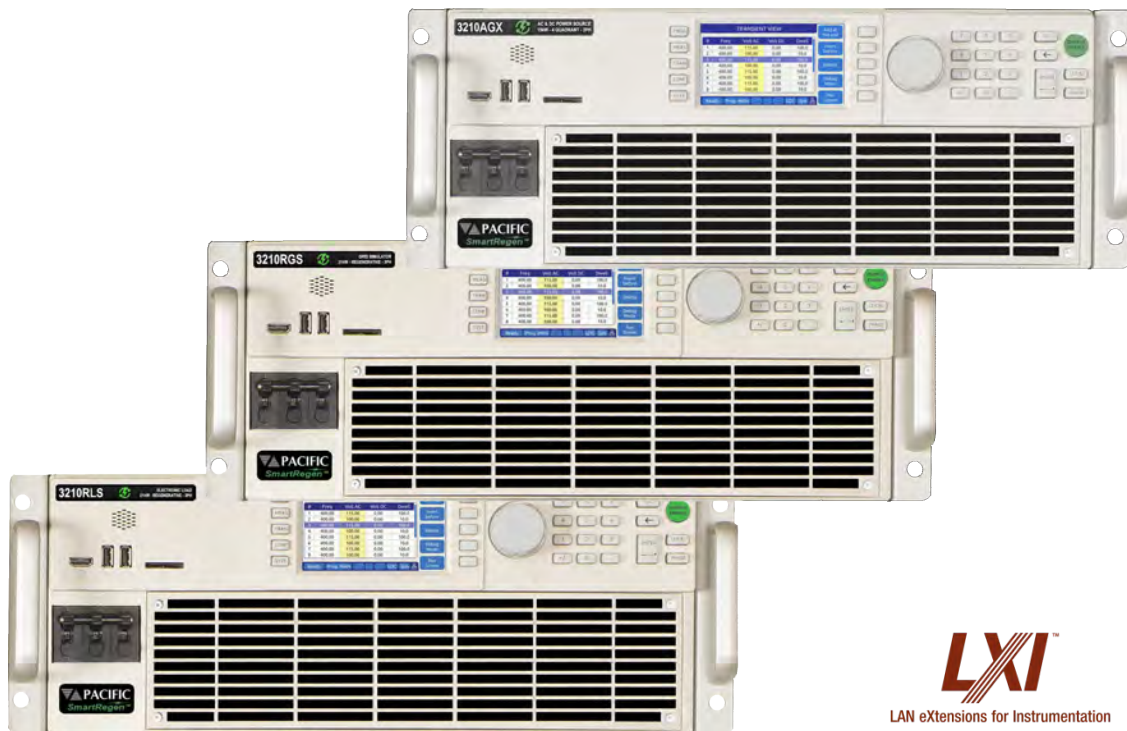


Operation Manual

AGX, RGS, RLS Series® – Rev 1.2.8

P/N 163620-10

AGX & RGS Series® Programmable Power Source RLS Series® Programmable Electronic Load



LXI
LAN eXTensions for Instrumentation

 **PACIFIC POWER SOURCE** **PACIFIC POWER SOURCE**

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1 Contact Information

AMERICA / CANADA

Pacific Power Source

2802 Kelvin Avenue, Suite 100

Irvine, CA 92614

USA

Phone: +1(949) 251-1800

Fax: +1 (949) 756-0756

Email: support@pacificepower.com

EUROPE

Pacific Power Source Europe GmbH.

Binzigstraße 21

77876 Kappelrodeck

Germany

Phone: +49(0)7842-99722-20

Fax: +49(0) 7842-99722-29

Email: info@pacificpower.eu

CHINA

PPST Shanghai Co. Ltd.

4 floors , building 2, No. 2185 Lai Fang Road

Jiu Ting Town, Song Jiang District

Shanghai 201615

Phone: +86-21-6763-9223

Fax: +86-21-5763-8240

Email: support@pacificepower.comWeb: <https://pacificpower.com>

2 Safety & Warranty Information

2.1 General Terms & Conditions

The General Terms & Conditions document defines payment terms, shipping charges, title passage, packaging, indemnification, warranty terms as well as Pacific's Service & Spare Parts Limited Warranty. We encourage you to read these terms and conditions very carefully at <https://pacificpower.com/support/>. Any additional or different terms or conditions in any form presented by you ("the customer") outside of the Pacific Power Source, Inc. General Terms & Conditions are hereby deemed to be material modifications and notice of disapproval to them and rejection of them is hereby delivered.

2.2 Safety Information

This chapter contains important information you should read BEFORE attempting to install and power-up PPS Equipment. The information in this chapter is provided for use by experienced operators. Experienced operators understand the necessity of becoming familiar with, and then observing, life-critical safety and installation issues. Topics in this chapter include:

- Safety Notices
- Cautions
- Preparation for Installation
- Installation Instructions

Make sure to familiarize yourself with the **SAFETY SYMBOLS** shown on the next page. These symbols are used throughout this manual and relate to important safety information and issues affecting the end user or operator.

SAFETY SYMBOLS**Direct current (DC)****Alternating current (AC)****Both direct and alternating current****Three-phase alternating current****Protective Earth (ground) terminal****On (Supply)****Off (Supply)****Fuse****Caution: Always consult this manual when you see this warning symbol marking in order to familiarize yourself with the nature of the potential hazard and actions to be taken to avoid them.****Caution, risk of electric shock**

2.3 Safety Notices

SAFETY SUMMARY

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



CAUTION: CLASS 1 INSTRUMENT

This product is a Safety Class 1 instrument (provided with a protective earth terminal). The protective features of this product may be impaired if it is used in a manner not specified in the operation instructions.



AVERTISSEMENT: APPAREIL CLASSE 1

Cet produit est un appareil Classe 1 (avec terre de protection). Les dispositifs de sécurité de ce produit peuvent être altérés si le produit est utilisé d'une manière non spécifiée dans le manuel d'utilisation.



CAUTION: ENVIRONMENTAL CONDITIONS

This instrument is intended for indoor use in an installation category II, pollution degree 2 environments only. It is designed to operate at a maximum relative humidity of 80% for temperatures up to 40 °C and at altitudes of up to 2000 meters. Refer to the specifications tables for the ac mains voltage requirements and ambient operating temperature range.



AVERTISSEMENT: CONDITIONS ENVIRONNEMENTALES

Cet appareil est destiné à une utilisation intérieure dans une installation de catégorie II, degré de pollution 2. Il est conçu pour fonctionner sous humidité relative maximale de 80%, pour des températures allant jusqu'à 40°C et à des altitudes allant jusqu'à 2000 m. Se reporter aux tableaux de spécifications pour les exigences en terme de tension secteur et plage de température ambiante de fonctionnement.

**CAUTION: BEFORE APPLYING POWER**

Verify that the product AC input specifications noted on the model tag matches the available utility line voltage and frequency.

**ATTENTION: AVANT DE METTRE SOUS TENSION**

Vérifier que les spécifications de tension d'alimentation de l'équipement notées sur l'étiquette sont bien compatibles avec la tension et fréquence secteur disponibles.

**SAFETY NOTICE: GROUNDING**

This product is a Safety Class 1 instrument (provided with a protective earth terminal). To minimize shock hazard, the instrument chassis or cabinet must be connected to an electrical safety ground. The instrument must be connected to the AC power supply mains through a properly rated three phase power cable with protective earth (L1-L2-L3-E). 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.

This instrument is equipped with a line filter to reduce electromagnetic interference and must be properly grounded to minimize electric shock hazard. Operation at line voltages or frequencies in excess of those stated on the model type plate may cause leakage currents in excess of 5.0 mA peak.

**REGLE DE SECURITE: MISE A LA TERRE**

Ce produit est un équipement de Classe 1 (muni d'une borne de mise à la terre). Pour minimiser le risque de choc électrique, le châssis de l'appareil ou de l'armoire/rack doit impérativement être relié à une terre de sécurité électrique. L'appareil doit être branché sur le secteur d'alimentation électrique à courant alternatif par un câble d'alimentation triphasé approprié avec terre de protection (L1-L2-L3-PE). Toute interruption de la mise à la terre de protection ou de déconnexion de la borne de terre causera un risque de choc électrique qui pourrait entraîner des blessures.

Cet appareil est équipé d'un filtre secteur pour réduire les interférences électromagnétiques et doit être correctement mis à la terre afin de minimiser le risque de choc électrique. Le fonctionnement sous tensions et fréquences supérieures à celles indiquées sur l'étiquette peut provoquer des courants de fuite de plus de 5,0 mA peak.

**CAUTION: DO NOT OPERATE IN AN EXPLOSIVE ATMOSPHERE**

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

**AVERTISSEMENT: NE PAS UTILISER SOUS ATMOSPHERE
EXPLOSIVE**

Ne pas faire fonctionner l'appareil en présence de gaz ou vapeurs inflammables.

**CAUTION**

The AC input connections must include a disconnect device (an external switch or circuit-breaker) as part of the installation. The disconnect device must be suitably located and easily reached and must be marked as the disconnecting device for the equipment. The disconnect device must disconnect all line conductors simultaneously.

An external overcurrent protection device must be provided (by, e.g., fuses or circuit breaker). The breaking capacity of the overcurrent protection device should be compatible with the current rating of the installation.

A minimum of basic insulation is required between mains-connected parts of opposite polarity on the supply side of the overcurrent protection device.

Overcurrent protection devices shall not be fitted in the protective conductor. Fuses or single pole circuit-breakers shall not be fitted in the neutral conductor of multi-phase equipment.

Installation should be in accordance with ANSI/NFPA 70, NEC.

After disconnecting grid power, ALWAYS wait at least 1 minute, then use a Digital Voltmeter (DMM) in VDC Mode to check for any residual DC voltage from each Line terminal to the Chassis ground stud to check for safe voltage levels (< 5 Vdc) before touching the unit or any terminal blocks or pins.

**AVERTISSEMENT**

Les connexions d'entrée AC doivent inclure un dispositif de déconnexion (un commutateur externe ou disjoncteur) dans le cadre de l'installation. Le dispositif de déconnexion doit être convenablement situé et facilement accessible et doit être marqué comme le dispositif de déconnexion de l'équipement. Le dispositif de déconnexion doit déconnecter tous les conducteurs de ligne simultanément.

Un dispositif de protection de surintensité externe doit être fourni (par exemple, par des fusibles ou coupe-circuit). Le pouvoir de coupure du dispositif de protection contre les surintensités doit être compatible avec le courant nominal de l'installation.



AVERTISSEMENT

Un minimum d'isolation de base est nécessaire entre les parties de réseau connecté de polarité opposée sur le côté d'alimentation du dispositif de protection contre les surintensités.

Les dispositifs de protection contre les surintensités ne doivent pas être installés dans le conducteur de protection. Fusibles ou simples disjoncteurs ne doivent pas être installés dans le conducteur neutre des équipements multi-phasés.

L'installation doit être conforme à la norme ANSI / NFPA 70, NEC.

Après avoir débranché l'alimentation du réseau, attendez TOUJOURS au moins 1 minute, puis utilisez un voltmètre numérique (DMM) en mode VDC pour vérifier toute tension CC résiduelle de chaque borne de ligne sur le plot de masse du châssis pour vérifier les niveaux de tension sécurisés (<5 Vcc) avant de toucher l'unité ou des borniers ou des broches.

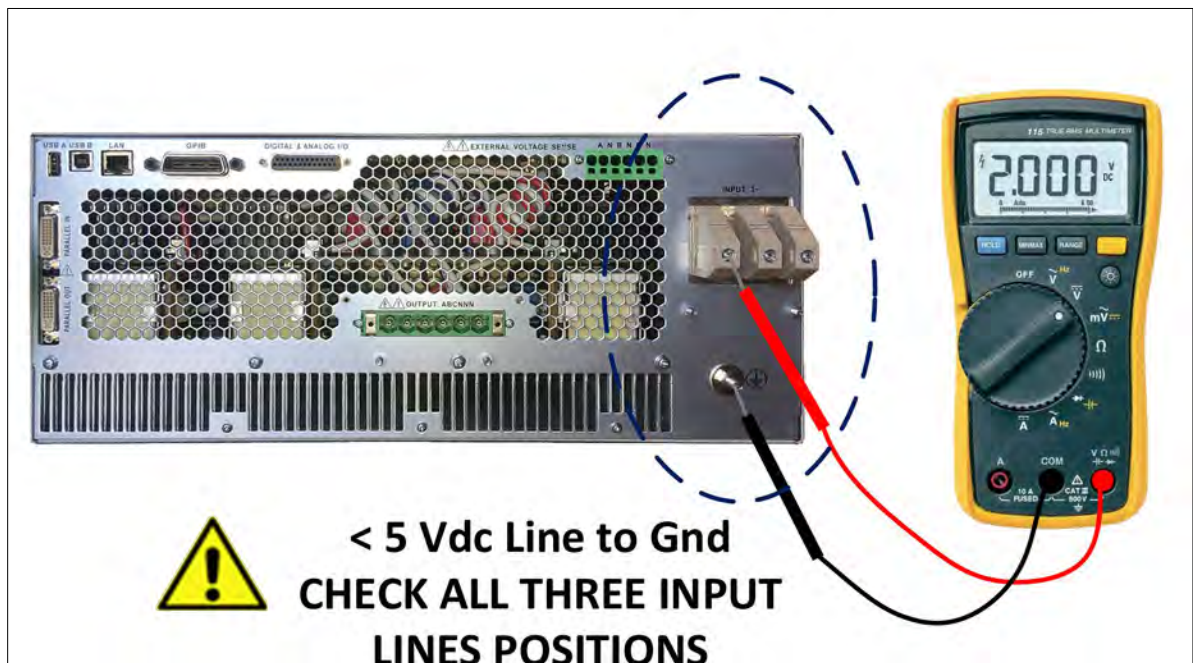


Figure 2-1: EMI AC Input Filter Residual Voltage Check after disconnecting AC Mains power



CAUTION: DO NOT SUBSTITUTE PARTS OR MODIFY INSTRUMENT

Because of the danger of introducing additional hazards, do not install substitute parts or perform any unauthorized modification to the instrument. Return the instrument to a Pacific Power Source Sales and Service Office for service and repair to ensure that safety features are maintained.

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

**AVERTISSEMENT: NE PAS REMPLACER DE PIÈCES ET DE COMPOSANTS
– NE PAS MODIFIER L'ÉQUIPEMENT**

En raison d'introduction de dangers supplémentaires, ne pas installer des pièces de rechange et ne pas effectuer de modification de l'équipement non autorisés. Retourner l'appareil à un bureau de ventes et services Pacific Power Source pour le service et la réparation afin d'assurer le maintien des caractéristiques de sécurité. Les appareils qui semblent endommagés ou défectueux doivent être rendus inopérants et protégés contre le fonctionnement involontaire jusqu'à ce qu'ils puissent être réparés par un personnel qualifié.

**CAUTION: INSTRUMENT LOCATION**

Do not position this instrument in such a way as to block easy access to any mains disconnect device or in any way that makes it difficult to operate the mains disconnect device.

**ATTENTION: EMPLACEMENT DE L'APPAREIL**

Ne pas placer cet appareil de manière à bloquer l'accès facile à tout débranchement du réseau électrique ou d'une façon qui rende difficile l'opération de débranchement du réseau électrique.

3 Product Overview

This chapter provides an overview of the PPS AGX Series® programmable power sources. It introduces the reader to general operating characteristics of these power supplies.

3.1 General Description

The Pacific Power Source (PPS) AGX Series® power source. RGS Series® grid simulators and RLS Series® Electronic Loads are designed to source and/or sink accurate, stable and clean AC or DC power to or from a unit under test. The products can be operated from the front panel (manual mode) or using RS232, USB, GPIB or LAN (Ethernet) remote control.

The performance of these models are detailed in section 4, “Technical Specifications”. Maximum voltage, current and power capability depends on the specific model. This manual covers standard AGX Series®, RGS Series® and RLS Series® models. Modified units are generally shipped with a manual addendum as a supplement to this manual. The manual addendum covers specific modifications from the standard model(s).

3.2 Model Number Encoders

All models series use a common model number and options designation scheme. The model decoders for each series shown in the diagrams below. All models have a wide input voltage range of 380Vac ~ 480Vac 3 Phase ±10%. Some lower power models are available with 208Vac 3 phase line input.

3.2.1 AGX Series

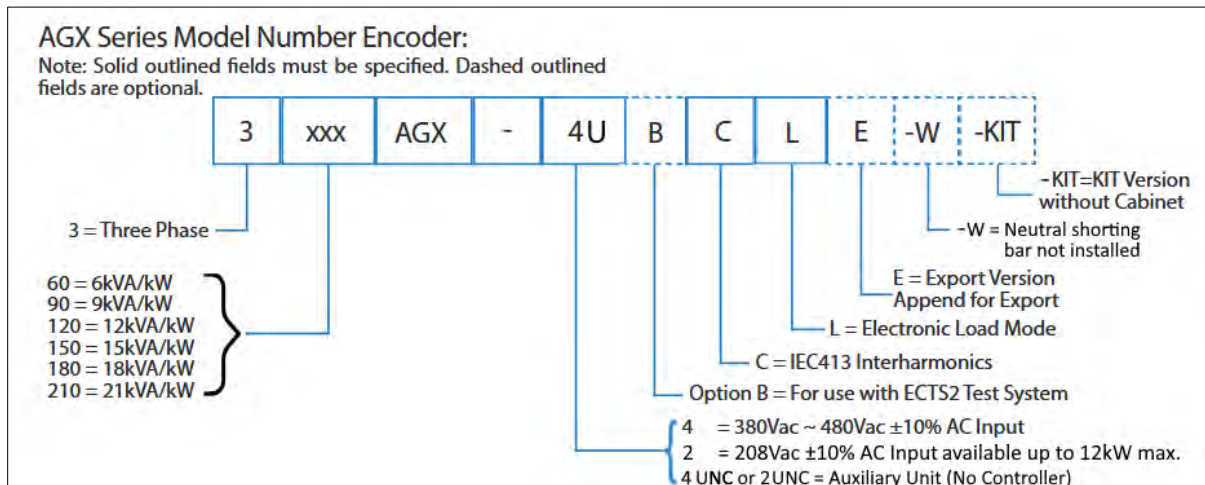
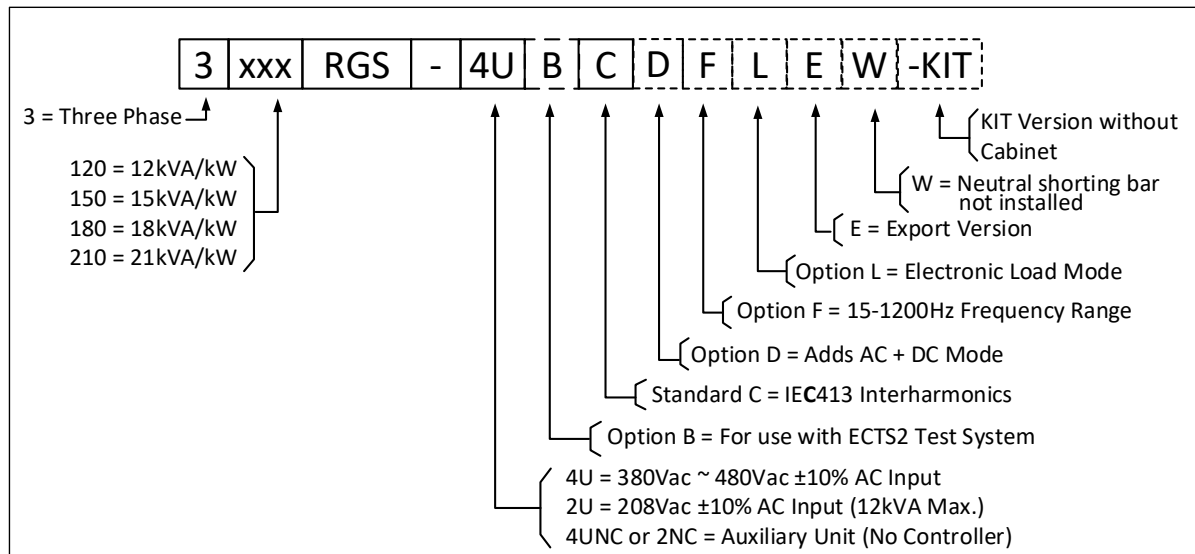
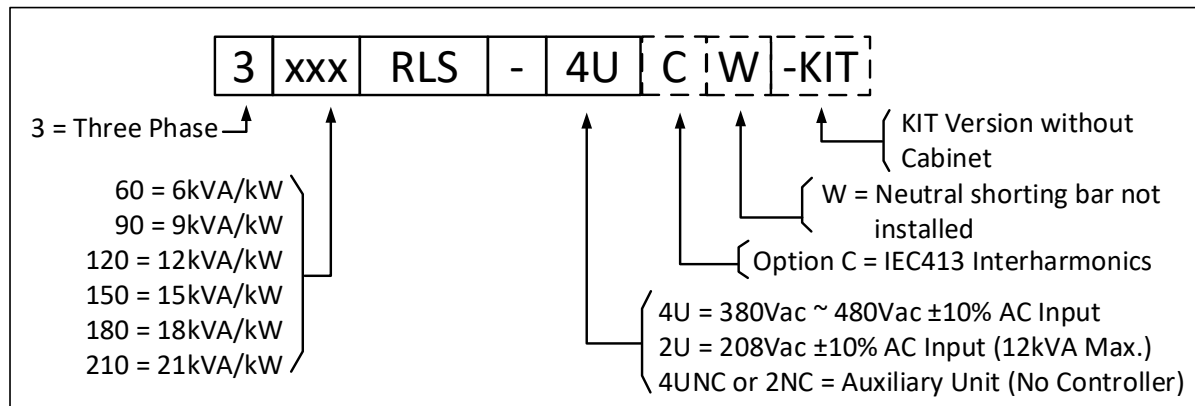


Figure 3-1: AGX Series Model Number Decoder

3.2.2 RGS Series



3.2.3 RLS Series



3.3 Product Features

Product features vary by model series but the following key characteristics apply to most models;

- Three or Two in one design: Voltage Source, Current Source, Electronic Load.
- AC, DC and AC+DC modes.
- Four Quadrant Operation – Source and Sink
- Regenerates energy back to the grid.
- Fully programmable with advanced controller functions.

- Six Forms of operation including Single (FORM1), Split (FORM2) and Three phase modes (FORM3), three independent single phases (FORM4), or split (FORM5) and single phase (FORM6) combinations
- Fully remote control of all settings and metering read back.
- Single constant power mode Voltage or Current range eliminates the need to switch between high and low ranges.
- Over voltage, over current and overpower protections.
- External Voltage sense.
- Programmable Output Impedance (R + L) (Source modes)
- Auxiliary I/O – Analog and Digital.
- Optional Electronic Load Mode on AGX and RGS.
- Optional independent output modes (Option W). **Must be specified at time of order.**

3.4 Block Diagram

The block diagram of these products is shown in Figure 3-2 below. It shows the key functional blocks for all models.

