phases.

Parameter	Typical Return
OUTPut0 OUTPut1 OUTPut2 OUTPut3	OUTP0 OUTP1 OUTP2 OUTP3
Select phase 2: INST OUTPUT2	

### INSTrument:NSElect 0|1|2|3 INSTrument:NSElect?

Selects the phase to be controlled by output phase number. 0 selects all phases.

Parameter	Typical Return
0 1 2 3	0 1 2 3
Select phase 2: INST:NSEL 2	

## LXI Subsystem

The LXI subsystem controls the LXI functions.

### LXI:IDENTify[:STATe] LXI:IDENTify[:STATe]?

Turns the front-panel LXI identify indicator (blinking "Lan" annunciator) on or off. When turned on, the front-panel "LAN" annunciator blinks to identify the instrument that is being addressed.

Parameter	Typical Return
ON 1 OFF 0	0 (OFF) or 1 (ON)
Blink the front panel LXI annunciator: LXI:IDENT ON	

The **\*RST** command, the **\*RCL** command, a LAN reset, and a LAN restart all turn the LXI indicator off.

### LXI:MDNS[:STATe] LXI:MDNS[:STATe]?

Turns the LAN mDNS service on or off.

Parameter	Typical Return
ON 1 OFF 0	0 (OFF) or 1 (ON)
Turn the mDNS service on: LXI:MDNS ON	

The **\*RST** command, the **\*RCL** command, a LAN reset, and a LAN restart all turn the mDNS service off.

## MEMory Subsystem

The MEMory subsystem controls the memory functions.

### MEMory:RECall[:IMMediate] 1|2

Recalls the output settings saved in location 1 or 2. To view the contents that are stored in a memory location, use MEMory:RECall:PREView.

Parameter	Typical Return
1 2	(none)
Recalls the memory saved in location 1: MEM:REC 1	

### MEMory:RECall:PREView? 1|2

Displays the memory contents saved in location 1 or 2

Parameter	Typical Return
1 2	NR3, NR3, NR3, NR1, ...
Previews the contents saved in location 2: MEM:REC:PREV 2	

Returns the following items in order, in a comma-separated format. All return formats are NR3, except for waveform bank number, which is NR1.

**For single-phase output:** AC voltage, DC voltage, Frequency, Waveform bank number.

**For single-phase three-wire output:** Phase 1 AC voltage, Phase 2 AC voltage, Phase 1 DC voltage, Phase 2 DC voltage, Frequency, Phase1 waveform bank number, Phase2 waveform bank number.

**For three-phase output:** Phase 1 AC voltage, Phase 2 AC voltage, Phase 3 AC voltage, Phase 1 DC voltage, Phase 2 DC voltage, Phase 3 DC voltage, frequency, Phase 1 waveform bank number, Phase 2 waveform bank number, Phase 3 waveform bank number.

### MEMory:SAVE[:IMMediate] 1|2

Saves the output settings to memory location 1 or 2.

Parameter	Typical Return
1 2	(none)
Saves the output settings to location 1: MEM:SAVe 1	

## OUTPut Subsystem

The OUTPut subsystem configures the output state, power-on state, coupling mode, digital pin, and protection.

### OUTPut[:STATe] ON|1|OFF|0 OUTPut[:STATe]?

Enables or disables the instrument's output.

Parameter	Typical Return
ON 1 OFF 0	0 (OFF) or 1 (ON)
Turn on the output: <code>OUTP ON</code>	

The **\*RST** command sets this parameter to 0.

### OUTPut:COUPling AC|DC|ACDC OUTPut:COUPling?

Sets the output coupling mode.

Parameter	Typical Return
AC DC ACDC	AC DC ACDC
Default AC	
Set the output mode to ACDC: <code>OUTP:COUP ACDC</code>	

AC produces AC output

DC produces DC output

ACDC combines AC and DC output

The **\*RST** command sets this parameter to AC.

### OUTPut:IMPedance[:STATe] ON|1|OFF|0 OUTPut:IMPedance[:STATe]?

Enables or disables the output impedance control.

Parameter	Typical Return
ON 1 OFF 0	0 (OFF) or 1 (ON)
Enable the output impedance control: <code>OUTP:IMP ON</code>	

The **\*RST** command sets this parameter to 0.

**OUTPut:IMPedance:REACtive <value>|MINimum|MAXimum [,(@chanlist)]**  
**OUTPut:IMPedance:REACtive? [MINimum|MAXimum] [,(@chanlist)]**

Sets the reactive part of the output impedance in Henries. The optional (@chanlist) parameter lets you designate specific output phases.

Parameter	Typical Return
<value> see table	NR3
Sets the reactance to 100 $\mu$ H: <code>OUTP:IMP:REAC 100UH</code>	

The **\*RST** command sets this parameter to 0.

This command is valid when the output impedance state is ON. Refer to the following table for valid output impedance values:

Model	Low Range		High Range	
	1-phase	1- phase 3-wire, 3- phase	1-phase	1- phase 3-wire, 3- phase
AC6903	27 $\mu$ H to 667 $\mu$ H	80 $\mu$ H to 2000 $\mu$ H	107 $\mu$ H to 2667 $\mu$ H	320 $\mu$ H to 8000 $\mu$ H
AC6906	13 $\mu$ H to 333 $\mu$ H	40 $\mu$ H to 1000 $\mu$ H	53 $\mu$ H to 1333 $\mu$ H	160 $\mu$ H to 4000 $\mu$ H
AC6912	7 $\mu$ H to 167 $\mu$ H	20 $\mu$ H to 500 $\mu$ H	27 $\mu$ H to 667 $\mu$ H	80 $\mu$ H to 2000 $\mu$ H
AC6918	4 $\mu$ H to 111 $\mu$ H	13 $\mu$ H to 333 $\mu$ H	18 $\mu$ H to 444 $\mu$ H	53 $\mu$ H to 1333 $\mu$ H

**OUTPut:IMPedance:REAL <value>|MINimum|MAXimum [,(@chanlist)]**  
**OUTPut:IMPedance:REAL? [MINimum|MAXimum] [,(@chanlist)]**

Sets the resistance part of the output impedance in ohms. The optional (@chanlist) parameter lets you designate specific output phases.

Parameter	Typical Return
ON 1 OFF 0	NR3
Set the resistance to 100 m $\Omega$ : <code>OUTP:IMP:REAL 100MOHM</code>	

The **\*RST** command sets this parameter to 0.

This command is valid when the output impedance state is ON. Refer to the following table for valid output impedance values:

Model	Low Range		High Range	
	1-phase	1- phase 3-wire, 3- phase	1-phase	1- phase 3-wire, 3- phase
AC6903	0 $\Omega$ to 667 m $\Omega$	0 $\Omega$ to 2000 m $\Omega$	0 $\Omega$ to 2 667 m $\Omega$	0 $\Omega$ to 8000 m $\Omega$
AC6906	0 $\Omega$ to 333 m $\Omega$	0 $\Omega$ to 1000 m $\Omega$	0 $\Omega$ to 1333 m $\Omega$	0 $\Omega$ to 4000 m $\Omega$
AC6912	0 $\Omega$ to 167 m $\Omega$	0 $\Omega$ to 500 m $\Omega$	0 $\Omega$ to 667 m $\Omega$	0 $\Omega$ to 2000 m $\Omega$
AC6918	0 $\Omega$ to 111 m $\Omega$	0 $\Omega$ to 333 m $\Omega$	0 $\Omega$ to 444 m $\Omega$	0 $\Omega$ to 1333 m $\Omega$

### **OUTPut:INHibit:MODE LATChing|LIVE 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. You can specify the polarity of the remote inhibit digital pin using **[SOURce:]DIGital:PIN:POLarity POSitive|NEGative**.

Parameter	Typical Return
LATChing LIVE OFF	LATC,LIVE, or OFF
Sets the inhibit input to Live mode: <b>OUTP:INH:MODE LIVE</b>	

**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. Note that the output remains disabled after the protection is cleared and must be re-enabled with the **OUTPut ON** command to turn it on again.

**LIVE** - allows the enabled output to follow the state of the Inhibit input.

**OFF** - the Inhibit input is ignored.

The inhibit mode is stored in non-volatile memory.

### **OUTPut:PHASe:OFF[:STATe] ON|1|OFF|0 OUTPut:PHASe:OFF[:STATe]?**

Enables or disables the output-off phase control when **OUTPut OFF** is sent. This command is invalid if the signal source is an external signal source.

Parameter	Typical Return
ON 1 OFF 0	0 (OFF) or 1 (ON)
Enable the output-off phase control: <b>OUTP:PHAS:OFF ON</b>	

The **\*RST** command sets this parameter to 0.

**OUTPut:PHASe:OFF:LEVel <value>**  
**OUTPut:PHASe:OFF:LEVel?**

Sets the output-off phase angle when OUTPut OFF is sent in degrees. This command is invalid if the signal source is an external signal source.

Parameter	Typical Return
0.0 - 360.0	90
Set the output-off phase level: <code>OUTP:PHAS:OFF:LEV 90</code>	

The **\*RST** command sets this parameter to 0.

**OUTPut:PHASe:ON[:STATe] ON|1|OFF|0**  
**OUTPut:PHASe:ON[:STATe]?**

Enables or disables the output-on phase control when OUTPut ON is sent. This command is invalid if the signal source is an external signal source.

Parameter	Typical Return
ON 1 OFF 0	0 (OFF) or 1 (ON)
Enable the output-on phase control: <code>OUTP:PHAS:ON ON</code>	

The **\*RST** command sets this parameter to 0.

**OUTPut:PHASe:ON:LEVel <value>**  
**OUTPut:PHASe:ON:LEVel?**

Sets the output-on phase angle when OUTPut ON is sent in degrees. This command is invalid if the signal source is an external signal source.

Parameter	Typical Return
0.0 - 360.0	90
Set the output-on phase level: <code>OUTP:PHAS:ON:LEV 90</code>	

The **\*RST** command sets this parameter to 0.

**OUTPut:PHASe:P1Offset <value>|MINimum|MAXimum**  
**OUTPut:PHASe:P1Offset? [MINimum|MAXimum]**

Sets the absolute phase 1 offset angle to the specified reference in degrees. It cannot be set when in 1P or 1P3W mode. This command is invalid if the signal source is an external signal source.

Parameter	Typical Return
0.0 - 360.0	90
Set the output phase 1 offset angle: <code>OUTP:PHAS:P10 90</code>	

The **\*RST** command sets this parameter to 0.

**OUTPut:PHASe:P12 <value>|MINimum|MAXimum**  
**OUTPut:PHASe:P12? [MINimum|MAXimum]**

Sets the difference between the phase 1 angle and the phase 2 angle in degrees. It cannot be set when in 1P or 1P3W mode. This command is invalid if the signal source is an external signal source.

Parameter	Typical Return
0.0 - 360.0	90
Set the difference between P1 and P2 offset angle: <code>OUTP:PHAS:P12 90</code>	

The **\*RST** command sets this parameter to 120 in 3P, or 180 in 1P3W.

**OUTPut:PHASe:P13 <value>|MINimum|MAXimum**  
**OUTPut:PHASe:P13? [MINimum|MAXimum]**

Sets the difference between the phase 1 angle and the phase 3 angle in degrees. It cannot be set when in 1P or 1P3W mode. This command is invalid if the signal source is an external signal source.

Parameter	Typical Return
0.0 - 360.0	90
Set the difference between P1 and P3 offset angle: <code>OUTP:PHAS:P13 90</code>	

The **\*RST** command sets this parameter to 240.

### **OUTPut:PON:SAFE ON|1|OFF|0** **OUTPut:PON:SAFE?**

When enabled, holds the output off (disabled) during instrument power-on.

Parameter	Typical Return
ON 1 OFF 0	0 (OFF) or 1 (ON)
Enable the output safe state at power-on: <code>OUTP:PON:SAFE ON</code>	

The **\*RST** command sets this parameter to 1.

### **OUTPut:PON:STATe RST|RCL<0-9>|AUTO** **OUTPut:PON:STATe?**

Sets the power-on output state.

Parameter	Typical Return
RST RCL0 AUTO	RST, RCL0, or AUTO
Set the power-on state to the *RST state: <code>OUTP:PON:STAT RST</code>	

**RST** specifies that the instrument powers on in a state equivalent to \*RST.

**RCL0** loads the state stored in state storage memory location 0.

**AUTO** specifies that the instrument powers on in the power-down state. The output state is always off.

This parameter is not affected by **\*RST** or **\*RCL**.

This parameter is saved in nonvolatile memory.

### **OUTPut:PROTection:CLEAr**

Resets the latched protection. This clears the latched protection status that disables the output when a protection condition occurs. It also clears the latched Inhibit Input function.

Parameter	Typical Return
(none)	(none)
Clears the latched protection status: <code>OUTP:PROT:CLE</code>	

All conditions that generate the fault must be removed before the latched status can be cleared. The output remains in the OFF state after the fault/inhibit condition is cleared.

### **OUTPut:PROTection:WDOG[:STATe] ON|1|OFF|0 OUTPut:PROTection:WDOG[:STATe]?**

Enables or disables the I/O watchdog timer.

Parameter	Typical Return
0 OFF 1 ON	0 (OFF) or 1 (ON)
Enables the watchdog timer protection: <code>OUTP:PROT:WDOG ON</code>	

When the watchdog timer is 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.

The watchdog timer function is NOT reset by front-panel activity; the output will still shut down after the time period has elapsed.

The **\*RST** command sets this parameter to 0.

### **OUTPut:PROTection:WDOG:DELaY <value>|MINimum|MAXimum OUTPut:PROTection:WDOG:DELaY? [MINimum|MAXimum]**

Sets the watchdog delay time.

Parameter	Typical Return
1 to 3600 (seconds)	600
Sets a delay of 600 seconds: <code>OUTP:PROT:WDOG:DEL 600</code>	

Values (seconds) must be whole numbers.

The **\*RST** command sets this parameter to 60.

### **OUTPut:SSTart[:STATe][:RISE] ON|1|OFF|0 OUTPut:SSTart[:STATe][:RISE]?**

Enables or disables the soft-start rise. This command is invalid if the voltage compensation mode has been set to SOFT.

Parameter	Typical Return
ON 1 OFF 0	0 (OFF) or 1 (ON)
Enable the soft start rise: <code>OUTP:SST ON</code>	

The **\*RST** command sets this parameter to 0.

**OUTPut:SSTart[:STATe]:FALL ON|1|OFF|0**  
**OUTPut:SSTart[:STATe]:FALL?**

Enables or disables the soft-start fall. This command is invalid if the voltage compensation mode has been set to SOFT.

Parameter	Typical Return
ON 1 OFF 0	0 (OFF) or 1 (ON)
Enable the soft start fall: <code>OUTP:SST:FALL ON</code>	

The **\*RST** command sets this parameter to 0.

**OUTPut:SSTart:TIME[:RISE] <value>|MINimum|MAXimum**  
**OUTPut:SSTart:TIME[:RISE]? [MINimum|MAXimum]**

Sets the soft-start rise time in seconds.

This command is only valid if the soft-start rise state is enabled.

Parameter	Typical Return
0.1 - 30.0	10
Set the soft start rise time : <code>OUTP:SST:TIME 10</code>	

The **\*RST** command sets this parameter to 0.1.

**OUTPut:SSTart:TIME:FALL <value>|MINimum|MAXimum**  
**OUTPut:SSTart:TIME:FALL? [MINimum|MAXimum]**

Sets the soft-start fall time in seconds. This command is only valid if the soft-start fall state is enabled.

Parameter	Typical Return
0.1 - 3.0	1
Set the soft start fall time : <code>OUTP:SST:TIME:FALL 1</code>	

The **\*RST** command sets this parameter to 0.1.

**OUTPut:SSUPpression:STATeON|1|OFF|0**  
**OUTPut:SSUPpression:STATe?**

Enables or disables the voltage surge suppression feature.

Parameter	Typical Return
ON 1 OFF 0	0 (OFF) or 1 (ON)
Enable the voltage surge suppression: <code>OUTP:SSUP:STAT ON</code>	

The **\*RST** command sets this parameter to 0.

## PROGram Subsystem

The PROGram subsystem controls the individual sequence steps.

### PROGram:CLEar

Sets all sequence steps to their default values. This takes approximately three seconds.

Parameter	Typical Return
(none)	(none)
Set all sequence steps to their defaults: PROG:CLE	

**PROGram:EDIT <step>,<freq>,<ramp-bool>,<ac-volt>,<ramp-bool>,<dc-volt>,<ramp-bool>,<step-time>,<output-bool>,<status-bool>,<trigin-bool>,<trigout-bool>,<bank-number>**

**PROGram:EDIT? <step>**

Programs an individual sequence step.

Parameter	Typical Return
<list of 12 comma-separated parameters > see table	<list of 12 comma-separated parameters > (does not include step number)
Program step 1: PROG:EDIT 1,60,OFF,100,OFF,0,OFF,0.5,OFF,OFF,OFF,ON,0	

Settings must be programmed in the order shown in the table. Return values are returned in the order shown in the table starting with <freq>.

Parameter	Value and Unit	*RST	Description
<step>	1 - 600	(none)	The number of the step to configure
<freq>	1 - 5000	50	The frequency in Hz
<ramp-bool>	ON 1 OFF 0	OFF	Enables/disables the frequency ramp
<ac-volt>*	0 - 322.0	0	The ac voltage value
<ramp-bool>	ON 1 OFF 0	OFF	Enables/disables the ac voltage ramp
<dc-volt>*	0 - ±455.0	0	The dc voltage value
<ramp-bool>	ON 1 OFF 0	OFF	Enables/disables the dc voltage ramp
<step-time>	0.0001 - 60,000	0.01	The step time in seconds
<output-bool>	ON 1 OFF 0	ON	Enables/disables the output
<status-bool>	ON 1 OFF 0	OFF	Enables/disables the status output
<trigin-bool>	ON 1 OFF 0	OFF	Enables/disables the trigger input
<trigout-bool>	ON 1 OFF 0	OFF	Enables/disables the trigger output
<bank-number>*	0 - 256	0	The waveform bank number

\*For 3-phase units, the query only returns the value of the phase 1.

**PROG:EDIT:FUNCTION[:SHAPE]:BANK[:INDEX] <step>, <bank-number> [,@chanlist]**  
**PROG:EDIT:FUNCTION[:SHAPE]:BANK[:INDEX]? <step> [,@chanlist]**

Sets the waveform bank number of the designated sequence step.

The optional (@chanlist) parameter lets you designate specific output phases.

Parameter	Typical Return
1 - 600 (step)	(none)
0 - 256 (bank number)	0
Program step 1: PROG:EDIT:FUNC:BANK 1, 256	

Returns the waveform bank number of the designated step.

**PROG:EDIT:IMPedance[:STATE] <step>, ON|1|OFF|0**  
**PROG:EDIT:IMPedance[:STATE]? <step>**

Enables or disables the output impedance of the step.

Parameter	Typical Return
1 - 600 (step)	(none)
ON 1 OFF 0	0 (OFF) or 1 (ON)
Enable the program impedance of step 1: PROG:EDIT:IMP 1, ON	

The **\*RST** command sets this parameter to 0.

**PROG:EDIT:IMPedance:REACTIVE <step>, <value> [,@chanlist]**  
**PROG:EDIT:IMPedance:REACTIVE? <step> [,@chanlist]**

Sets the reactive component of the output impedance of the step.

The optional (@chanlist) parameter lets you designate specific output phases.

Parameter	Typical Return
1 - 600 (step)	(none)
<value> see table	NR3
Sets the reactance of step 1 to 100 $\mu$ H: PROG:EDIT:IMP:REAC 1, 100UH	

This command is valid when the program impedance state is ON. Refer to the following table for valid output impedance values:

Model	Low Range		High Range	
	1-phase	1-phase 3-wire, 3-phase	1-phase	1-phase 3-wire, 3-phase
AC6903	27 $\mu$ H to 667 $\mu$ H	80 $\mu$ H to 2000 $\mu$ H	107 $\mu$ H to 2667 $\mu$ H	320 $\mu$ H to 8000 $\mu$ H

Model	Low Range		High Range	
	1-phase	1- phase 3-wire, 3- phase	1-phase	1- phase 3-wire, 3- phase
AC6906	13 $\mu$ H to 333 $\mu$ H	40 $\mu$ H v 1000 $\mu$ H	53 $\mu$ H to 1333 $\mu$ H	160 $\mu$ H to 4000 $\mu$ H
AC6912	7 $\mu$ H to 167 $\mu$ H	20 $\mu$ H to 500 $\mu$ H	27 $\mu$ H to 667 $\mu$ H	80 $\mu$ H to 2000 $\mu$ H
AC6918	4 $\mu$ H to 111 $\mu$ H	13 $\mu$ H to 333 $\mu$ H	18 $\mu$ H to 444 $\mu$ H	53 $\mu$ H to 1333 $\mu$ H

The **\*RST** command sets this parameter to 0.

**PROG:EDIT:IMPedance:REAL <step>, <value> [,(@chanlist)]**

**PROG:EDIT:IMPedance:REAL? <step> [,(@chanlist)]**

Sets the resistive component of the output impedance of the step.

The optional (@chanlist) parameter lets you designate specific output phases.

Parameter	Typical Return
1 - 600 (step)	(none)
<value> see table	NR3
Set the resistance of step 1 to 100 m $\Omega$ : <code>PROG:EDIT:IMP:REAL 1, 100MOHM</code>	

This command is valid when the program impedance state is ON. Refer to the following table for valid output impedance values:

Model	Low Range		High Range	
	1-phase	1- phase 3-wire, 3- phase	1-phase	1- phase 3-wire, 3- phase
AC6903	0 $\Omega$ to 667 m $\Omega$	0 $\Omega$ to 2000 m $\Omega$	0 $\Omega$ to 2 667 m $\Omega$	0 $\Omega$ to 8000 m $\Omega$
AC6906	0 $\Omega$ to 333 m $\Omega$	0 $\Omega$ to 1000 m $\Omega$	0 $\Omega$ to 1333 m $\Omega$	0 $\Omega$ to 4000 m $\Omega$
AC6912	0 $\Omega$ to 167 m $\Omega$	0 $\Omega$ to 500 m $\Omega$	0 $\Omega$ to 667 m $\Omega$	0 $\Omega$ to 2000 m $\Omega$
AC6918	0 $\Omega$ to 111 m $\Omega$	0 $\Omega$ to 333 m $\Omega$	0 $\Omega$ to 444 m $\Omega$	0 $\Omega$ to 1333 m $\Omega$

The **\*RST** command sets this parameter to 0.