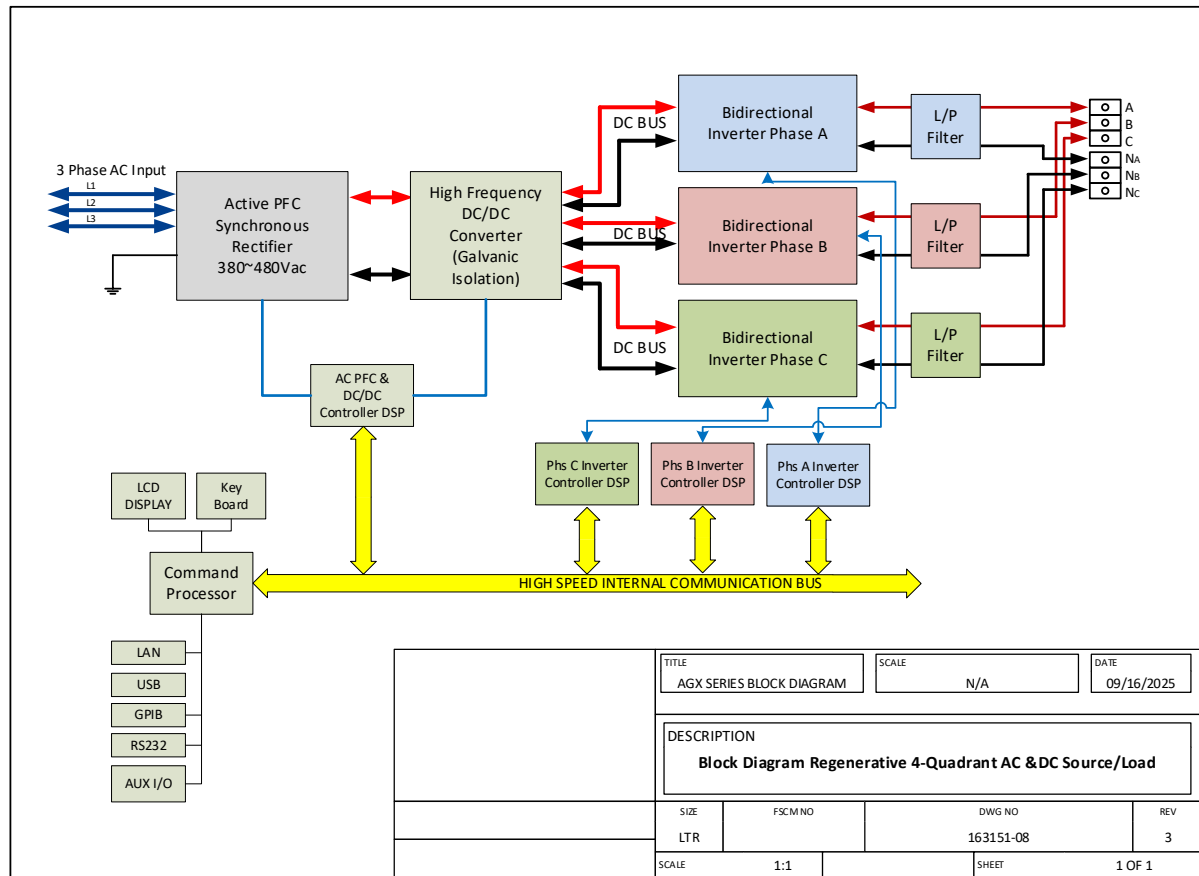


Figure 3-2: Functional Block Diagram

3.5 Controller Description

The AGX / RGS / RLS Series® power supplies and loads use an advanced command processor that communicates with the internal power stages using several high-speed communication buses and with the outside world through a variety of interfaces. One of these interfaces is the front panel keyboard and LCD display which supports manual operation of the AC power source.

The command processor handles all user inputs as well as any analog or digital input provided to the unit. All power stages are operated autonomously and take input from the main command processor. For larger power configurations consisting of multiple chassis, the master unit command processor communicates to all chassis that are connected on the master/auxiliary interconnect bus.

3.6 Measurement Readback

The voltage, frequency and current limit settings of can be set from the front panel or over any of the available digital remote-control interfaces. During operation, voltage, frequency, current and power can be read back for each of the available phases.

Notes:

- In source mode of operation, current and power measurements will be displayed with a minus sign and a green background color when the AGX is sending power back to the grid.
- In Load mode of operation (Option L), current and power measurements will be shown with a minus sign and a green background color.

3.7 AC & DC Voltage Source Mode of Operation (AGX, RGS)

The Voltage Source mode of operation is typically used for grid simulation, DC power supply applications and other AC or DC testing of products that require an input voltage – either AC or DC or both – to operate. In this mode, the output voltage can be set by the user and is precisely regulated by the power source. Current and power limits can be set as well to act as protection against overcurrent or over-power conditions that may damage the load. Over voltage protection is available as well in case an unexpected over of under voltage occurs.

3.8 AC & DC Current Source Mode of Operation (AGX)

The Current Source mode of operation is typically used to test current protection and switching devices or magnetic loads where precise current control, and regulation is required. The output voltage, either AC or DC, is determined by the load impedance in this mode and over / under voltage and power protection limits can be set by the user. The AC or DC current is programmed by the user and regulated precisely.

3.9 Load Mode of Operation (RLS or AGX & RGS with Option L)

This section provides a basic overview of the electronic load functions of the RLS or the AGX if equipped with the Electronic Load mode option (Option L).

Units equipped with Option L will have the letter “L” appended to the model number when queries over the bus with the *IDN? Command. For example, a 3210AGX with Option L and AC input configured for 380~400Vac would return:

PPSC,3210AGX-4UL,0,3.5.1

The RLS always operates as an electronic load. To operate the AGX as an electronic load rather than a power source, the mode needs to be set to LOAD in the UNIT CONFIGURATION menu using the “**Operating Mode**” field. Select “**Active Load**” to enable load operation.

Note: When used as a load, the AGX output becomes an input and is normally connected to a voltage source type EUT.

The other settings like Voltage Range and Coupling serve the same purpose as in Source mode.

The “Load Type” setting only appears in Load Mode and allows selection between the following load operation modes:

- Constant Current
- Constant Resistance
- Constant Power

Note: A Constant Voltage mode of operation is available in Source mode only (AGX or RGS-L, not on RLS models)

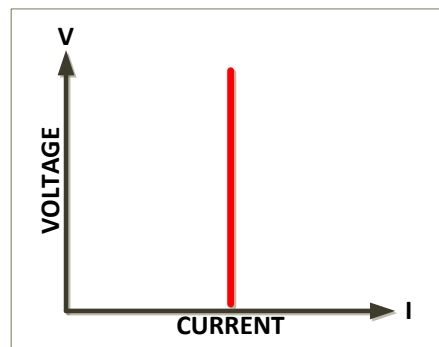
In load mode, most energy absorbed from the unit under test is returned to the utility grid. This reduces the amount of heat generated by the AGX compared to a conventional dissipative load considerably.

3.9.1 Constant Current (CC) Mode

This is the most commonly used mode of operation when testing a voltage source such as an AC or DC power supply, battery or Power converter. In this mode of operation, the load will sink a constant level of AC and/or DC current as set by the user, regardless of any voltage variations. A real time feedback loop ensures a stable current under any voltage variation on the input.

Both AC and DC current can be set independently as needed.

This mode is recommended for load regulation testing, loop stability testing, battery discharge testing and any other form of voltage regulation loop testing.



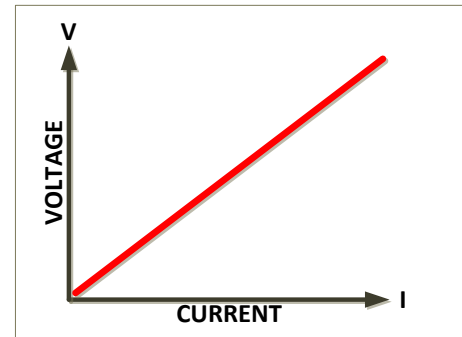
Available features in CC mode are:

- Transient programming – Set points are in current.
- Analog programming – The units are in current. For RMS modes, the input signal waveshape controls the current waveform and amplitude of the analog input signal defines current amplitude.
- User Limits.
- Programmable Slew Rate.
- Arbitray Current Waveforms
- Programmable Phase Shift between Voltage and Current to control power factor
- Interharmonics and Harmonics Generation.

3.9.2 Constant Resistive (CR) Mode

In Constant Resistance mode, the load will sink AC and/or DC current directly proportional to the sensed input voltage. The ratio between voltage and current is linear per ohms law and can be set by the user within the operating range of the load. The current is defined by the formula shown here where R is the set value in CR mode and V is the dc input voltage from the unit under test.

$$I = V/R$$



The AGX supports four different Constant Resistive Modes:

- Resistance RMS
- Conductance RMS
- Instant Resistance (Real-Time)
- Instant Conductance (Real-Time)

Coupling can be set to AC, DC or AC&DC. In AC&DC mode, AC and DC current can be programmed independently. Each mode offers different capabilities that are suited for a wide range of applications.

Available features in CR mode are:

- Transient programming – Same as Current Mode but set points are in resistance or inductance depending on selected mode.
- Analog programming – The units are in resistance or conductance. For RMS modes, the input signal waveshape controls the current waveform but the amplitude of the analog input signal defines the resistance or the conductance.
- User Limits - Same as constant current load mode but the limits are in resistance or conductance depending on the type.
- Slew Rate - Same as constant current load but the slew rates are in resistance or conductance depending on the type.

Not available in CR mode:

- Current Interharmonics and Harmonics or Arbitrary Current Waveforms.

The following sections explain each mode in more detail.

3.9.2.1 Constant Resistance RMS Mode

This mode programs both AC and DC resistance in Ohms. An “Infinite” value setting is available for all resistance modes/.

For AC applications, the current waveform can be set to a sinewave (SINE), the RECTIFIER waveform or a user defined arbitrary waveform. The RECTIFIER Waveform is available for RMS modes only.

The output current is computed as:

$$Out = \frac{Vac}{Sac} * waveform(t) + \frac{Vdc}{Sdc}$$

Where:

- Vac is the measured voltage AC
- Vdc is the measured voltage DC
- Waveform is the normalized arbitrary or rectifier one.
- Sac is the AC setpoint
- Sdc is the DC setpoint

The SYNC mode setting allows the current to be phase synced with the AC input voltage waveform so the current syncs up to the voltage and the phase angle of the current can be shifted as needed. Thus, it allows the Power Factor to be adjusted. Any power factor load from -1.0 (lagging) to +1.0 (leading) can be simulated.

For DC applications, the SYNC mode is turned off allowing an AC+DC current waveform to be used based on resistance settings in $I_{rms} = V_{dc} / R_{prog}$

Note: Analog programming using the AUX I/O input function controls the current waveform, but the RMS value is programmed in Ohms.

3.9.2.2 Constant Conductance RMS Mode

This mode is the inverse version of the Constant Resistance mode. Instead of setting a Resistance value (Ohms), the user programs in Conductance (Siemens = 1 / Ohms).

The advantage of this somewhat unusual mode of operating is that a zero conductance setting results in zero Amps of current being drawn by the load. In Constant Resistance mode, a zero set value is not possible as it would require infinite current.

3.9.2.3 Instant Resistance (Real-Time) Mode

This mode programs both AC and DC resistance in Ohms just like the CR RMS mode but the SINE or arbitrary waveform selected defines the resistance setting as a function of time, not the actual current. This mode is the most versatile CR mode available.

One good example of using this mode is to emulate a DC only resistance so the current waveform will follow the input voltage waveform.

This mode can be synced or not as well. Non-synced is useful with a DC input voltage to generate an AC waveform that defines a changing resistance value in real-time.

Note: Analog programming using the AUX I/O input function controls the resistance waveform in real-time.

This mode supports Transients, Ramp Time and Slew Rate programming.

- Resistance Modulation – In real-time R mode, the value of the Resistor can be modulated in real-time using the modulation setting. The phase shift between Vac and Iac is fixed at zero as it simulates a resistor.

MODULATED RESISTANCE	∞	10.00	Ohm	+	-
CONSTANT RESISTANCE	∞	10.00	Ohm	+	-
MODE	MODULATED ▾				
PHASE SHIFT		0.0	°	+	-

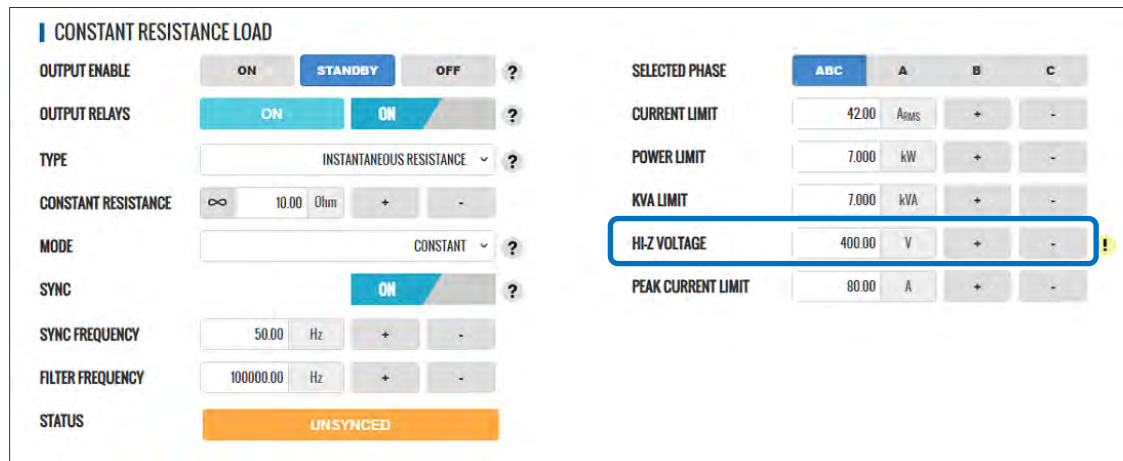
Summarizing, the following commonly found DC Load Modes can be supported with the Constant Resistance Real-Time mode:

- CR Mode
- CR + CV Mode *(with some additional commands but not on RLS models)*

The instantaneous resistance/conductance mode is naturally stable and should not trip OVP when the load input is opened. If this happens in this mode of operation, the voltage will collapse to zero. For applications where the resistance set value is very low, i.e. 0.5 Ohms, these may be some instability. If so, try to reduce the filter frequency setting and retry. See sample web browser interface program screen below.

CONSTANT RESISTANCE LOAD					
OUTPUT ENABLE	ON	STANDBY	OFF	?	
OUTPUT RELAYS	ON	ON		?	
TYPE	INSTANTANEOUS RESISTANCE ▾ ?				
CONSTANT RESISTANCE	∞	10.00	Ohm	+	-
MODE	CONSTANT ▾ ?				
SYNC	ON ?				
SYNC FREQUENCY	50.00	Hz	+	-	
FILTER FREQUENCY	100000.00	Hz	+	-	
STATUS	UNSYNCED				
SELECTED PHASE					
ABC A B C					
CURRENT LIMIT	42.00	Arms	+	-	
POWER LIMIT	7.000	kW	+	-	
KVA LIMIT	7.000	kVA	+	-	
HI-Z VOLTAGE	400.00	V	+	- !	
PEAK CURRENT LIMIT	80.00	A	+	-	

There is also a useful High Impedance mode (HI-Z VOLTAGE setting) available in this mode of operation. This can be useful for situations where the input to the load is suddenly removed, for example when opening a fuse or circuit breaker. Normally, under these circumstances, the peak input voltage may spike up. If this happens and this peak voltage exceeds the programmed threshold voltage (or the maximum peak voltage supported by the load), the load enters a high impedance mode (stops switching). This field is used to set this limit with a margin above the maximum absolute peak voltage of operation of the EUT. (E.g. 35Vdc for a 28Vdc application.) For AC applications, once the load detects and AC input voltage again and syncs to it, it resumes normal load operation again.



3.9.2.4 Instant Conductance (Real-Time) Mode

This mode is the same as the resistance Real-Time mode but the set points and waveform is the conductance of the load instead of resistance.

3.9.3 Constant Power (CP) Mode

In Constant Power mode, the DC load will attempt to maintain the programmed Power dissipation by sinking current at the voltage sensed. The current is defined by the formula shown below.

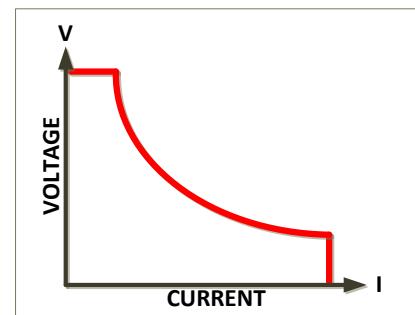
$$I = P/V$$

The constant power has also three modes, very similar to constant resistance:

- Apparent Power RMS Mode
- Active Power RMS Mode
- Instant Power Mode (Real-Time)

In CP mode the setpoints are in power (kW) or KVA. The units generate the current based on the voltage measurement and the load input sense points. All the CP types have the sync control.

Available features in CP mode are:



- Transient programming – Same as Current Mode but set points are in KW or KVA depending on selected mode.
- Analog programming – The units are in KW or KVA. For RMS modes, the input signal waveshape controls the current waveform but the amplitude of the analog input signal defines the KW or KVA level.
- User Limits - Same as constant current load mode but the limits are in KW or KVA depending on the type.
- Slew Rate - Same as constant current load but the slew rates are in KW or KVA depending on the type.

Not available in CP mode:

- Interharmonics and Harmonics Generation.

The following sections explain each mode in more detail.

3.9.3.1 Apparent Power RMS Mode

This mode sets the kVA level using the current waveform. This mode can be Synced to allow phase shifting with respect to an AC input voltage. It can also be unsynced which is appropriate for DC input voltage applications.

An AC rectifier waveform is available in this mode based on a programmable Current Crest factor setting.

When a phase shift is programmed in Synced mode, the amplitude of the AC waveform will be adjusted (increased or decreased as needed) to maintain the active power level programmed by the user.

The output current is computed as:

$$Out = \frac{Sac}{Vrms} * waveform(t) + \frac{Sdc}{Vrms}$$

Where:

- Vrms is the measured voltage RMS
- Waveform is the normalized arbitrary or rectifier one
- Sac is the AC setpoint
- Sdc is the DC setpoint

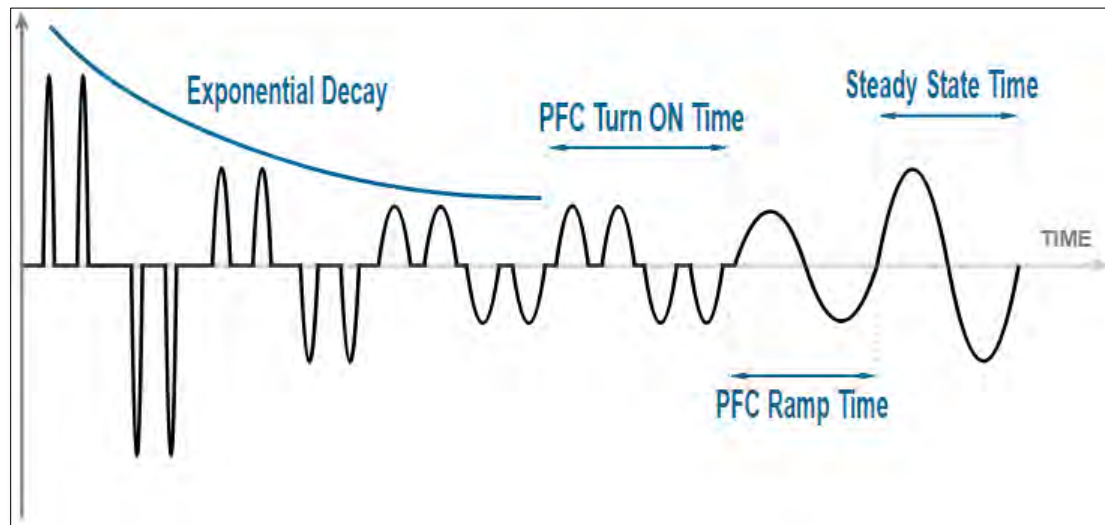
The following less common Load modes can be emulated using this mode:

- Constant VA mode (CVA)
- Constant VA mode + Phase Shift

3.9.4 Inrush Current Simulation Mode

The special mode applies to both Current Source and Electronic Load modes of operation as either mode controls current and is used to create typical inrush current scenarios for testing the ability of a power source design to handle challenging inrush current demands.

Examples of current events that can be programmed using this operating mode are shown in the figure below. This current waveform shows both rectified peak currents as caused by a three-phase diode bridge capacitor non-power corrected circuit as well as subsequent power factor corrected current waveforms for a three phase AC input product. The various time periods and current waveshapes can be programmed by the user in both amplitude, duration, waveform etc.



This mode of operation uses the inherent transient sequence programming functions of the AGX-L or RLS Series unit but eliminates the need for tedious transient list sequence programming by allow a higher level of data entry mode using inrush current decay rate settings, PFC turn on delay setting and steady state setting definitions provided by the user.

This section provides an overview of the use of this functionality. Note that on the AGX the “L” Load Option is required to use this functionality.

Note: As needed, these current inrush functions may also be used as part of a customer ATE program using any of the remote-control interfaces by sending the relevant SCPI Commands. For a summary of available remote control commands for these functions, refer to section 8.9.11, “Transient Inrush Current Mode Commands” on page 469.

3.9.5 Load Relay Control In Load Mode

The relay that connects the programmable load to the unit under test is referred to as “OUTPUT” relay as this manual covers both the AC & DC Sources (AGX & RGS) and the AC & DC Load product version (RLS) of this product line.

In load mode, the use of the output On/Off is somewhat different than in source mode as the RLS input must be connected to the EUT in order to ‘sense’ the input voltage coming from the EUT. As long as the relay is “open”, it cannot sense the voltage or frequency of the connected EUT output.

If the output relay is OPEN and an input voltage higher than 50Vac RMS or 50Vdc is present on the input for the programmable load, an error message will be generated when trying to close the relay using the front panel On/Off button on the web browser interface CONTROL screen, an error message will appear:

**“Cannot close relays and enable with voltage present at the output.
Relays will be closed automatically when voltage goes down.
Once relays are closed press output enable again.”**



This condition is needed to protect the load input capacitors from excessive peak inrush current needed to charge to the input voltage level present. To enable engaging the load, there are a few options: **1. Disconnecting, 2. Turning source off or 3. Lowering source output voltage to less than 50V.**

- Turn OFF or reduce the voltage from the EUT source if possible so the RGS will see less than 50Vrms or 50Vdc and the load will close the relays. Then they turn the source again and they should be able to enable the RGS.
- If reducing the voltage from the source is not an option, disconnect it from the load and close the RGS relays. Then reconnect the EUT voltage source.

3.10 Accessories Included (Ship Kit)

Included

The following accessories are included with each model series. If one or more of these is missing upon incoming inspection of the product, please contact Pacific Power Source customer service. Note that AC input and AC output wiring, grid connection devices or external terminal blocks are NOT included with the power source or source cabinet systems.

Item	Quantity
Operation Manual in PDF Format	Available from PPS website
Mating Output Connector	1
AC Input Terminal Safety Cover (metal)	1
Certificate of Conformance	1

Table 3-1: Included Accessories

Available (Optional)

Item	PPS Part Number
Three Phase AC Input & Output Covers and Strain Relief Kit for AGX/RGS/RLS	

3.11 Remote Control Interfaces

Following remote control interfaces are standard:

- LAN, USB, GPIB, RS232, AUX I/O, ModBus TCP.

Optional: CAN / CAN-FD, FieldBus, Other protocols

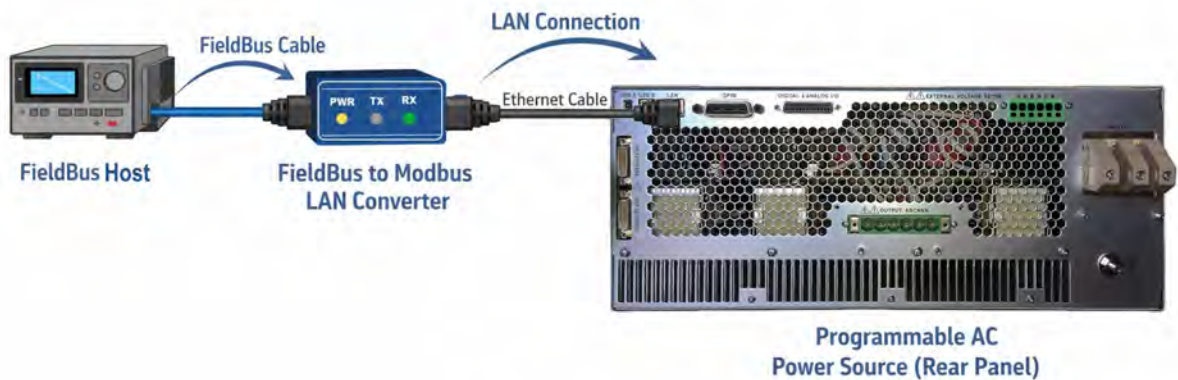


Figure 3: Other Protocol Support via LAN ModBus connection

3.12 Available Options

The following options may be specified at the time of ordering. These options are not field-installable. See Model Number Encoders section or technical specification for more details. .

Option Suffix	Description
Option B	Configuration provision for use of AGX with ECTS2 EMC test systems
Option C	Interharmonics Generator for IEC 61000-4-13 Immunity test. Includes Ects_413Gui Windows software for IEC 61000-4-13 test and report generation. Note: Option C is standard on AGX & RGS models
Option L	Electronic AC or DC Load Operation available on AGX or RGS Series Note: Option L is standard on AGX models
Option W	Isolated Output Neutrals. Output neutral terminals and all -4U models are isolated on AGX, RGS and RLS Series but shipped with a Neutral shorting bar installed. If option W is specified, this bar is removed at time of shipment and added to the shipkit. Note: Option W is standard on RLS Series.
Option E	Export Version. Relevant for AGX and RGS-F Series.

Table 3-2: Available options

3.12.1 Option B

The B option configures the voltage and or current maximum outputs to work with the ECTS2 Series Harmonics and Flicker test systems. It is only required on AGX or RGS power sources that are part of an ECTS2 EMC test system.

3.12.2 Option C

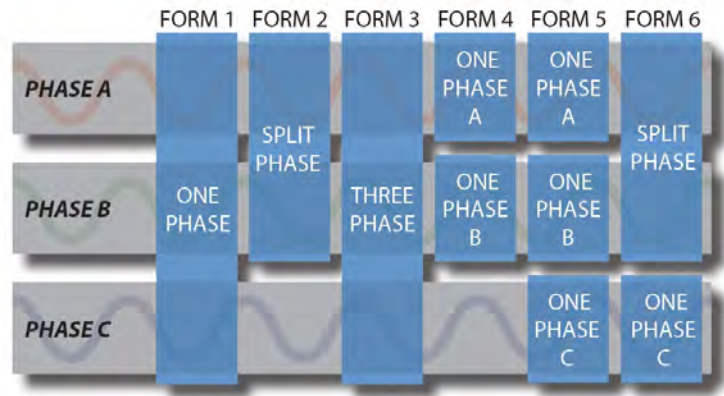
Option C adds interharmonics generation to the power source controller feature set. This option is required to support IEC 61000-4-13 Harmonics and Interharmonics compliance testing. It can also be used to generate interharmonics on the output of the power source for other immunity test purposes. For IEC 61000-4-13 compliance testing. A web browser based IEC 61000-4-13 Test Sequence is available to perform these tests. Note: Option C is standard on AGX and RGS models, optional on RLS models.

3.12.3 Option L

Option L adds electronic AC and DC load mode functionality to the AGX power source or RGS grid simulator turning it into a fully functional programmable load. Standard AGX or RGS modes remain available to select if this option is configured. Note: Option L is standard on AGX models, optional on RGS models.

3.12.4 Option W

Option W means the three output neutral terminals are not shorted together. On -4U models, the user can remove the shorting bar to obtain isolated output neutrals also. This configuration allows each phase / output to be used as an independent Source or Load (if configured with Option L). It also supports output FORM4, FORM5 and FORM6.



Considerations for operating modes and output connections with isolated vs shorted neutrals are:

The standard AGX and RGS units in three phase mode have 3 sources (phases) in a Y (star) connection if all neutrals are connected together. In voltage mode they function as three **voltage sources**, in current or load mode the AGX can also function as three **current sources**.

The W Option means the internal neutral shorting bar has been removed at the factory (it can be reinstalled by the end user if needed). This converts the unit to three independent (and thus floating) voltage or current sources, like having three sources, which can be externally connected in Y (star) or delta.

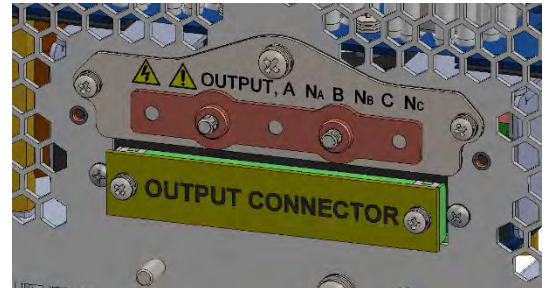


Figure 3-4: Neutral shorting bar not installed on -4U Models

With the AGX or RGS working in voltage mode, if the outputs are connected in delta mode it is equivalent to connecting voltage sources in parallel, which is a problem since voltage sources that are connected in parallel, will “fight” to control the voltage. This results in at least one of them tripping an overcurrent protection.

Delta connection of the AGX or RGS output is mostly meant to be used in load mode. In general, voltage mode should be used with star (Y) connection of the outputs.

Something similar happens with a standard unit (with star connection) in load (or current mode) with the neutral terminals **not** connected to a voltage source (unit under test). It’s equivalent to having current sources in parallel, which is not permissible as one phase will saturate its output trying to control the current.

To summarize:

- AGX or RGS in three phase voltage mode, output “should” be connected in star (Y), as the standard AGX.
- AGX or RGS in three phase current or load mode, output “should” have the Neutral connected to the voltage source or changed to delta connection.

With the AGX-L or RLS working as a load, these are the possible combinations:

- AGX / RLS (load) in star + UUT (voltage source) in star = WORKS (with neutral connection to the AGX)
- AGX / RLS (load) in star + UUT (voltage source) in delta = DOES NOT WORK => need to remove shorting bar+ delta connection in AGX
- AGX-W / RLS (load) in delta + UUT (voltage source) in delta = WORKS
- AGX-W / RLS (load) in delta + UUT (voltage source) in star (no neutral connection) = WORKS

One more important consideration is that the load mode is based on **current sources**. So even in “resistive” emulation mode, the output power stages work as current sources and don’t behave as actual resistors. So, they cannot have a current source connected to them as a unit under test. The unit under test **MUST** be a voltage source.

3.12.5 Option E

The Export option (Option E) is identified by a trailing letter “E” appended to the model number of the power source. This means the power source has restricted frequency resolution to comply with US nuclear proliferation requirements for export to certain countries. For details, see section 4.3, “AC Output Mode”, Note 4.

3.12.6 Multi-unit Parallel Systems Option Support

Power systems consisting of two or more units are controlled by only one of the units called the Master unit. All other units connected through the parallel DVI cable interface act as Auxiliary units and their controller is disabled. Only those options installed on the Master unit are available for use. Thus, if the unit used as the Master is not configured with an option, that option is not available to use at the parallel system level.

4 Technical Specifications

Technical specifications for power, voltage and current shown here apply at an ambient temperature from 0° to 40° C.

4.1 Single Chassis Models

Models shown in the table below are single chassis bench top or rack mountable units.

Model ⁴	Phases	Rated Power ¹ AC / DC mode	Voltage Ranges ² Vac L-N / Vdc	Max. AC/DC Current ² 3 & 2 Phase Mode	Max. AC/DC Current ² 1 Phase Mode ³	Rack Height
360AGX-xU 360RGS-xU 360RLS-xU	1, 2 & 3 Phase	6 kVA, kW / 6 kW	0-350 Vac / 0-500 Vdc	17.0 Arms / 17.0 Adc	51 Arms / 51.0 Adc	4U
390AGX-xU 390RGS-xU 390RLS-xU	1, 2 & 3 Phase	9 kVA, kW / 9 kW	0-350 Vac / 0-500 Vdc	25.0 Arms / 21.0 Adc	75 Arms / 63 Adc	4U
3120AGX-xU 3120RGS-xU 3120RLS-xU	1, 2 & 3 Phase	12 kVA, kW / 12 kW	0-350 Vac / 0-500 Vdc	34.0 Arms / 21.0 Adc	100 Arms / 63.0 Adc	4U
3150AGX-4U 3150RGS-4U 3150RLS-4U	1, 2 & 3 Phase	15 kVA, kW / 15 kW	0-350 Vac / 0-500 Vdc	42.0 Arms / 21.0 Adc	126 Arms / 63.0 Adc	4U
3180AGX-4U 3180RGS-4U 3180RLS-4U	1, 2 & 3 Phase	18 kVA, kW / 18 kW	0-350 Vac / 0-500 Vdc	42.0 Arms / 21.0 Adc	126 Arms / 63.0 Adc	4U
3210AGX-4U 3210RGS-4U 3210RLS-4U	1, 2 & 3 Phase	21 kVA, kW / 21 kW	0-350 Vac / 0-500 Vdc	42.0 Arms / 21.0 Adc	126 Arms / 63.0 Adc	4U

Note 1: Rated power shown is for Three Phase or Single-Phase mode operation. For Split Phase mode, rated power is 2/3 of 3 Phase mode. Not all models available in all markets.

Note 2: Voltage Ranges, some frequency and Vthd restrictions apply above 350Vac. Rated Currents are full specification, nominal values. DC voltage range applies for AC Source mode. **In Load or Current source mode, max DC voltage range is 475Vdc iso 500Vdc.**

Note 3: Contact factory for cabinet output wiring modifications to support single phase AC mode on cabinets above 84kVA.

Note 4: Models without the "U" immediately after the '-4' input identification have an output connector with A-B-C-N-N-N pin orientation and common shorted neutrals.

4.2 Multiple Unit Kit Models

Multi chassis model kits consist of a single master unit and one or more auxiliary units connected through a high-speed parallel bus. Each unit requires its own three-phase AC input and must be turned on at the front panel using its individual circuit breaker. This avoids massive inrush current at power up of the system as each unit can be turned on one at a time. Multi chassis systems can be installed in a suitable 19" cabinet by the end user. Contact factory for turnkey integrated AGX, RGS or RLS Series cabinet systems.

Model	Phases	Rated Power ¹ AC / DC mode	Voltage Ranges ² Vac L-N / Vdc	Max. AC/DC Current ² 3 & 2 Phase Mode	Cabinet Space ³
3240AGX-4U -KIT 3240RGS-4U -KIT 3240RLS-4U -KIT	2 & 3 Phase	24 kVA, kW / 24 kW	0-350 Vac / 0-500 Vdc	68.0Arms / 42 Adc	8U
3300AGX-4U -KIT 3300RGS-4U -KIT 3300RLS-4U -KIT	2 & 3 Phase	30 kVA, kW / 30 kW	0-350 Vac / 0-500 Vdc	84.0 Arms / 42.0 Adc	8U
3360AGX-4U -KIT 3360RGS-4U -KIT 3360RLS-4U -KIT	2 & 3 Phase	36 kVA, kW / 36 kW	0-350 Vac / 0-500 Vdc	84.0 Arms / 42.0 Adc	8U
3420AGX-4U -KIT 3420RGS-4U -KIT 3420RLS-4U -KIT	2 & 3 Phase	42 kVA, kW / 42 kW	0-350 Vac / 0-500 Vdc	84.0 Arms / 42.0 Adc	8U
3630AGX-4U -KIT 3630RGS-4U -KIT 3630RLS-4U -KIT	2 & 3 Phase	63 kVA, kW / 63 kW	0-350 Vac / 0-500 Vdc	126.0 Arms / 63.0 Adc	12U
3840AGX-4U -KIT 3840RGS-4U -KIT 3840RLS-4U -KIT	2 & 3 Phase	84 kVA, kW / 84 kW	0-350 Vac / 0-500 Vdc	168.0 Arms / 84.0 Adc	16U
31050AGX-4U -KIT 31050RGS-4U -KIT 31050RLS-4U -KIT	2 & 3 Phase	105 kVA, kW / 105 kW	0-350 Vac / 0-500 Vdc	210.0 Arms / 105.0 Adc	20U
31260AGX-4U -KIT 31260RGS-4U -KIT 31260RLS-4U -KIT	2 & 3 Phase	126 kVA, kW / 126 kW	0-350 Vac / 0-500 Vdc	252.0 Arms / 126.0 Adc	24U
31470AGX-4U -KIT 31479RGS-4U -KIT 3240RLS-4U -KIT	2 & 3 Phase	147 kVA, kW / 147 kW	0-350 Vac / 0-500 Vdc	294.0 Arms / 147.0 Adc	28U
31680AGX-4U -KIT 31680RGS-4U -KIT 31680RLS-4U -KIT	2 & 3 Phase	168 kVA, kW / 168 kW	0-350 Vac / 0-500 Vdc	336 Arms / 168.0 Adc	32U

Note 1: Rated power shown is for Three Phase mode operation. For Split Phase mode, rated power is 2/3. Higher power parallel system configuration are available up to 252kW.

Note 2: DC voltage range applies for AC Source mode. **In Load or Current source mode, max DC voltage range is 475Vdc iso 500Vdc**

Note 3: Contact factory for cabinet output wiring requirements to support single phase AC mode on cabinet systems.

Note 4: Models without the "U" immediately after the '-4' input identification have an output connector with A-B-C-N-N pin orientation and common shorted neutrals.

4.3 AC Voltage Source Mode

AC VOLTAGE SOURCE OUTPUT	
Voltage	
AC Range	0 - 350 V L-N rms / 0 - 606V L-L rms
Extended AC Range	0 - 365V L-N rms / 0 - 632V L-L rms
Programming Resolution	0.01 V
Accuracy	± 0.25% F.S.
Waveforms	Sine wave, Clipped, Square, Triangle, Saw tooth, Arbitrary Max. No. of waveforms: 200
DC Offset	< 20 mV
Harmonic Distortion ² (Vthd) (Full, Resistive Load)	< 100 Hz < 0.3% 100 Hz to 500Hz < 0.5% 500 to 1000 Hz < 1.0% > 1000 Hz < 1.5%
Output Noise (DC – 300 kHz)	< 150 mV rms
Load Regulation	± 0.02% (CSC Mode on)
Line Regulation	± 0.1% for 10% Line Change
External Voltage Sense	External Sense, max. voltage drop 5% FS.
Voltage Slew Rate	At least 1.0 V/us (AC Mode)
Isolation	550 Vrms maximum allowable voltage of any of the 6 outputs (A, B, C line or any of three neutrals) to chassis ground
Harmonics Generation Range	2 ~ 50 using arbitrary waveform.
Frequency	
Range see Note 3	AGX: 15.00 – 1200.0 Hz RGS: 15.00 – 200Hz std. / Option F: 15 – 1200Hz
Extended Frequency Ranges ²	Ext. Low Freq. Range: 1.00 ~ 15.00 Hz Ext. High Freq. Range: 1200 ~ 3000 Hz, see Note 2 & 3
Programming Resolution ³	0.01 Hz
Accuracy	± 0.01%
Current Limit	See model tables
Range	See model tables in sections 4.1 and 4.2
Current Overload	Available 30% Current overload for up to 2.0 seconds when enabled.
Crest Factor	2.5:1 @ 41.67 to 6.3:1 @ 16.67 (104Apk / phase)
Programming Resolution	0.01 A rms
Accuracy	± 0.5% F.S.
Modes	Constant Current Mode or Output Trip
Phase Angles (3 Phase Models)	
Phase Offsets ⁴	A = 0°, B = 240°, C = 120° (programmable in source mode)
Accuracy ⁴	± 0.35°
Phase Rotation in 3-Phs mode (default)	A, B, C = 0°, 120°, 240° (L1, L2, L3) In source mode. Consistent with Pacific Power UPC Controller products. Phase rotation default phase rotation selectable using “reversed phase polarity” setting if desired.
Accuracy	± 0.35°
Note 1: Extended voltage range Vthd < 1.0 % max. @ 50/60 Hz from 350Vac ~ 365Vac range under steady state load conditions. For voltage settings above 350Vac, a sudden load step can result in some cycles with a slightly higher distortion.	
Note 2: Extended operation from 1Hz to 15Hz supported at reduced maximum power on 12kVA and higher power rated models. Refer to Figure 3-2 on page 22. Instantaneous peak power (Vpk * Ipk) limited to 7kVA/phase below 15Hz. Extended operation from 1200Hz to 3000Hz supported at reduced maximum voltage. Requires option F on RGS models. Some specification deratings apply. Refer to Figure 4-3 on page 55 and Figure 4-4 on page 56.	

AC VOLTAGE SOURCE OUTPUT

Note 3: FREQUENCY PROGRAM RESOLUTION FOR EXPORT MODELS (E Suffix):

See Section 4.3.1 below.

Note 4: Actual output phase angles may be slightly different from programmed values for highly unbalanced three phase load conditions, in particular at high frequency due to amplifier phase shift differences.

4.3.1 Export Option Frequency Resolution

Frequency programming resolution of Power Sources with the Export Option:

Per U.S.A. Bureau of Industry and Security, ECCN 3A225, frequency control is limited to no better than 0.2% at frequencies of 600 Hz or higher for unrestricted export products. To meet that requirement, frequency programming on all models with the “E” option has three resolution ranges, which round the frequency to the nearest increment, as defined in the table below.

Frequency Resolution for Export Models (E suffix) is:

Range	Resolution
1.00 - 99.99 Hz	0.01 Hz
100-599.9 Hz	0.1 Hz
600 and higher	0.2% of setting

4.3.2 AC Voltage and Current Charts

AC VOLTAGE RANGES

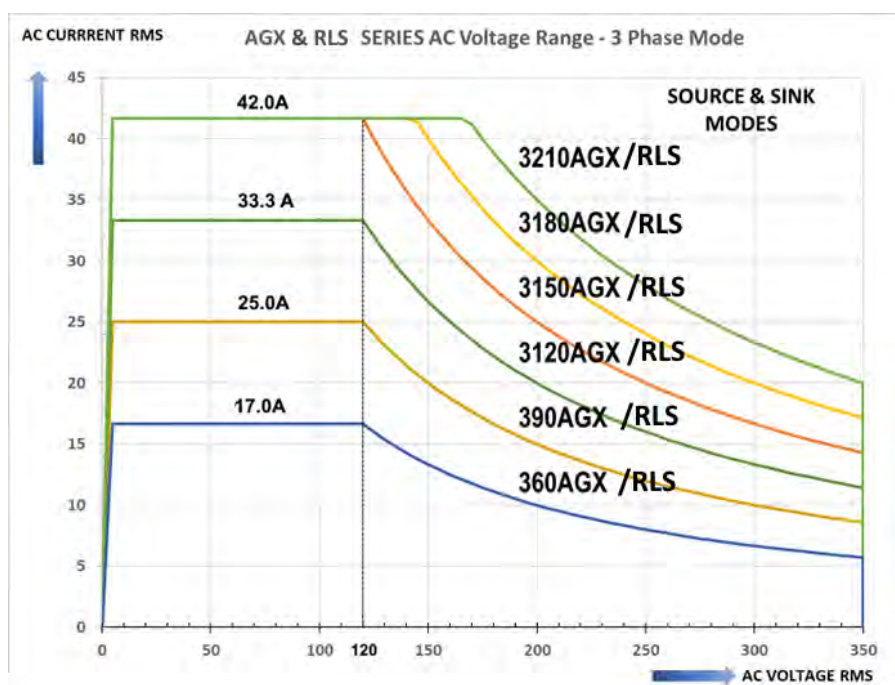


Figure 4-1: AGX & RLS Series AC Mode Voltage/Current range - 3 or 2-phase mode.

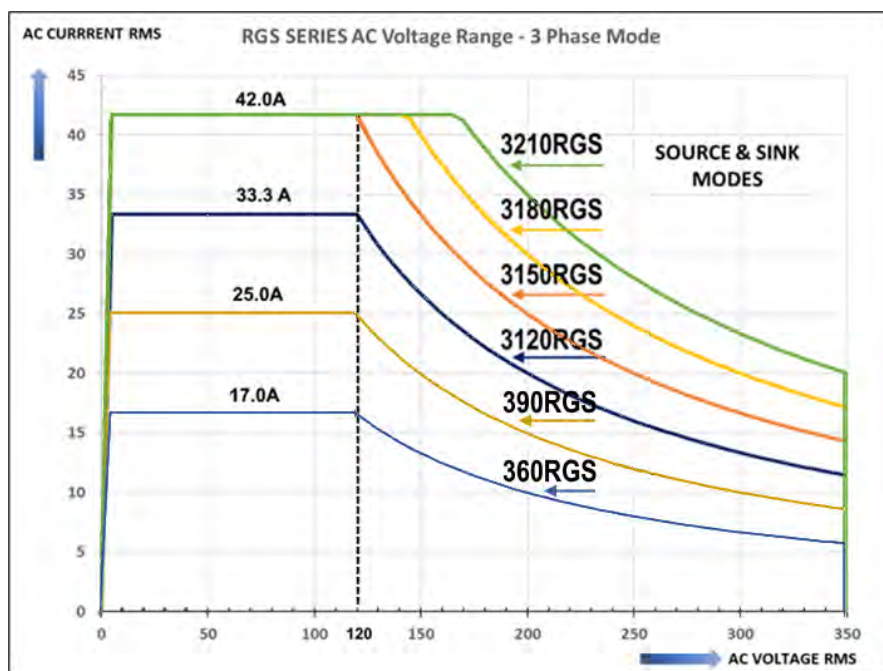


Figure 4-2: RGS Series AC Mode Voltage/Current range - 3 or 2-phase mode

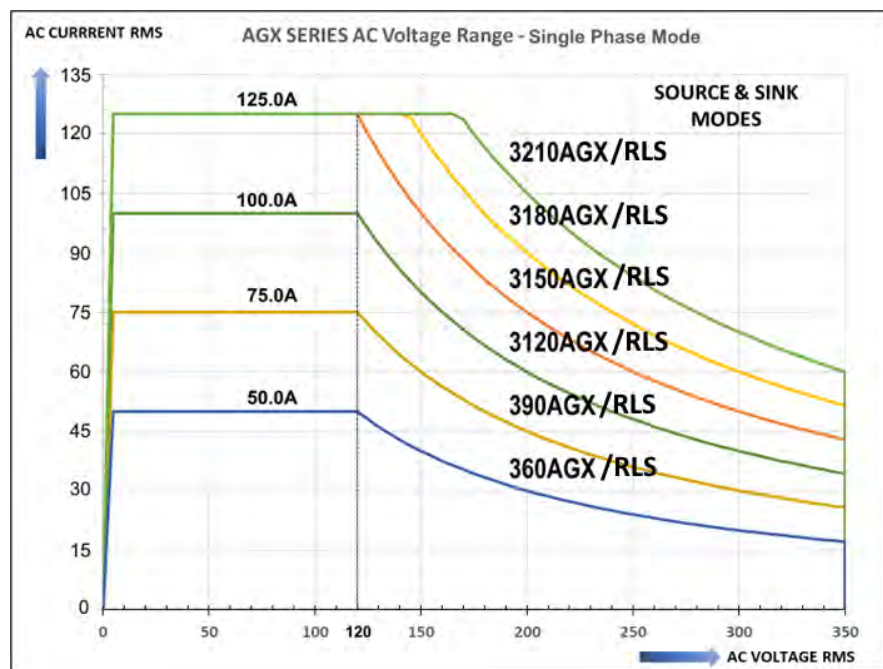


Figure 4-3: AGX & RLS Series AC Mode Voltage/Current range – 1 phase mode.