**PROG:EDIT:JUMP <step>,<jump-bool>,<jump-step>,<jump-count>**  
**PROG:EDIT:JUMP? <step>**

Configures the jump settings of the sequence step.

Parameter	Typical Return
1 - 600 (number of steps)	(none)
ON 1 OFF 0	0 (OFF) or 1 (ON)
1 - 600 (destination step)	2
1- 9998 (jump repetition count) 9999 = repeat indefinitely	1
Configures the jump settings of step 1: PROG:EDIT:JUMP 1, ON, 2, 1	

When <jump-bool> is ON, the program jumps to the specified <jump-step>. When <jump-bool> is OFF, the program proceeds to the next step.

Returns the jump settings in the following order: <bool>,<destination step>,<jump count>.

The **\*RST** command sets the parameters to OFF, 1, 1.

**PROG:EDIT:PHASe:P1Offset <step>,<enable-bool>,<value>**  
**PROG:EDIT:PHASe:P1Offset? <step>**

Sets the phase 1 offset angle of the sequence step in degrees and enables the phase control.

Parameter	Typical Return
1 - 600 (step)	(none)
ON 1 OFF 0	0 (OFF) or 1 (ON)
-360.00 - 360.00	180
Sets the phase 1 offset angle of step 1: PROG:EDIT:PHAS:P10 1,ON,180	

The **\*RST** command sets both parameters to 0.

**PROG:EDIT:PHASe:P12 <step>,<enable-bool>,<value>**  
**PROG:EDIT:PHASe:P12? <step>**

Sets the Phase 1 and Phase 2 angle difference of the step in degrees and enables the phase control.

Parameter	Typical Return
1 - 600 (step)	(none)
ON 1 OFF 0	0 (OFF) or 1 (ON)
0.00 - 360.00	180
Sets the phase 1 and 2 angle difference of step 1: PROG:EDIT:PHAS:P12 1,ON,180	

The **\*RST** command sets both parameters to 0.

**PROG:EDIT:PHASE:P13 <step>,<enable-bool>,<value>**  
**PROG:EDIT:PHASE:P13? <step>**

Sets the Phase 1 and Phase 3 angle difference of the step in degrees and enables the phase control.

Parameter	Typical Return
1 - 600 (step)	(none)
ON 1 OFF 0	0 (OFF) or 1 (ON)
0.00 - 360.00	180
Sets the phase 1 and 3 angle difference of step 1: PROG:EDIT:PHAS:P13 1,ON,180	

The **\*RST** command sets both parameters to 0.

**PROG:EDIT:PHASE:RAMP <step>, <OFF|LEAD|LAG>, <OFF|LEAD|LAG>, <OFF|LEAD|LAG>**  
**PROG:EDIT:PHASE:RAMP? <step>**

Sets the phase signal change characteristics of the sequence step.

The first parameter sets the Phase 1 angle with the Phase 1 offset.

The second parameter sets the Phase 2 angle with the Phase 1-2 difference.

The third parameter sets the Phase 3 angle with the Phase 1-3 difference.

Parameter	Typical Return
1 - 600 (step)	(none)
<OFF LEAD LAG>, <OFF LEAD LAG>, <OFF LEAD LAG>	OFF, OFF, OFF
Sets phase change characteristics of step 1: PROG:EDIT:PHAS:RAMP 1, LAG, OFF, OFF	

**OFF** - turns the ramp off

**LEAD** - turns the ramp on with a leading phase angle

**LAG** - turns the ramp on with a lagging phase angle

Returns the ramp settings in the following order: <Phase 1>,<Phase 2>,<Phase 3>.

The **\*RST** command sets this parameter to 0.

**PROG:EDIT:PHAS:STARt <step>, <value>**

**PROG:EDIT:PHAS:STARt? <step>**

Sets the starting phase angle of the sequence step in degrees.

Parameter	Typical Return
1 - 600 (step)	(none)
0.0 - 360.0	180
Sets the starting phase angle of step 1: PROG:EDIT:PHAS:STAR 1, 180	

The **\*RST** command sets this parameter to 0.

**PROG:EDIT:PHAS:STOP <step>, <value>**

**PROG:EDIT:PHAS:STOP? <step>**

Sets the stopping phase angle of the sequence step in degrees.

Parameter	Typical Return
1 - 600 (step)	(none)
0.0 - 360.0	180
Sets the stopping phase angle of step 1: PROG:EDIT:PHAS:STOP 1, 180	

The **\*RST** command sets this parameter to 0.

**PROG:EDIT:VOLTage <step>, <value>**

**PROG:EDIT:VOLTage? <step>**

Sets the unbalanced ac voltage of the sequence step in volts.

Parameter	Typical Return
1 - 600 (step)	(none)
0.0 - 322.0	300
Sets the unbalanced ac voltage of step 1: PROG:EDIT:VOLT 1, 300	

The **\*RST** command sets this parameter to 0.

**PROG:EDIT:VOLTage:OFFSet <step>, <value>****PROG:EDIT:VOLTage:OFFSet? <step>**

Sets the unbalanced dc voltage of the sequence step in volts.

Parameter	Typical Return
1 - 600 (step)	(none)
-455.0 to +455.0	400
Sets the unbalanced dc voltage of step 1: <code>PROG:EDIT:VOLT:OFFS 1, 400</code>	

The **\*RST** command sets this parameter to 0.

**PROG:EXECuting STOP|RUN|PAUSE, <time>, <loop>, <step>****PROG:EXECuting?**

Changes the execution state of the sequence program.

Parameter	Typical Return
STOP RUN PAUSE	STOP RUN PAUS
0.0001 - 60,000 s (elapsed time), 1 - 9998 (loop count), 1 - 600 (step)	<time>, <loop>, <step>
Runs the program at the specified time, count and step: <code>PROG:EXEC RUN, 1, 1, 1</code>	

**STOP** - stops the program at the specified time, count, and step

**RUN** - resumes the program at the specified time, count, and step

**PAUSE** - pauses the program at the specified time, count, and step

**PROG:LOOP <value>****PROG:LOOP?**

Sets the number of sequence repetitions.

Parameter	Typical Return
1 - 9998 (repeat count) 9999 = repeat indefinitely	100
Configures the sequence repetitions: <code>PROG:LOOP 100</code>	

The **\*RST** command sets this parameter to 1.

**PROG:STEP:ADD <step>**

Adds a new program step.

Parameter	Typical Return
1 - 600	(none)
Adds program step number 2: PROG:STEP:ADD 2	

**PROG:STEP:CLEAr <step>**

Deletes a program step.

Parameter	Typical Return
1 - 600	(none)
Deletes program step number 2: PROG:STEP:CLE 2	

**PROG:STEP:END <step>****PROG:STEP:END?**

Sets the sequence ending step.

Parameter	Typical Return
1 - 600	100
Sets the sequence ending step at 100: PROG:STEP:END 100	

**PROG:STEP:START <step>****PROG:STEP:START?**

Sets the sequence starting step.

Parameter	Typical Return
1 - 600	10
Sets the sequence starting step at 10: PROG:STEP:STAR 10	

## SENSe Subsystem

### SENSe:AVERage <value>

#### SENSe:AVERage?

Sets the moving averaging count for both voltage and current measurements.

Parameter	Typical Return
1 - 32	1
Set the moving average to 4 counts: SENS:AVER 4	

Averaging is not performed when the count is set to 1. This parameter does not apply to the peak current measurement.

The **\*RST** command sets this parameter to 1.

### SENSe:CURREnt:AVERage <value>

#### SENSe:CURREnt:AVERage?

Sets the moving averaging count for current measurements.

Parameter	Typical Return
1 - 32	1
Set the moving average current to 4 counts: SENS:CURR:AVER 4	

Averaging is not performed when the count is set to 1. This parameter does not apply to the peak current measurement.

The **\*RST** command sets this parameter to 1.

### SENSe:CURREnt[:PEAK]:HOLD:CLEar

Clears the peak held current measurement.

Parameter	Typical Return
(none)	(none)
Clear the peak current measurement: SENS:CURR:HOLD:CLE	

Use **FETCh:CURREnt:AMPLitude:MAXimum:HOLD?** to query the peak held current measurement.

**SENSe:CURRent[:PEAK]:HOLD:TIME <value>|MINimum|MAXimum**  
**SENSe:CURRent[:PEAK]:HOLD:TIME? [MINimum|MAXimum]**

Sets the peak hold time for current measurements in seconds.

Parameter	Typical Return
1 - 10 MAX = infinity	1
Sets the peak current hold time to 5: <code>SENS:CURR:HOLD:TIME 5</code>	

Returns +9.90000E+37 when the hold time is set to infinity.

The **\*RST** command sets this parameter to 1.

**SENSe:VOLTage:AVERage <value>**  
**SENSe:VOLTage:AVERage?**

Sets the moving averaging count for voltage measurements.

Parameter	Typical Return
1 - 32	1
Set the moving average voltage to 4 counts: <code>SENS:VOLT:AVER 4</code>	

Averaging is not performed when the count is set to 1. This parameter does not apply to the peak voltage measurement.

The **\*RST** command sets this parameter to 1.

**SENSe:VOLTage[:PEAK]:HOLD:CLEar**

Clears the peak held voltage measurement.

Parameter	Typical Return
(none)	(none)
Clear the peak voltage measurement: <code>SENS:VOLT:HOLD:CLE</code>	

Use **FETCh:VOLTage:AMPLitude:MAXimum:HOLD?** to query the peak held voltage measurement.

**SENSe:VOLTage[:PEAK]:HOLD:TIME <value>|MINimum|MAXimum**  
**SENSe:VOLTage[:PEAK]:HOLD:TIME? [MINimum|MAXimum]**

Sets the peak hold time for voltage measurements in seconds.

Parameter	Typical Return
1 - 10	1
MAX = infinity	

---

Sets peak voltage hold time to infinity: `SENSe:VOLTage[:PEAK]:HOLD:TIME MAX`

Returns +9.90000E+37 when the hold time is set to infinity.

The **\*RST** command sets this parameter to 1.

## SIMulation Subsystem

The SIMulation subsystem lets you simulate power line abnormalities.

### **SIMulation:EXECuting RUN|STOP, <repeat-count>**

#### **SIMulation:EXECuting?**

Runs or stops a power line abnormality simulation.

Parameter	Typical Return
RUN STOP	RUN STOP
1 - 9998 <repeat count>	<repeat-count>

Runs the simulation at the repeat count of 1: SIM:EXEC RUN, 1

**STOP** - stops the simulation at the specified repeat count

**RUN** - resumes the simulation at the specified repeat count

The query returns the execution state and the repeat count.

### **SIMulation:POLarity POSitive|NEGative**

#### **SIMulation:POLarity?**

Sets the voltage polarity of the power line simulation.

Parameter	Typical Return
POSitive NEGative	POS NEG

Inverts the voltage polarity: SIM:POL NEG

The **\*RST** command sets this parameter to POSitive.

### **SIMulation:REPeat:COUNT <value>**

#### **SIMulation:REPeat:COUNT?**

Sets the repeat count of the power line simulation.

Parameter	Typical Return
1 - 9998	100
9999 - repeats indefinitely	

Specifies a repeat count of 100: SIM:REP:COUN 100

The **\*RST** command sets this parameter to 1.

### **SIMulation:STATe ON|1|OFF|0** **SIMulation:STATe?**

Enables or disables a power line simulation sequence.

Parameter	Typical Return
ON 1 OFF 0	0 (OFF) or 1 (ON)
Disables the simulation: SIM:STAT 0	

0 Disables the power line simulation

1 Enables the power line simulation

The **\*RST** command enables the power line simulation.

### **SIMulation:T1:PHASe[:LEVel] <value>|MINimum|MAXimum** **SIMulation:T1:PHASe[:LEVel]? [MINimum|MAXimum]**

Sets the starting phase angle of the simulation in degrees.

Parameter	Typical Return
0.0 - 359.9	180
Specifies a phase angle of 180: SIM:T1:PHAS 180	

This command is valid when voltage variation is set to be started by Phase angle

The **\*RST** command sets this parameter to 0.

### **SIMulation:T1:PHASe:STATeON|1|OFF|0** **SIMulation:T1:PHASe:STATe?**

Selects whether the simulation start will be set in terms of time or phase.

Parameter	Typical Return
ON 1 OFF 0	0 (OFF) or 1 (ON)
Select Phase to start the simulation: SIM:T1:PHAS:STAT 1	

0 - the value is set in terms of Time.

1 - the value is set in terms of Phase.

The **\*RST** command sets this parameter to 0.

**SIMulation:T1:TIME[:LEVel] <value>|MINimum|MAXimum  
SIMulation:T1:TIME[:LEVel]? [MINimum|MAXimum]**

Sets the starting time of the simulation in seconds.

Parameter	Typical Return
0.0000 - 0.9999	0.1
Specifies a starting time of 0.5: SIM:T1:TIME 0.5	

This command is valid when voltage variation is set to be started by Time.

The **\*RST** command sets this parameter to 0.1.

**SIMulation:T2:TIME[:LEVel] <value>|MINimum|MAXimum  
SIMulation:T2:TIME[:LEVel]? [MINimum|MAXimum]**

Sets the first slope time of the simulation in seconds.

Parameter	Typical Return
0.000 - 99.990	10
Specifies a slope time of 10: SIM:T2:TIME 10	

The **\*RST** command sets this parameter to 0.

**SIMulation:T3:TIME[:LEVel] <value>|MINimum|MAXimum  
SIMulation:T3:TIME[:LEVel]? [MINimum|MAXimum]**

Sets the voltage regulation time of the simulation in seconds.

Parameter	Typical Return
0.0000 - 9.9990	0.1
Specifies a voltage regulation time of 1: SIM:T3:TIME 1	

The **\*RST** command sets this parameter to 0.1.

**SIMulation:T3:VOLTage[:LEVel] <value>|MINimum|MAXimum  
SIMulation:T3:VOLTage[:LEVel]? [MINimum|MAXimum]**

Sets the regulated voltage of the simulation in volts.

Parameter	Typical Return
0.0 - 315.0	100
Specifies a voltage regulation of 150: SIM:T3:VOLT 150	

The **\*RST** command sets this parameter to 0.

**SIMulation:T4:TIME[:LEVel] <value>|MINimum|MAXimum**  
**SIMulation:T4:TIME[:LEVel]? [MINimum|MAXimum]**

Sets the second slope time of the simulation in seconds.

Parameter	Typical Return
0.000 - 99.990	10
Specifies a slope time of 10: SIM:T4:TIME 10	

The **\*RST** command sets this parameter to 0.

**SIMulation:T5:CYCLe[:LEVel] <value>**  
**SIMulation:T5:CYCLe[:LEVel]?**

Sets the number of return cycles of the simulation in seconds.

Parameter	Typical Return
0 - 999900	100
Specifies a number of 100 return cycles: SIM:T5:CYCL 100	

This command is valid when the returned state is configured to be in Cycles.

The **\*RST** command sets this parameter to 0.

**SIMulation:T5:CYCLe:STATeON|1|OFF|0**  
**SIMulation:T5:CYCLe:STATe?**

Selects whether the simulation remaining in the returned state will be set in terms of time or cycles.

Parameter	Typical Return
ON 1 OFF 0	0 (OFF) or 1 (ON)
Select the return state to be in terms of Cycles: SIM:T5:CYCL:STAT 0	

0 - the value is set in terms of Time.

1 - the value is set in terms of Cycles.

The **\*RST** command sets this parameter to 0.

**SIMulation:T5:TIME[:LEVel] <value>|MINimum|MAXimum**  
**SIMulation:T5:TIME[:LEVel]? [MINimum|MAXimum]**

Sets the return time of the simulation in seconds.

Parameter	Typical Return
0.000 - 99.990	10
Specifies a return time of 10: SIM:T5:TIME 10	

This command is valid when the returned state is configured to be in Time.

The **\*RST** command sets this parameter to 0.1.

## STATus Subsystem

Status register programming lets 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.

The Status subsystem is also programmed using Common commands. Common commands control additional status functions such as the Service Request Enable and the Status Byte registers. Refer to [Status Overview](#) for more information.

### STATus:OPERation[:EVENT]?

Queries the event of the Operation status group. This is a read-only register, which stores (latches) all events that are passed by the Operation NTR and/or PTR filter. Reading the Operation Event register clears it.

Parameter	Typical Return
(none)	<bit value>
Read the operation event register: STAT:OPER?	

The value returned is the binary-weighted sum of all bits set in the register. For example, with bit 3 (value 8) and bit 5 (value 32) set (and corresponding bits enabled), the query returns +40.

**\*RST** does not affect this register unless the reset causes an event that the filters are configured to capture.

### STATus:OPERation:CONDition?

Queries the condition of the Operation status group. This is a read-only register, which holds the instrument's live (unlatched) operational status. Reading the Operation Condition register does not clear it.

Parameter	Typical Return
(none)	<bit value>
Read the operation condition register: STAT:OPER:COND?	

The value returned is the binary-weighted sum of all bits set in the register. For example, with bit 3 (value 8) and bit 5 (value 32) set (and corresponding bits enabled), the query returns +40.

The condition register bits reflect the current condition. If a condition goes away, the corresponding bit is cleared.

A **\*RST** clears this register, other than those bits where the condition still exists after \*RST.

### **STATus:OPERation:ENABLE <value>** **STATus:OPERation:ENABLE?**

Sets the value of the enable register of 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. The **STATus:PRESet** command clears all enable register bits.

Parameter	Typical Return
Decimal sum of the bits in the register, default 0. For example, to enable bit 2 (value 4), bit 3 (value 8), and bit 7 (value 128), use decimal sum 140 (4 + 8 + 128). Default 0.	<bit value>
Enable bits 3 and 4 in the enable register: STAT:OPER:ENAB 24	

For example, with bit 3 (value 8) and bit 5 (value 32) set (and corresponding bits enabled), the query returns +40.

A **\*CLS** does not clear the enable register, but does clear the **event register**.

### **STATus:OPERation:NTRansition <value>** **STATus:OPERation:NTRansition?** **STATus:OPERation:PTRansition <value>** **STATus:OPERation:PTRansition?**

Sets and queries the value of negative and positive transition filters of the Operation status group. These registers serve as a polarity filter between the Operation Condition and Operation Event registers.

When a bit in the NTR register is 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 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.

The **STATus:PRESet** command sets all bits in the PTR registers and clears all bits in the NTR registers.

Parameter	Typical Return
Decimal sum of the bits in the register, default 0. For example, to enable bit 2 (value 4), bit 3 (value 8), and bit 7 (value 128), use decimal sum 140 (4 + 8 + 128). Default 0.	<bit value>
Enable bits 3 and 4 in the NTR register: STAT:OPER:NTR 24	

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:OPERation:INSTrument[:EVENT]?**

Queries the event of the Operation Instrument status group.

This is a read-only register, which stores (latches) all events that are passed by the Operation Instrument NTR and/or PTR filter. Reading the Operation Instrument Event register clears it.

Parameter	Typical Return
(none)	<bit value>
Read the operation instrument event register: STAT:OPER:INST?	

The value returned is the binary-weighted sum of all bits set in the register. For example, with bit 3 (value 8) and bit 5 (value 32) set (and corresponding bits enabled), the query returns +40.

**\*RST** does not affect this register unless the reset causes an event that the filters are configured to capture.

**STATus:OPERation:INSTrument:CONDition?**

Queries the condition of the Operation Instrument status group. This is a read-only register, which holds the instrument's live (unlatched) operational status. Reading the Operation Instrument Condition register does not clear it.

Parameter	Typical Return
(none)	<bit value>
Read the operation instrument condition register: STAT:OPER:INST:COND?	

The value returned is the binary-weighted sum of all bits set in the register. For example, with bit 3 (value 8) and bit 5 (value 32) set (and corresponding bits enabled), the query returns +40.

The condition register bits reflect the current condition. If a condition goes away, the corresponding bit is cleared.

A **\*RST** clears this register, other than those bits where the condition still exists after \*RST.

**STATus:OPERation:INSTrument:ENABLE <value>  
STATus:OPERation:INSTrument:ENABLE?**

Sets the value of the enable register of the Operation Instrument status group. The enable register is a mask for enabling specific bits from the Operation Instrument Event register to set the OPER (operation summary) bit of the Status Byte register. The **STATus:PRESet** command clears all enable register bits.

## 4 SCPI Programming

Parameter	Typical Return
Decimal sum of the bits in the register, default 0. For example, to enable bit 2 (value 4), bit 3 (value 8), and bit 7 (value 128), use decimal sum 140 (4 + 8 + 128). Default 0.	<bit value>
Enable bits 3 and 4 in the instrument enable register: <code>STAT:OPER:INST:ENAB 24</code>	

For example, with bit 3 (value 8) and bit 5 (value 32) set (and corresponding bits enabled), the query returns +40.

A **\*CLS** does not clear the enable register, but does clear the **event register**.

**STATus:OPERation:INSTrument:NTRansition <value>**

**STATus:OPERation:INSTrument:NTRansition?**

**STATus:OPERation:INSTrument:PTRansition <value>**

**STATus:OPERation:INSTrument:PTRansition?**

Sets and queries the value of negative and positive transition filters of the Operation Instrument status group. These registers serve as a polarity filter between the Operation Instrument Condition and Operation Instrument Event registers.

When a bit in the NTR register is 1, then a 1-to-0 transition of the corresponding bit in the Operation Instrument Condition register causes that bit in the Operation Instrument Event register to be set.

When a bit in the PTR register is 1, then a 0-to-1 transition of the corresponding bit in the Operation Instrument Condition register causes that bit in the Operation Instrument Event register to be set.

The **STATus:PRESet** command sets all bits in the PTR registers and clears all bits in the NTR registers.

Parameter	Typical Return
Decimal sum of the bits in the register, default 0. For example, to enable bit 2 (value 4), bit 3 (value 8), and bit 7 (value 128), use decimal sum 140 (4 + 8 + 128). Default 0.	<bit value>
Enable bits 3 and 4 in the NTR register: <code>STAT:OPER:INST:NTR 24</code>	

If the same bits in both NTR and PTR registers are set to 1, then any transition of that bit at the Operation Instrument Condition register sets the corresponding bit in the Operation Instrument 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 Instrument Condition register can set the corresponding bit in the Operation Instrument Event register.

The value returned is the binary-weighted sum of all bits set in the register.