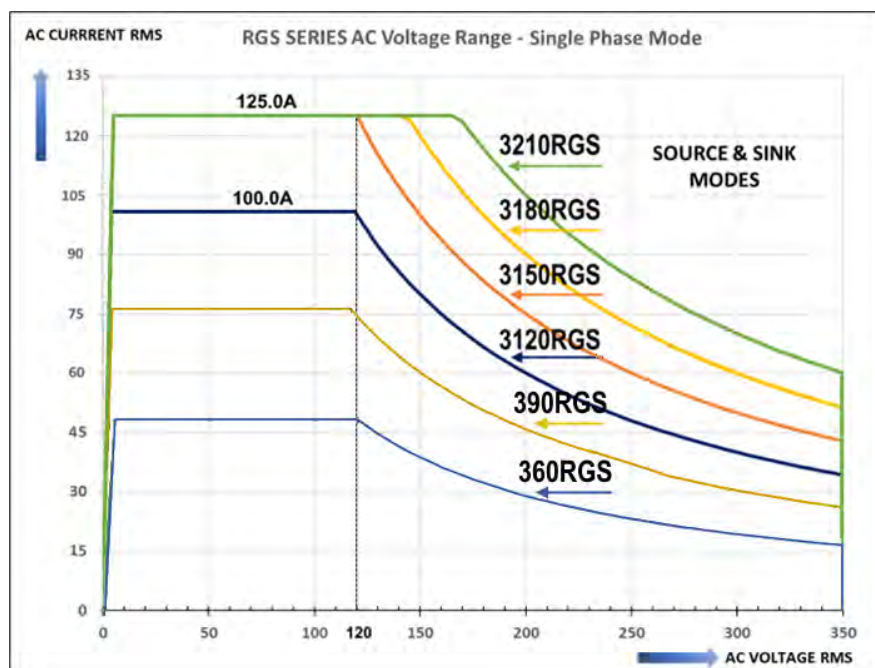


Figure 4-4: RGS Series AC Mode Voltage/Current range – 1 phase mode

4.3.3 Extended AC Voltage Range

The AGX and RGS provide an extended voltage range to 365Vac RMS Line to Neutral / 632Vac Line to Line. The extended range is activated by setting the AC voltage user limit to a value between 350 and 365. More details on extended range are provided in section 6.4.16, page 144. The following restrictions apply when operating at voltage settings between 350V_{LN} and 365V_{LN}:

- Voltage distortion (V_{THD}) at 365Vac may increase to < 1.0% at 50~60Hz.
- At 365Vac, if a sudden load step occurs, there may be several cycles with somewhat higher distortion so this < 1% THD applies to steady state operation.

4.3.4 Extended AC Current Range

AGX/RGS/RLS models support an extended current range that allows a higher RMS Current to be supported than the standard 42Arms per phase on the max power single chassis mode in three phase mode. This mode can be enabled by setting the current limit to a value shown in the table below.

Unit Power Rating	Extended Mode Max Irms/phase, 3 or 2 phase mode
6kVA / kW	19.0 Arms / 15Hz – 200Hz
9kVA / kW	29.0 Arms/ 15Hz – 200Hz
12kVA / kW	39.0 Arms/ 15Hz – 200Hz
15kVA / kW	48.0 Arms/ 15Hz – 200Hz
18kVA / kW	48.0 Arms/ 15Hz – 200Hz
21kVA / kW	48.0 Arms/ 15Hz – 200Hz

This higher current is available from 15Hz to 200Hz. For frequencies higher than 200Hz, the maximum RMS current derated from

Units 6 kVA: 19 Arms @ 200Hz to the normal Inom 17 Arms @ 1200Hz
 Units 9kVA: 29 Arms @ 200Hz to the normal Inom 29 Arms @ 1200Hz
 Units 12kVA: 39 Arms @ 200Hz to the normal Inom 39 Arms @ 1200Hz
 Units 15 to 21kVA: 48 Arms @ 200Hz to the normal Inom 42 Arms @ 1200Hz

The quadratic current derating between 200Hz and 1200Hz is shown in the figure below. A table frequency setting and max extended RMS current is shown. Both are based on the following derating formula:

$$I_{rms\ max} = I_{nom} + 6 * (F - 1200)^2 / 1E6$$

Where $I_{rms\ max}$ is for a single phase in 3 phase or split phase and F is the programmed frequency from 200 to 1200 Hz. For single phase, these values are times three. For parallel systems, these values are times the number of units in parallel for 3 phase or split phase mode.

Note: A firmware update may be required for this extended current range.

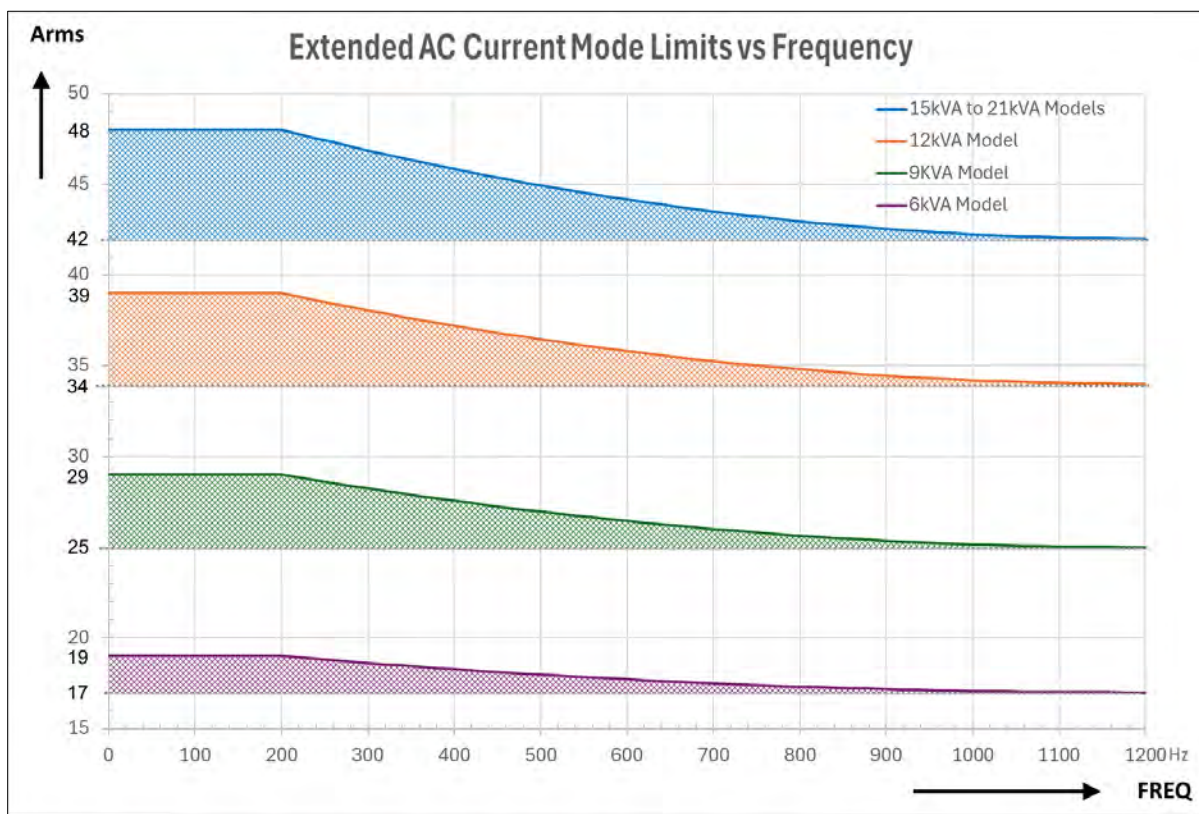


Figure 4-5: Available Extended AC Current Ranges as a Function of Frequency

Available AC rms current in 2 or 3 phase mode for commonly used frequencies for all models are shown in the table below.

F set	6kVA Models	9kVA Models	12kVA Models	15kVA to 21kVA Models
200 Hz	19.0 Arms	29.0 Arms	39.0 Arms	48.0 Arms
400 Hz	18.3 Arms	27.6 Arms	37.2 Arms	45.8 Arms
650 Hz	17.6 Arms	26.4 Arms	35.5 Arms	43.8 Arms
800 Hz	17.3 Arms	25.6 Arms	34.8 Arms	42.9 Arms
1000 Hz	17.1 Arms	26.2 Arms	34.2 Arms	42.2 Arms
1200 Hz	17.0 Arms	25.0 Arms	34.0 Arms	42.0 Arms

Over Current Protection Feature:

Note: If these stated current limits are exceeded, the unit will self-protect by throwing an overload fault and tripping off the output.

Disclaimer: It is important to note that the protection algorithm used for this extended RMS current mode is implemented using the measured frequency (and reported) by the RMS measurement function of the unit's programmable controller. This means that **it will not** properly detect the right frequency in some specific operating conditions, for example a custom waveform with a fundamental signal that consists of a higher order harmonic instead of the 1st harmonic. In those specific cases, where the measured frequency does not represent the actual fundamental current's frequency, it is the user's responsibility to operate the extended current range under the very specified operating conditions and not rely on this overcurrent protection feature.

4.4 AC Current Source Mode (AGX)

AC CURRENT SOURCE	
Voltage Input	
AC Range	0 - 350 V L-N rms / 0 - 606V L-L rms
External Voltage Sense	External Sense, max. voltage drop 5% FS.
Isolation	550 Vrms maximum allowable voltage of any of the 6 outputs (A, B, C line or any of three neutrals) to chassis ground
Frequency	
Range	15.00 – 1200.0 Hz
Extended Frequency Ranges ¹	Ext. Low Freq. Range: 1.00 ~ 15.00 Hz, see Note 1 Ext. High Freq. Range: 1200 ~ 3000 Hz, see Note 1
Current	See model tables
Range	See model tables in sections 4.1 and 4.2 and Section 4.3.4
Waveforms	Sine wave, Clipped, Square, Triangle, Saw tooth, Arbitrary Max. No. of waveforms: 200
Current Regulation	± 0.5% (CSC Mode on)
Crest Factor	2.5:1 @ 41.67 to 6.3:1 @ 16.67 (104Apk / phase)
Programming Resolution	0.01 A rms
Accuracy	± 0.5% F.S.
Response Time	Rise time is 30 ~ 50us when driving a short or a voltage source.
Modes	CC
Note 1: Extended operation from 1Hz to 15Hz supported at reduced maximum power on 12kVA and higher models. Refer to Figure 4-6 on page 55. Instantaneous peak power ($V_{pk} * I_{pk}$) limited to 7kVA/phase below 15Hz. Requires firmware 2.0.0 or higher. Extended operation from 1200Hz to 3000Hz supported at reduced maximum voltage. Some specifications exceptions apply. Refer to Figure 4-3 on page 55 and Figure 4-4 on page 56.	

4.5 AC Load Mode

AC LOAD	
Voltage Input	
AC Range	0 - 350 V L-N rms Max.
External Voltage Sense	External Sense, max. voltage drop 5% FS.
Isolation	550 Vrms maximum allowable voltage of any of the 6 outputs (A, B, C line or any of three neutrals) to chassis ground
Frequency	
Input Range	15.00 – 1200.0 Hz
Extended Frequency Ranges ¹	Ext. Low Freq. Range: 1.00 ~ 15.00 Hz, see Note 3 Ext. High Freq. Range: 1200 ~ 3000 Hz, see Note 3
Current	See model tables
Range	See model tables in sections 4.1 and 4.2 and Section 4.3.4
Waveforms	Sine wave, Clipped, Square, Triangle, Saw tooth, Arbitrary Max. No. of waveforms: 200
Current Regulation	± 0.5% (CSC Mode on)
Crest Factor	2.5:1 @ 41.67 to 6.3:1 @ 16.67 (104Apk / phase)
Programming Resolution	0.01 A rms
Accuracy	± 0.5% F.S.
Response Time	Rise time is 30 ~ 50us when driving a short or a voltage source.
Modes	CC, CR, CP
CC Mode – Range	0.1 Aac ~ Max Rating. See Section 4.1and 4.2
CR Mode – Range	0.8 Ohm ~ 100 kOhm
CP Mode Range	10 VA/W ~ Max Rating. See Section 4.1and 4.2
Note 1: Extended operation from 1Hz to 15Hz supported at reduced maximum power on 12kVA and higher models. Refer to Figure 4-6 on page 55. Instantaneous peak power ($V_{pk} * I_{pk}$) limited to 7kVA/phase below 15Hz. Requires firmware 2.0.0 or higher. Extended operation from 1200Hz to 3000Hz supported at reduced maximum voltage. Some specifications exceptions apply. Refer to Figure 4-7 on page 55 and Figure 4-8 on page 56.	

4.6 DC Voltage Supply Mode

DC OUTPUT	
Voltage	
Range	Voltage Source Mode: 0 – 500 Vdc Refer to Figure 4-10 and Figure 4-11 for Voltage vs Current Constant Power Mode profile for 3 phase and 1 phase modes
Programming Resolution	0.01 V
Accuracy	± 0.25% F.S.
Noise & Ripple	< 150 mV rms
Load Regulation	± 0.02%
Line Regulation	± 0.1% for 10% Line Change
External Voltage Sense	External Sense, max. voltage drop 5% FS.
Voltage Slew Rate	At least 3.0 V/us (DC Mode)
Isolation	550 Vdc maximum allowable voltage of any of the 6 outputs (A, B, C or any of three neutrals) to chassis ground
Current Limit	
Range	See model tables, Figure 4-10 and Figure 4-11
Programming Resolution	0.01 Adc
Accuracy	± 0.5% F.S.
Modes	Constant Current Mode or Output Trip

4.6.1 DC Voltage and Current Charts

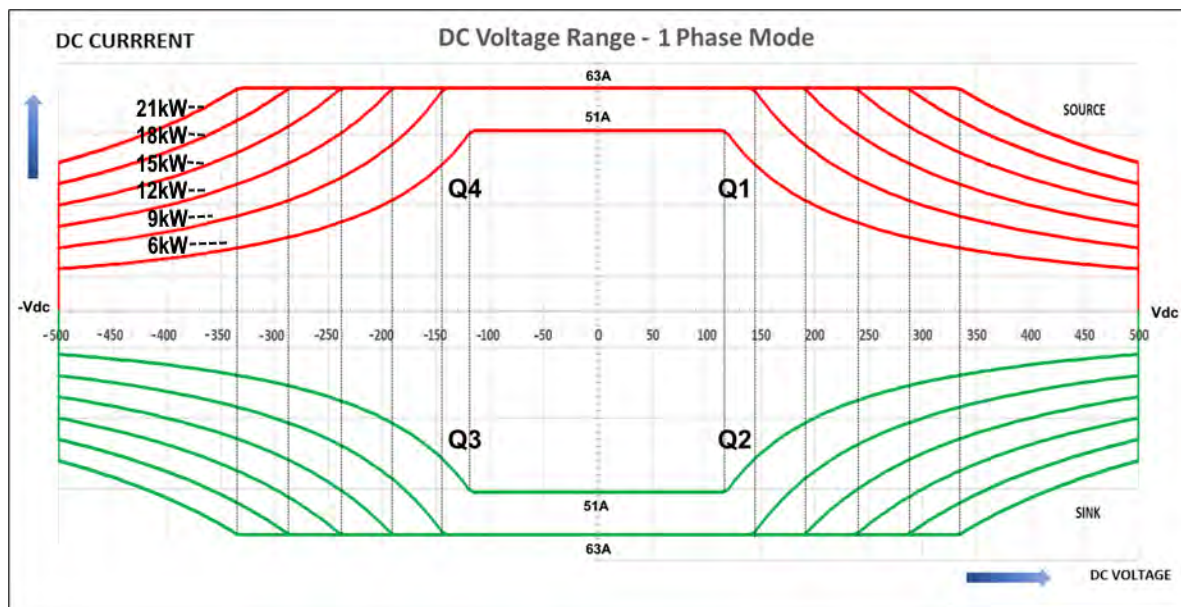


Figure 4-6: DC Mode Voltage/Current range - 1 phase mode.

Note: For three or dual outputs in DC mode, the current per output is one third of that shown in the chart above.

4.7 DC Current Source Mode (AGX)

DC CURRENT SOURCE	
Voltage Input	
DC Range	0 – ±500Vdc
External Voltage Sense	External Sense, max. voltage drop 5% FS.
Isolation	550 Vdc maximum allowable voltage of any of the 6 outputs (A, B, C line or any of three neutrals) to chassis ground
Frequency	
Input Range	15.00 – 1200.0 Hz
Extended Frequency Ranges ¹	Ext. Low Freq. Range: 1.00 ~ 15.00 Hz, see Note 3 Ext. High Freq. Range: 1200 ~ 3000 Hz, see Note 3
Current	See model tables
Range	See model tables in sections 4.1 and 4.2
Waveforms	Sine wave, Clipped, Square, Triangle, Saw tooth, Arbitrary Max. No. of waveforms: 200
Current Regulation	± 0.5% (CSC Mode on)
Crest Factor	2.5:1 @ 41.67 to 6.3:1 @ 16.67 (104Apk / phase)
Programming Resolution	0.01 A rms
Current Accuracy	± 0.5% F.S.
Response Time	Rise time is 30 ~ 50us when driving a short or a voltage source.
Modes	CC

4.8 DC Load Mode

DC LOAD	
Voltage Input	
DC Range	0 – ±475Vdc
External Voltage Sense	External Sense, max. voltage drop 5% FS.
Isolation	550 Vdc maximum allowable voltage of any of the 6 outputs (A, B, C line or any of three neutrals) to chassis ground
Current	See model tables
Range	See model tables in sections 4.1 and 4.2
Waveforms	Sine wave, Clipped, Square, Triangle, Saw tooth, Arbitrary Max. No. of waveforms: 200
Current Regulation	± 0.5% (CSC Mode on)
Crest Factor	2.5:1 @ 41.67 to 6.3:1 @ 16.67 (104Apk / phase)
Programming Resolution	0.01 A rms
Accuracy	± 0.5% F.S.
Response Time	Rise time is 30 ~ 50us when driving a short or a voltage source.
Modes	CC, CR, CP
CC Mode – Range	0.1 Adc ~ Max Rating. See Section 4.1and 4.2
CR Mode – Range	0.8 Ohm ~ 100 kOhm
CP Mode Range	10 W ~ Max Rating. See Section 4.1and 4.2

4.9 Programmable Output Impedance

4.9.1 Impedance Ranges by Phase Mode

This function applies to AGX and RGS models only. The programmable range for output impedance varies based on model and phase mode setting. The table below summarizes the available ranges as function of these. The ranges are the same for Real-Time Mode and RMS Mode.

Note: For units with T option, impedance is multiplied by the square of the transformer ratio. Thus, for a TR of 2:1, the impedance range is multiplied by 4.

Models	Phase Mode	± Limits	0 - Max Limits
		R +/- Ohms	L + mH
All single chassis AGX, RGS models	Three Phase	-10.00 ~ + 10.00	0 ~ 2.00
	Split Phase	-20.00 ~ + 20.00	0 ~ 4.00
	Single Phase	-10.00 ~ + 10.00	0 ~ 2.00

Table 4-1: Programmable Impedance Ranges by Phase mode

4.9.2 Programmable Impedance operation

Considerations when using Programmable Impedance functions.

In order to maximize the setting range for prog-Z, the AC Source controller gradually reduces the bandwidth of the feedback loop. This means that higher impedances (resistance and/or inductance) are slower to react.

At frequency settings of 50~60Hz, this works well in over the entire range. At higher frequencies the impedance accuracy will decrease, especially the inductive part (L).

Also, setting a high resistance (>1ohm) R impedance when the AC source is driving a highly capacitive load can result in instability.

The user should verify the prog-Z stability with the load before using it. ***Tight protection settings (peak and RMS current) are recommended to protect the power source and the load in case the system oscillates.***

Also, when using a negative impedance setting, the AC source can easily become unstable, depending on the load impedance, because negative impedance implies positive feedback which has a higher likelihood of causing instability.

4.10 Extended Frequency Ranges – Supplemental specs

Extended frequency range operation is supported for applications that require less than 15 Hz or more than 1200Hz fundamental frequency output. With the extended frequency enabled, the AGX, RGS or RLS allow increasing the frequency user limit up to 3000 Hz (default on AGX is 1200 Hz and on RGS is 200 Hz or 1200 Hz with option F) and consequently the frequency setpoint. On RGS, the F Option is required for Extended frequency range.

However, as the frequency increases above 1200Hz, the AC voltage setpoint (AGX, RGS in source mode) or max. input voltage (RLS Load or AGX, RGS-L in Electronic Load Mode), current limit/setting, power limit and KVA limit are derated with the following formulas:

$$v\_ac\_max = 350 * 1200 / frequency$$

$$current\_limit\_max = 42.0 * parallel\ inverters * 1200 / frequency$$

$$power\_limit\_max = 7 * parallel\ inverters * 1200 / frequency$$

$$kva\_limit\_max = 7 * parallel\ inverters * 1200 / frequency$$

If the output form is two or three phase, then parallel inverters = 1

If the output form is single phase, then parallel inverters = 3

For example, a standalone 3210AGX in three phase mode at 3000 Hz allows up to 140 Vrms and 16.8 Arms, 2kW and 2kVA per phase in three phase mode, 6kW//6kVA total for the unit.

- The **voltage derating** is to protect the power stage output capacitors, the higher the frequency the higher the current on the capacitors.
- The output **current derating** is to protect the power stage output inductors, the higher the frequency the higher the losses in the inductors. Since they are thermal limitations, the unit can withstand a few milliseconds beyond the rating before it trips a fault.

Note: When operating the AGX or RGS Sources beyond their ratings, they will protect and trip a fault. This applies to voltage source and current source modes.

WARNING: On RLS Electronic Load or AGX, RGS-L in electronic load mode of operation, applying too much input voltage at high frequency will cause a high current to the internal capacitors and can damage the unit. The end user must consider the max. voltage derating chart - Figure 4-7 - and take this into account when working in load modes. As long as the voltage is kept below the derating curve, it should be fine.

Charts below show graphical representation of extended frequency operation.

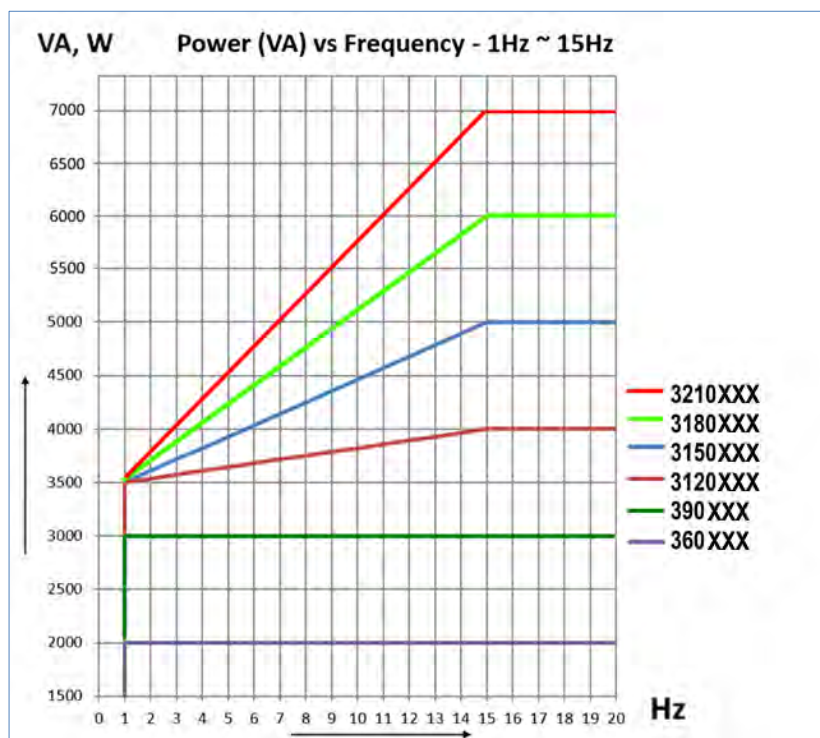


Figure 4-7: Extended Low Frequency Range – Power vs Frequency

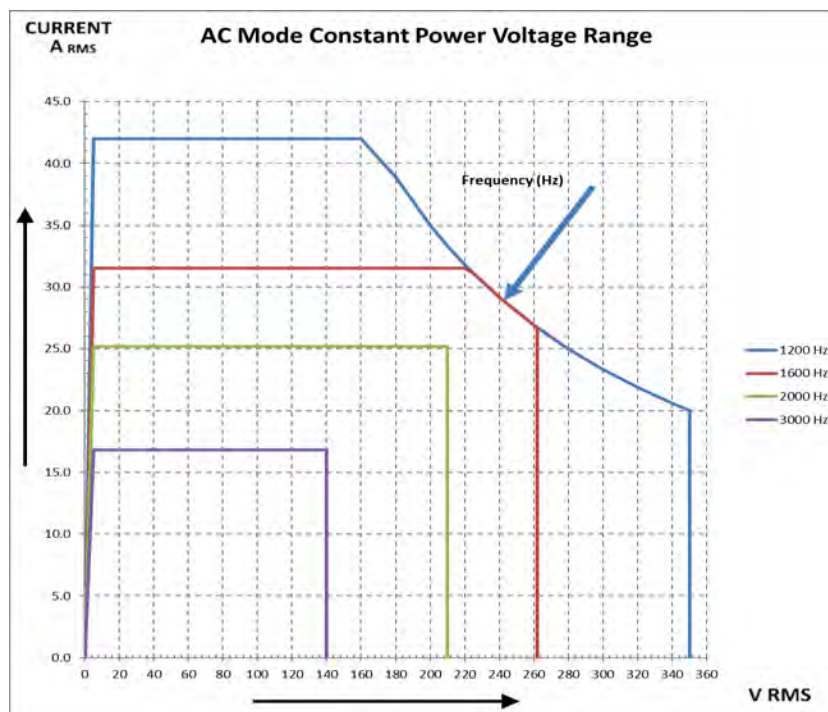


Figure 4-8: 1200Hz ~ 3000Hz Freq. Range Voltage vs. Current - 21kVA models in 3 Phase Mode

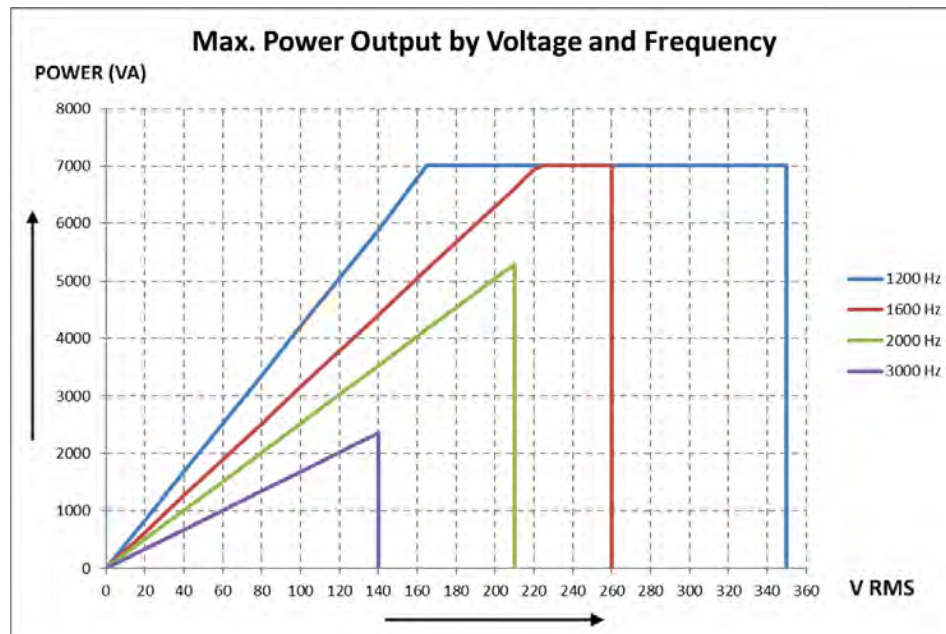
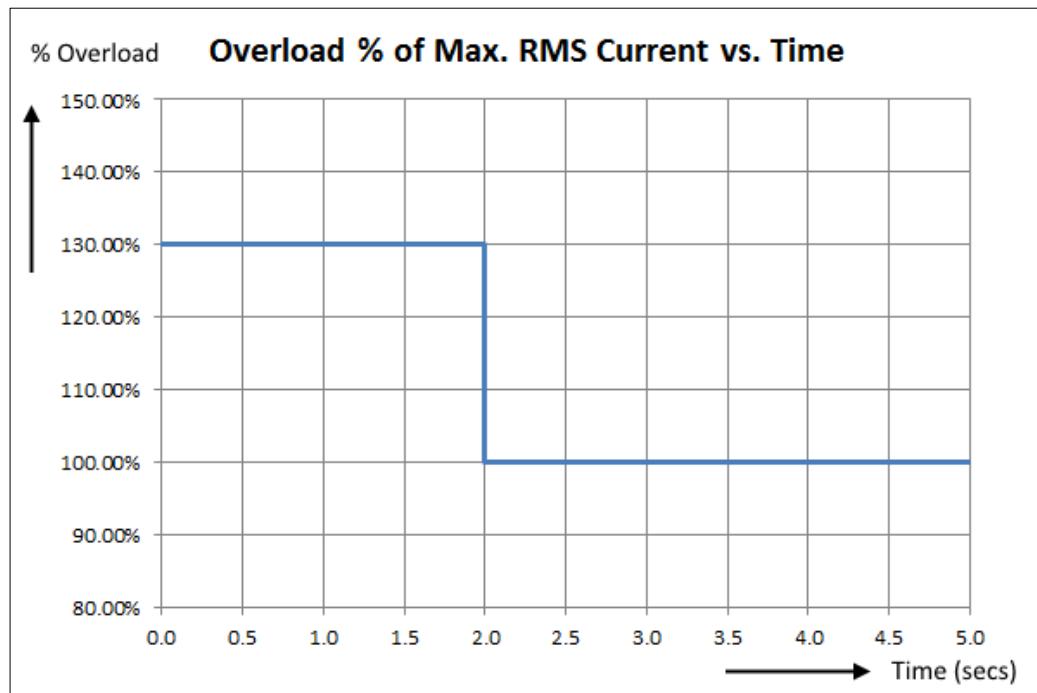


Figure 4-9: 1200Hz ~ 3000Hz Extended Freq. Range Power – 21kVA models in 3 Phase Mode

4.11 Temporary Current Overload



4.12 Protection Modes

PROTECTION	
Voltage Source Mode	
Protection Modes	Over Current fold-back or trip
	Progr. Peak Current Limit
	Power fold-back or trip
	Apparent Power fold-back or trip
	Over Voltage trip
	Over Temperature
OVP Range	0 - 105% Vmax
AC Input Voltage	Over and Under Voltage
Current Source or Load Mode	
Protection Modes	Over Voltage trip
	Programmable Voltage Limits
	Power fold-back or trip
	Over Temperature
OVP Range	0 - 105% Vmax

4.13 Metering

Technical specifications for measurements shown here apply at an ambient temperature of 25° C ± 5° C

MEASUREMENTS	
Voltage AC ⁽¹⁾	
Range	L-N: 0 – 350 V rms; L-L: 0 – 610 V rms
Resolution	FP: 0.01 V / Bus: 0.001 V
Accuracy	± 0.25% F.S.
Frequency (AC Mode Only)	
Range	15 – 1200Hz
Resolution	0.01 Hz
Accuracy	± 0.1% Reading
Current AC ⁽²⁾	
Range	See model table in section 4.1 or 4.2
Resolution	FP: 0.01 A / Bus: 0.001 A
Accuracy	± 0.5% F.S.
Peak Current	
Range	4 x RMS current
Resolution	FP: 0.01 A / Bus: 0.001 A
Accuracy	± 1.5% F.S.
Crest Factor	
Range	1.00 – 5.00
Resolution	FP: 0.01 / Bus: 0.001
Accuracy	± 2.0% F.S.
True Power ^(2,)	
Range	See model table in section 4.1 or 4.2
Resolution	FP: 1 W / Bus: 0.1 W
Accuracy	± 1.5% F.S.
Apparent Power ⁽²⁾	
Range	See model table in section 4.1 or 4.2
Resolution	FP: 1 VA / Bus: 0.1 VA

MEASUREMENTS		
	Accuracy	± 1.5% F.S.
Power Factor ⁽³⁾		
	Range	0.00 – 1.00
	Resolution	FP: 0.01 / Bus: 0.001
Voltage DC		
	Range	0- 500 Vdc
	Resolution	FP: 0.01 V / Bus: 0.001 V
	Accuracy	± 0.25% F.S.
Current DC		
	Range	See model table in section 4.1 or 4.2
	Resolution	FP: 0.01 A / Bus: 0.001 A
	Accuracy	± 0.5% F.S.

Note 1: AC Voltage measurement accuracy shown for Line to Neutral measurements. Line to Line voltage measurements are calculated based on VLN and phase angles and are < 0.5% F.S. and valid only for sinusoidal voltage waveforms with low levels of distortion and under balanced three phase load conditions. Applies to Voltage Source Mode only.

Note 2: Measurement Accuracies for Current and Power apply for load currents of 2.0 A or more.

Note 3: For Power level above 100 W

4.14 Other Measurements

Technical specifications for measurements shown here apply at an ambient temperature of 25° C ± 5° C

Measurements			
Waveform Capture			
Time Domain	1024 samples/period		
Parameters	V _{LN-A} , V _{LN-B} , V _{LN-C} , V _{LLAB} , V _{LLAC} , V _{LLBC} , IA, IB, IC		
Samples/cycle	1024 (512 in UPC Compatibility mode)		
Record Length	1 Period of fundamental Frequency		
Bandwidth / Sample Rate	3000 Hz / 54.93247 Ks/s		
Harmonics Measurements			
Parameters	V _{LN-A} , V _{LN-B} , V _{LN-C} , V _{LLAB} , V _{LLAC} , V _{LLBC} , IA, IB, IC		
Harmonics Range	H1 ~ H50		
Accuracy – Amplitude	± 1.0 % of RMS Reading		
Phase Angle Range	0 ~ 359.9		
Accuracy - Phase Angle	< 20 μsec		
Bandwidth	27,200 Hz		
	Max Harmonic measured @ Freq:		
	Fset	Max. no Harm.	Max. Freq
	15	50	750 Hz
	50	50	2,500 Hz
	400	50	20,000 Hz
	800	34	38,200 Hz
	1200	22	26,400 Hz
Display Modes	Table format, Graph Format		

4.15 Transients

Transients	
Programming	
No. of Entries	200 Steps, 400 Segments
Parameters	Voltage, Frequency, Phase B & C, Ramp Time, Dwell Time
Dwell Time Range	0.0 – 10,000,000 msec
Ramp Time Range	0.2 – 10,000,000 msec
Time Resolution	0.1 msec
Edit Modes	Add at End, Insert Before, Delete
Execution	
Run Control	Run from Step # to Step # Run, Step, Restart, Stop
Program Storage	
Non-Volatile	100, Programs + Transients

4.16 AC Grid Input

AC INPUT	6 kVA	9 kVA	12 kVA	15kVA	18kVA	21kVA
Frequency Range						
AC Input Frequency	47 - 63 Hz					
Connection	4 Wire, (L1, L2, L3 and PE) Delta					
208 Input (-2)						
Input Voltage Range	208 Vac ± 10%					
Nominal Line Current @ 208V 3ø	21 Arms	30 Arms	38 Arms	n/a	n/a	n/a
Max. Rated Phase Current	24 Arms	34 Arms	42 Arms	n/a	n/a	n/a
Efficiency	> 87%~90% (Worst case @ low AC line, max output current)					
380 ~ 480 Input (-4)						
Input Voltage Range	380 Vac – 480 Vac ± 10%					
Nominal Line Current @ 400V 3ø	10 Arms	14 Arms	19 Arms	24 Arms	29 Arms	34 Arms
Max. Rated Phase Current	12 Arms	17 Arms	23 Arms	27 A rms	32 Arms	38 Arms
Nominal Line Current @ 480V 3ø	8 Arms	12 Arms	16 Arms	20 Arms	24 Arms	28 Arms
Max. Rated Phase Current	9 A rms	14 A rms	19 A rms	23 A rms	27 Arms	31 Arms
Efficiency	> 90% (Worst case @ low AC line, max output current)					
Other						
Peak Inrush Current ¹	< 1.5 x I _{rms}					
AC Input Current THD	< 2 %					
Input Power Factor	> 0.99					
Internal Line Fuses -4 / -2			NOT USER SERVICEABLE			
Type	FUSE, SEMICONDUCTOR,22X58MM PPS P/N 712114					
Rating	80A,600VAC					

NOTE: For models consisting of multiple chassis, power input ratings apply to each chassis.

4.17 Dimensions & Weight

DIMENSIONS & WEIGHT	
Dimensions	
Height	7.0" / 178 mm / 4U
Width	17.0" / 432 mm – w/o rack handles 19.0" / 483 mm - with attached rack handles

¹ For nominal line input voltage

Depth	25.0" / 635 mm
Weight	
Net	111.2lbs. / 50.4 kg
Shipping	130 lbs. / 59 kg

NOTE: For models consisting of multiple chassis, multiply weight and height by the number of chassis.

See dimension drawing. 3D Step Models Available @ www.pacificpower.com.

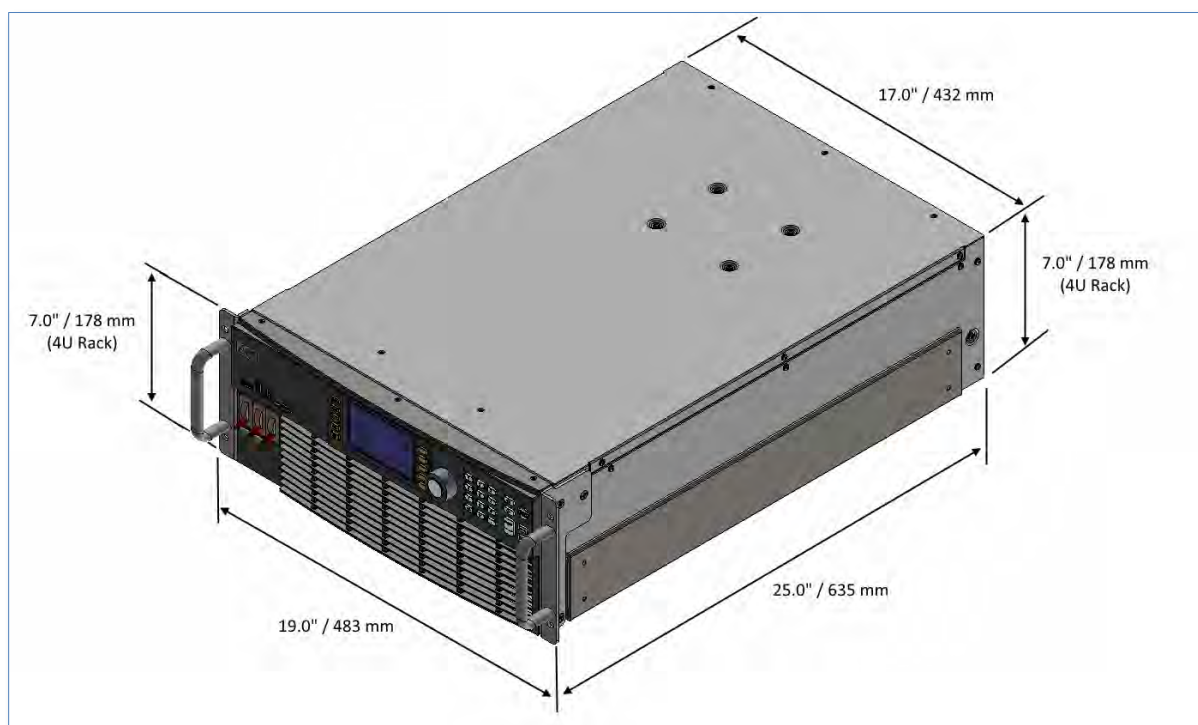


Figure 4-11: Dimension Drawing AGX, RGS & RLS Series®

4.18 Environmental

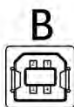
ENVIRONMENTAL	
Cooling	Fan Cooled
Audible Noise (at 1 meter)	Standby: 38 dBA Full power: 70 dBA typical
Operating Temperature	0 to 40 °C / 32 to 104 °F
Storage Temperature	-20 to 70 °C / -4 to 158 °F
Humidity	< 80%, non-condensing for temperatures up to 40° C
Altitude (max.)	2000 m / 6500 feet
Equipment ingress protection rating per IEC 60529	IP20

4.19 Safety & Regulatory

SAFETY & REGULATORY	
Safety Standard	EN 61010-1;2010 (Edition 3)
EMC Emissions	EN 55011:2009+A1:2010
EMC Immunity	EN 6100-4-2, -3, -4, -5, -6, -8, -11

Product Category	EN61326-1:2010 (Measurement, Laboratory and Control Equipment)
Approvals	CE Mark, NTRL Nemko US/Canada

4.20 Digital Interfaces

USB	
USB Standard	USB 2
USB Class	
Front Panel	Type A USB Host (2)
Connector	Type A, standard
Rear Panel	Type A USB Host (1) Type B USB Device (1)
Connector Types	 

RS232	
Baud rate:	9600, 14400, 19200, 38400, 57600, 62500, 115200
Parity:	O = Odd = uneven parity E = Even = even parity N = None = no parity bit
Number of data bits:	7 or 8
Number of stop bits:	1 or 2
Handshake:	Xon/Xoff
Signal Levels:	
Inputs (RxD)	Maximum input voltage: ± 25 V Input Impedance: 5 k Ω typical Switching thresholds: $V_H < -3$ V, $V_L > +3$ V
Outputs (TxD)	Output voltage (at $R_{LOAD} > 3$ k Ω): min ± 5 V, typical ± 5.4 V Output Impedance: < 300 Ω min., 10 M Ω typical in power off state Short circuit current: Typ. ± 35 mA typical

Ethernet (L)	
Protocol	Ethernet TCP/IP, 100Mb/1000Mb
Connector	RJ45
Webserver	Built-in
LXI Compliance	Core, version 1.4

GPIO	
IEEE Standard	IEEE488.1, IEEE488.2 (2003 incl., NI HS488) IEC 60488-1, IEC 60488-2 (2004)
IEEE Functions Supported	SH1, AH1, T6, L3, SR1, RL1, DC1, DT1
Connector	Amphenol 24 pin, Micro ribbon connector. Rear Panel Set screws: M3.5x0.6 metric threads.

Remote Inhibit	
Operation	Contact closure enables Output On/Off control Open circuit disables On/Off control
Modes	Disabled, Live or Latching (Configurable)
Connector	Rear Panel (See Auxiliary I/O)

4.21 Auxiliary I/O

The following technical specifications apply to the Auxiliary I/O functions.