**STATus:OPERation:INSTrument:ISUMmary<1|2|3>[:EVENT]?**

Queries the event of the Operation Instrument Isummary status group. The parameters 1|2|3 specify the phase.

This is a read-only register, which stores (latches) all events that are passed by the Operation Instrument Isummary NTR and/or PTR filter. Reading the Operation Instrument Isummary Event register clears it.

Parameter	Typical Return
(none)	<bit value>
Read the operation instrument Isummary event register for phase3: STAT:OPER:INST:ISUM3?	

The value returned is the binary-weighted sum of all bits set in the register. For example, with bit 3 (value 8) and bit 5 (value 32) set (and corresponding bits enabled), the query returns +40.

**\*RST** does not affect this register unless the reset causes an event that the filters are configured to capture.

**STATus:OPERation:INSTrument:ISUMmary<1|2|3>:CONDition?**

Queries the condition of the Operation Instrument Isummary status group. This is a read-only register, which holds the instrument's live (unlatched) operational status. Reading the Operation Instrument Isummary Condition register does not clear it.

Parameter	Typical Return
(none)	<bit value>
Read the operation instrument Isummary condition register for phase3: STAT:OPER:INST:ISUM3:COND?	

The value returned is the binary-weighted sum of all bits set in the register. For example, with bit 3 (value 8) and bit 5 (value 32) set (and corresponding bits enabled), the query returns +40.

The condition register bits reflect the current condition. If a condition goes away, the corresponding bit is cleared.

A **\*RST** clears this register, other than those bits where the condition still exists after \*RST.

**STATus:OPERation:INSTrument:ISUMmary<1|2|3>:ENABLE <value>****STATus:OPERation:INSTrument:ISUMmary<1|2|3>:ENABLE?**

Sets the value of the enable register of the Operation Instrument Isummary status group. The enable register is a mask for enabling specific bits from the Operation Instrument Isummary Event register to set the OPER (operation summary) bit of the Status Byte register. The **STATus:PRESet** command clears all enable register bits.

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Parameter	Typical Return
Decimal sum of the bits in the register, default 0. For example, to enable bit 2 (value 4), bit 3 (value 8), and bit 7 (value 128), use decimal sum 140 (4 + 8 + 128). Default 0.	<bit value>
Enable bits 3 and 4 in the instrument Isummary enable register for phase2: STAT:OPER:INST:ISUM2:ENAB 24	

For example, with bit 3 (value 8) and bit 5 (value 32) set (and corresponding bits enabled), the query returns +40.

A **\*CLS** does not clear the enable register, but does clear the **event register**.

**STATus:OPERation:INSTrument:ISUMmary<1|2|3>:NTRansition <value>**

**STATus:OPERation:INSTrument:ISUMmary<1|2|3>:NTRansition?**

**STATus:OPERation:INSTrument:ISUMmary<1|2|3>:PTRansition <value>**

**STATus:OPERation:INSTrument:ISUMmary<1|2|3>:PTRansition?**

Sets and queries the value of negative and positive transition filters of the Operation Instrument Isummary status group. These registers serve as a polarity filter between the Operation Instrument Isummary Condition and Operation Instrument Isummary Event registers.

When a bit in the NTR register is 1, then a 1-to-0 transition of the corresponding bit in the Operation Instrument Isummary Condition register causes that bit in the Operation Instrument Isummary Event register to be set.

When a bit in the PTR register is 1, then a 0-to-1 transition of the corresponding bit in the Operation Instrument Isummary Condition register causes that bit in the Operation Instrument Isummary Event register to be set.

The **STATus:PRESet** command sets all bits in the PTR registers and clears all bits in the NTR registers.

Parameter	Typical Return
Decimal sum of the bits in the register, default 0. For example, to enable bit 2 (value 4), bit 3 (value 8), and bit 7 (value 128), use decimal sum 140 (4 + 8 + 128). Default 0.	<bit value>
Enable bits 3 and 4 in the NTR register for phase2: STAT:OPER:INST:ISUM2:NTR 24	

If the same bits in both NTR and PTR registers are set to 1, then any transition of that bit at the Operation Instrument Isummary Condition register sets the corresponding bit in the Operation Instrument Isummary 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 Instrument Isummary Condition register can set the corresponding bit in the Operation Instrument Isummary Event register.

The value returned is the binary-weighted sum of all bits set in the register.

## STATus:PRESet

Initializes the transition and enable filters for both OPERation and QUEStionable register groups.

The STATus:PRESet command only affects the ENABLE register and the transition filter register of the status data structure. It does not clear any event registers or the error/event queue. To reset all event registers and the queue within the device status reporting mechanism, use \*CLS.

For status data required by SCPI, STAT:PRES sets the transition filter registers so that only positive transitions are detected and sets the ENABLE register to all zeros. The settings of the service request enable register, parallel poll enable register, memory registers related to the \*SAV command, the instrument address, output queue, and power on status clear flag are not affected by this command.

Operation register	Questionable register	Preset Value
STAT:OPER:ENAB	STAT:QUES:ENAB	0 - all bits disabled
STAT:OPER:NTR	STAT:QUES:NTR	0 - all bits disabled
STAT:OPER:PTR		65535 all bits enabled
	STAT:QUES:PTR	65535 all bits enabled

Parameter	Typical Return
(none)	(none)
Preset the Operation and Questionable registers: STAT:PRES	

## STATus:QUEStionable[:EVENT]?

Queries the event of the Questionable status group. This is a read-only register, which stores (latches) all events that are passed by the Operation NTR and/or PTR filter. Reading the Questionable Status Event register clears it.

Parameter	Typical Return
(none)	<bit value>
Read the questionable status event register: STAT:QUES?	

The value returned is the binary-weighted sum of all bits set in the register. For example, to enable bit 2 (value 4) and bit 4 (value 16), the corresponding decimal value would be 20 (4 + 16).

**\*RST** does not affect this register.

**STATus:QUEStionable:CONDition?**

Queries the condition of the Questionable status group. This is a read-only register, which holds the instrument's live (unlatched) operational status. Reading the Questionable Status Condition register does not clear it.

Parameter	Typical Return
(none)	<bit value>
Read questionable status condition register: STAT:QUES:COND?	

The value returned is the binary-weighted sum of all bits set in the register. For example, to enable bit 2 (value 4) and bit 4 (value 16), the corresponding decimal value would be 20 (4 + 16).

The condition register bits reflect the current condition. If a condition goes away, the corresponding bit is cleared.

A **\*RST** clears this register, other than those bits where the condition still exists after \*RST.

**STATus:QUEStionable:ENABle <value>****STATus:QUEStionable:ENABle?**

Sets the value of the enable register of the Questionable status group. The enable register is a mask for enabling specific bits from the Questionable Event register to set the QUES (questionable summary) bit of the Status Byte register. The **STATus:PRESet** command clears all enable register bits.

Parameter	Typical Return
Decimal sum of the bits in the register, default 0. For example, to enable bit 2 (value 4), bit 3 (value 8), and bit 7 (value 128), use decimal sum 140 (4 + 8 + 128). Default 0.	<bit value>
Enable bits 2 and 4 in the questionable enable register: STAT:QUES:ENAB 24	

For example, to enable bit 2 (value 4) and bit 4 (value 16), the corresponding decimal value would be 20 (4 + 16).

A **\*CLS** does not clear the enable register, but does clear the **event register**.

**STATus:QUESTIONable:NTRansition <value>**

**STATus:QUESTIONable:NTRansition?**

**STATus:QUESTIONable:PTRansition <value>**

**STATus:QUESTIONable:PTRansition?**

Sets and queries the value of negative and positive transition filters of the Questionable status group. These registers serve as a polarity filter between the Questionable Condition and Questionable Event registers.

When a bit in the NTR register is 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 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.

The **STATus:PRESet** command sets all bits in the PTR registers and clears all bits in the NTR registers.

Parameter	Typical Return
Decimal sum of the bits in the register, default 0. For example, to enable bit 2 (value 4), bit 3 (value 8), and bit 7 (value 128), use decimal sum 140 (4 + 8 + 128). Default 0.	<bit value>
Enable bits 3 and 4 in the questionable PTR register: STAT:QUES:PTR 24	

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.

**STATus:QUESTIONable:INSTrument[:EVENT]?**

Queries the event of the Questionable Instrument status group.

This is a read-only register, which stores (latches) all events that are passed by the Questionable Instrument NTR and/or PTR filter. Reading the Questionable Instrument Event register clears it.

Parameter	Typical Return
(none)	<bit value>
Read the questionable instrument event register: STAT:QUES:INST?	

The value returned is the binary-weighted sum of all bits set in the register. For example, with bit 3 (value 8) and bit 5 (value 32) set (and corresponding bits enabled), the query returns +40.

**\*RST** does not affect this register unless the reset causes an event that the filters are configured to capture.

**STATus:QUESTIONable:INSTrument:CONDition?**

Queries the condition of the Questionable Instrument status group. This is a read-only register, which holds the instrument's live (unlatched) operational status. Reading the Questionable Instrument Condition register does not clear it.

Parameter	Typical Return
(none)	<bit value>
Read the questionable instrument condition register: STAT:QUES:INST:COND?	

The value returned is the binary-weighted sum of all bits set in the register. For example, with bit 3 (value 8) and bit 5 (value 32) set (and corresponding bits enabled), the query returns +40.

The condition register bits reflect the current condition. If a condition goes away, the corresponding bit is cleared.

A **\*RST** clears this register, other than those bits where the condition still exists after \*RST.

**STATus:QUESTIONable:INSTrument:ENABLE <value>**  
**STATus:QUESTIONable:INSTrument:ENABLE?**

Sets the value of the enable register of the Questionable Instrument status group. The enable register is a mask for enabling specific bits from the Questionable Instrument Event register to set the QUES (questionable summary) bit of the Status Byte register. The **STATus:PRESet** command clears all enable register bits.

Parameter	Typical Return
Decimal sum of the bits in the register, default 0. For example, to enable bit 2 (value 4), bit 3 (value 8), and bit 7 (value 128), use decimal sum 140 (4 + 8 + 128). Default 0.	<bit value>
Enable bits 3 and 4 in the instrument enable register: STAT:QUES:INST:ENAB 24	

For example, with bit 3 (value 8) and bit 5 (value 32) set (and corresponding bits enabled), the query returns +40.

A **\*CLS** does not clear the enable register, but does clear the **event register**.

**STATus:QUESTIONable:INSTrument:NTRansition <value>**  
**STATus:QUESTIONable:INSTrument:NTRansition?**  
**STATus:QUESTIONable:INSTrument:PTRansition <value>**  
**STATus:QUESTIONable:INSTrument:PTRansition?**

Sets and queries the value of negative and positive transition filters of the Questionable Instrument status group. These registers serve as a polarity filter between the Questionable Instrument Condition and Questionable Instrument Event registers.

When a bit in the NTR register is 1, then a 1-to-0 transition of the corresponding bit in the Questionable Instrument Condition register causes that bit in the Questionable Instrument Event register to be set.

When a bit in the PTR register is 1, then a 0-to-1 transition of the corresponding bit in the Questionable Instrument Condition register causes that bit in the Questionable Instrument Event register to be set.

The **STATus:PRESet** command sets all bits in the PTR registers and clears all bits in the NTR registers.

Parameter	Typical Return
Decimal sum of the bits in the register, default 0. For example, to enable bit 2 (value 4), bit 3 (value 8), and bit 7 (value 128), use decimal sum 140 (4 + 8 + 128). Default 0.	<bit value>
Enable bits 3 and 4 in the NTR register: STAT:QUES:INST:NTR 24	

If the same bits in both NTR and PTR registers are set to 1, then any transition of that bit at the Questionable Instrument Condition register sets the corresponding bit in the Questionable Instrument 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 Instrument Condition register can set the corresponding bit in the Questionable Instrument Event register.

The value returned is the binary-weighted sum of all bits set in the register.

### **STATus:QUESTionable:INSTrument:ISUMmary<1|2|3>[:EVENT]?**

Queries the event of the Questionable Instrument Isummary status group. The parameters 1|2|3 specify the phase.

This is a read-only register, which stores (latches) all events that are passed by the Questionable Instrument Isummary NTR and/or PTR filter. Reading the Questionable Instrument Isummary Event register clears it.

Parameter	Typical Return
(none)	<bit value>
Read the questionable instrument Isummary event register for phase3: STAT:QUES:INST:ISUM3?	

The value returned is the binary-weighted sum of all bits set in the register. For example, with bit 3 (value 8) and bit 5 (value 32) set (and corresponding bits enabled), the query returns +40.

**\*RST** does not affect this register unless the reset causes an event that the filters are configured to capture.

**STATus:QUESTIONable:INSTrument:ISUMmary<1|2|3>:CONDition?**

Queries the condition of the Questionable Instrument Isummary status group. This is a read-only register, which holds the instrument's live (unlatched) operational status. Reading the Questionable Instrument Isummary Condition register does not clear it.

Parameter	Typical Return
(none)	<bit value>
Read the questionable instrument Isummary condition register for phase3: STAT:QUES:INST:ISUM3:COND?	

The value returned is the binary-weighted sum of all bits set in the register. For example, with bit 3 (value 8) and bit 5 (value 32) set (and corresponding bits enabled), the query returns +40.

The condition register bits reflect the current condition. If a condition goes away, the corresponding bit is cleared.

A **\*RST** clears this register, other than those bits where the condition still exists after \*RST.

**STATus:QUESTIONable:INSTrument:ISUMmary<1|2|3>:ENABLE <value>**  
**STATus:QUESTIONable:INSTrument:ISUMmary<1|2|3>:ENABLE?**

Sets the value of the enable register of the Questionable Instrument Isummary status group. The enable register is a mask for enabling specific bits from the Questionable Instrument Isummary Event register to set the QUES (questionable summary) bit of the Status Byte register. The **STATus:PRESet** command clears all enable register bits.

Parameter	Typical Return
Decimal sum of the bits in the register, default 0. For example, to enable bit 2 (value 4), bit 3 (value 8), and bit 7 (value 128), use decimal sum 140 (4 + 8 + 128). Default 0.	<bit value>
Enable bits 3 and 4 in the instrument Isummary enable register for phase2: STAT:QUES:INST:ISUM2:ENAB 24	

For example, with bit 3 (value 8) and bit 5 (value 32) set (and corresponding bits enabled), the query returns +40.

A **\*CLS** does not clear the enable register, but does clear the **event register**.

**STATus:QUESTIONable:INSTrument:ISUMmary<1|2|3>:NTRansition <value>**

**STATus:QUESTIONable:INSTrument:ISUMmary<1|2|3>:NTRansition?**

**STATus:QUESTIONable:INSTrument:ISUMmary<1|2|3>:PTRansition <value>**

**STATus:QUESTIONable:INSTrument:ISUMmary<1|2|3>:PTRansition?**

Sets and queries the value of negative and positive transition filters of the Questionable Instrument Isummary status group. These registers serve as a polarity filter between the Questionable Instrument Isummary Condition and Questionable Instrument Isummary Event registers.

When a bit in the NTR register is 1, then a 1-to-0 transition of the corresponding bit in the Questionable Instrument Isummary Condition register causes that bit in the Questionable Instrument Isummary Event register to be set.

When a bit in the PTR register is 1, then a 0-to-1 transition of the corresponding bit in the Questionable Instrument Isummary Condition register causes that bit in the Questionable Instrument Isummary Event register to be set.

The **STATus:PRESet** command sets all bits in the PTR registers and clears all bits in the NTR registers.

Parameter	Typical Return
Decimal sum of the bits in the register, default 0. For example, to enable bit 2 (value 4), bit 3 (value 8), and bit 7 (value 128), use decimal sum 140 (4 + 8 + 128). Default 0.	<bit value>
Enable bits 3 and 4 in the NTR register for phase2: STAT:QUES:INST:ISUM2:NTR 24	

If the same bits in both NTR and PTR registers are set to 1, then any transition of that bit at the Questionable Instrument Isummary Condition register sets the corresponding bit in the Questionable Instrument Isummary 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 Instrument Isummary Condition register can set the corresponding bit in the Questionable Instrument Isummary Event register.

The value returned is the binary-weighted sum of all bits set in the register.

## SYSTem Subsystem

The SYSTem subsystem controls instrument functions that are not directly related to output control, measurement, or status functions. Note that IEEE-488 Common commands also control system functions such as state management.

### SYSTem:BEEPer[:IMMEDIATE]

Issues a single beep.

Parameter	Typical Return
(none)	(none)
Issue a single beep: SYST:BEEP	

This command overrides the current beeper state . You can issue a beep even if the beeper is turned off by **SYSTem:BEEPer:STATe**.

Programmed beeps may be useful for program development and troubleshooting.

### SYSTem:BEEPer:KCLick ON|1|OFF|0

#### SYSTem:BEEPer:KCLick?

Disables or enables the click tone heard when you press a front-panel key.

Parameter	Typical Return
ON 1 OFF 0	0 (OFF) or 1 (ON)
Disable front-panel key click: SYST:BEEP:KCLick OFF	

The front-panel key click and instrument beeper settings do not affect each other.

This parameter is not affected by **\*RST** or **\*RCL**.

### SYSTem:BEEPer:STATe ON|1|OFF|0

#### SYSTem:BEEPer:STATe?

Disables or enables the beep heard when an error is generated.

Parameter	Typical Return
ON 1 OFF 0	0 (OFF) or 1 (ON)
Disable the beeper state: SYST:BEEP:STAT OFF	

The front-panel key click and instrument beeper settings do not affect each other.

A beep is always emitted (even with beep state OFF) when **SYSTem:BEEPer** is sent.

This parameter is not affected by **\*RST** or **\*RCL**.

**SYSTem:COMMunicate:LAN:CONTRol?**

Returns the TCP port number for SCPI-RAW.

Parameter	Typical Return
(none)	<TCP port number>
Queries: SYST:COMM:LAN:CONTRol?	

**SYSTem:COMMunicate:RLState LOCAL|REMOte|RWLlock  
SYSTem :COMMunicate:RLState?**

Configures the remote/local/lockout state of the instrument.

Parameter	Typical Return
LOCAL REMOte RWLlock	LOC, REM, or RWL
Sets the remote/local state to remote: SYST:COMM:RLST REM	

The LOCAL parameter (the power-on default), disables the remote interface, the REMote parameter enables remote control of the instrument, and RWLlock enables remote control of the instrument and locks out front-panel operation. The RWLocal parameter also locks out the operation of the Sense switch on the rear panel.

The remote/local instrument state can also be set by other interface commands over the GPIB and other I/O interfaces. If multiple remote interfaces are active, the interface with the most recently changed remote/local state takes precedence. This parameter is not affected by **\*RST** or **\*RCL**.

**SYSTem:CONFigure:ADJust:VOLTage:FINE <value>|MINimum|MAXimum [,(@chanlist)]  
SYSTem:CONFigure:ADJust:VOLTage:FINE? [MINimum|MAXimum] [,(@chanlist)]**

Sets the voltage offset value in volts. Use SYSTem:CONFigure:ADJust:VOLTage:TERMinal:MODE to specify where the voltage offset is sensed.

The optional (@chanlist) parameter lets you designate specific output phases.

Parameter	Typical Return
-200 to +200 (resolution = 10)	180
Sets the voltage offset to 180: SYST:CONF:ADJ:VOLT:FINE 180	

The one's digit is rounded.

The **\*RST** command sets this parameter to 0.

### **SYSTem:CONFigure:ADJust:VOLTage:TERMinal:MODE OUTPut|SENSE SYSTem:CONFigure:ADJust:VOLTage:TERMinal:MODE?**

Set whether the sensing function is enabled or disabled for the voltage offset setting. Use SYSTem:CONFigure:ADJust:VOLTage:FINE to set the voltage offset value.

Parameter	Typical Return
OTERM STERM	STERM
Enables the sense terminals for the voltage offset: SYST:CONF:ADJ:VOLT:TERM:MODE STERM	

OTERM - disables the voltage offset sensing function (sensing is at the output terminals).

STERM - enables the voltage offset sensing function (sensing is at the sense terminals).

The **\*RST** command sets this parameter to OTERM.

### **SYSTem:CONFigure:FORMation:FRAMe[:COUNT]?**

Queries the number of units operating in parallel. Parallel operation does not apply to AC6903 units.

Parameter	Typical Return
(none)	1 2 3
Query the number of paralleled units: SYST:CONF:FORM:FRAM?	

Returns a 1 if parallel operation is not being performed.

### **SYSTem:CONFigure:FORMation:FRAMe:INFO? <value>**

Queries information about the specified unit operating in parallel. Returns the model number, serial number, and firmware version in comma-separated format. Parallel operation does not apply to AC6903 units.

Parameter	Typical Return
0 1 2 3	<model number>, <serial number>, <firmware version>
Queries information about the specified unit: SYST:CONF:FORM:FRAM:INFO? 1	

0 - queries the primary or standalone unit (this is the only value that applies to AC6903 units)

1 - queries the first secondary unit

2 - queries the second secondary unit

3 - queries the third secondary unit

**SYSTem:CONFigure:FORMation:PMODule[:COUNt]? <value>**

Queries the number of power modules in the specified unit. Each power module is rated at 6 kW.

Parameter	Typical Return
0 1 2 3 (frame)	<number of power modules>
Queries the number of power modules in the specified unit: SYST:CONF:FORM:PMOD? 1	

0 - queries the primary or standalone unit (this is the only value that applies to AC6903 units)

1 - queries the first secondary unit

2 - queries the second secondary unit

3 - queries the third secondary unit

**SYSTem:CONFigure:FORMation:PMODule:INFO? <frame>, <module>**

Queries information about the specified module operating in a frame.

Parameter	Typical Return
0 1 2 3 (frame)	<number of power modules>
1-4 (module index)	
Queries the specified power module in the specified unit: ,1 SYST:CONF:FORM:PMOD:INFO? 1	

0 - queries the primary or standalone unit (this is the only value that applies to AC6903 units)

1 - queries the first secondary unit

2 - queries the second secondary unit

3 - queries the third secondary unit

1-4 - Specifies the index of the power module. Up to four power modules can be installed in a frame.

**SYSTem:CONFigure:FORMation:PSAVer:MAXimum <value>|MINimum|MAXimum  
SYSTem:CONFigure:FORMation:PSAVer:MAXimum?**

Sets the maximum expected power for the power saver function in Watts.

Parameter	Typical Return
0 to total output wattage of the unit	<power saver limit>
Specifies the power saver limit: SYST:CONF:FORM:PSAV:MAX 3000	

The **\*RST** command sets all instruments to their maximum rated power.