AUX I/O SIGNAL SPECIFICATIONS	
Digital Inputs	
Input Signals	Remote Inhibit, External Trigger Input, Phase Sync, User Inputs (3)
Voltage Levels	Logic low: $V_{in} < 0.4\text{ V}$ Logic High: $V_{in} > 2.0\text{ V}$
Input Impedance	10 k Ω
Absolute max. voltage	12V
Response time	From 50 to 500 msec
Digital Outputs	
Output Signals	<i>Open Collector (0.5A max. protection):</i> FORM Relay Control, Transformer Relay Control Note: DO1 and DO2 are TTL outputs with 5.2V output and 200Ω output impedance. Into a 5kΩ load, the output voltage is ~5V. Note: DO3 and DO4 are open-drain outputs with internal pull-up of 1k to 5.5V with a diode protection. At no load, these outputs will measure 5.5V. With a 5kΩ impedance, these outputs will measure ~4.6V. <i>TTL Level:</i> Relay State/Function Strobe / Trigger Out Phase Reference (sync output) User programmable outputs (2)
Voltage Levels @ 0.4 mA	Logic low: $V_{in} < 0.4\text{ V}$ Logic High: $V_{in} > 4.6\text{ V}$
Output impedance	200 Ω
Analog Inputs	
Signals	Analog Inputs (4) - AI #1, #2, #3, #4, user defined setpoint programming, not real time (50 to 500ms).
Voltage Range	-10V to +10V
Accuracy	$\pm 0.1\%$ F.S.
Sampling Rate	10 Hz or 10 times/sec
Open Circuit Level	2 ~ 3 % of F.S. if analog input is left floating (no connection)
Input Impedance	5 k Ω
Absolute max. voltage	12V
Response time	From 50 to 500 msec
Analog Outputs	
Signals	Analog Outputs (4) - user defined monitor (RMS and average measurements, 100ms)
Voltage Range	0V – 5V
Accuracy	$\pm 0.1\%$ F.S. (with 5 k Ω load or higher)
Update Rate	10 Hz or 10 times/sec
Output Impedance	< 10 Ω
Power	
Output	12.0 Vdc
Accuracy	$\pm 0.1\%$ Vdc
Max. Current	0.5 Adc
RS232	
Signals	Tx, Rx
Handshake	Xon/ Xoff
Baud rates	9600 – 460800 bps

Auxiliary I/O Signal Protection Information and Recommendations

- All the signals on the auxiliary I/O DB25 port have double insulation with respect to high voltage. They are safe to touch (SELV) and safe to connect to any other equipment.
- These signals are referenced to earth, so any data acquisition card or equipment used to control the power source should be referenced to the same earth as the power source. For the power source unit, earth is its chassis.
- If the controlling computer connected to the power source is connected to an earth with different potential - this can happen when using different outlets or AC utility circuits - , that voltage difference can damage low-signal circuits.
- Analog outputs cannot be negative and cannot be higher than 5V. Any DAQ card or instrument used to monitor/read these outputs must have a sufficient input voltage range.
- In general, it is recommended to limit signal input voltages with series resistors and clamping diodes in case the “source” can generate a voltage higher than the maximum allowed by the analog inputs of the power source. See relevant specification on the previous page.

4.22 IEC413 Interharmonics

The interharmonics functions are standard on the AGX and RGS Series and available as an option on the RLS Series. This feature supports inter harmonic generation. Models with this feature have the letter “C” in the model number designation immediately following the –“4U” part. For example, 3210AGX-4UC.

This option removes to user programmable features from the standard AGX feature set:

- User programmable output OVP level. The OVP level is fixed at the maximum allowable setting.
- User programmable Peak output current protection. The peak level is fixed at the maximum level.

Note: Disabling these features does not affect reliability of the power source.

Interharmonics control is available through SCPI bus commands only. No front panel user interface is included with this feature.

This interharmonics waveform generator may be used to support IEC61000-4-13 harmonics and interharmonics immunity testing of an EUT. An IEC413 Test Sequence for the SmartSource Suite web browser interface is available for feature. This test sequence handles all harmonics and interharmonics frequency steps and amplitudes programming.

Technical Specifications:

IEC413 Option C	
Frequency Range	15.00 Hz to 10,000 Hz
Amplitude Range	0.00 Vac to 300.00 Vac
Phase Angle Programming	0.0° to 359.9° with respect to Phase fundamental
Standard on Model	RGS Series
Available Option on Models	AGX & RLS Series

5 Unpacking and Installation

5.1 Inspection

The AGX, RGS and RLS Series® of AC power sources and loads are carefully inspected before shipment. If instrument damage has occurred during transport, please inform Pacific Power Source' nearest sales and service office or representative.

All models require three-phase AC input and are furnished with a compression terminal block for AC input. A suitable line cord and power disconnect is required (but not included) to connect these power supplies to the mains.

Refer to "check line voltage" to check the line voltage selection and fuse type.

Note: For input and output connections to cabinet systems, refer to Section 5.15, "Cabinet Systems" starting on page 92.

5.2 Lifting and Carrying Instructions



CAUTION

THIS UNIT IS HEAVY. Two persons are required to lift or carry this unit. DO NOT attempt to lift alone. DO NOT use the front panel rack handles alone to lift this unit. The unit must be supported in front and back when carrying.



AVERTISSEMENT

CET EQUIPEMENT EST LOURD. Deux personnes sont requises pour transporter ou soulever cet équipement. NE PAS tenter de soulever ou déplacer seul. NE PAS utiliser les poignées en face avant pour soulever l'appareil. L'équipement doit être pris en charge à l'avant et à l'arrière pour le transport.

This equipment weighs over 100 lbs. / 50 Kg and requires two persons to lift or carry. To remove the equipment from its packaging, use the provided handgrip openings on either side of the unit to lift the unit from its packaging and place it on a suitable surface that is rated to support the weight of the unit. Two persons are required to remove the unit from its packaging, one on each long side of the box. Refer to Figure 5-2 for reference.

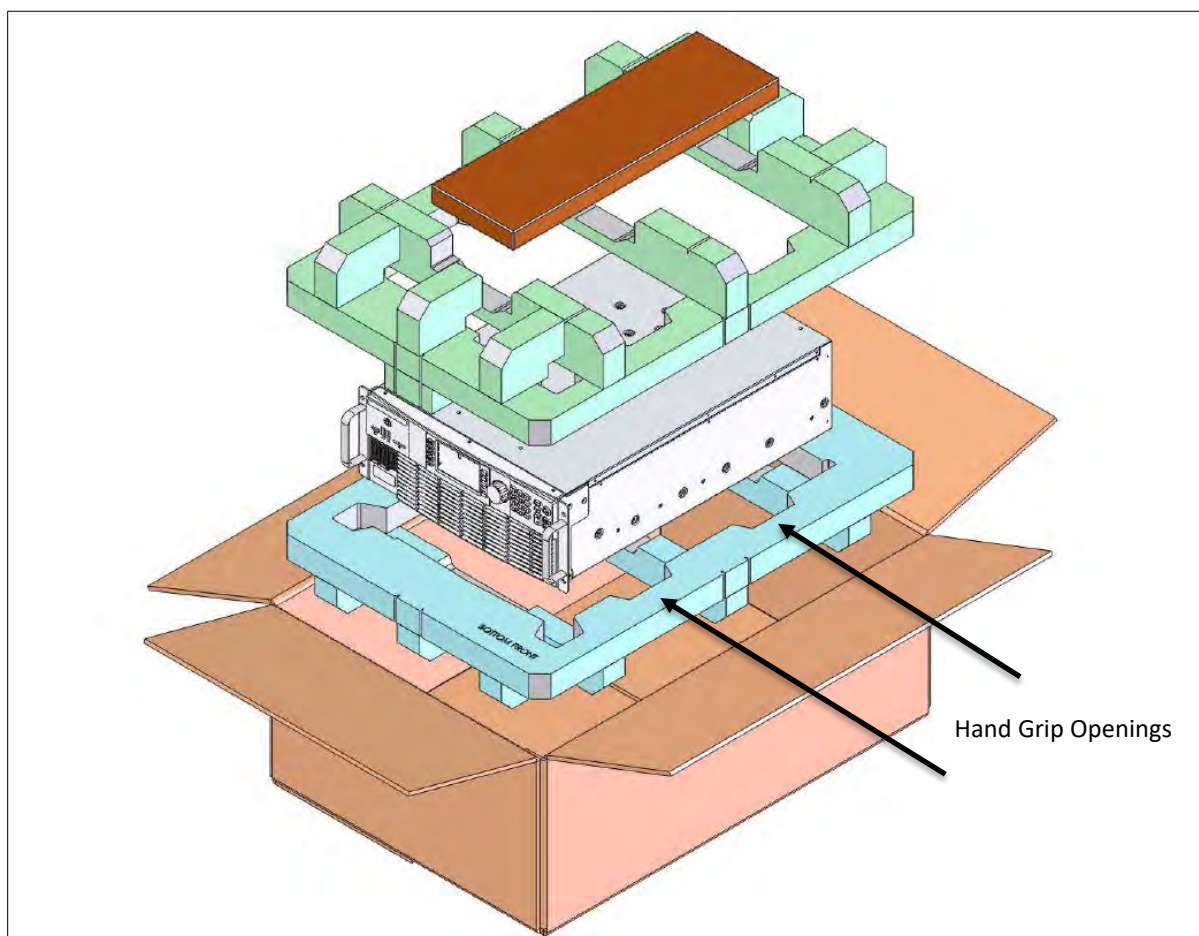


Figure 5-1: Exploded view of unit packaging.

If the unit is to be installed in an instrument rack, the straps may be removed. In that case, a suitable lift must be used to position the unit at the desired rack height and pushed in place using either rack slides or L-brackets (not included with the unit). The front panel handles may be used to pull or push the unit in or out of a rack space only.

Note: The front panel handles are not designed to carry the entire unit. It must be supported on front and back or both sides by two persons when being handled.

5.3 Verify Correct AC Input Line Voltage

Prior to connecting the AC power source to the local mains, it is important to check the type label on the unit to verify that its AC input configuration matches the local utility power.

Do not connect the power supply to the mains if the AC input voltage, phasing and frequency does not match.



CAUTION

DO NOT CONNECT A 380 – 480 V AC INPUT AGX MODEL TO A 208V TO 240V THREE PHASE UTILITY LINE VOLTAGE AS THE UNIT WILL NOT OPERATE.



AVERTISSEMENT

NE PAS CONNECTER UNE 380 - 480 V AC ENTRÉE AGX MODÈLE À UN 208V TO 240V TRIPHASE UTILITAIRE TENSION QUE L'APPAREIL NE FONCTIONNE PAS.

5.4 AC Input Connections



CAUTION

The AC input connections must include a disconnect device (an external switch or circuit-breaker) as part of the installation. The disconnect device must be suitably located and easily reached and must be marked as the disconnecting device for the equipment. The disconnect device must disconnect all line conductors simultaneously.

An external overcurrent protection device must be provided (by, e.g., fuses or circuit breaker). The breaking capacity of the overcurrent protection device should be compatible with the current rating of the installation.

A minimum of basic insulation is required between mains-connected parts of opposite polarity on the supply side of the overcurrent protection device.

Overcurrent protection devices shall not be fitted in the protective conductor. Fuses or single pole circuit-breakers shall not be fitted in the neutral conductor of multi-phase equipment.

Installation should be in accordance with ANSI/NFPA 70, NEC.

After disconnecting grid power, ALWAYS wait at least 1 minute, then use a Digital Voltmeter (DMM) in VDC Mode to check for any residual DC voltage from each Line terminal to the Chassis ground stud to check for safe voltage levels (< 5 Vdc) before touching the unit or any terminal blocks or pins.



AVERTISSEMENT

Les connexions d'entrée AC doivent inclure un dispositif de déconnexion (un commutateur externe ou disjoncteur) dans le cadre de l'installation. Le dispositif de déconnexion doit être convenablement situé et facilement accessible et doit être marqué comme le dispositif de déconnexion de l'équipement. Le dispositif de déconnexion doit déconnecter tous les conducteurs de ligne simultanément.

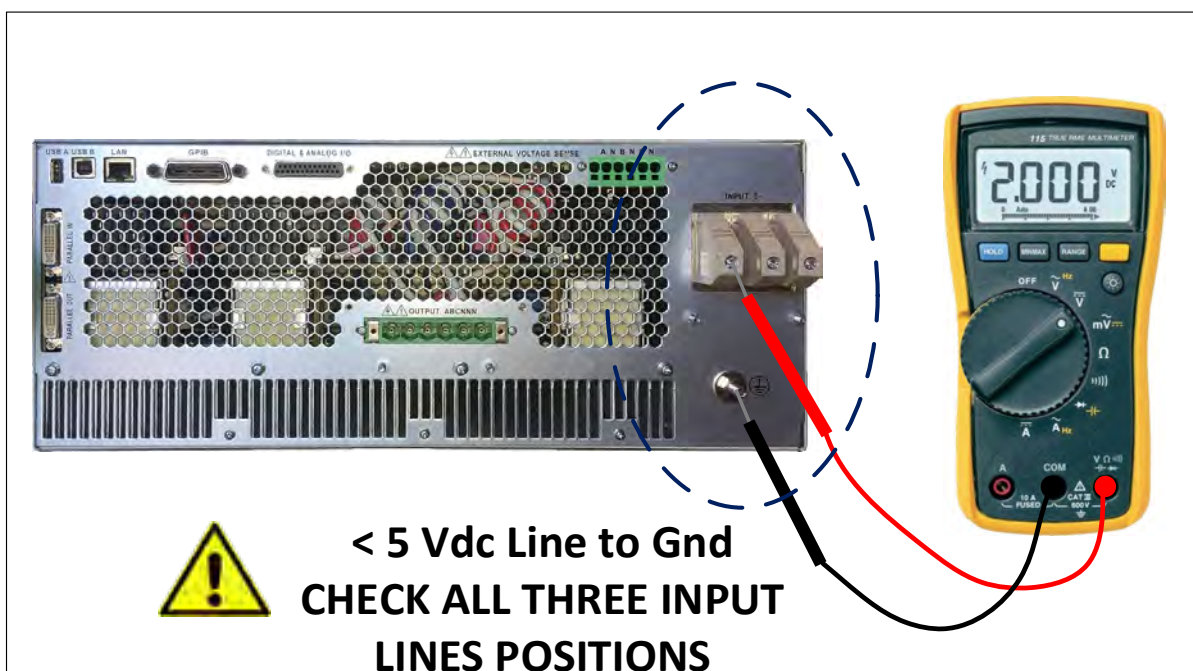
Un dispositif de protection de surintensité externe doit être fourni (par exemple, par des fusibles ou coupe-circuit). Le pouvoir de coupure du dispositif de protection contre les surintensités doit être compatible avec le courant nominal de l'installation.

Un minimum d'isolation de base est nécessaire entre les parties de réseau connecté de polarité opposée sur le côté d'alimentation du dispositif de protection contre les surintensités.

Les dispositifs de protection contre les surintensités ne doivent pas être installés dans le conducteur de protection. Fusibles ou simples disjoncteurs ne doivent pas être installés dans le conducteur neutre des équipements multi-phasés.

L'installation doit être conforme à la norme ANSI / NFPA 70, NEC.

Après avoir débranché l'alimentation du réseau, attendez TOUJOURS au moins 1 minute, puis utilisez un voltmètre numérique (DMM) en mode VDC pour vérifier toute tension CC résiduelle de chaque borne de ligne sur le plot de masse du châssis pour vérifier les niveaux de tension sécurisés (<5 Vcc) avant de toucher l'unité ou des borniers ou des broches.



Consult the table below for recommended wire size by model number and AC input rating.

MODEL	INPUT VOLTAGE	INPUT CURRENT @ 400 / 480 Vnom	RECOMMENDED INPUT SERVICE	MINIMUM COPPER WIRE SIZE, 75°C RATED
360AGX/RLS-4U	-4 = 380Vac ~ 480Vac ±10% -2 = 208Vac ~ ±10%	10 A rms, max / 8 A rms, max	14 A rms / 11 A rms	1.62 mm ² (AWG 18) 1.02 mm ² (AWG 20)
390AGX/RLS -4U		14 A rms, max / 12 A rms, max	20 A rms / 15 A rms	2.08 mm ² (AWG 14) 3.36 mm ² (AWG 12)
3120AGX/RGS/RLS -4U		19 A rms, max / 16 A rms, max	25 A rms / 20 A rms	3.36 mm ² (AWG 12) 2.08 mm ² (AWG 14)
3150AGX/RGS/RLS -4U 360AGX/RGS/RLS -2U		24 A rms, max / 20 A rms, max	30 A rms / 25 A rms	5.26 mm ² (AWG 10) 3.36 mm ² (AWG 12)
3180AGX/RGS/RLS -4U 390AGX/RGS/RLS -2U		29 A rms, max / 24 A rms, max	35 A rms / 30 A rms	5.26 mm ² (AWG 10)
3210AGX/RGS/RLS -4U 3120AGX/RGS/RLS -2U		34 A rms, max / 28 A rms, max	35 A rms / 35 A rms	5.26 mm ² (AWG 10)

Table 5-1: AC Input Wire Size Table

Note: Maximum wire size that will fit the AC Input terminal block is AWG 4.

AWG	Diameter		Turns of wire, without insulation		Area	
	(in)	(mm)	(per in)	(per cm)	(kcmil)	(mm ²)
4	0.2043	5.189	4.89	1.93	41.7	21.2

The AC input connections must be made at the rear panel AC terminal block. This input block has a removable safety cover that must be installed when the instrument is used on a bench or is otherwise accessible at the rear. If mounted in a cabinet with a locked door or screen, the AC input safety cover may be omitted if needed.

The following wire strip lengths are required for the AC input wires listed.

L1, L2, L3 Wires: 11/16", 17 mm

Neutral, Ground Wires: 3/4", 19 mm

Wire Strip Length

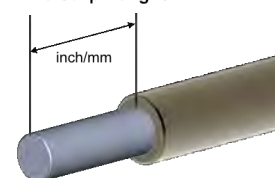
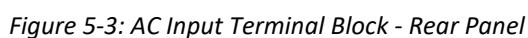


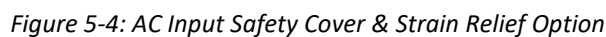
Figure 5-2: Rear Panel Layout

EARTH GROUND

The AC input terminal phasing is marked on the rear panel and shown in the illustration below. A four-wire mains connection is required. (L1, L2, L3 and Earth Ground). Ground connection is located directly below the AC Line input terminal block as shown in Figure 5-3 above.



For bench use or installation other than a 19" rack with rear safety screen, an optional safety cover with wire strain relief is available. P/N 128081-001 for 208V AC input models or P/N 128081-002 for 400~480V AC input models. This cover is pictured below.



5.5 Grounding Requirements

5.5.1 Chassis Ground Connection Required



CAUTION

SHOCK HAZARD: Equipment must be grounded.



AVERTISSEMENT

RISQUE DE CHOC: l'équipement doit être mis à la terre.

The unit **MUST** be grounded via the AC Input. A line cord with proper Earth Ground must be used at all times. Correct grounding of your electrical system infrastructure according to applicable national standards must also be observed.

5.5.2 Output Neutral Grounding

The output neutral terminals of the power source are **NOT** connected to earth ground but rather floating. This allows the output of the power source to float with respect to ground. Some loads will have their neutral input grounded, which will result in the power source neutral being grounded through the load. Alternatively, the user may ground the output neutral terminals himself by running a suitable wire size from one of the output neutral terminals to the ground stud on the rear panel of the power source as shown in Figure 5-5.

Grounding the output neutral can help reduce common mode noise at the output of the power source.

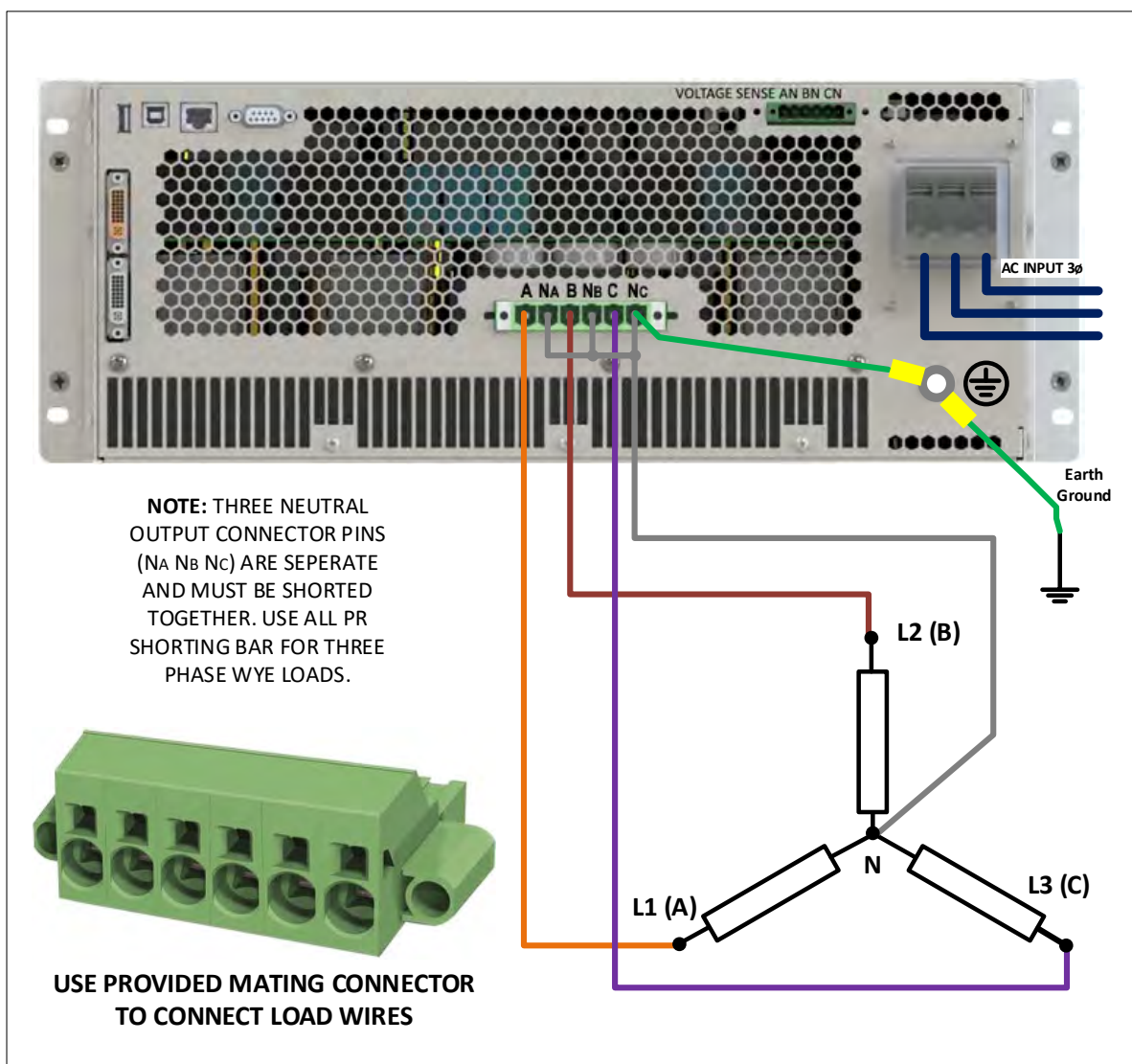


Figure 5-5: Grounding Floating Neutral Output

5.6 AC Input Circuit Breaker

This product is fitted with a mains input circuit breaker on the left hand side of the front panel. The power off position of the circuit breaker handle is marked “O”. The power on position of the circuit breaker is marked “I”.

5.7 Bench Use



CAUTION

When placing this instrument on a workbench or table, ensure the maximum weight rating of the bench/table exceeds the actual weight of the unit.



ATTENTION

Lorsque l'appareil est placé sur un banc de travail ou une table, s'assurer que la capacité de charge maximale du banc / table dépasse le poids réel de l'appareil.

The AGX Series® chassis is not equipped with surface protection feet as it is intended primarily for 19" rack mount use. When used on a bench, use care not to damage bench surface by sliding AGX unit.

5.8 Rack Mounting

The chassis is designed to be rack mounted in a standard 19-inch rack for system applications. Zero stacking with other units or test equipment is possible. The weight of the unit **MUST** be supported properly. Either use rack slides or L brackets of sufficient weight rating that are compatible with the dimensions of the cabinet used.