### **SYSTem:CONFigure:FORMation:PSAVer:MODules E|D {,E|D} . . . SYSTem:CONFigure:FORMation:PSAVer:MODules?**

Sets the specified power modules to run using the power saver function

Parameter	Typical Return
E D [,E D]...	E D [,E D]...
Enable half of the power modules in a standalone unit: SYST:CONF:FORM:PSAV:MOD EEDD	

E - the power module is disabled

D - the power module is enabled

Up to four parameter pairs can be specified. The first pair configures the power modules in the stand-alone or primary unit. The subsequent pairs program the power modules the secondary units.

The **\*RST** command sets all power modules in all frames to E (enabled).

### **SYSTem:CONFigure:FORMation:PSAVer:RESet**

Resets the power saver settings. This command is invalid when the output is on.

Parameter	Typical Return
(none)	(none)
Resets the power settings: SYST:CONF:FORM:PSAV:RES?	

### **SYSTem:CONFigure:NOUTputs 1|2|3**

### **SYSTem:CONFigure:NOUTputs?**

### **SYSTem:CONFigure:WIRing 1|2|3**

### **SYSTem:CONFigure:WIRing?**

Specifies the output configuration. The two commands are equivalent.

Parameter	Typical Return
1 2 3	1
Specify single-phase output: SYST:CONF:NOUTputs 1 Specify single-phase output: SYST:CONF:WIRing 1	

1 - specifies single-phase output

2 - specifies single-phase three-wire output

3 - specifies three-phase output

This command is invalid when the output is on (OUTP ON).

This command is invalid when a sequence or a simulation is running.

## **SYSTem:DATE <yyyy>,<mm>,<dd>** **SYSTem:DATE?**

Sets the local date of the system clock.

Parameter	Typical Return
2016 - 2037 (year)	2021,7,28
1-12 (month)	
1-31 (day)	

---

Sets the date to 2021,2,28: SYST:DATE 2021,7,28

Returns the year, month, and day in a comma-separated NR1 format.

## **SYSTem:ERRor[:NEXT]?**

Reads and clears one error from the error queue.

Parameter	Typical Return
(none)	

---

Reads and clear first error in error queue: SYST:ERR?

The Err annunciator turns on when any error is in the error queue. Error retrieval is first-in-first-out, 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 than 16 errors have occurred, the most recent error is replaced with -350,"Error queue overflow". No additional errors are stored until you remove errors from the queue. Reading the error queue when it is empty yields the message +0,"No error".

The error queue is cleared by \*CLS and power cycling. It is not cleared by \*RST.

Errors have the following format (the error string may contain up to 255 characters).

<error code>,<error string>

For a list of error codes and error strings, see [SCPI Error Messages](#).

**SYSTem:ERRor[:NEXT]:COUNt?**

Returns the number of errors in the error queue.

Parameter	Typical Return
(none)	+11
Return the number of errors in the error queue: SYST:ERR:COUN?	

The returned value always begins with a + character, even if the number is 0.

The Err annunciator turns on when any error is in the error queue. Error retrieval is first-in-first-out, 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 than 16 errors have occurred, the most recent error is replaced with -350, "Error queue overflow". No additional errors are stored until you remove errors from the queue. Reading the error queue when it is empty yields the message +0, "No error".

The error queue is cleared by \*CLS and power cycling. It is not cleared by \*RST.

Errors have the following format (the error string may contain up to 255 characters).

<error code>, <error string>

For a list of error codes and error strings, see [SCPI Error Messages](#).

**SYSTem:LOCal****SYSTem:REMote****SYSTem:RWLock**

These three commands are included for compatibility. Use the equivalent SYSTem:COMMunicate:RLST when creating new programs.

**SYSTem:PASSword[:CENable] "<password>"****SYSTem:PASSword[:CENable]?**

Enables password protection by entering the password set by SYSTem:PASSword:NEW.

Parameter	Typical Return
"<password>"	(none)
Enable password protection: SYST:PASS "<password>"	

**SYSTem:PASSword[:CENable]:STATe?**

Queries if password protection is enabled.

Parameter	Typical Return
(none)	0 = disabled 1 = enabled

---

Queries if password is enabled: SYST:PASS:STAT?

**SYSTem:PASSword:CDISable "<password>"**

Disables password protection. Enter the existing password in quotes to disable password protection.

Parameter	Typical Return
"<password>"	(none)

---

Disables the password: SYST:PASS:CDIS "<password>"

**SYSTem:PASSword:NEW "<existing\_password>","<new\_password>"**

Sets a new password. Enter the existing password and the new password in quotes.

The password must be 4 to 15 characters long and may include any of these characters:

Characters	Description
A-Z	Upper case letters
a-z	Lower case letters
0-9	Numeric digits
_ , -	underscore and hyphen

Parameter	Typical Return
"<existing_password>"	(none)
"<new_password>"	

---

Sets a new password: SYST:PASS:NEW "<existing>","<new>,"

**SYSTem:SECurity:IMMEDIATE**

Clears all user memory (including stored states) and reboots the instrument in the \*RST state.

Sanitization is per the National Industrial Security Program Operating Manual (NISPOM). Factory 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 typically performed only when you need to remove an instrument from a secure area. The sanitization procedure is not recommended for use in routine applications because of the possibility of unintended loss of data.

## 4 SCPI Programming

Parameter	Typical Return
(none)	(none)
Sanitize the instrument: SYST:SEC:IMM	

When parallel operation is in use, set the rotary switches for the address and the number of secondary units on the primary unit and all secondary units to zero, and then use this command.

If your unit includes a micro-SD card (Option MEM), you can simply remove the card to sanitize the instrument. Refer to [Removing and Installing an SD Card](#) for details.

### **SYSTem:SLEep:EXECute**

Immediately activates sleep mode.

Parameter	Typical Return
(none)	(none)
Enter instrument sleep mode: SYST:SLE:EXEC	

### **SYSTem:VERSion?**

Returns the version of SCPI that the instrument uses.

Parameter	Typical Return
(none)	1999.0
Return the SCPI version: SYST:VERS?	

The query always returns 1999.0

The SCPI version cannot be determined from front panel.

### **SYSTem:TIME <hh>,<mm>,<ss>**

#### **SYSTem:TIME?**

Sets the local time of the system clock in hours, minutes, and seconds.

Parameter	Typical Return
0 - 23 (hour)	20,30,00
0-59 (minute)	
0-59 (second)	
Sets the time to 8:30 PM: SYST:TIME 20,00,00	

Returns the hours, minutes, and seconds in a comma-separated NR1 format.

## TRIGger Subsystem

The TRIGger subsystem sets the measurement operation and trigger functions for various instrument operations:

TRIGger:ACQuire - triggers a measurement acquisition

TRIGger:Program - triggers the start of a program

TRIGger:SIMulation - triggers the start of a simulation

TRIGger:TRANsient - triggers synchronizes output changes

### TRIGger:ACQuire[:IMMediate]

Sends a software trigger to the ACQuire subsystem.

Parameter	Typical Return
(none)	(none)
Configure and trigger the ACQuire subsystem:	
TRIG:ACQ:SOUR BUS	
INIT:ACQ	
TRIG:ACQ	

### TRIGger:ACQuire:SOURce IMMEDIATE|BUS TRIGger:ACQuire:SOURce?

Sets the trigger source that starts the measurement after INIT:ACQ. Specify IMMEDIATE to start the measurement immediately, or BUS (the default) to wait for a software trigger (\*TRG, or TRIG:ACQ).

Parameter	Typical Return
IMMEDIATE BUS	IMM or BUS
Set the trigger source to BUS: TRIG:ACQ:SOUR BUS	

The **\*RST** or **\*RCL** commands or power-on set this parameter to IMMEDIATE.

### TRIGger:PROGram[:IMMediate]

Sends a software trigger to the PROGram subsystem.

Parameter	Typical Return
(none)	(none)
Configure and trigger the PROGram subsystem:	
TRIG:PROG:SOUR BUS	
INIT:PROG	
TRIG:PROG	

### TRIGger:PROGram:SOURceIMMEDIATE|BUS TRIGger:PROGram:SOURce?

Sets the trigger source that starts the program after INIT:PROG. Specify IMMEDIATE to start the program immediately, or BUS (the default) to wait for a software trigger (\*TRG or TRIG:PROG).

Parameter	Typical Return
IMMEDIATE BUS	IMM or BUS
Set the trigger source to BUS: TRIG:PROG:SOUR BUS	

The **\*RST** or **\*RCL** commands or power-on set this parameter to IMMEDIATE.

### TRIGger:SIMulation[:IMMEDIATE]

Sends a software trigger to the SIMulation subsystem.

Parameter	Typical Return
(none)	(none)
Configure and trigger the SIMulation subsystem: TRIG:SIM:SOUR BUS INIT:SIM TRIG:SIM	

### TRIGger:SIMulation:SOURceIMMEDIATE|BUS TRIGger:SIMulation:SOURce?

Sets the trigger source that starts the simulation after INIT:SIM. Specify IMMEDIATE to start the simulation immediately, or BUS (the default) to wait for a software trigger (\*TRG or TRIG:SIM).

Parameter	Typical Return
IMMEDIATE BUS	IMM or BUS
Set the trigger source to BUS: TRIG:SIM:SOUR BUS	

The **\*RST** or **\*RCL** commands or power-on set this parameter to IMMEDIATE.

**TRIGger:TRANSient[:IMMediate]**

Triggers the TRANSient subsystem.

Parameter	Typical Return
(none)	(none)

Configure and trigger the TRANSient subsystem:

```
VOLT:MODE STEP
FREQ:MODE STEP
TRIG:TRAN:SOUR BUS
INIT:TRAN
TRIG:TRAN
```

**TRIGger:TRANSient:SOURce IMMEDIATE|BUS**  
**TRIGger:TRANSient:SOURce?**

Sets the trigger source for changing the output value after INIT:TRAN. Specify IMMEDIATE (the default) to start the measurement immediately, or BUS to wait for a software trigger (\*TRG or TRIG:TRAN).

Parameter	Typical Return
IMMEDIATE BUS	IMM or BUS

Set the trigger source to BUS: TRIG:TRAN:SOUR BUS

The **\*RST** or **\*RCL** commands or power-on set this parameter to IMMEDIATE.

## VOLTage Subsystem

Voltage commands program the output voltage of the instrument.

**WARNING** Soft limits apply only if the corresponding limit state is on, and they only apply to voltage settings executed after the limit state is set on. Soft limits do not retroactively apply to the existing voltage setting.

```
[SOURce:]VOLTage[:LEVel][:IMMediate][:AMPLitude] <value>|MINimum|MAXimum[, <low_
limit>|MINimum|MAXimum, <high_limit>|MINimum|MAXimum] [,@chanlist]
[SOURce:]VOLTage[:LEVel][:IMMediate][:AMPLitude]? [MINimum|MAXimum] [,@chanlist]
[SOURce:]VOLTage[:LEVel]:TRIGgered[:AMPLitude] <value>|MINimum|MAXimum [,@chan-
list]
[SOURce:]VOLTage[:LEVel]:TRIGgered[:AMPLitude]? [MINimum|MAXimum]
```

Sets the immediate or triggered AC voltage level, and optionally the soft limits for the immediate voltage. The triggered level is the value that is transferred to the output when an output step is triggered. Units are in volts (rms).

The optional (@chanlist) parameter lets you designate specific output phases.

Parameter	Typical Return
AC mode 160 V range: 0.0 to 161.0 V	+2.00000E+01
AC mode 320 V range: 0.0 to 322.0 V	

Sets the output voltage to 20 V: VOLT 20

Sets the triggered voltage to 10 V: VOLT:TRIG 10

This command takes one or three arguments. You cannot have a low or high limit without the other.

Voltage units (MV, V, KV) are supported.

This command applies to AC and AC+DC.

This command is invalid when the combined value with the DC voltage is outside the allowable range (L range: -227.5 V to 227.5 V, H range: -455.0 V to 455.0 V).

This command is invalid if the signal source is set to external signal source (VOLT:EXT:EXTDC:SIGN:SOUR EXT).

This command is invalid when an external analog signal is used to control the voltage or frequency (VOLT:EXT:FUNC:MODE VPR).

The **\*RST** command sets this parameter to 0.

**[SOURce:]VOLTage[:LEVel]:LIMit:LOWer <value>|MINimum|MAXimum**  
**[SOURce:]VOLTage[:LEVel]:LIMit:LOWer? [MINimum|MAXimum]**  
**[SOURce:]VOLTage[:LEVel]:LIMit:UPPer <value>|MINimum|MAXimum**  
**[SOURce:]VOLTage[:LEVel]:LIMit:UPPer? [MINimum|MAXimum]**

Sets the lower and upper AC voltage limits. Units are in volts (rms).

Parameter	Typical Return
AC mode 160 V range: 0.0 to 161.0 V	+2.50000E+02
AC mode 320 V range: 0.0 to 322.0 V	
Limit the AC voltage to between 150 and 250 Vrms:	
VOLT:LIM:LOW 150	
VOLT:LIM:UPP 250	
VOLT:LIM ON	

This command applies to AC and AC+DC.

If the new setting conflicts with the existing immediate voltage setting (because the limit range becomes tighter), this command coerces the voltage setting to fit with the new upper and lower limits.

A SCPI error (-222, "Data out of range") occurs if the entered parameter value is outside the range.

The **\*RST** command sets the upper limit to 322 and lower limit to 0.

**[SOURce:]VOLTage:COMPensate:MODE DISabled|HARD|SOFT**  
**[SOURce:]VOLTage:COMPensate:MODE?**

Sets the compensation mode.

Parameter	Typical Return
DISabled HARD SOFT	DIS HARD SOFT
Set the voltage compensation mode to HARD: VOLT:COMP:MODE HARD	

DISabled - disables the voltage compensation.

HARD - compensates the voltage drop up to 1.5 V per load line at the load.

SOFT - compensates the voltage up to  $\pm 10\%$  of the output's set voltage at the load.

The **\*RST** command sets this parameter to DISabled.

**[SOURce:]VOLTage:COMPensate:SOFT:CONTRol[:STATus] AC|DC**  
**[SOURce:]VOLTage:COMPensate:SOFT:CONTRol[:STATus]?**

Sets the compensated voltage mode.

Parameter	Typical Return
AC DC	AC DC
Set the DC voltage compensation: VOLT:COMP:SOFT:CONT DC	

AC - compensates the AC voltage. This setting is invalid if the DC voltage is not zero.

DC - compensates the DC voltage. This setting is invalid if the AC voltage is not zero.

This command is invalid when the output is ON.

The **\*RST** command sets this parameter to AC.

**[SOURce:]VOLTage:COMPensate:SOFT:TERMinal OUTPut|SENSing**  
**[SOURce:]VOLTage:COMPensate:SOFT:TERMinal?**

Sets the compensation sensing point.

Parameter	Typical Return
OUTPut SENSe	OUTP SENS
Selects the output terminals as the sensing point: VOLT:COMP:SOFT:TERM SENS	

OUTPut - selects the output terminals as the compensation sensing point.

SENSe - selects the sense terminals as the compensation sensing point.

This command is invalid when the output is ON.

The **\*RST** command sets this parameter to SENSing.

**[SOURce:]VOLTage:LTLIne <value>|MINimum|MAXimum**  
**[SOURce:]VOLTage:LTLIne? [MINimum|MAXimum]**

Sets the line-to-line AC voltage. Units are in volts (rms).

Parameter	Typical Return
0.0 to 322.0 in single-phase lower range	+2.50000E+02
0.0 to 644.0 in single-phase upper range	
0.0 to 278.8 in three-phase lower range	
0.0 to 557.7 in three-phase upper range:	
Set the immediate line-to-line voltage to 150 V: VOLT:LTL 150	

This command applies in single-phase, three-wire output.

This command also applies in three-phase output when the phase 1- to- phase 2 difference is 120, and the phase 1- to- phase 3 difference is 240.

This command is invalid when an external analog signal is used to control the voltage or frequency, and when the signal source is set to external.

The **\*RST** command sets this parameter to 0.

**[SOURce:]VOLTage:OFFSet[:IMMEDIATE] <value>|MINimum|MAXimum [,<low\_limit>|MINimum|MAXimum,<high\_limit>|MINimum|MAXimum] [,@chanlist]**  
**[SOURce:]VOLTage:OFFSet[:IMMEDIATE]? [MINimum|MAXimum] [,@chanlist]**  
**[SOURce:]VOLTage:OFFSet:TRIGgered <value>|MINimum|MAXimum [,@chanlist]**  
**[SOURce:]VOLTage:OFFSet:TRIGgered? [MINimum|MAXimum]**

Sets the immediate or triggered DC voltage in VDC, and optionally sets the soft limits for the immediate DC voltage. The optional (@chanlist) parameter lets you designate specific output phases.

Parameter	Typical Return
DC mode 160 V range: -227.5 to +227.5 V	+1.50000E+02
DC mode 320 V range: -455.0 to +455.0 V	
AC+DC mode: The total voltage must be within the voltage limits, and the AC+DC peak must be between -455 and +455 V.	
Set the immediate DC voltage to 150 V: VOLT:OFFS 150	

This command takes one or three arguments. You cannot have a low or high limit without the other.

This command applies to DC and AC+DC.

Error message +160 is generated if the IMMEDIATE voltage is set outside the MIN/MAX limits, and error message +161 is generated if the TRIGgered voltage is set outside the MIN/MAX limits.

Voltage units (MV, V, KV) are supported.

The **\*RST** command sets this parameter to 0.

**[SOURce:]VOLTage:OFFSet:LIMit:LOWer <value>|MINimum|MAXimum**  
**[SOURce:]VOLTage:OFFSet:LIMit:LOWer? [MINimum|MAXimum]**  
**[SOURce:]VOLTage:OFFSet:LIMit:UPPer <value>|MINimum|MAXimum**  
**[SOURce:]VOLTage:OFFSet:LIMit:UPPer? [MINimum|MAXimum]**

Sets the lower and upper DC voltage soft limits.

Parameter	Typical Return
160 V range: -227.5 to +227.5 V	(none)
320 V range: -455.0 to +455.0 V	
Set the voltage limits to the be 100 and 350 V:	
VOLT:OFFS:LIM:LOW 100	
VOLT:OFFS:LIM:UPP 350	

This command takes one or three arguments. You cannot have a low or high limit without the other.

This command applies to DC and AC+DC.

Error message +166 is generated if the lower limit is beyond the MIN/MAX limits, and error message +167 is generated if the upper limit is beyond the MIN/MAX limits.

Voltage units (MV, V, KV) are supported.

The **\*RST** command sets the upper limit to 452 and lower limit to -452.

**[SOURce:]VOLTage:OFFSet:LTLIne<value>|MINimum|MAXimum**  
**[SOURce:]VOLTage:OFFSet:LTLIne?[MINimum|MAXimum]**

Sets the line-to-line DC voltage. Units are in volts (rms).

Parameter	Typical Return
-455.0 to +455.0 V in DC mode lower range	+2.50000E+02
-890.0 to +890.0 in DC mode upper range	
Set the immediate line-to-line voltage to 300 V: VOLT:OFFS:LTL 300	

This command applies in single-phase, three-wire output.

This command is invalid when the signal source is set to external.

The **\*RST** command sets this parameter to 0.

**[SOURce:]VOLTage:PROGramming:EXTernal:EXTDC:ADJust:GAIN <channel>,<value>**

**[SOURce:]VOLTage:PROGramming:EXTernal:EXTDC:ADJust:GAIN? <channel>**

Sets the voltage gain when varying the voltage or frequency with the external analog signal EXTDC for each A, B, and C channel..

Parameter	Typical Return
0 1 2 - the specified channel	(none)
5 - 220	10
Set the voltage gain of the external signal to 10: VOLT:PROG:EXT:EXTDC:ADJ:GAIN 10	

0 - specifies channel A

1 - specifies channel B

2 - specifies channel C

The **\*RST** command sets this parameter to 100.

**[SOURce:]VOLTage:PROGramming:EXTernal:EXTDC:ADJust:OFFSet <channel>,<value>**

**[SOURce:]VOLTage:PROGramming:EXTernal:EXTDC:ADJust:OFFSet? <channel>**

Sets the voltage offset when varying the voltage or frequency with the external analog signal EXTDC for each A, B, and C channel..

Parameter	Typical Return
0 1 2 - the specified channel	(none)
-200 - 200	100
Set the voltage offset of the external signal to 100: VOLT:PROG:EXT:EXTDC:ADJ:OFFS 100	

0 - specifies channel A

1 - specifies channel B

2 - specifies channel C

The **\*RST** command sets this parameter to 0.

**[SOURce:]VOLTage:PROGramming:EXTernal:EXTDC:APERture <value>|MINimum|MAXimum**  
**[SOURce:]VOLTage:PROGramming:EXTernal:EXTDC:APERture? [MINimum|MAXimum]**

Sets the external analog input signal's aperture time in seconds.

Parameter	Typical Return
0.1 - 1.0	0.5
Set the external programming aperture to 0.5: VOLT:PROG:EXT:EXTDC:APER 0.5	

This command is valid when the signal source is set to external.

The **\*RST** command sets this parameter to 0.1.

**[SOURce:]VOLTage:PROGramming:EXTernal:EXTDC:SIGNal:POLarity <channel>, NORMal|INVerted**  
**[SOURce:]VOLTage:PROGramming:EXTernal:EXTDC:SIGNal:POLarity? <channel> <value>**

Sets the external analog input programming signal polarity for each A, B, and C channel.

Parameter	Typical Return
0 1 2 - the specified channel	(none)
NORMal INVerted	NORM INV
Set the external signal polarity for channel A to invert: VOLT:PROG:EXT:EXTDC:SIGN:POL 0, INV	

0 - specifies channel A

1 - specifies channel B

2 - specifies channel C

NORMal - specifies a signal whose polarity is the same as the input signal

INVerted - specified a signal whose polarity is the opposite as the input signal

The **\*RST** command sets this parameter to NORMal.

**[SOURce:]VOLTage:PROGramming:EXTernal:EXTDC:SIGNal:SOURce EXTernal|INT\_EXT**  
**[SOURce:]VOLTage:PROGramming:EXTernal:EXTDC:SIGNal:SOURce?**

Sets the external analog input programming signal source.

Parameter	Typical Return
EXTernal INT_EXT	EXT INT_EXT
Set the external programming signal source to INT_EXT: VOLT:PROG:EXT:EXTDC:SIGN:SOUR INT_EXT	

EXTernal - the external signal.

INT\_EXT - the internal signal and the external signal

The **\*RST** command sets this parameter to EXTernal.

**[SOURce:]VOLTage:PROGramming:EXTernal:MODE EXTDC|VPRogram|OFF**  
**[SOURce:]VOLTage:PROGramming:EXTernal:MODE?**

Sets the external analog signal's programming mode.

Parameter	Typical Return
EXTDC VPRogram OFF	EXTDC VPR OFF
Set the external programming mode to EXTDC: VOLT:PROG:EXT:MODE EXTDC	

EXTDC - the external signal amplifies the output voltage.

VPRogram - the external signal programs the output voltage using a fixed gain.

OFF - Turns the external analog signal programming mode off.

The **\*RST** command sets this parameter to OFF.

This command is invalid when the output is ON.

**[SOURce:]VOLTage:PROGramming:EXTernal:VPRogram:ADJust:GAIN <channel>,<value>**  
**[SOURce:]VOLTage:PROGramming:EXTernal:VPRogram:ADJust:GAIN? <channel>**

Sets the voltage gain when varying the voltage or frequency with the external analog signal VPRogram.

Parameter	Typical Return
5 - 50	10
Set the voltage gain of the external signal to 10: VOLT:PROG:EXT:VPR:ADJ:GAIN 10	

The **\*RST** command sets this parameter to 10.

**[SOURce:]VOLTage:PROGramming:EXTernal:VPRogram:ADJust:OFFSet <channel>, <value>**  
**[SOURce:]VOLTage:PROGramming:EXTernal:VPRogram:ADJust:OFFSet? <channel>**

Sets the voltage offset when varying the voltage or frequency with the external signal VPRogram.

Parameter	Typical Return
-200 - 200	100
Set the voltage offset of the external signal to 100: VOLT:PROG:EXT:VPR:ADJ:OFFS 100	

The **\*RST** command sets this parameter to 0.

**[SOURce:]VOLTage:PROGramming:EXTernal:VPRogram:MAPALL|ACVoltage|DCVoltage**  
**[SOURce:]VOLTage:PROGramming:EXTernal:VPRogram:MAP?**

Sets the voltage programming output mapping when varying the voltage or frequency with the external analog signal.

Parameter	Typical Return
ALL ACVoltage DCVoltage	ALL ACV DCV
Set the external programming mode to ACVoltage: VOLT:PROG:EXT:VPR:MAP ACV	

ALL - sets channel A to AC voltage; channel B to DC voltage; channel C to Frequency

ACVoltage - sets channel A to phase 1, AC voltage; channel B to phase 2, AC voltage; channel C to phase 3, AC voltage.

DCVoltage - sets channel A to phase 1, DC voltage; channel B to phase 2, DC voltage; channel C to phase 3, DC voltage.

This command is invalid for single-phase output and single-phase three-wire output.

The **\*RST** command sets this parameter to ALL.

**[SOURce:]VOLTage:PROGramming:EXTernal:VPRogram:STATe <channel>, ON|1|OFF|0**  
**[SOURce:]VOLTage:PROGramming:EXTernal:VPRogram:STATe? <channel>**

Sets the voltage programming output state for each channel when varying the voltage or frequency with the external analog signal.

Parameter	Typical Return
0 1 2 - the specified channel	(none)
ON 1 OFF 0	0 (OFF) or 1 (ON)
Set the voltage programming output state for channel A: VOLT:PROG:EXT:VPR:STAT: 0, ON	

0 - specifies channel A

1 - specifies channel B

2 - specifies channel C

The **\*RST** command sets this parameter to 0.

**[SOURce:]VOLTage:PROGramming:SOURce INTernal|EXTernal**  
**[SOURce:]VOLTage:PROGramming:SOURce?**

Sets the voltage programming source.

Parameter	Typical Return
INTernal EXTernal	INT EXT
Set the voltage programming source to external: VOLT:PROG:SOUR EXT	

INTernal - programs the output voltage from the front panel or from a program.

EXTernal - programs the output voltage using an external signal.

The **\*RST** command sets this parameter to INTernal.

**[SOURce:]VOLTage:PROTection:LOWer <value>|MINimum|MAXimum**  
**[SOURce:]VOLTage:PROTection:LOWer? [MINimum|MAXimum]**

Sets the under-voltage protection value.

Parameter	Typical Return
0 - 500.5	120
Set the under-voltage protection to -120: VOLT:PROT:LOW 120	

This command is valid when the UVP function is enabled.

For single-phase three-wire output and three-phase output, this value applies to all phases.

The **\*RST** command sets this parameter to 0.

**[SOURce:]VOLTage:PROTection:LOWer:STATe ON|1|OFF|0**  
**[SOURce:]VOLTage:PROTection:LOWer:STATe?**

Enables or disables the under-voltage protection

Parameter	Typical Return
ON 1 OFF 0	0 (OFF) or 1 (ON)
Enable under-voltage protection: <code>VOLT:PROT:LOW:STAT ON</code>	

The **\*RST** command sets this parameter to 0.

**[SOURce:]VOLTage:PROTection:UPPer <value>|MINimum|MAXimum [,<neg\_limit>, <pos\_limit>]**  
**[SOURce:]VOLTage:PROTection:UPPer? [MINimum|MAXimum]**

Sets the over-voltage protection value in rms volts. Optionally, you can include the positive and negative peak voltage limit values.

Parameter	Typical Return
0 - 500.5 - the rms over-voltage value	200
0 - 500.5 - the optional positive peak limit	
-500.5 - 0 - the optional negative peak limit	
Set the over-voltage protection to 200 with a peak limit of 250: <code>VOLT:PROT:UPP 200, 250</code>	

For single-phase three-wire output and three-phase output, set the limits using phase voltages.

The **\*RST** command sets this parameter to 500.5.

**[SOURce:]VOLTage:PROTection:PEAK:LOWer <value>|MINimum|MAXimum**  
**[SOURce:]VOLTage:PROTection:PEAK:LOWer? [MINimum|MAXimum]**

Sets the negative peak OVP limit in volts.

Parameter	Typical Return
-500.5 - 0 - the negative peak voltage limit	-250
Set the negative peak limit -250: <code>VOLT:PROT:PEAK:LOW -250</code>	

The **\*RST** command sets this parameter to -500.5.

**[SOURce:]VOLTage:PROTection:PEAK:UPPer <value>|MINimum|MAXimum**  
**[SOURce:]VOLTage:PROTection:PEAK:UPPer? [MINimum|MAXimum]**

Sets the positive peak OVP limit in volts.

Parameter	Typical Return
0 - 500.5 - the positive peak voltage limit	250
Set the negative peak limit 250: <code>VOLT:PROT:PEAK:UPP 250</code>	

The **\*RST** command sets this parameter to 500.5.

**[SOURce:]VOLTage:RANGe[:UPPer] <value>|MINimum|MAXimum**  
**[SOURce:]VOLTage:RANGe[:UPPer]? [MINimum|MAXimum]**

Sets the voltage range. If the voltage range is switched, the **VOLT:TRIG** and **VOLT:OFFS:TRIG** settings are cleared, and **ABORt[:ALL]** is applied.

Parameter	Typical Return
161 322 MINimum MAXimum	+2.70000E+02
Set the voltage range to 320 V: <code>VOLT:RANG MAX</code>	

You may only change the voltage range when the output is OFF.

Entering a value from 0 to 161 sets the Low range; entering a value above 161 V sets the High range.

The **\*RST** command sets this parameter to 161.

**[SOURce:]VOLTage:RESPonse SLOW|MEDIum|FAST**  
**[SOURce:]VOLTage:RESPonse?**

Sets the output response.

Parameter	Typical Return
SLOW MEDIum FAST	SLOW MED FAST
Set the output voltage response to SLOW: <code>VOLT:RESP SLOW</code>	

SLOW - specifies slower response with high stability.

MEDIum - specifies normal output response.

FAST - specifies fastest output response. This setting is invalid when units are paralleled.

This command is invalid when the output is ON.

This command is invalid when a sequence or a simulation is running.

The **\*RST** command sets this parameter to MEDIum.

## WAVE Subsystem

The WAVE subsystem programs a user-defined waveform.

**WAVE:DATA:ARbitrary <bank\_number>, <block>**

**WAVE:DATA:ARbitrary? <bank\_number>**

Sets a user-defined waveform with block data at the specified waveform bank.

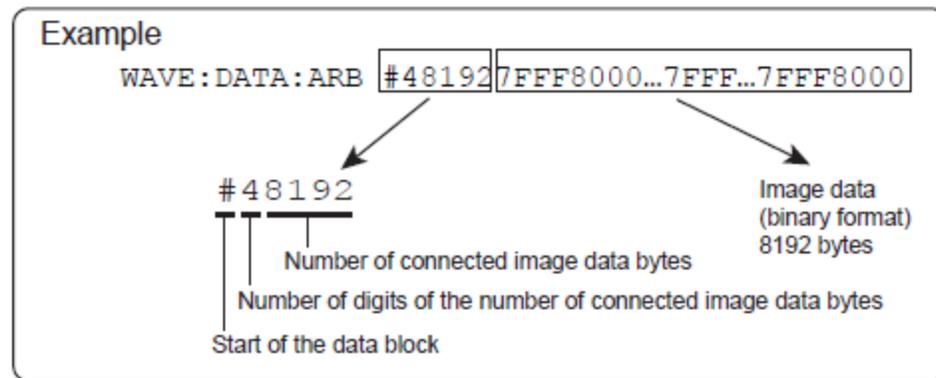
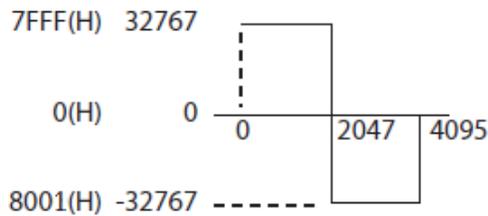
If you overwrite the content of the bank selected with FUNC:BANK, the change is immediately applied.

This command is invalid when the synchronization function is on.

Parameter	Typical Return
1 - 256 (waveform bank number)	(none)
<block> (user defined)	<block>
Sets the waveform with block data: WAVE:DATA:ARB 5,#481927FFF7FFF...7FFF...80008000	

The user-defined waveform is fixed to Big Endian with a size of 4096 words or 8192 octets.

In a 16-bit integer array, each value ranges from -32767 to +32767



**WAVE:DATA:CLIP <bank\_number>, <value>|MINimum|MAXimum**

**WAVE:DATA:CLIP? <bank\_number> [MINimum|MAXimum]**

Sets the crest factor of the peak clipped waveform that you specify by its bank number.

Parameter	Typical Return
1 - 256 (bank number)	(none)
0.10 - 1.40 (pclip value)	0.5
Sets the waveform crest value: WAVE:DATA:CLIP 5, 0.5	

This command is invalid when the synchronization function is on.

The **\*RST** command sets this parameter to 1.4.

**WAVE:DATA:IECPclip <bank\_number>, <value>|MINimum|MAXimum**  
**WAVE:DATA:IECPclip? <bank\_number> [MINimum|MAXimum]**

Sets the clip factor of the flat curve waveform that you specify by its bank number.

Parameter	Typical Return
1 - 256 (bank number)	(none)
0.4 - 1.0 (IECPclip value)	0.5
Sets the waveform clip value: WAVE:DATA:IECP 5, 0.5	

This command is invalid when the synchronization function is on.

The **\*RST** command sets this parameter to 1.0.

**WAVE:DATA:POINT <bank\_number>, <point>, <data>**  
**WAVE:DATA:POINT? <bank\_number>, <point>**

Programs the arbitrary waveform by specifying the waveform bank number and the point.

Parameter	Typical Return
1 - 256 (bank number)	(none)
0 - 4095 (point)	1023
-32767 to +32767	32767
Set point 1023 of bank number 2 to 32767: WAVE:DATA:POIN 2,1023,32767	

**WAVE:DATA:SINusoid <bank\_number>**

Resets the waveform to a sinusoid.

Parameter	Typical Return
1 - 256 (bank number)	(none)
Resets the waveform to a sinusoid: WAVE:DATA:SIN 5	

This command is invalid when the synchronization function is on.

**WAVE:DATA:TYPE? <bank\_number>**

Queries the type of waveform at the specified bank number.

Parameter	Typical Return
1 - 256 (bank number)	(none)
Resets the waveform to a sinusoid: WAVE:DATA:TYPE? 5	

Return values include:

SINusoid - sine waveform.

CLIP - peak-clipped waveform.

IECPclip - flat-curve waveform

ARBitrary - user-defined waveform

**WAVE:STATe ON|1|OFF|0**

Enables or disables the custom waveform.

Parameter	Typical Return
ON 1 OFF 0	0 (OFF) or 1 (ON)
Enables the custom waveform: WAVE:STAT ON	

This command is invalid when the synchronization function is on.

## Trigger System Overview

The AC6900 Series has four different trigger subsystems.

**TRANsient** - this subsystem is used to change the voltage and frequency settings.

**ACQuire** - this subsystem is used to measure voltage, current, and power.

**SIMulation** - this subsystem executes power line abnormality simulations.

**PROGram** - this subsystem executes sequences.

### Basic Trigger States

All trigger subsystems have three basic states: an IDLE state, an INITiated state, and a Waiting (WTG) state.

#### IDLE state

When the product is turned on, all trigger subsystems are in the IDLE state. In this state, the trigger subsystem ignores all triggers. If you send any of the following commands, the trigger subsystem is switched to the IDLE state, regardless of its current state.

ABORt

\*RST

\*RCL

IEEE488.1 selected device clear, or device clear

#### INITiated state

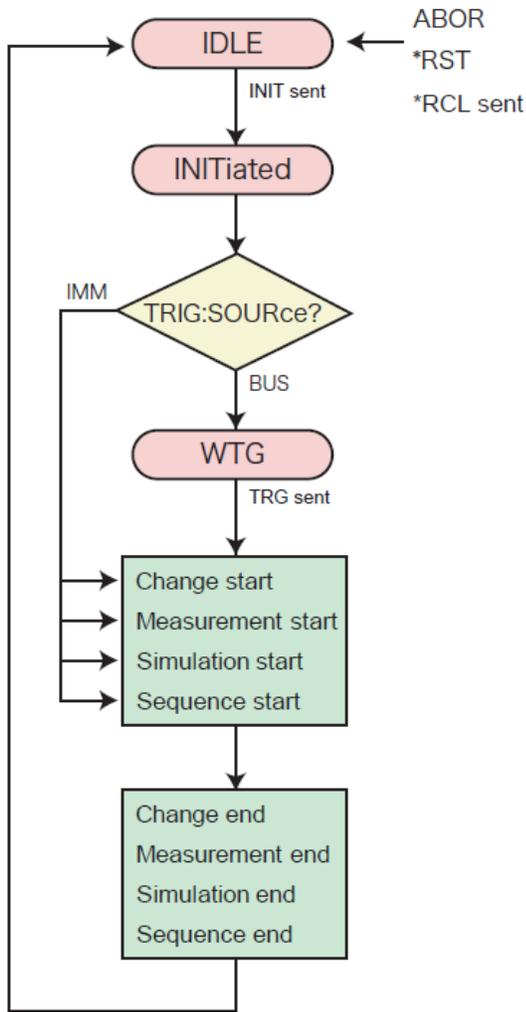
When you send the INIT command while the product is in the IDLE state, the trigger function begins operating, and the tester switches to the INITiated state. If the trigger source is set to IMMEDIATE, the settings are changed immediately, or the measurement, power line abnormality simulation, or sequence starts immediately.

If the trigger source is set to BUS, the product switches to the WTG (Waiting for Trigger) state.

#### WTG (Waiting for Trigger) state

If a trigger is received in the WTG state, the settings are changed, or the measurement, power line abnormality simulation, or sequence starts.

The following figure illustrates the basic functionality of the trigger system.



### Transient Trigger Example

You can use the TRIGger:TRANSient subsystem to synchronize the changes in the output with triggers. This is useful when you want to synchronize the changes in the output to the operation of external devices, such as DC power supplies and electronic loads.

The programmable parameters of the TRANSient group are AC voltage, DC voltage, and frequency. The current limit setting cannot be changed using triggers. Use the VOLTage:TRIGgered, VOLTage:OFFSet:TRIGgered, and FREQUENCY:TRIGgered command to reserve the trigger settings.

**VOLTage 110**

Sets the voltage to 110 V

**FREQUENCY 60**

Sets the frequency to 60 Hz

**VOLTage:TRIGgered 100**

Sets the voltage when a trigger is received to 100 V

**FREQUENCY:TRIGgered 50**

Sets the frequency when a trigger is received to 50 Hz

**TRIGger:TRANSient:SOURce BUS**

Sets the trigger source to BUS

**INITiate:TRANSient**

Starts or initiates the transient function

**TRIGger:TRANSient**

Applies a software trigger to start the output change

If you repeatedly change the output, a trigger error (-210) may occur. By using the \*OPC command, you can prevent this error. -> "Waiting for Operation Complete"

**TRIGger:TRANSient;\*OPC** Applies a trigger and waits until the output change is complete

The INITiate:TRANSient command pulls the trigger subsystem out of the IDLE state and starts (or initiates) the trigger function. When set to BUS, the trigger subsystem enters the WTG (Waiting For Trigger) state. When a software trigger is subsequently received (through the TRIGger:TRANSient command or \*TRG command), the output changes begin.

When the trigger transient source is set to IMMEDIATE instead of BUS, transient starts immediately after INITiate:TRANSient and sets the voltage and frequency to their new values.

When the operation is complete, the trigger subsystem returns to the IDLE state again. If the ABORT command or an equivalent command is received instead of a trigger, the changes are canceled, and the trigger subsystem returns to the IDLE state.

You can also use the \*TRG command or the IEEE488.1 get (Group Execute Trigger) command to apply a software trigger to all trigger subsystems. If there are other trigger subsystems in the initiated state, their trigger operations will also be executed at the same time.

## Acquire Trigger Example

With advanced measurements, you can separate and control the starting of measurement and the referencing of data.

To start a measurement immediately, set the trigger source to IMMEDIATE, and then use the INITiate command.

**TRIGger:ACQuire:SOURce IMMEDIATE** Sets the trigger source to IMMEDIATE  
**INITiate:ACQuire** Starts or initiates the acquire function

To use software triggers to start the measurement, change the trigger source to BUS.

**TRIGger:ACQuire:SOURce BUS** Sets the trigger source to BUS  
**INITiate:ACQuire** Starts or initiates the acquire function  
**TRIGger:ACQuire** Applies a software trigger to start the measurement

When the measurement finishes, you can use the FETCh query to retrieve the measured data.

**FETCh:VOLTage:ACDC?** Queries the rms voltage  
**FETCh:CURRent:ACDC?** Queries the rms current  
**FETCh:POWer:ACDC?** Queries the power  
**FETCh:POWer:ACDC:APParent?** Queries the apparent power

If you send a FETCh command before the measurement is complete, correct measurement data will not be obtained. By using the \*OPC command, you can obtain correct measurement data.

## 4 SCPI Programming

**INITiate:ACQuire;\*OPC** Initiates the acquire function and waits for completion.

The INITiate:ACQuire command pulls the trigger subsystem out of the IDLE state and starts (or initiates) the trigger function. When set to BUS, the trigger subsystem enters the WTG (Waiting For Trigger) state. When a software trigger is subsequently received (through the TRIGger:ACQuire command or \*TRG command), the measurement starts.

When the trigger acquire source is set to IMMEDIATE instead of BUS, the measurement starts immediately after INITiate:ACQuire.

When the measurement finishes, the TRIGger subsystem enters the IDLE state again. If the ABORT command or an equivalent command is received instead of a trigger, the measurement is canceled, and the TRIGger subsystem returns to the IDLE state.

The ABORT command and IEEE488.1 selected device clear, or device clear commands abort measurements that are in progress. These commands do not invalidate measured data that has already been retrieved. On the other hand, the \*RST and \*RCL common commands not only abort a measurement that is in progress but also invalidate the acquired measured data. If you send \*RST;:FETC:VOLT?, an error will occur because there is no measured data that the FETCh query can retrieve and there is no new measurement that is going to be performed.

The difference between the MEASure command and the FETCh command is as follows. The MEASure command starts a new measurement and then queries the measured data. The FETCh command queries the measured data without first starting a new measurement. The valid measurement parameters are exactly the same between MEASure and FETCh.

### Simulation Trigger Example

You can use triggers to synchronize power line abnormality simulations by using the TRIGger:SIMulation subsystem

To start a simulation immediately, set the trigger source to IMMEDIATE, and then use the INITiate command.

**TRIGger:SIMulation:SOURce IMMEDIATE** Sets the trigger source to IMMEDIATE

**INITiate:SIMulation** Starts or initiates the simulation

To use software triggers to start the simulation, change the trigger source to BUS.

**TRIGger:SIMulation:SOURce BUS** Sets the trigger source to BUS

**INITiate:SIMulation** Starts or initiates the simulation

**TRIGger:SIMulation** Applies a software trigger to start the simulation

INITiate:SIMulation pulls the TRIGger subsystem out of the IDLE state and starts (initiates) the trigger function. When set to BUS, the trigger subsystem enters the WTG (Waiting For Trigger) state. When a software trigger is subsequently received (through the TRIGger:SIMulation command or \*TRG command), the simulation starts.

When the trigger acquire source is set to IMMEDIATE instead of BUS, the simulation starts immediately after INITiate:SIMulation.

When the simulation finishes, the TRIGger subsystem enters the IDLE state again. If the ABORT command or an equivalent command is received when a simulation is being executed, the simulation is canceled, and the TRIGger subsystem returns to the IDLE state.

Send the \*RST command to reset all the parameters of the power line abnormality simulation.

You can also use the \*TRG command or the IEEE488.1 get (Group Execute Trigger) command to apply a software trigger to all trigger subsystems. If there are other trigger subsystems in the initiated state, their trigger operations will also be executed at the same time.

## Program Trigger Example

You can use triggers to synchronize sequences by using the TRIGger:PROGram subsystem.

To start a sequence immediately, set the trigger source to IMMEDIATE, and then use the INITiate command.

<b>TRIGger:PROGram:SOURce IMMEDIATE</b>	<b>Sets the trigger source to IMMEDIATE</b>
<b>INITiate:PROGram</b>	<b>Starts or initiates the sequence</b>

To use software triggers to start the sequence, change the trigger source to BUS.