These units are available as factory installed 19" instrument cabinet systems including input and output wiring to connection terminal blocks at the bottom rear of the cabinet.

Customers (i.e. System Integrators) preferring to install one or more units in their own cabinet systems can order Master and multiple Auxiliary parallel systems as a **KIT** with no 19" cabinet or wiring included.

5.9 Airflow

The power sources or loads are cooled by drawing in air through the front and out at the back of each unit. Do not install units in a manner that blocks the free flow of air such as in a cabinet with a solid rear door. Allow a minimum of 6" (15 cm) free of obstructions behind the unit to prevent overheating.

5.10 Sound Levels



CAUTION

Sound pressure level from power source may exceed 70 dBA.

Sound pressure level should be measured both at the operator's position in normal use and at whatever point 1 meter from the power source enclosure that has the highest sound pressure level.

The installer shall provide measures to reduce the sound pressure level at the operator's point of use to a safe level. These measures may include the fitting of noise-reducing baffles or hoods or provision of protective earpieces.



AVERTISSEMENT

Le niveau sonore de l'appareil peut dépasser 70 dBA.

Le niveau sonore doit être mesuré à la fois à la position de l'opérateur en utilisation normale et quelque soit le point à 1 mètre de l'enceinte de l'appareil qui a le niveau sonore le plus élevé.

L'installateur doit prendre des mesures visant à réduire le niveau sonore au point d'utilisation de l'opérateur. Ces mesures peuvent inclure la mise en place de hottes antibruit, ou la fourniture d'oreillettes de protection.



When the equipment is operated at or near full rated output power, fan speed will be at its highest and corresponding noise levels will be higher. Operators should wear ear protection while exposed to these levels of sound.

5.11 Cleaning



CAUTION

BEFORE you clean the unit, switch the unit off at the front panel breaker AND remove all mains power using the mains disconnect.

- Please do NOT use any organic solvent capable of changing the nature of the plastic such as benzene or acetone.
- Please ensure that no liquid is allowed to penetrate this product.



ATTENTION

AVANT de nettoyer l'appareil, mettez l'appareil hors tension au niveau du disjoncteur de face avant ET retirez tout câble d'alimentation secteur.

- Ne pas utiliser **de** solvant organique capable de changer la nature de la matière plastique tel que le benzène ou l'acétone.
- Veiller à ce qu'aucun liquide ne pénètre à l'intérieur de l'appareil

To clean this product, use a soft or slightly damp cloth.

5.12 Air Intake Filter Removal and Cleaning

Units equipped with a removable air intake filter must have their filter material cleaned on a regular basis. A six-month cleaning interval is recommended. For units deployed in particularly dirty environments, this cleaning interval should be shortened to three months or less to prevent the air filter from clogging up with dirt. This applies to both Master units and Auxiliary units.

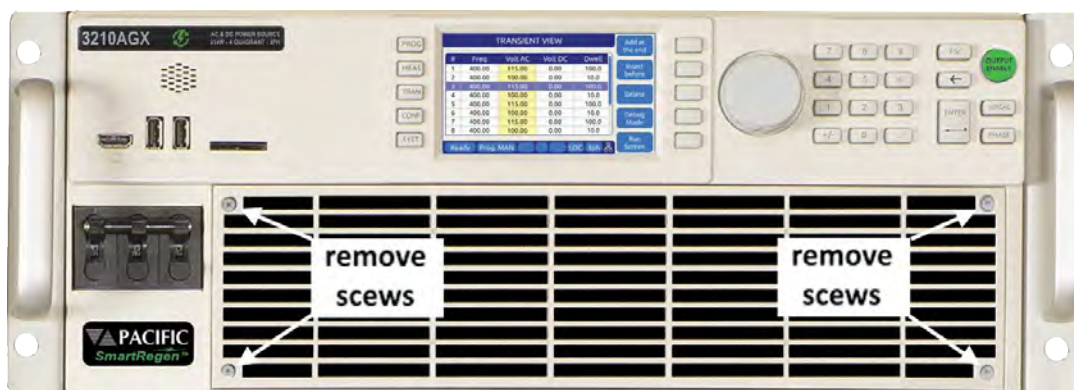


Figure 5-6: Air Intake Filter Removal

5.12.1 Air Filter Removal

To remove the air filter, proceed as follows:

1. Turn the unit off first.
2. Using a small Philips screwdriver, remove the four M3 Philips screws from each corner of the filter panel on the front of the unit.
3. Pull the filter panel toward you carefully and remove the filter material.

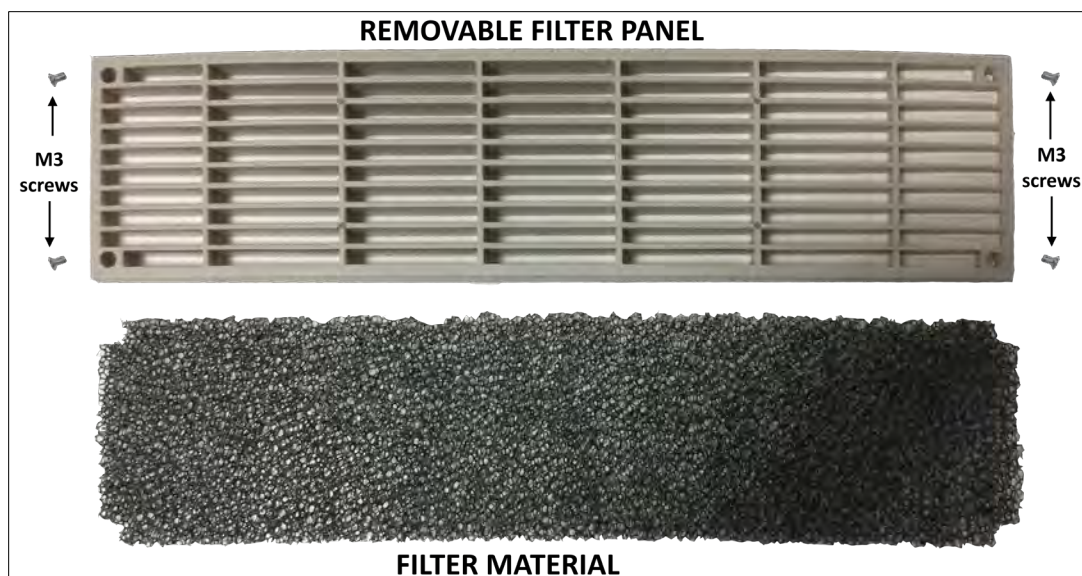


Figure 5-7: Air Intake Filter and Filter Panel

5.12.2 Filter Cleaning

Use warm water and some mild detergent to rinse all dirt out of the filter material. Allow the filter to dry for 2 hours or more till fully dry before re-installing. If the filter material is too dirty to clean, replace it with a new filter. Contact customer service for replacement filters.

5.12.3 Air Filter Installation

To reinstall the filter material, proceed as follows:

1. Place the cleaned filter material against the lower part of the units front panel.
2. Line up the filter materials so the corner cut-outs align with the four corners
3. Install the removable filter panel using the four M3 Philips screws.

5.13 Liquids

These products offer no protection against liquid spills. Do not install where chemicals are used or where liquids could spill into the unit.

5.14 Load Connections



CAUTION

HAZARDOUS OUTPUT: The power source output may be set to hazardous voltage levels. It provides basic isolation from the AC input mains. Therefore, the output must always be considered hazardous. Connections must be inaccessible to the operator in all situations when AC input mains voltage is applied. For RLS load, input terminal may be connected to hazardous voltage levels as well. Always disconnect power supply from the mains before connecting or disconnecting to the hazardous output terminals.



AVERTISSEMENT

SORTIE DANGEREUSE: La sortie de la source d'alimentation peut être réglée à des niveaux de tension dangereux. Il fournit une isolation de base du secteur d'entrée CA. C'est pourquoi la sortie doit toujours être considérée comme dangereuse. Les connexions doivent être inaccessibles à l'opérateur dans toutes les situations où la tension secteur d'entrée CA est appliquée. Pour la charge RLS, la borne d'entrée peut également être connectée à des niveaux de tension dangereux. Débranchez toujours l'alimentation électrique du secteur avant de connecter ou de déconnecter les bornes de sortie dangereuses.

The AC power source or electronic load can be configured for either single-phase output or three-phase output.

Note: The External Voltage Sense connector always has three phase and three neutral connections but in single-phase mode of operation, only the A phase and one neutral connection are required.

5.14.1 Output Wiring and Recommended Wire Sizing

Connections from the AC source output terminal to the load should be made using the provided mating output connector. This connector is safety rated and does not require an output cover. It **MUST** be used when connecting load wires.

Load currents are a function of the load so care must be taken by the user to select appropriately size output wires in accordance with local electrical codes.

Note: Since local electrical codes vary by location, Pacific Power Source **DOES NOT INCLUDE** any AC input or AC output wires with its power sources.

Maximum output voltage and current ratings of the available power source models are shown in section 4, "Technical Specifications" and should be consulted when determining correct wire size. Also consider the voltage insulation rating of the load wires and External voltage sense wires used.

5.14.2 Three Phase Wye or Split Phase Load Connection

Connection of a three-or split phase load requires the mating connector provided in the AGX Series® ship kit. This six-pole connector uses a spring loaded wire attachment system. To unlock a position, use a small screwdriver or pin to push down in the square hole located directly above each connection. Once you push in, you will feel the spring unlatch. Now push the stripped wire end into the connector and pull out the small screwdriver or pin. This will release the spring locking down the wire. Use a pull test to make sure the wire is clamped down securely.



Note: The output terminal diameter is 16 mm² so the largest wire gauge that can be used is AWG6.

AWG	Diameter		Turns of wire, without insulation		Area	
	(in)	(mm)	(per in)	(per cm)	(kcmil)	(mm ²)
6	0.1620	4.115	6.17	2.43	26.3	13.3

Repeat for the three (3 Phase load) or two phase (Split phase load) wires and the neutral wire. Note that the three neutral positions on the rear panel output power connector are not shorted together unless the shorting bar is installed. Thus, there are three neutrals, one for each output phase. For balanced three phase Wye loads, all neutral positions must be connected to the load's neutral position unless the neutral shorting bar is installed.

For split phase applications, the A and B phases are connected to the load. The C phase load and C phase Voltage sense connections are not used.

For bench use or setups where the rear panel is accessible, an optional output safety cover and wire strain relief is available as P/N 128080 pictured here.

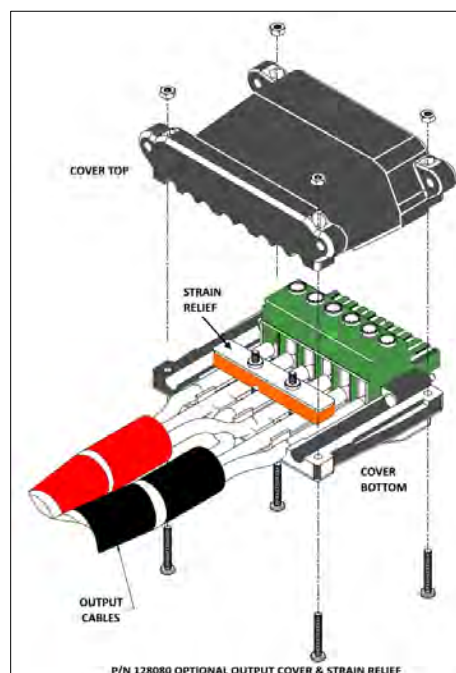


Figure 5-8: Output Cover
Option P/N 128080

The requisite WYE load output wiring is shown in Figure 5-8 using internal voltage sense and Figure 5-9 when using external voltage sense.

Note Load and sense wiring are **NOT** included with the power source and must be supplied by the end-user.

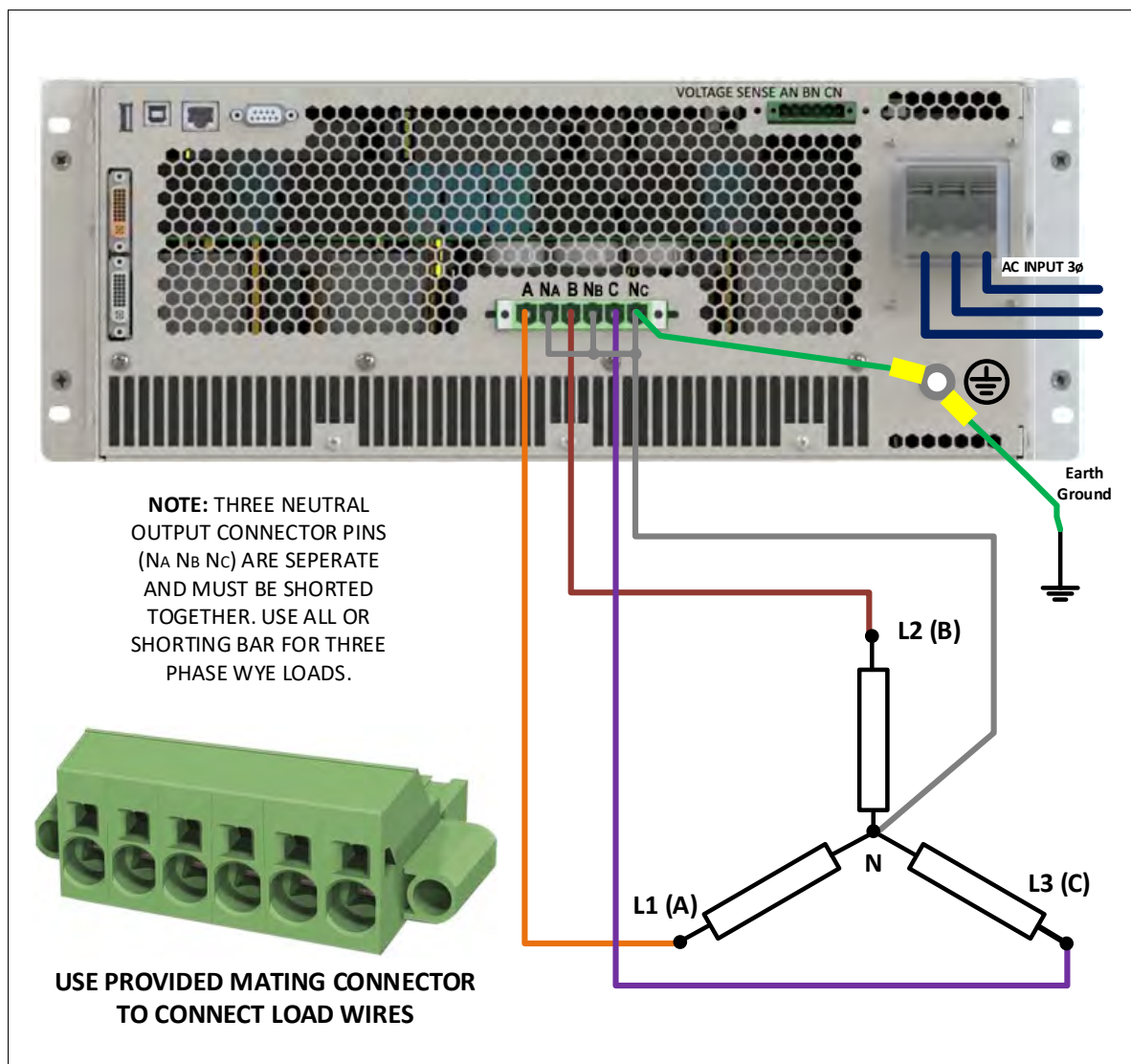


Figure 5-9: Three phase Wye Load Output Connections – Internal Voltage Sense

Note Load and sense wiring are **NOT** included with the power source and must be supplied by the end-user.

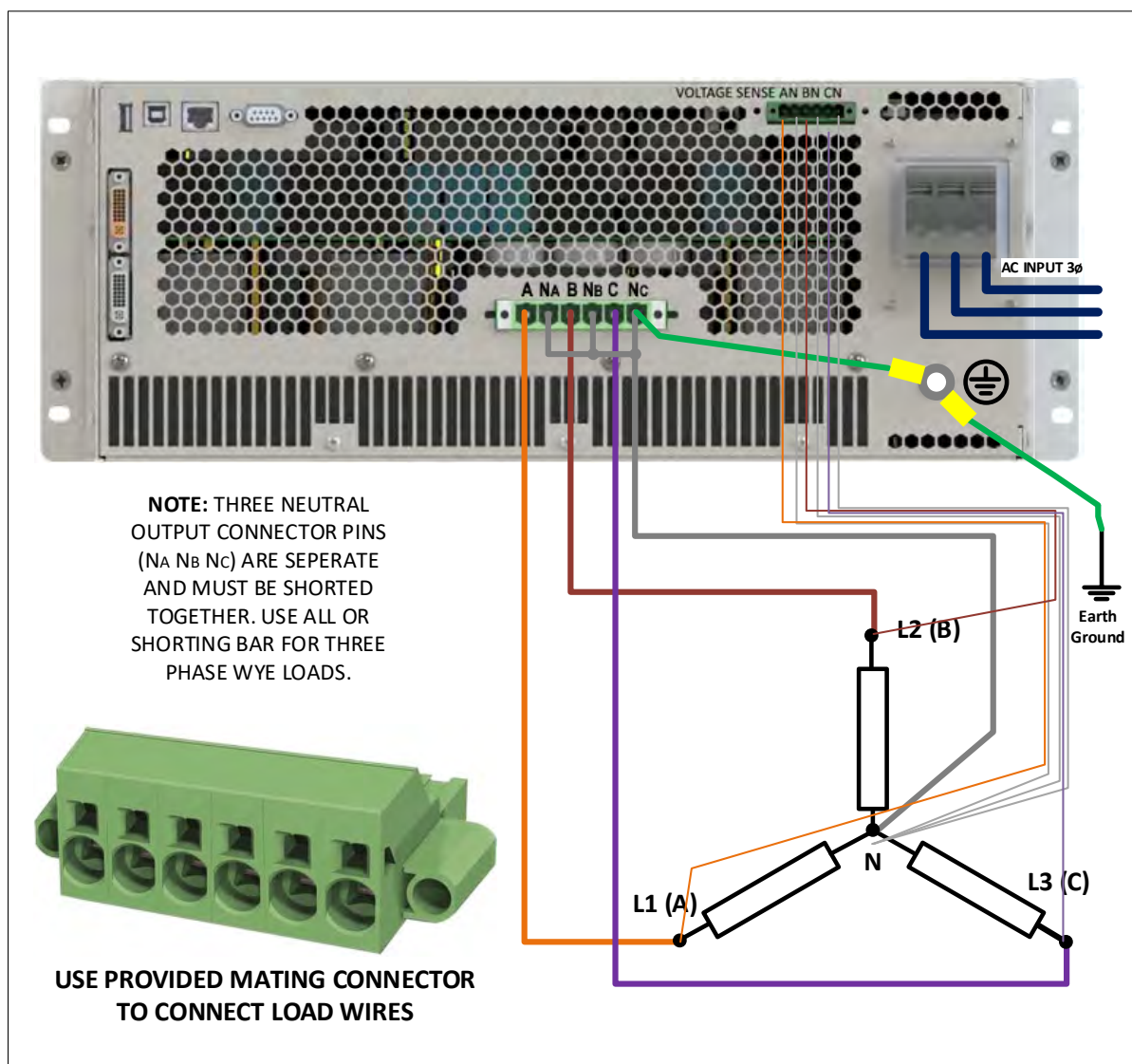


Figure 5-10: Three phase Wye Load Output Connections – External Voltage Sense

5.14.3 Three Phase Delta Load Connection

Connection of a three-phase load requires the mating connector provided in the AGX Series® ship kit. This six-pole connector uses a spring loaded wire attachment system. To unlock a position, use a small screwdriver or pin to push down in the square hole located directly above each connection. Once you push in, you will feel to spring unlatch. Now push the stripped wire end into the connector and pull out the small screwdriver or pin. This will release the spring locking down the wire. Use a pull test to make sure the wire is clamped down securely.

Note Load and sense wiring are **NOT** included with the power source and must be supplied by the end-user.



Note: The output terminal diameter is 16 mm² so largest wire gauge that can be used is AWG6.

AWG	Diameter		Turns of wire, without insulation		Area	
	(in)	(mm)	(per in)	(per cm)	(kcmil)	(mm ²)
6	0.1620	4.115	6.17	2.43	26.3	13.3

Repeat for the three phase wires. For Delta loads, there is no neutral connection.

The requisite DELTA load output wiring is shown in Figure 5-10 using internal voltage sense and Figure 5-11 when using external voltage sense.

Note Load and sense wiring are **NOT** included with the power source and must be supplied by the end-user.

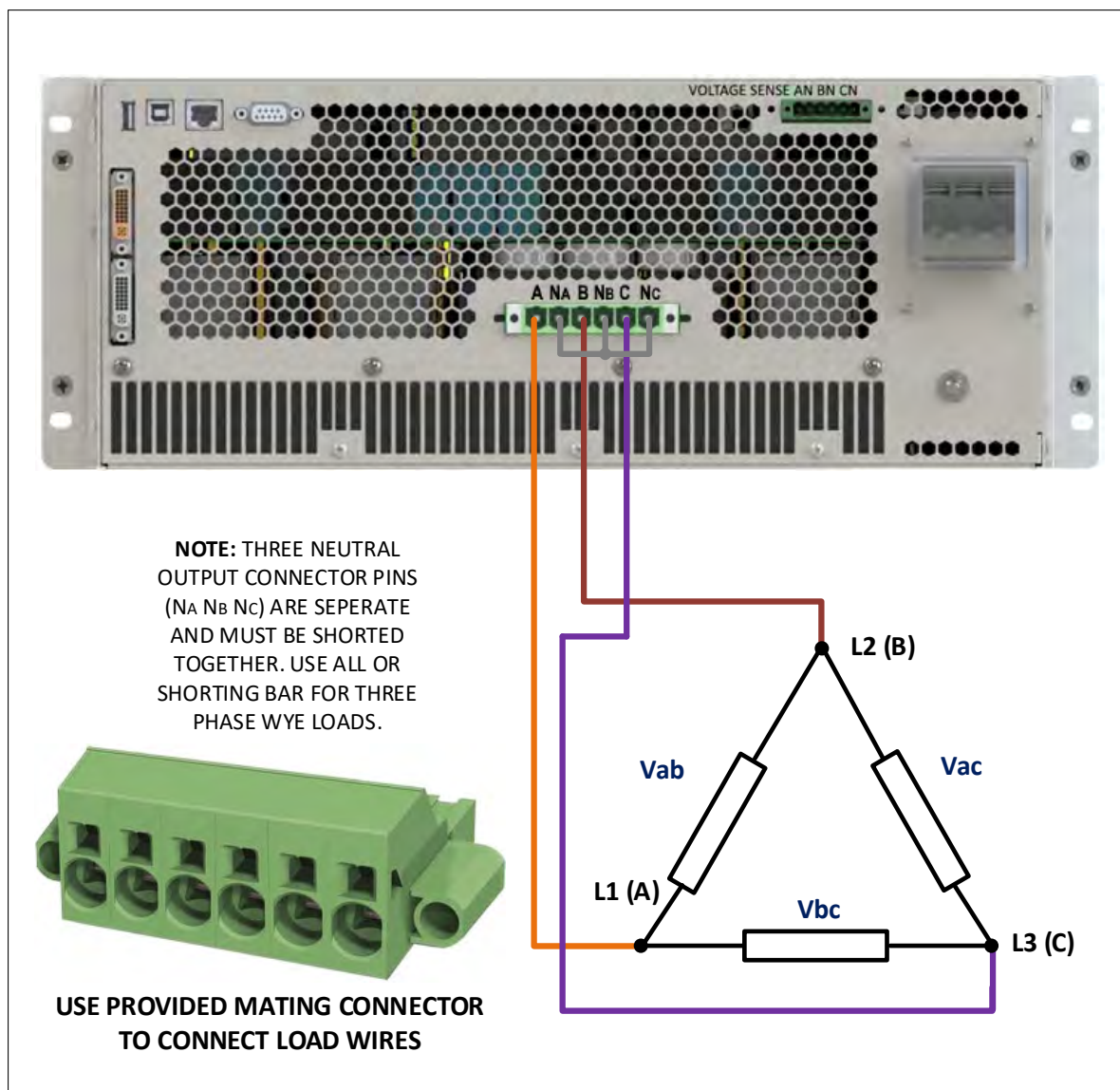


Figure 5-11: Three phase Delta Load Output Connections – Internal Voltage Sense

Note Load and sense wiring are **NOT** included with the power source and must be supplied by the end-user.