<b>TRIGger:PROGram:SOURce BUS</b>	<b>Sets the trigger source to BUS</b>
<b>INITiate:PROGram</b>	<b>Starts or initiates the sequence</b>
<b>TRIGger:PROGram</b>	<b>Applies a software trigger to start the sequence</b>

INITiate:PROGram pulls the TRIGger subsystem out of the IDLE state and starts (initiates) the trigger function. When set to BUS, the trigger subsystem enters the WTG (Waiting For Trigger) state. When a software trigger is subsequently received (through the TRIGger:PROGram command or \*TRG command), the sequence starts.

When the trigger acquire source is set to IMMEDIATE instead of BUS, the sequence starts immediately after INITiate:PROGram.

When the sequence finishes, the TRIGger subsystem enters the IDLE state again. If the ABORT command or an equivalent command is received in the WTG state or when a sequence is being executed, the sequence is canceled, and the TRIGger subsystem returns to the IDLE state.

You can also use the \*TRG command or the IEEE488.1 get (Group Execute Trigger) command to apply a software trigger to all trigger subsystems. If there are other trigger subsystems in the initiated state, their trigger operations will also be executed at the same time.

When all the PROGram processes are complete, the product's settings are those of the last step. Note that if the output is on in the last step of the sequence, the output will remain on when the sequence is completed.

## Status System Overview

### Status Registers

#### Operation Status Group

#### Questionable Status Group

#### Standard Event Status Group

#### Status Byte Register

#### Error and Output Queues

### Status Diagrams

This section provides a detailed description of the individual registers and register groups. The status diagrams provide an graphical view of how the status registers and groups are interconnected.

## Status Registers

The Operation and Questionable status groups use four different types of registers to track qualify, flag, and enable instrument events. The Standard Event group only uses Event and Enable registers.

The instrument uses IEEE 488 and SCPI registers for the status reports. Each SCPI status register has the following subregisters: CONDition register, EVENT register, and ENABLe register.

The registers also include NTRansition and PTRansition filters.

Item	Description
CONDition register	A Condition register continuously monitors the instrument state and its bits are updated in real time. The bits are not latched, and reading this register does not affect the contents.
EVENT register	An Event register latches transitions that pass through the positive and negative transition registers. When an event bit is set, it remains set until the Event register is read. Reading the Event register clears it. The EVENT register bits are automatically set according to the changes in the CONDition register and is reset when read. The rule varies depending on the positive and negative transition filters (PTRansition and NTRansition).
ENABLe register	An Enable register defines which bits in the event register are reported to the Status Byte register. You can write to or read from an enable register.
Transition filter	The transition filters enable or disable the reporting of events when the condition changes from false to true (PTRansition - positive) or from true to false (NTRansition - negative). Use the PTRansition (positive transition) filter to report events when the condition changes from false to true. Use the NTRansition (negative transition) filter to report events when the condition changes from true to false.  If both filters are enabled, events will be reported each time the status changes; if both filters are cleared, event reporting is disabled.

## 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 OR-ed into the OPERation summary bit (7) of the Status Byte register. See [Status Registers](#) for a description of each register.

Bit	Value	Bit Name	Description
0-3	1 to 8	(not used)	(not used)
4	16	ACQ busy	A measurement is in progress.
5	32	ACQ wtg	The instrument is waiting for a measurement trigger.
6	64	TRAN busy	The instrument is running a sequence, a simulation, or changing settings.
7	128	TRAN wtg	The instrument is waiting for a trigger to run a sequence, a simulation, or change settings.
8	256	CV	The instrument is in constant voltage (CV) output mode.
9	512	SST	Indicates whether a soft start is being performed.
10	1024	SYNC	Indicates whether the synchronization function is in operation.
11-12	2048 to 4096	(not used)	(not used)
13	8,192	INSTRument lsummary	Summary bit of the OPERation:INSTRument subregister.
14	16,384	(not used)	(not used)
15	32,768	(not used)	0 is returned

## Questionable Status Group

These registers record signals that indicate abnormal operation. The bits in this register may indicate problems with acquired data. The group consists of a Condition, PTR/NTR, Event, and Enable register. The outputs of the Questionable Status group are logically OR-ed into the QUESTionable summary bit (3) of the Status Byte register. See [Status Registers](#) for a description of each register.

Bit	Value	Bit Name	Description
0	1	OV	Output is disabled by the overvoltage protection
1	2	OC	Output is disabled by the overcurrent protection
2	4	HWF	Output is disabled by hardware failure
3	8	LV	Low voltage detected
4	16	OT	Output is disabled by the overtemperature protection
5	32	WDOG	Watchdog protection (caused by no SCPI IO activity over specified time)
6	64	OC2	Overcurrent internal semiconductor protection activated
7	128	UNSYNC	Frequency synchronization error occurred
8	256	OP	Overpower protection activated
9	512	SD	Forced output shutdown

## 4 SCPI Programming

Bit	Value	Bit Name	Description
10	1024	CL-PEAK	Current Limit on PEAK (overload state)
11	2048	PL	Power limit (overload state)
12	4096	CL-RMS	Current Limit on RMS (overload state)
13	8192	INSTrument Summary	Summary bit of the QUEStionable:INSTrument subregister
14	16,384	(not used)	(not used)
15	32,768	(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. See [Status Registers](#) for a description of each register.

The event status register bits are set when certain events occur during instrument operation.

The register is controlled by the IEEE 488 commands \*ESE, \*ESE?, and \*ESR?.

Bit	Value	Bit Name	Description
0	1	Operation Complete (OPC)	All commands before and including *OPC have completed.
1	2	(not used)	0 is returned
2	4	Query Error (QYE)	The instrument tried to read an empty output buffer, a command was received before a previous query was read, or the input and output buffers are full.
3	8	Device Dependent Error (DDE)	A device-specific error occurred. <a href="#">Error Messages</a>
4	16	Execution Error (EXE)	An execution error occurred. <a href="#">Error Messages</a> . A valid SCPI command may not be executed correctly depending on the instrument's conditions.
5	32	Command Error (CME)	A command syntax error occurred. <a href="#">Error Messages</a>
6	64	Reserved	0 is returned
7	128	Power ON (PON)	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 and stores STB and RQS messages as defined by the IEEE 488 standard. The \*STB? query reads the status byte register and transmits the contents of the status byte register and the master status summary (MSS) message. The \*STB? query does not change the status byte, MSS, or RQS.

Bit	Value	Bit Name	Description
0, 1		Reserved	0 is returned
2	4	Error/Event Queue (EEQ)	One or more errors are in the error queue. Use SYSTem:ERRor? to read and delete errors.
3	8	Questionable Status Summary (QUES)	One or more bits are set in the Questionable Data Register and the corresponding QUESTionable status enable register bit is true. See STATus:QUESTionable:ENABLE.
4	16	Message Available (MAV)	Data is available in the instrument's output buffer.
5	32	Event Status Summary (ESB)	One or more bits are set in the Standard Event Status Register. Bits must be enabled, see <b>*ESE</b> .
6	64	Request Service (RQS/MSS)	One or more bits are set in the Status Byte Register and may generate a Request for Service or the Master Summary Status has one or more event bits. Bits must be enabled, see <b>*SRE</b> .
7	128	Operation Status Summary (OPER)	An event in the Operation Status register has been generated. Bits must be enabled, see <b>STATus:OPERation:ENABLE</b> .

## Master Status Summary and Request for Service 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 when 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 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. Other Status Byte register bits 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.

### OPERation:INSTrument Subregister Group

This is the subregister (16 bits) of bit 13 of the OPERation status register.

Bit	Value	Bit Name	Description
0	1	Instrument 1	Phase 1 (OPER:INST:ISUM1) summary bit
1	2	Instrument 2	Phase 2 (OPER:INST:ISUM2) summary bit
2	4	Instrument 3	Phase 3 (OPER:INST:ISUM3) summary bit
3 - 15	8 to 32,768	(not used)	(not used)

### OPERation:INSTrument:ISUMmary[1|2|3] Subregister Group

This is the subregister of bits 1 to 3 of the OPERation:INSTrument subregister. This is a 16-bit register that contains information about the normal operating conditions of the product for each phase.

Of the parameters {1|2|3}, 1 represents Phase 1, 2 represents Phase 2, and 3 represents Phase 3.

Bit	Value	Bit Name	Description
0-3	1 to 8	(not used)	(not used)
4	16	ACQ busy	A measurement is in progress.
5	32	ACQ wtg	The instrument is waiting for a measurement trigger.
6	64	TRAN busy	The instrument is running a sequence, a simulation, or changing settings.
7	128	TRAN wtg	The instrument is waiting for a trigger to run a sequence, a simulation, or change settings.
8	256	CV	The instrument is in constant voltage (CV) output mode.
9	512	SST	Indicates whether a soft start is being performed.
10	1024	SYNC	Indicates whether the synchronization function is in operation.
11-14	2048 to 16,384	(not used)	(not used)
15	32,768	(not used)	0 is returned

### QUEStionable:INSTrument Subregister

This is the subregister (16 bits) of bit 13 of the QUEStionable status register.

Bit	Value	Bit Name	Description
0	1	Instrument 1	Phase 1 (QUES:INST:ISUM1) summary bit
1	2	Instrument 2	Phase 2 (QUES:INST:ISUM2) summary bit
2	4	Instrument 3	Phase 3 (QUES:INST:ISUM3) summary bit
3 - 15	8 to 32,768	(not used)	(not used)

### QUESTionable:INSTrument:ISUMmary[1|2|3] Subregister Group

This is the subregister of bits 1 to 3 of the QUESTionable:INSTrument subregister. This is a 16-bit register that contains information about the product's questionable events and status that occur during operation for each phase.

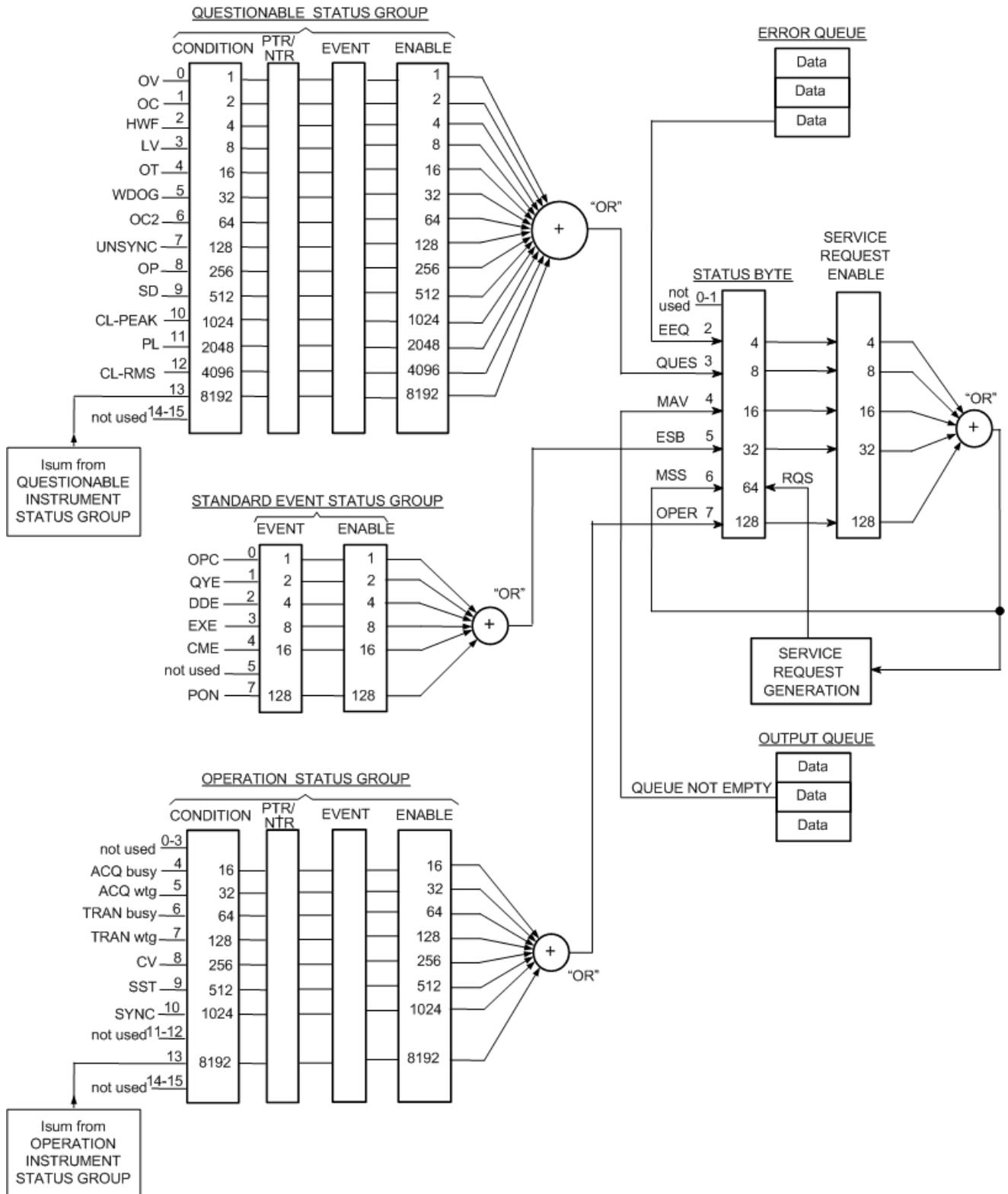
Of the parameters {1|2|3}, 1 represents Phase 1, 2 represents Phase 2, and 3 represents Phase 3.

The QUESTionable status register bits may indicate that there are problems with the product's measured data.

Bit	Value	Bit Name	Description
0	1	OV	Output is disabled by the overvoltage protection
1	2	OC	Output is disabled by the overcurrent protection
2	4	HWF	Output is disabled by hardware failure
3	8	LV	Low voltage detected
4	16	OT	Output is disabled by the overtemperature protection
5	32	WDOG	Watchdog protection (caused by no SCPI IO activity over specified time)
6	64	OC2	Overcurrent internal semiconductor protection activated
7	128	UNSYNC	Frequency synchronization error occurred
8	256	OP	Overpower protection activated
9	512	SD	Forced output shutdown
10	1024	CL-PEAK	Current Limit on PEAK (overload state)
11	2048	PL	Power limit (overload state)
12	4096	CL-RMS	Current Limit on RMS (overload state)
13 - 14	8192 to 16,384	(not used)	(not used)
15	32,768	(not used)	0 is returned

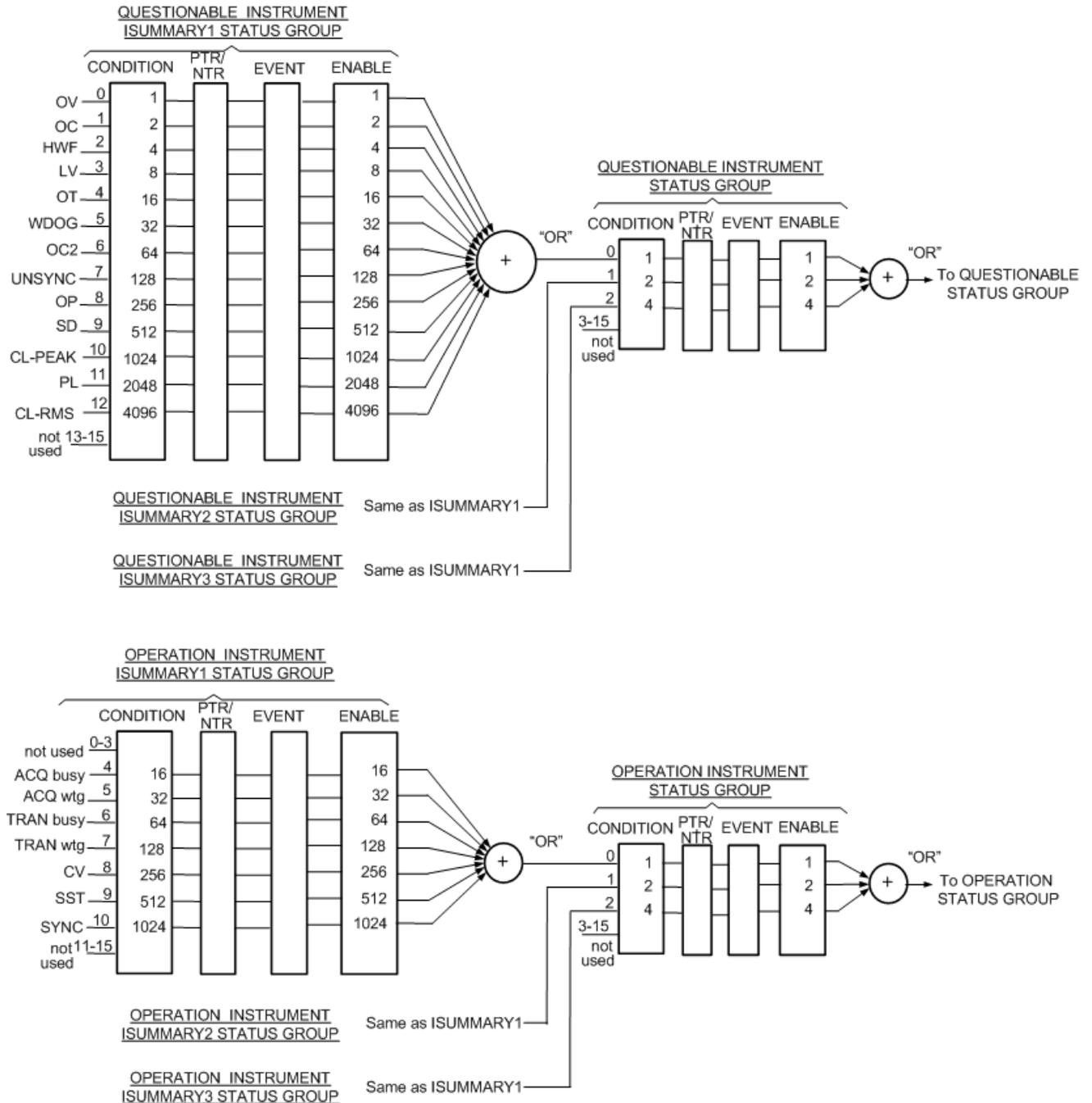
## Status Diagrams

### Status for Single-Phase output



### Status for Three-Phase output and Single-phase three-wire output

Note that single-phase three-wire only returns results form the Isummary1 and Isummary2 groups.



## Default Settings

### Front panel default settings

### Waveform bank settings

### Simulation settings

### Sequence settings

### SCPI \*RST settings

### Front panel default settings

Note that as the instrument is used, specific front panel settings can be saved in setup memory or on an external USB device for recall at a later time.

Front panel setting		AC6903	AC6906	AC6912	AC6918
Frequency				50 Hz	
Voltages, AC and DC				0.0 V	
Output when the POWER switch is turned on				Safe	
Output voltage range)				Low	
Upper AC voltage limit				322.0 V	
Lower AC voltage limit				0.0 V	
Upper DC voltage limit				455.0 V	
Lower DC voltage limit				-455.0 V	
Upper frequency limit		5000 Hz (550 Hz on the 550 Hz limit model)			
Lower frequency limit		1.00 Hz			
AC current limit	1P output	33.0 A	66.0 A	132.0 A	198.0 A
	1P 3W output, 3P output	11.0 A	22.0 A	44.0 A	66.0 A
Positive current peak limit	1P output	126.0 A	252.0 A	504.0 A	756.0 A
	1P 3W output, 3P output	42.0 A	84.0 A	168.0 A	252.0 A
Negative current peak limit	1P output	-126.0 A	-252.0 A	-504.0 A	-756.0 A
	1P 3W output, 3P output	-42.0 A	-84.0 A	-168.0 A	-252.0 A
Current limit operation		Trip			
Current limit trip time		10 s			
Output overvoltage protection (OVP)		489.5 V			
Positive peak OVP		489.5 V			

Front panel setting		AC6903	AC6906	AC6912	AC6918
Negative peak OVP				-489.5 V	
Output undervoltage protection (UVP)				0.0 V	
Sync function		Off, 0.0 deg, synchronizes to the input power supply			
Output-on phase		Phase control disabled, 0.0 deg			
Output-off phase		Phase control disabled, 0.0 deg			
1-2 phase difference		120.00°			
1-3 phase difference		240.00°			
Waveform bank # to execute		0 (sine wave)			
Waveform bank # to edit		1			
Soft start		Off, 0.1 s			
Soft stop		Off, 0.1 s			
Compensation		Off, regulation adjustment correction value: 0			
Output impedance		Off, 0 m $\Omega$ , 0 $\mu$ H			
Panel display	Phase	All (Phase voltage display)			
	Voltage	Rms voltage			
	Current, power, power factor	Rms current			
Peak voltage hold time		0 s			
Peak current hold time		0 s			
Measurement average	Voltage	1			
	Current, power, power factor	1			
Sleep function		OFF, 60 min			
AC coupling		Disabled			
Harmonic analysis		Current, all harmonics			
Maximum expected power		3000 VA	6000 VA	12000 VA	18000 VA
Preset memory recall		Confirm and recall			
Preset memory (all memories 1 and 2)	AC voltage	0.0 V			
	DC voltage	0.0 V			
	Frequency	50.00 Hz			
	Waveform bank #	0			

## Waveform bank settings

These settings are saved only to an external USB device

Waveform bank parameter	Factory Default
Waveform type	Sine
User-defined waveform (set only from remote control)	Sine
Crest factor	1.40
Clip factor	1.0

## Simulation settings

These settings are saved only to an external USB device

Simulation parameter	Factory Default
T1 setting unit	Phase
Voltage regulation polarity	Positive
T5 setting unit	Time
Regulated voltage T3	0
Repetition count	9999 (infinity)
T1 time	0.1 s
T1 angle	0 deg
T2 time	0 s
T3 time	0.1 s
T4 time	0 s
T5 time	0.1 s
T5 return cycles	0

## Sequence settings

These settings are saved only to an external USB device

Sequence parameter	Factory Default
Starting step number	1
Ending step number	600
Repetition count	1
Sequence parameter (for all steps)	
Frequency	50.00 Hz, ramp off
Voltages, AC and DC	0.0 V, ramp off
Jump type	Next step

Sequence parameter (for all steps)	
Jump destination step	0
Number of jump repetitions	1
Output impedance	Off, 0 m $\Omega$ , 0 $\mu$ H
Execution time	10 ms
Waveform bank number	0
Output	On
Status output	On
Trigger output	Off
Trigger input	Off
Start phase	Free, 0.0 deg
End phase	Free, 0.0 deg
Sudden phase change	Off
Phase 1 offset	Off, 0.00 deg, ramp off
Phase 1-2 difference	Off, 120.00 deg, ramp off
Phase 1-3 difference	Off, 240.00 deg, ramp off

### SCPI \*RST settings

These are set by an \*RST (reset) command or at power-on.

Command	*RST
DISPlay[:WINDow][:STATe]	ON
DISPlay[:WINDow]:METer:COUPling	ACDC
DISPlay[:WINDow]:METer:COUPling:CURRent	ACDC
DISPlay[:WINDow]:METer:COUPling:VOLTagE	ACDC
DISPlay[:WINDow]:PHASe	P123
DISPlay[:WINDow]:VIEW	METER_ALL
INSTrument[:SElect]	OUTPut0
INSTrument:NSElect	0
OUTPut[:STATe]	OFF
OUTPut:COUPling	AC
OUTPut:IMPedance[:STATe]	OFF
OUTPut:IMPedance:REACtive	0
OUTPut:IMPedance:REAL	0
OUTPut:PHASe:OFF[:STATe]	OFF
OUTPut:PHASe:OFF:LEVel	0
OUTPut:PHASe:ON[:STATe]	OFF
OUTPut:PHASe:ON:LEVel	0

## 4 SCPI Programming

Command	*RST
OUTPut:PHASe:P1Offset	0
OUTPut:PHASe:P12	120 in 3P; 180 in 1P3W
OUTPut:PHASe:P13	240
OUTPut:PON:SAFE	ON
OUTPut:PROTection:WDOG[:STATe]	OFF
OUTPut:PROTection:WDOG:DELay	60
OUTPut:SStart[:STATe][:RISE]	OFF
OUTPut:SStart[:STATe]:FALL	OFF
OUTPut:SStart:TIME[:RISE]	0.1
OUTPut:SStart:TIME:FALL	0,1
OUTPut:SSUPpression:STATe	OFF
SENSe:AVERage	1
SENSe:CURRent:AVERage	1
SENSe:CURRent[:PEAK]:HOLD:TIME	1
SENSe:VOLTag:e:AVERage	1
SENSe:VOLTag:e[:PEAK]:HOLD:TIME	1
[SOURce:]CURRent[:LEVel][:IMMediate][:AMPLitude]	MAX
[SOURce:]CURRent:PEAK:LOWer	MAX
[SOURce:]CURRent:PEAK:UPPer	MAX
[SOURce:]CURRent:PROTection:STATe	ON
[SOURce:]CURRent:PROTection:TRIP:DELay	10
[SOURce:]FREQuency[:CW]	50
[SOURce:]FREQuency[:IMMediate]	
[SOURce:]FREQuency:LIMit:LOWer	MIN
[SOURce:]FREQuency:LIMit:UPPer	MAX
[SOURce:]FREQuency:TRIGgered	50
[SOURce:]FREQuency:SYNCronous[:STATe]	OFF
[SOURce:]FREQuency:SYNCronous:MODE	LINE
[SOURce:]FREQuency:SYNCronous:PHASe:DELay	0
[SOURce:]FUNCTion[:SHAPE]:BANK[:INDex]	0
[SOURce:]VOLTag:e[:LEVel][:IMMediate][:AMPLitude]	0
[SOURce:]VOLTag:e[:LEVel]:TRIGgered[:AMPLitude]	0
[SOURce:]VOLTag:e[:LEVel]:LIMit:LOWer	0
[SOURce:]VOLTag:e[:LEVel]:LIMit:UPPer	322
[SOURce:]VOLTag:e:COMPensate:MODE	DIS
[SOURce:]VOLTag:e:COMPensate:SOFT:CONTRol[:STATus]	AC
[SOURce:]VOLTag:e:COMPensate:SOFT:TERMinal	SENSe

Command	*RST
[SOURce:]VOLTage:LTLIne	0
[SOURce:]VOLTage:OFFSet[:IMMediate]	0
[SOURce:]VOLTage:OFFSet:LIMit:LOWer?	-452
[SOURce:]VOLTage:OFFSet:LIMit:UPPer?	452
[SOURce:]VOLTage:OFFSet:TRIGgered	0
[SOURce:]VOLTage:OFFSet:LTLIne	0
[SOURce:]VOLTage:PROGramming:EXTernal:EXTDC:ADJust:GAIN	100 (all channels)
[SOURce:]VOLTage:PROGramming:EXTernal:EXTDC:ADJust:OFFSet	0 (all channels)
[SOURce:]VOLTage:PROGramming:EXTernal:EXTDC:APERture	0.1
[SOURce:]VOLTage:PROGramming:EXTernal:EXTDC:SIGNal:POLarity	NORMAL
[SOURce:]VOLTage:PROGramming:EXTernal:EXTDC:SIGNal:SOURce	EXTernal
[SOURce:]VOLTage:PROGramming:EXTernal:MODE	OFF
[SOURce:]VOLTage:PROGramming:EXTernal:VPRogram:ADJust:GAIN	10
[SOURce:]VOLTage:PROGramming:EXTernal:VPRogram:ADJust:OFFSet	0
[SOURce:]VOLTage:PROGramming:EXTernal:VPRogram:MAP	ALL
[SOURce:]VOLTage:PROGramming:EXTernal:VPRogram:STATe	OFF
[SOURce:]VOLTage:PROGramming:SOURce	INTernal
[SOURce:]VOLTage:PROTection:LOWer	0
[SOURce:]VOLTage:PROTection:LOWer:STATe	OFF
[SOURce:]VOLTage:PROTection:UPPer	500.5
[SOURce:]VOLTage:PROTection:PEAK:LOWer	-500.5
[SOURce:]VOLTage:PROTection:PEAK:UPPer	500.5
[SOURce:]VOLTage:RANGe[:UPPer]	160
[SOURce:]VOLTage:RESPonse	MEDium
SYSTem:CONFigure:ADJust:VOLTage:FINE	0
SYSTem:CONFigure:ADJust:VOLTage:TERMinal:MODE	OTERM
SYSTem:CONFigure:FORMation:PSAVer:MAXimum	MAX
SYSTem:CONFigure:FORMation:PSAVer:MODulesE[D {,E D} . . .	Enabled
TRIGger:ACQuire:SOURce	IMMediate
TRIGger:PROGram:SOURce	IMMediate
TRIGger:SIMulation:SOURce	IMMediate
TRIGger:TRANSient:SOURce	IMMediate

## Measurement Details

This section summarizes the mathematical processing used to extract desired measurement values from arrays of digitized voltage and current data. I

Required mathematical processing is similar for voltage and current. All raw measurements, i.e. individual A/D conversions and associated array elements, are understood to be DC coupled.

Additional measurement considerations must include the effects of windowing (normally used to ensure stable readings), and any adjustments that must be made to correct for window gain (always less than unity when compared to a rectangular window).

General definitions are as follows:

Array Length: N

Array Index Variable: n = 0 ... N-1

Voltage Array: Volt[N]

Current Array Current[N]

Measurement	Equations
AC voltage	$V_{AC} = \sqrt{(V_{RMS})^2 - (V_{DC})^2}$
DC voltage	$V_{DC} = \frac{1}{N} \left[ \sum_{n=0}^{N-1} [Volt_n] \right]$
RMS voltage	$V_{RMS} = \sqrt{\frac{1}{N} \left[ \sum_{n=0}^{N-1} [Volt_n]^2 \right]}$
AC apparent power	$VA_{AC} = V_{AC} \cdot I_{AC}$
AC+DC apparent power	$VA_{AC+DC} = V_{RMS} \cdot I_{RMS}$
AC reactive power	$VAR_{AC} = \sqrt{(VA_{AC})^2 - (Watts_{AC})^2}$
AC+DC reactive power	$VAR_{AC+DC} = \sqrt{(VA_{AC+DC})^2 - (Watts_{AC+DC})^2}$
AC current	$I_{AC} = \sqrt{(I_{RMS})^2 - (I_{DC})^2}$

Measurement	Equations
DC current	$I_{DC} = \frac{1}{N} \left[ \sum_{n=0}^{N-1} [Current_n] \right]$
RMS current	$I_{RMS} = \sqrt{\frac{1}{N} \left[ \sum_{n=0}^{N-1} [Current_n]^2 \right]}$
Maximum current amplitude	$I_{MAX} = \text{Max}(Current_n) \text{ for } n \in [0, N - 1]$
AC Power factor	$PF_{AC} = \frac{Watts_{AC}}{VA_{AC}}$
AC+DC Power factor	$PF_{AC+DC} = \frac{Watts_{AC+DC}}{VA_{AC+DC}}$
AC active power (Watts)	$Watts_{AC} = Watts_{AC+DC} - Watts_{DC}$
DC average power (Watts)	$Watts_{DC} = V_{DC} \cdot I_{DC}$
AC+DC Watts	$Watts_{AC+DC} = \frac{1}{N} \sum_{n=0}^{N-1} Volt_n \cdot Current_n$
Current crest factor	$CF = \frac{I_{MAX}}{I_{RMS}}$

# Error and Limit Checking

## Basic Principles

### Range Error Checking

### Soft Limits Checking

### Settings Error Checking

### Output Coupling Error Checking

### Coupled Parameter Error Checking

## Basic Principles

The AC6900 Series instruments include error checking measurements and soft limits that prevent unintended operations from being carried.

Settings are not automatically changed by either front-panel or SCPI commands, unless the changes are obvious and expected.

Improper settings or combination of settings are not allowed for active settings.

User actions which would result in improper active settings generate error messages.

Inactive settings are not checked for errors in response to range changes. If these settings will become active due to output mode changes, such as switching coupling from AC to DC, or due to the enabling of soft limits, error checks are performed before making the settings active.

Error checks should be performed in response to the following events:

- Changing Settings invokes Settings Error Checking
- Enabling soft limits invokes Settings Error Checking
- Changing ranges from high to low invokes Range Error Checking
- Changing output coupling invokes Output Coupling Error Checking
- Changing to Step mode invokes Settings Error Check

## Range Error Checking

The instrument uses the following method to check for range errors.

1. Active settings are limited by MINimum and MAXimum values. The active settings considered are only those relevant to the output coupling. In AC+DC coupling, both DC and AC voltage settings are active, so range checking is applied to the peak absolute value of the combined waveforms.

2. In addition to the immediate DC and AC voltage, in Step mode the triggered voltage setting (VOLT:OFFS:TRIG or VOLT:TRIG, depending on the output coupling) is also checked to ensure that an accepted trigger does not cause an invalid state.
3. Frequency settings are independent of range, output on/off status, and output coupling.
4. Output coupling and output range may only be changed when the output is off. Therefore, the instrument always checks for inconsistent settings when you try to change the output coupling or range before turning the output on.
5. If output coupling settings are changed, the Range Error Checking and Soft Limits Checking are both made for any parameter that becomes active as a result of the output coupling change.
6. Settings that are valid on the low output range are always valid on the high output range, but the Range Error Checking and Soft Limits Checking are both performed whenever the instrument is asked to change ranges in either direction.

### Soft Limits Checking

1. The soft limits are checked only if soft limits are enabled at the time the soft limits are set or at the time when the soft limits are enabled.
2. Soft limits can be configured for DC voltage, AC voltage, and Frequency. The soft limit check is independently performed for the AC and DC components in AC+DC coupling.
3. Soft limits also apply to the corresponding trigger values of DC voltage, AC voltage, and Frequency but only in Step mode.

### Settings Error Checking

These settings verify that the voltage setting is correct.

In AC and DC output modes, the setting must be between the range's MIN and MAX values.

In AC+DC mode, an additional check verifies that the peak voltage does not exceed 227.5 V (low range) or 455 V (high range).

If soft limits are enabled, the instrument checks that the setting is within the low and high soft limits.

Settings errors are checked when the user changes the mode setting to Step mode.

### Output Coupling Error Checking

Changing output coupling from AC+DC requires no error check. Otherwise, changing to DC coupling runs the Volts DC settings error check, and changing to AC or AC+DC runs the Volts AC settings error check.

## Coupled Parameter Error Checking

Inactive parameters generally are not checked for being within range or compliant with soft limits even if soft limits are active for the parameter type. This minimizes nuisance error messages when setting values for inactive parameters. Instead, checks are performed when the parameter is made active.

However, parameter entries are always checked for being within the MIN and MAX values even if the parameter is inactive. For example, VOLT:TRIG must be from 0 to 320, even if VOLT:MODE is FIXed.

If coupled parameter settings change, the instrument check on each active parameter setting.

For AC+DC mode, the peak value of the waveform cannot be outside the -455 V to 455 V range for H range and -227.5 V to 227.5 V range for L range.

For AC mode, the voltage setting must be from 0 to the full scale value of the range, and for DC mode, the value must be between the positive and negative full scale value of the range.

Checks are performed in the following order:

1. The Coupled Parameters Error Checking is performed first.
2. Depending on the pending front-panel entry or remote command and the instrument's operating status, the Coupled Parameters Error Checking may lead to the other error checks.
3. In some cases, multiple passes through the Settings Error Check are required. For example, if OUTPUT:COUPLing is changing from AC to ACDC and VOLT:OFFSet:MODE is STEP, then both the IMMEDIATE and TRIGgered values for DC volts are checked for being within range and for meeting the peak voltage constraint for the currently selected range. These checks occur before the OUTPUT:COUPLing change is accepted.

# 5

## Maintenance

**Servicing the Instrument**

**Cleaning the Instrument**

**Removing and Installing an SD Card**

**Error Messages**

**Hardware Error Codes**

## Servicing the Instrument

### 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. You may also purchase a service contract that extends coverage after the standard warranty.

To obtain service for your instrument, contact your nearest Keysight Service Center. Refer to [www.keysight.com/find/assist](http://www.keysight.com/find/assist). 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.

### Calibration

The instrument was calibrated before shipment. To maintain long-term performance, Keysight recommends periodic calibration. To have your instrument calibrated, contact your nearest Keysight Service Center.

### Self-test Verification

The instrument performs an automatic self-test at power-on. This test verifies the basic functionality of the instrument's logic and power mesh subsystems without placing any voltages on the output.

The \*TST? query returns the result of that test, but it does not run another self-test. If self-test fails, turn the instrument off, remove all connections (front and rear), and turn the instrument back on. The purpose of this is to eliminate signals present on external wiring that can act as antennae.

See [SCPI Error Messages](#) for a list of error messages.

### Before Returning the Unit

If the unit is inoperative, verify that the AC power is securely connected to the instrument, the mains outlet is live, and the power switch is on. Before returning the unit, cycle power on the unit to run the self-test as described above. Press **[Error]** to view errors in the error queue. Then report those errors to Keysight Support and be sure that the instrument was calibrated within the last year.

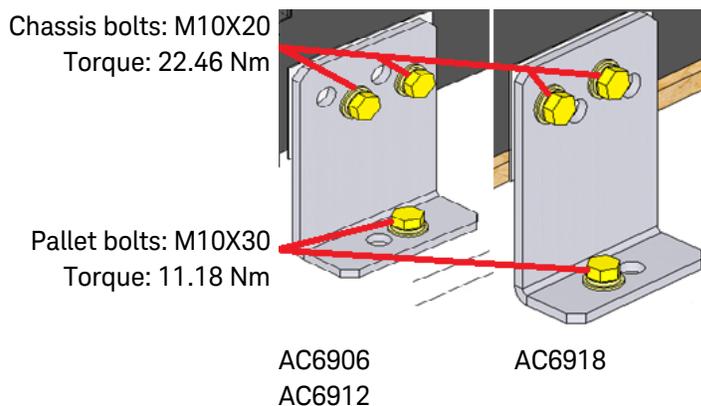
### Repackaging for Shipment

To ship the unit to Keysight for service or repair:

Attach a tag to the unit identifying the owner, model number, serial number, and required service.

Place the unit in its original container with appropriate packaging material. Secure the container with strong tape or metal bands.

**CAUTION** When returning the instrument in its original container, remember to install the angle brackets that secured the instrument to its shipping pallet. Otherwise the instrument will not be secure in the shipping container and may be damaged.



If the original shipping container is unavailable, order one of the following shipping kits to return your instrument. Using these shipping kits will help ensure that the instrument be returned without shipping damage.

Packaging Kit	Part Number	Description
AC6903H/L	AC6903-80021	Packaging Kit for AC6903H/L
AC6906H/L	AC6906-80021	Packaging Kit for AC6906H/L
AC6912H/L	AC6912-80021	Packaging Kit for AC6912H/L
AC6918H/L	AC6918-80021	Packaging Kit for AC6918H/L

Keysight recommends that you always insure shipments.

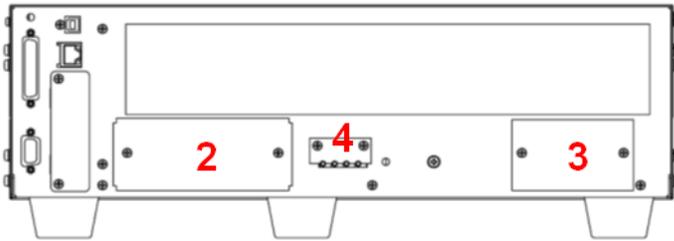
## User-Replaceable Parts

Reference Number	Description	AC6903H/L	AC6906H/L AC6912H/L	AC6918H/L
	Front panel louver (qty 1)	AC6903-40004	AC6900-40002	
	Dust filter (qty 1)	AC6903-40005	AC6900-80004	
	Rotary knob (qty 1)	W1312-40180	W1312-40180	
1	Rear metal cover kit w/screws	N/A	AC6900-50001	AC6918-50001
2	Output terminal block cover w/screws	AC6903-40001	AC6900-40004	AC6918-40002
3	AC input terminal block cover w/screws	AC6903-40003	AC6900-40003	AC6918-40001
4	Sensing terminal block cover w/screws	AC6903-40002	AC6900-40005	N/A
5	Output under terminal cover w/screws	N/A	N/A	AC6918-40006
6	Input under terminal cover w/screws (for 200 VAC)	N/A	N/A	AC6918-40004
7	Input under terminal cover w/screws (for 400 VAC)	N/A	N/A	AC6918-40005
8	Output terminal cover for Neutral w/screws	N/A	N/A	AC6918-40003

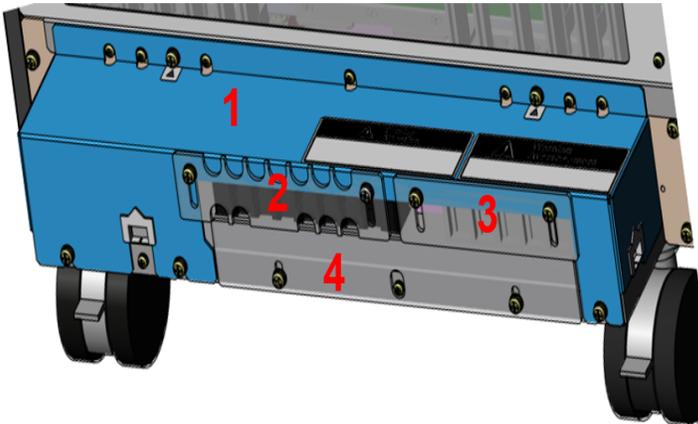
## 5 Maintenance

Reference Number	Description	AC6903H/L	AC6906H/L AC6912H/L	AC6918H/L
	D-Subminiature 25-pin plug (qty 1)	AC6900-30001	AC6900-30001	
	Cap bolt plug (qty 8)	N/A	AC6900-40001	
	Cable tie binder (qty 4)	N/A	AC6900-80001	
	Foot stand (qty 1)	AC6903-40006	N/A	

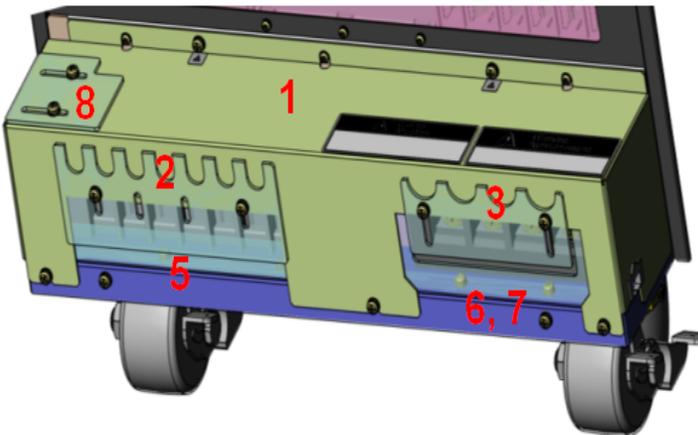
**AC6903H/L**



**AC6906H/L and AC6912H/L**



**AC6918H/L**



## Cleaning the Instrument

**WARNING** **SHOCK HAZARD** Always turn off the circuit breaker at the switchboard before cleaning.

---

### Cleaning the Outside

Clean the outside of the instrument with a soft, lint-free cloth, slightly damp with water. Do not use detergent. Do not disassemble the instrument. Do not clean the rear panel to avoid getting moisture near the connections. Ensure that the instrument is completely dry before turning it on.

### Cleaning the Filter

The following procedure illustrates the removal of one front panel louver.

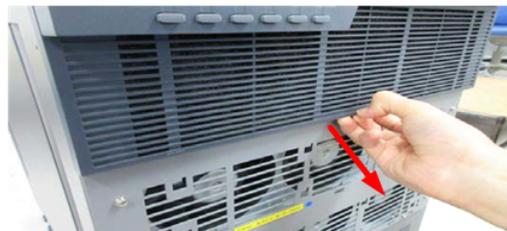
#### Remove the louver

1. For units with multiple louvers, start by removing the lowest louver and work your way up.



2. Start by pinching the center projection part of the louver and pulling the louver forward.

This removes the lock pin from the hole located in the center of the louver.



3. Next, pinch the left and right projection parts of the louver and pull the louver forward.

This removes the lock pins from the holes located at the left and right sides of the unit.



4. Slide the louver downward, and remove the louver.

This removes the hooks from the back of the louver.

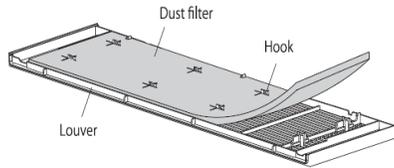


## 5 Maintenance

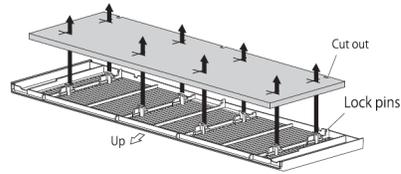
### Clean the filter

1. Remove the filter from the louver.
2. Vacuum the dust and particles that are attached to the filter. If the filter is extremely dirty, clean it using water-diluted neutral detergent. Ensure that the filter is completely dry before installing it.

#### Remove



#### Install



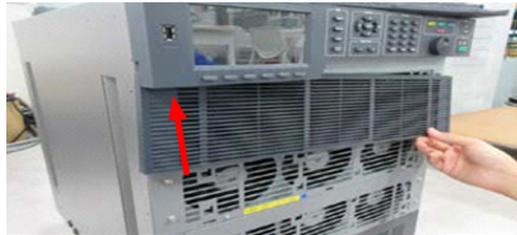
3. When installing, note that the side that has sections cut out is the bottom side. Firmly attach the dust filter so that the louver's tabs protrude from the top of the dust filter.

### Install the louver

When installing multiple louvers, start by installing the top louver and work your way down.

1. Start by placing the louver under the display and sliding it up.

Place the hook on the back of the louver into the hole on the unit.



2. Slide the right side of the louver up under the front panel.

Place the hooks on the top of the louver into the holes on the unit.

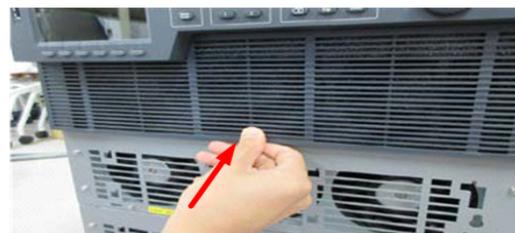


3. Press the lock pins on both sides of louver into the holes on the power unit.



4. Press the lock pin in the center of the louver into the center hole on the unit.

Ensure that all hooks have also been inserted into their corresponding holes.



5. Check that the louver is flush on the unit. There should be no gaps or bulges on the louvers.

## Removing and Installing an SD Card

AC6900-series units with Option MEM write sensitive user-data to a micro-SD card. This is in contrast to standard units, which write user-data to internal NAND flash memory. Having an SD card accessible on the side or top of the instrument allows for easy removal and sanitization.

The following information applies to units with Option MEM installed:

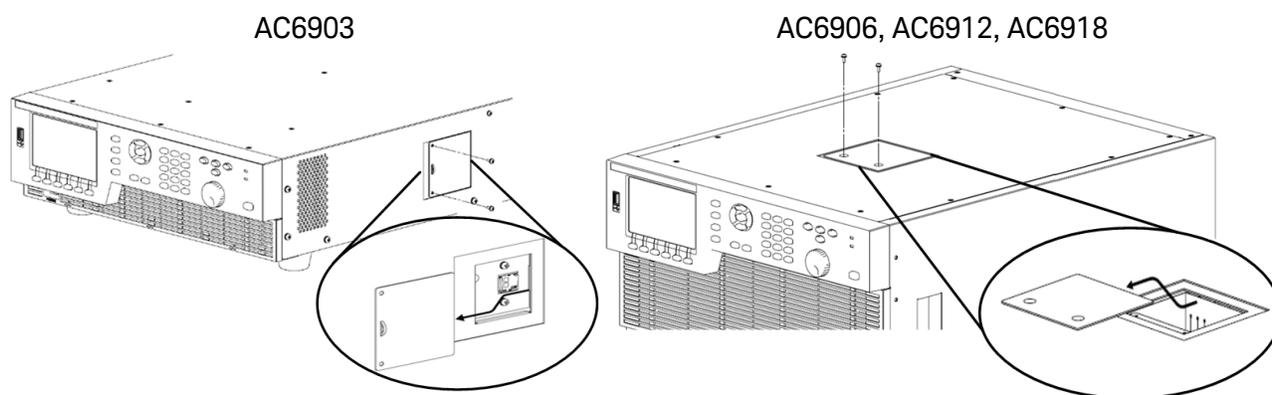
- Option MEM units require the use of Keysight micro-SD cards, part number AC6900-85000. Other SD cards cannot be used.
- There is no difference in functionality of Option MEM units and standard units.
- Instruments with Option MEM will not turn on if the original SD card is not installed in the unit.
- When an SD card is re-installed in the unit, the unit will turn on according to the start-up information last saved on the SD card.
- You cannot move or save the data on the SD card to any other memory device.
- Instrument firmware can be updated using the front-panel USB port or through the communication interface. However, the firmware for a standard unit cannot be installed on an Option MEM unit, neither can firmware for an Option MEM unit be installed on a standard unit.

### CAUTION

Always turn the power switch off before removing or installing the SD card.

## Procedure

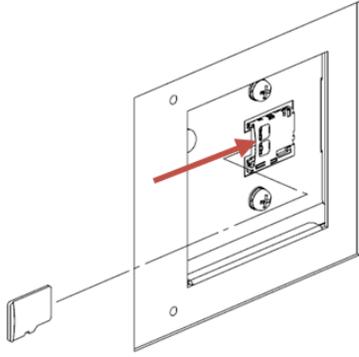
1. Remove the two cover screws along with the cover to access the SD card.



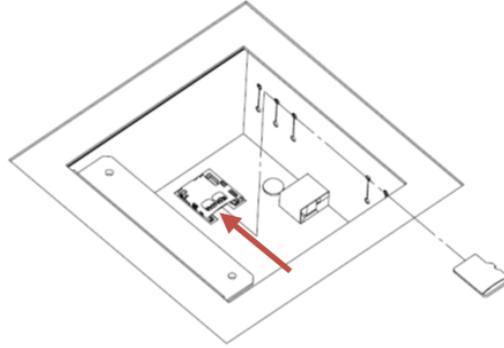
2. Remove the SD card by gently pushing on the card edge until the card is released from its housing (shown below). Then remove the card.
3. Install the SD card by first orienting it as shown in the illustration. Then gently push the card into its housing until it clicks into place.

5 Maintenance

AC6903



AC6906, AC6912, AC6918



4. Replace the cover.

## Error Messages

### Command Errors

### Execution Errors

### Product Specific Errors

### Query Errors

### Operation Complete Errors

### Product Dependent - configuration change

### Product Dependent - configuration conflict

### Product Dependent - invalid operations

### Security errors

### Self-test errors

### Internal errors

## Introduction

The error messages below are in the following format, with a numeric error code and a quoted error string separated by a comma:

```
-222,"Data out of range"
```

The error/event queue is empty and returns 0,"No error" when the \*CLS common command is sent, the last item in the error queue is read, or the instrument cycles power.

Error Code Range	Category	Description
-100 to -199	Command errors	An IEEE 488 syntax error has been detected by the instrument's parser.
-200 to -299	Execution errors	An error has been detected by the instrument's execution control block.
-300 to -399	Device-specific errors	A device-specific error has been detected, possibly related to a hardware failure.
-400 to -499	Query errors	The instrument's output queue control has detected a problem with the message exchange protocol.
-800 to -899	Operation errors	Errors related to instrument operation such as when the product wants to report an IEEE 488.2 operation complete event.
100 to 399	Product dependent errors	Errors in this class causes the Device Dependent Error bit (bit 3) in the event status register to be set.
500 to 599	Security errors	Errors related fo password useage.
900 and above	Self-test errors	Self-test errors have occurred.

## Command Errors

Code	Error Text	Description
-100	Command error	Generic syntax error
-101	Invalid character	An invalid character exists. A data element different than those allowed was recognized.
-102	Syntax error	Syntax error. An unrecognized command or data type was encountered.
-103	Invalid separator	Invalid separator The parser was expecting a separator and encountered an illegal character.
-104	Data type error.	Data type error. The parser recognized a data element different than one allowed.
-105	Get not allowed.	Get not allowed. A Group Execute Trigger was received in a program message.
-108	Parameter not allowed	Parameter not allowed More parameters were received than expected for the header.
-109	Missing parameter	Missing parameter Fewer parameters were received than required for the header.
-110	Command header error	Command header error. An error was detected in the header.
-112	Program mnemonic too long	Mnemonic too long. The number of characters in the command header exceeds 12 characters.
-113	Undefined header	Undefined header. Inappropriate for the product.
-114	Header suffix out of range	Invalid suffix exists in the header.
-115	Unexpected number of parameters	Unexpected parameters were received in the header.
-120	Numeric data error	Numeric data error. Generated when parsing a data element which appears to be numeric, including the nondecimal numeric types.
-128	Numeric data not allowed	Numeric data is not allowed.
-130	Suffix error	Suffix error. Generated when parsing a suffix.
-131	Invalid suffix	A suffix is invalid. The suffix does not follow the syntax, or the suffix is inappropriate for the product.
-138	Suffix not allowed	Suffix too long. The suffix contains too many characters. A suffix was encountered after a numeric parameter that does not allow suffixes.
-140	Character data error	Character data error. Generated when parsing a character data element.
-141	Invalid character data	Either the character data element contains an invalid character, or the element is not valid.
-144	Character data too long	Character data too long. The character data element contains too many characters.
-150	String data error	Character data is not allowed.
-151	Invalid string data	String data error. Generated when parsing a string data element.
-158	String data not allowed	Invalid string data. String data is not allowed.
-160	Block data error	Block data error. Generated when parsing a block data element.
-170	Expression error	Expression error. Generated when parsing an expression data element.
-180	Macro error	Generated when defining a macro or executing a macro.

## Execution Errors

Code	Error Text	Description
-200	Execution error	Generic execution error
-203	Command protected	Password protected program or query command cannot be executed.
-210	TRigger error	Trigger error.
-211	Trigger ignored	A trigger was received but ignored.
-213	Init ignored	A measurement initiate operation was ignored because measurement is in progress.
-214	Trigger deadlock	A deadlock occurred because a query was received before the software trigger.
-220	Parameter error	Invalid parameter.
-221	Settings conflict	A command was received that the product cannot execute in its present condition.
-222	Data out of range	Parameter was out of range.
-223	Too much data	Too many parameters were received for the requirements.
-224	Illegal parameter value	Received invalid parameter data.
-230	Data corrupt or stale	Received a data query before the measurement completed.
-241	Hardware missing	Cannot be executed because the optional hardware is not installed.

## Product Specific Errors

Code	Error Text	Description
-310	System Error	System error
-311	Memory Error	Memory error. Physical damage to the device memory.
-313	Calibration memory lost	Calibration memory lost.* Damage to nonvolatile calibration data by CAL?.
-314	Save/recall memory lost	Memory data lost.* Damage to nonvolatile data by SAV?.
-315	Configuration memory lost	Configuration data lost. Damage to nonvolatile panel settings.
-330	Self-test error	Self-test failed.
-350	Queue overflow	Queue overflow.
-363	Communication error	Communication error that occurs when flow control is off. This is an error when using RS232C.
-362	Framing error in programming message.	Framing error. This is an error when using RS232C.
-363	Buffer overflow overrun	Buffer overflow error. This is an error when using RS232C.
-365	Time out error	Time out error. This is an error when using RS232C.

## Query Errors

Code	Error Text	Description
-400	Query error	Generic query error
-410	Query INTERRUPTED	Received a new command after the query was received and before the response was read.
-420	Query UNTERMINATED	The controller attempted to read the response after the device received an unsupported query or did not received a query. The “-100 COMMAND ERROR” and this error are stored in the error queue. The controller will time out.
-430	Query DEADLOCKED	The error queue, input buffer, and output buffer are full when sending large binary data as a response, and the transmission timing is off.
+440	Query UNTERMINATED after indefinite response	Received a separate query in semicolon-delimited format after a query that returns a response in an indefinite form. (Example: A compound command such as *IDN?;SYST:ERR?)

## Operation Complete Errors

Code	Error Text	Description
-800	Operation complete	All selected pending operations in accordance with the IEEE 488.2, 12.5.2 synchronization protocol have completed.

## Product Dependent - configuration change

Code	Error Text
+100	Setting change denied while OUTPUT ON state
+101	Setting change denied while TRANSient trigger in progress
+102	Setting change denied while SIMulation trigger in progress
+103	Setting change denied while PROGram trigger in progress
+104	Setting change denied while frequency synchronous.
+105	Setting change denied while BUSY
+106	Setting change denied while SIMulation in progress
+107	Setting change denied while PROGram in progress
+108	Setting change denied while SLEep mode
+109	Setting change denied while EXT PROGram SOURce selected
+110	Setting change denied while INT+EXT PROGram SOURce selected
+111	Setting change denied while V PROGram SOURce selected
+112	Setting change denied while SStart in progress
+113	Setting change denied while SStop in progress

**Product Dependent - configuration conflict**

Code	Error Text
+201	Conflicts with OUTPUT OFF state
+202	Conflicts with PROTECTION state
+203	Conflicts with WIRING configuration
+204	Conflicts with BUSY state.
+205	Conflicts with CURRENT PROTECTION LIMIT selected
+206	Conflicts with CURRENT PROTECTION TRIP selected
+207	Conflicts with SSTART function enabled
+208	Conflicts with Remote Inhibit operation
+209	Conflicts with EXTERNAL PROGRAM SOURCE selected
+210	Conflicts with INTERNAL PROGRAM SOURCE selected
+211	Conflicts with unbalanced PHASE configuration
+212	Conflicts with unbalanced VOLTAGE configuration
+213	Conflicts with TRANSIENT trigger in progress
+214	Conflicts with SIMULATION trigger in progress
+215	Conflicts with PROGRAM trigger in progress
+216	Conflicts with external digital input.
+217	Conflicts with OUTPUT IMPEDANCE REAL
+218	Conflicts with OUTPUT IMPEDANCE REACTIVE
+219	Conflicts with SSTOP function enabled
+220	Conflicts with V PROGRAM SOURCE selected
+225	Conflicts with Out of RANGE(VOLT)
+226	Conflicts with Out of RANGE(FREQ)
+227	Conflicts with Out of RANGE(IMP)
+228	Conflicts with Out of RANGE(TIME)
+230	Conflicts with existing AC VOLTAGE (IMMEDIATE)
+231	Conflicts with existing AC VOLTAGE (TRIGGERED)
+232	Conflicts with existing DC VOLTAGE (IMMEDIATE)
+233	Conflicts with existing DC VOLTAGE (TRIGGERED)
+234	Conflicts with existing AC+DC overlaid VOLTAGE (IMMEDIATE)
+235	Conflicts with existing AC+DC overlaid VOLTAGE (TRIGGERED)
+236	Overlaying too much AC+DC voltage
+237	Conflicts with non-zero DC VOLTAGE
+238	Conflicts with high-ranged T3 VOLTAGE
+239	Conflicts with existing FREQUENCY (IMMEDIATE)

## 5 Maintenance

Code	Error Text
+240	Conflicts with existing FREQuency (IMMediate)
+241	Conflicts with soft VOLTage LIMit settings
+242	Conflicts with soft VOLTage OFFSet LIMit settings
+243	Conflicts with soft FREQuency LIMit settings
+244	Conflicts with TRIP in DISabled state
+245	Conflicts with non-zero AC VOLTage
+250	Conflicts with VOLTage COMPensate not in DISabled state
+251	Conflicts with HARD voltage compensation
+252	Conflicts with SOFT voltage compensation
+253	Conflicts with REG-ADJ voltage compensation
+254	Conflicts with CV RESPonse MEDium or FAST
+255	Conflicts with FREQuency SYNChronize function enabled
+256	Conflicts with OUTPut IMPedance function enabled
+257	Conflicts with non-zero waveform BANK active
+258	Conflicts with PHASe ON
+259	Conflicts with PHASe OFF
+260	Conflicts with PHAS.CHG in PROGram

### Product Dependent - invalid operations

Code	Error Text
+300	Invalid phase number
+301	Invalid WAVE BANK name
+302	Name already used by other BANK
+303	Block data is too long
+304	Block data is too short.
+306	Channel list is forbidden
+311	Illegal PROGram name
+312	PROGram nane already exists
+313	PROGram not found
+314	PROGram not selected
+315	PROGram not running
+316	Cannot delete selected PROGram
+317	Invalid STEP index
+318	Power saver unsupported

## Security errors

Code	Error Text
+501	Wrong password
+502	Illegal password format

## Self-test errors

Code	Error Text
+901	Detected empty power module slot
+902	Detected malfunctioning power module
+903	Invalid primary/secondary configuration

## Internal errors

The +1000 error is an internal error of the product.

## Hardware Error Codes

Hardware error codes appear on the front panel display when the instrument is being operated.



### Protection errors

Protection code	Description	Symptom and remedy
PROT-00-00 PROT-00-01 PROT-00-02	RMS OVP	The output overvoltage protection has been activated, 00=Phase 1, 01=Phase 2, 02=phase 3.  This occurs when the measured rms voltage exceeds the OVP setting for approximately 1 second.
PROT-01-00	P.U OVP (PFC)	An internal overvoltage protection has been activated. A voltage greater than or equal to the set voltage has been generated from the output side of the unit, or the output wires may have shorted during single-phase three-wire output or three-phase output. Alternatively, the unit may be malfunctioning. If the PROT occurs even after the problem appears to be resolved, stop using the unit immediately, and contact your nearest Keysight Service Center to request repairs.
PROT-02-00	P.U OHP	The internal overheat protection has been activated. Leave the unit on, and wait for about 10 minutes. If the protection has cleared after 10 minutes, the unit may have been installed incorrectly, or the dust filter may be clogged. If there are no problems with the installation or the dust filter, contact your nearest Keysight Service Center to request repairs.
PROT-02-00	OPP	The power limit protection has been activated.
PROT-02-13 PROT-02-14 PROT-02-15	UNBALANCE POWER	The output power of the internal inverter is biased, 13=Phase 1, 14=Phase 2, 15=phase 3.  When using single-phase output or parallel operation, check the wiring. If there are no problems, contact your nearest Keysight Service Center to request repairs.
PROT-03-00	OCP	The current limit protection has been activated.
PROT-03-3 PROT-03-4 PROT-03-5	UNBALANCE CURR	The output current of the internal inverter is biased, 3=Phase 1, 4=Phase 2, 5=phase 3.  When using single-phase output or parallel operation, check the wiring. If there are no problems, contact your nearest Keysight Service Center to request repairs.
PROT-04-00	P.U FAN ERR	A power module fan has failed.

Protection code	Description	Symptom and remedy
PROT-06-00 PROT-06-01 PROT-06-02	OVERLOAD	The overload protection function has been activated, 00=Phase 1, 01=Phase 2, 02=phase 3.  The output current has exceeded the rated value or the current limit. Fix the problem that caused the overload to occur and then press OUTPUT again. The overload should be cleared, and the output should turn on.
PROT-06-05	OVERLOAD L3	The overload protection function has been activated due to an output short. Remove the <b>shorting bar</b> for three-phase output operation.
PROT-07-00 PROT-07-01 PROT-07-02	UVP	The output undervoltage protection has been activated, 00=Phase 1, 01=Phase 2, 02=phase 3.  This occurs when the measured rms voltage is lower than the UVP setting for approximately 1 second.
PROT-08-00	P.U FAULT (ALL)	All the power modules are paused.
PROT-08-01	P.U FAULT	Power module malfunction. At least one of the power modules has malfunctioned. Contact your nearest Keysight Service Center to request repairs.
PROT-10-00	WDOG TIMEOUT	The communication monitoring (watchdog) function has activated. This is activated when a SCPI command is not received during the specified timeout period.
PROT-11-00 PROT-11-02 PROT-11-04	P.U INPUT VOLT	An input open phase was detected. 00=between L1 and L2, 02=between L2 and L3, 04=between L3 and L1.  There may be a problem with the input wiring or an interruption may have occurred. Turn the power off, check the input wiring, and then turn the power back on.
PROT-12-00 PROT-12-02 PROT-12-04	P.U INPUT	An input overvoltage or frequency error was detected. 00=L1, 02=L2, 04=L3  There may be a problem with the input wiring. Turn the power off, check the input wiring, and then turn the power back on.
PROT-15-00	CAL DATA ERR	Calibration value error. Contact your nearest Keysight Service Center to request repairs.
PROT-19-00	EXT ALARM SIGNAL_IN	A Disable occurred on the external signal, and the output was turned off.
PROT-19-01	EXT ALARM REMOTE	An external alarm signal was received from the remote input terminal.
PROT-29-00	AC INPUT LOW	The input voltage dropped lower than the rated value and then recovered. There may be a problem with the input wiring or an interruption may have occurred. Turn the power off, check the input wiring, and then turn the power back on.

For all other PROT error codes, contact your nearest Keysight Service Center to request repairs.

**Fault errors**

Fault code	Description	Symptom and remedy
FAULT-01-00	P.U ERR	Power module error. Stop using the product, and contact your nearest Keysight Service Center to request repairs.
FAULT-06-00	P.U UNDTCT (ALL)	Not all of the power modules can be detected. Contact your nearest Keysight Service Center to request repairs.
FAULT-11-00	P.U SWITCHING ERR	Internal switch status error. Contact your nearest Keysight Service Center to request repairs.
FAULT-14-00	EEPROM MAC (IFC)	Internal communication error, EEPROM value error. Contact your nearest Keysight Service Center to request repairs.
FAULT-14-01	INT-COMM (IFC-IOC)	Firmware update error. An error occurred during a firmware update through the front panel USB port. Cycle power and use a different USB memory device to update the firmware. If the error occurred other than during a firmware update, contact your nearest Keysight Service Center to request repairs.
FAULT-19-00	DIGITAL I/O DETACHED	Check that the supplied AC6900-30001, external Digital I/O Connector (D-Sub 25 Pin Plug) is connected to the DIGITAL I/O port on the rear panel. Turn the power off and then back on.
FAULT-20-00	MEAS FAIL	Measurement error. Contact your nearest Keysight Service Center to request repairs.
FAULT-22-00	VERSION (IFC-IOC)	In parallel operation, the combination of the firmware versions of the primary and secondary units are not correct. Update the firmware, and align the versions.
FAULT-23-00	OPTION ERR	Option board installation error. Install the board correctly. If the board is installed correctly, contact your nearest Keysight Service Center to request repairs.
FAULT-29-00	AC INPUT LOW	The input voltage has become lower than the rated value. There is a problem with the input wiring. Turn the power off, check the input wiring, and then turn the power back on.
FAULT-31-00	INT-COMM (P.D)	Parallel operation system error. The parallel operation configuration is in error. If the addresses and the number of secondary units are set correctly, contact your nearest Keysight Service Center to request repairs.

For all other FAULT error codes, contact your nearest Keysight Service Center to request repairs.

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