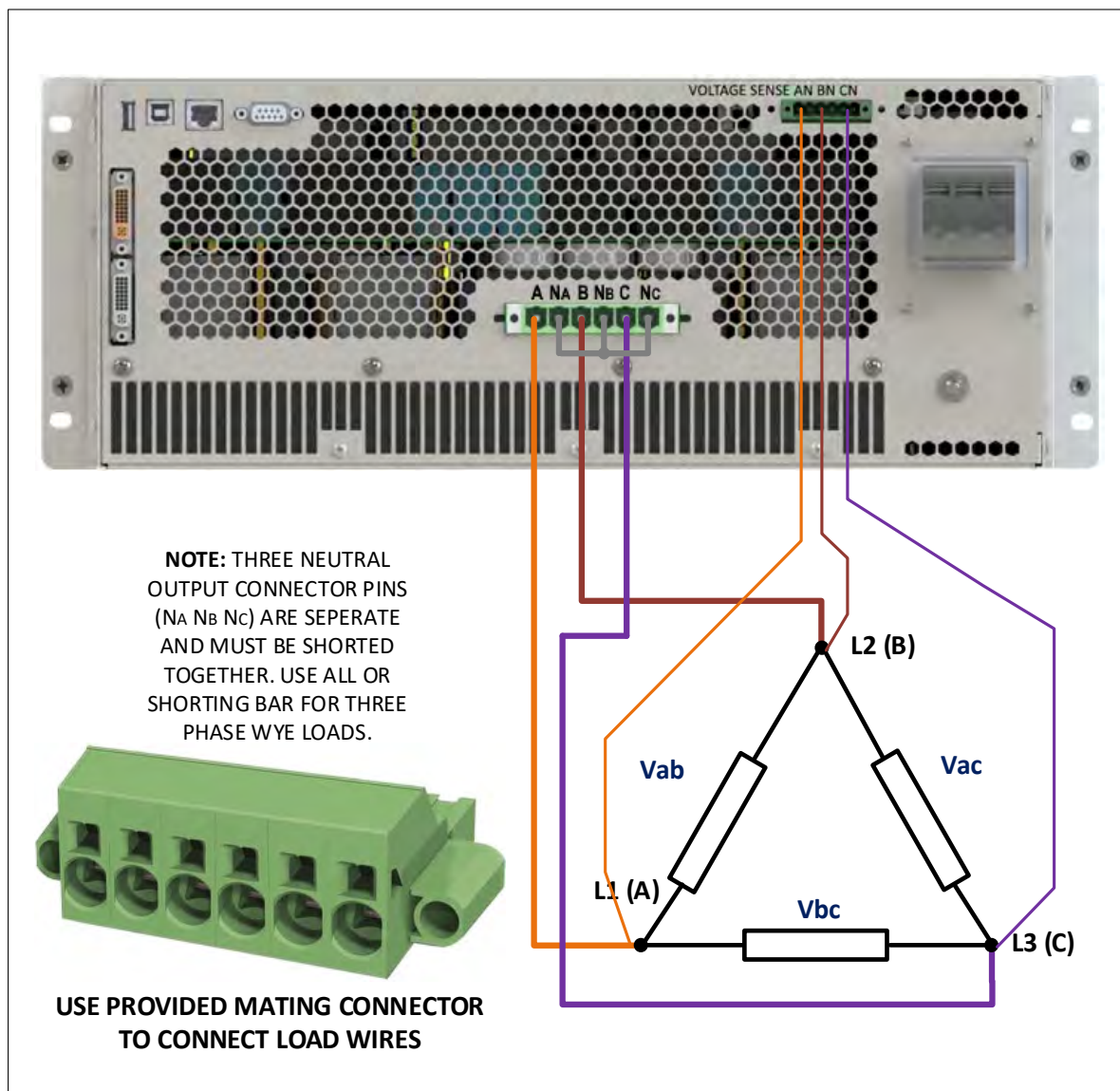


Figure 5-12: Three phase Delta Load Output Connections – External Voltage Sense

5.14.4 Load Mode STAR or DELTA Connections & W Option

When operating in electronic load mode – Option L or RLS models – care must be taken to use to correct three phase connections when connecting to a Delta AC Source. Unlike a Wye (aka Star) AC Source connection, to connect a 3-phase electronic load to a Delta AC Source, the load must be configured with isolated Neutrals for each phase on the “Output (load input)” Terminal block. This requires the “W” version which implies the unit is shipped from the factory with isolation Neutrals (NA, Nb and Nc). This means each phase (load input) has its own neutral, not internally connected to the other two phase (input) neutrals as is the case for a model without the W output configuration.

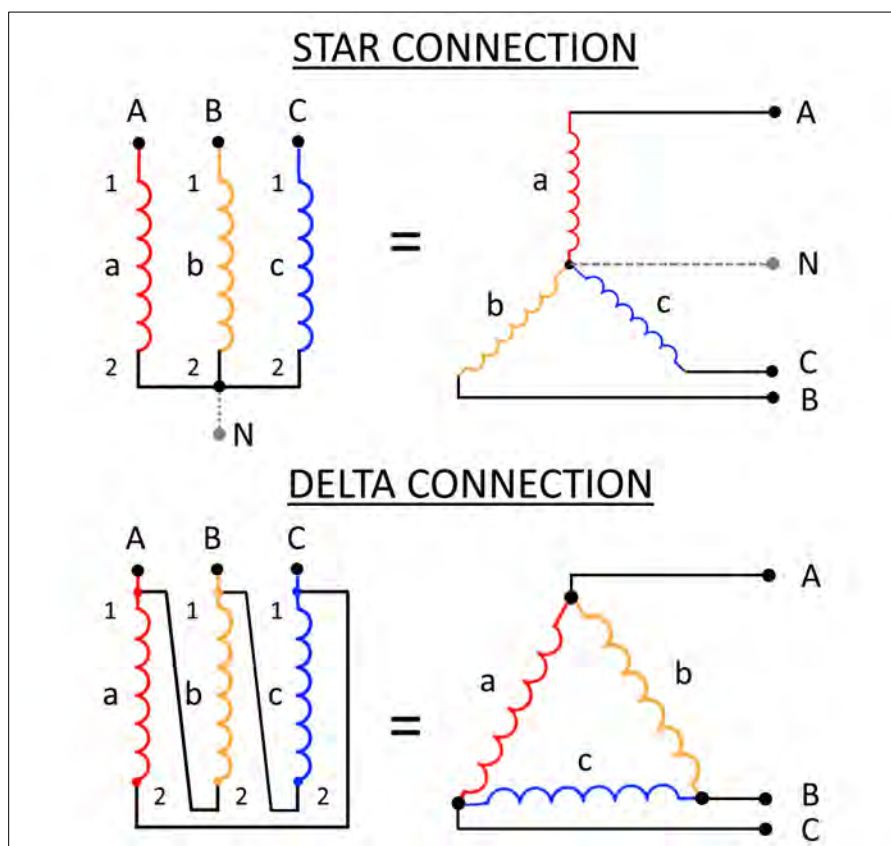


Figure 5-13: Three Phase AC Star versus Delta Connections

Note that in AC Voltage source mode, the unit can be connected to either a Wye or Delta three phase load without requiring isolated neutrals. For electronic Load or Current Source modes however, this will not work. The following conditions apply:

- RLS (load) in star + UUT (source) in star WORKS (with neutral connection to the RLS)
- RLS (load) in star + UUT (source) in delta DOES NOT WORK. Requires W option + delta connection in RLS
- RLS-W (load) in delta + UUT (source) in delta WORKS
- RLS-W (load) in delta + UUT (source) in star (no neutral connection) WORKS

5.14.5 Split Phase Load Connection

Connection of a split phase load requires the mating connector provided in the AGX Series® ship kit. This six-pole connector uses a spring loaded wire attachment system. To unlock a position, use a small screwdriver or pin to push down in the square hole located directly above each connection. Once you push in, you will feel the spring unlatch. Now push the stripped wire end into the connector and pull out the small screwdriver or pin. This will release the spring locking down the wire. Use a pull test to make sure the wire is clamped down securely.

For split phase EUTs, only phases A and B require connection to the unit under test. External voltage sense connections may be used if load wire voltage drop is to be compensated for.

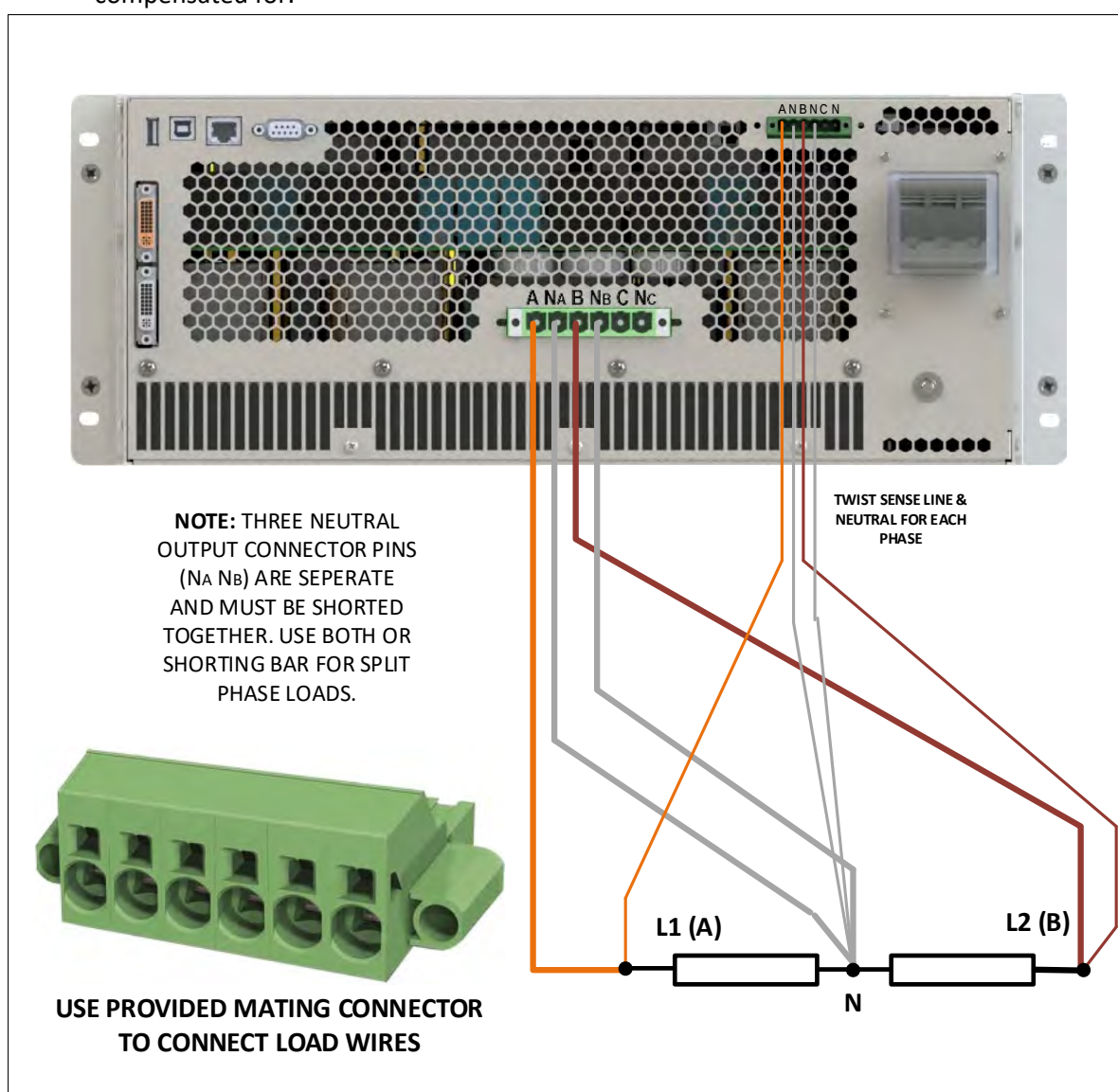


Figure 5-14: Split phase Load Output Connections – External Voltage Sense

5.14.6 Standard Output -4U Models & Option W - Load Connections

All units with the “U” letter after the -4 voltage input identifier are equipped with isolated neutral output boards as shown in image below. The Source output or Load input orientation is “A-NA-B-NB-C-Nc” as shown. -4 units with Option W configured have the internal neutral shorting bar removed and attached to the outside. This allows a unit with W option to support independent outputs (Source mode) or inputs (Load mode). The user can remove this shorting bar as needed as well on units that were shipped with it installed.

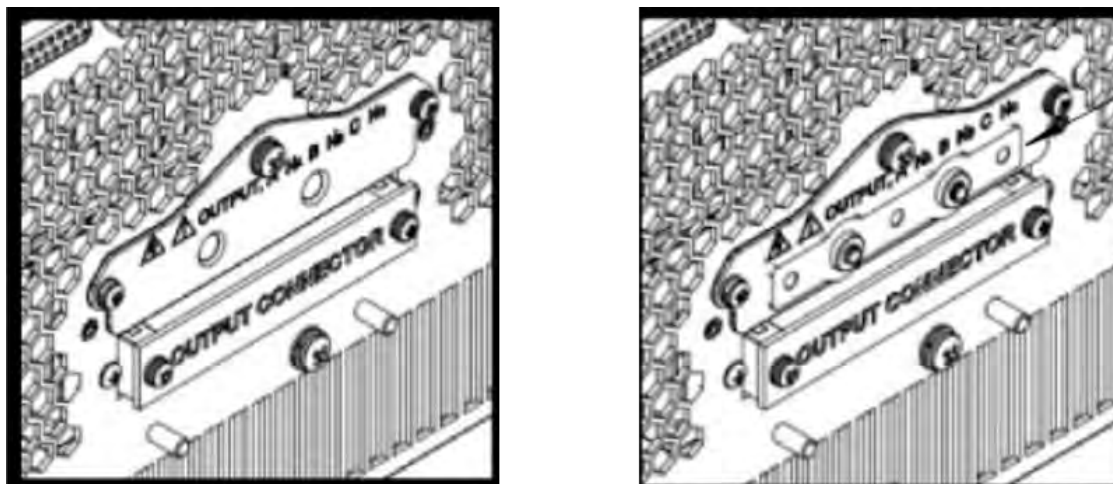
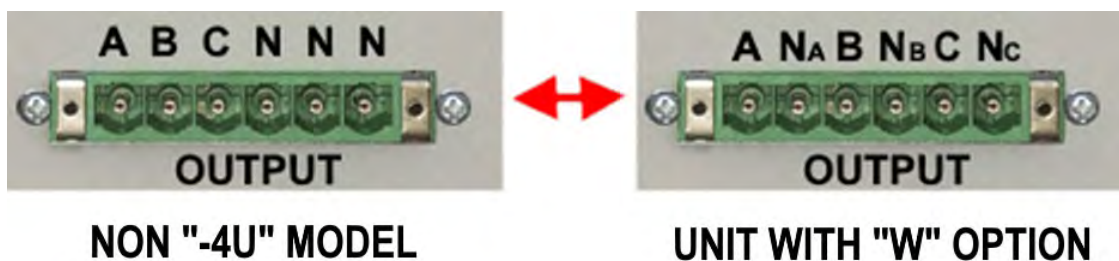


Figure 5-15: -4U Model Rear Panel – Standard on the Left or with W option on the right

Note the first year shipment -4 units (not -4U) were equipped with a different output board using a different pin out and shorted neutrals only. Same models were also offered with the “W” option that came equipped with an output board that has since become standard on AGX/RGS/RLS-4U models. See two versions below for AGX-4 and AGX-4W models.



5.14.7 Single Phase Load Output Connection

Connection of a single phase AC or DC load can be accomplished by using the three-phase mating connector available as an optional accessory. Single phase load connection requires shorting of the three phases or DC outputs. A power splicer terminal block like the one shown here may be used as well. Example of suitable splicer block is Marathon P/N 1322570, 600V, 175A.



Note Junction terminal blocks like the one shown above are **NOT** included with the power source and must be supplied by the end-user.

Connect phase A+B+C output to the Line connection of the AC load or DC+ side for a DC load. Connect all three-phase output connections to the Neutral connection of the AC load or the DC- side for a DC load. Refer to Figure 5-13 for single-phase mode load connection diagram.

Note Load and sense wiring are **NOT** included with the power source and must be supplied by the end-user.

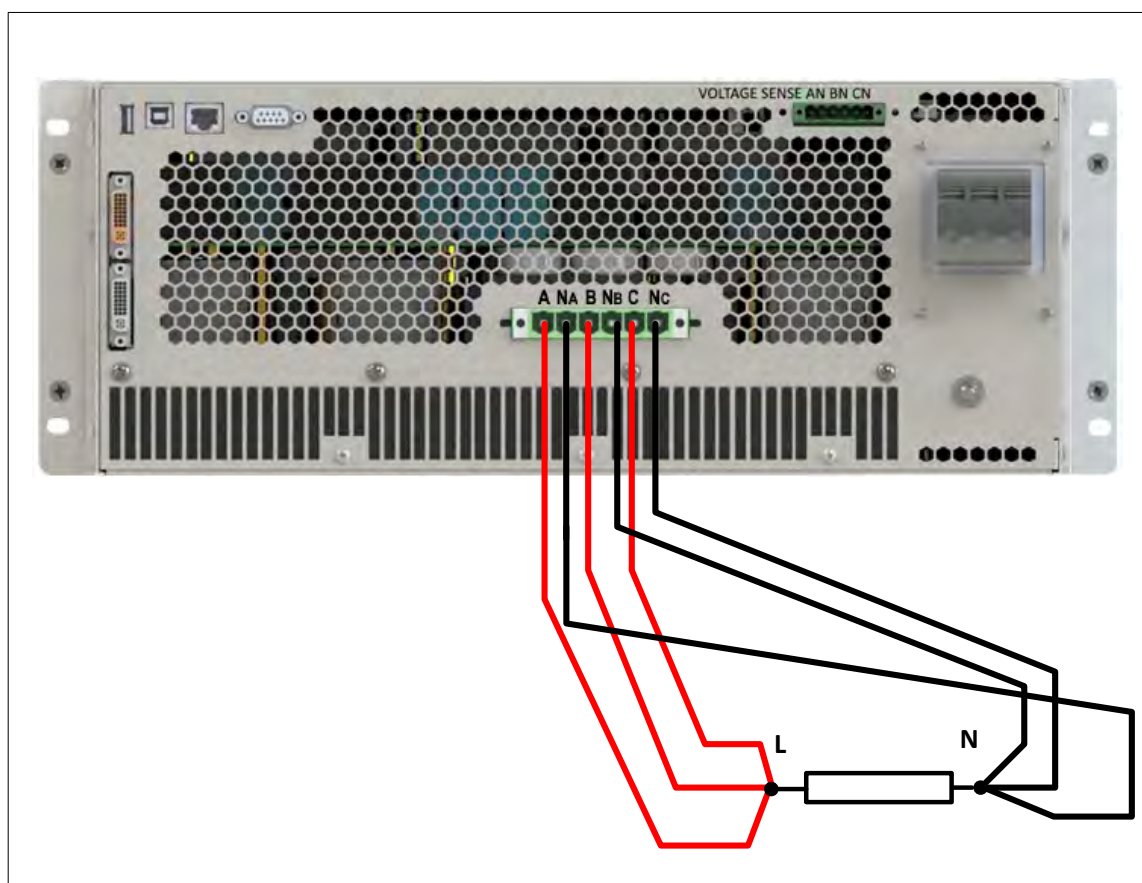


Figure 5-16: Single phase Load Output Connections (Models without W Option only)

5.14.8 External Voltage Sense Connections

**CAUTION**

HAZARDOUS OUTPUT: The power source output may be set to hazardous voltage levels. It provides basic isolation from the ac input mains. Therefore, the external voltage sense must also always be considered hazardous. Connections must be inaccessible to the operator in all situations when ac input mains voltage is applied.

Always disconnect power supply from the mains before connecting or disconnecting to the hazardous external voltage sense terminals.

Note Load and sense wiring are **NOT** included with the power source and must be supplied by the end-user.

**AVERTISSEMENT**

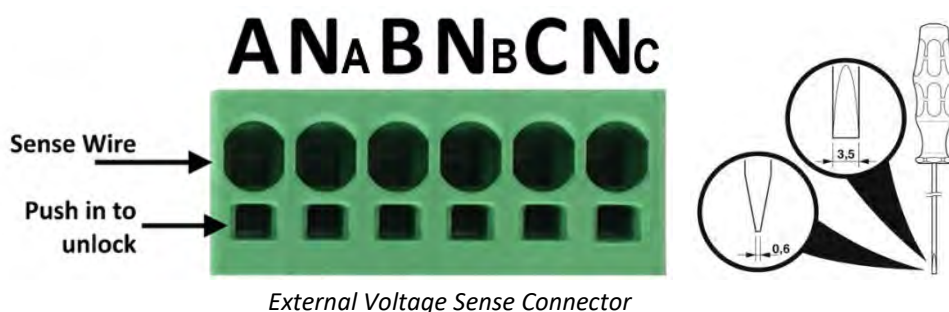
SORTIE DANGEREUSE: La sortie de l'appareil peut être réglée à des niveaux de tension dangereux. L'appareil fournit une isolation de base du réseau d'entrée AC. Par conséquent, les connexions de sense externes doivent toujours être considérées comme dangereuses. Les connexions doivent être inaccessibles à l'opérateur dans toutes les situations où la tension d'entrée secteur est appliquée.

Toujours débrancher l'alimentation secteur avant de connecter ou déconnecter les bornes de connexions de sense externes.

When using external voltage sense, sense wires must be connected between the rear panel External voltage sense terminal and the load. These wires do not carry any load current so can be sized accordingly.

Note: If the external sense connections are not used, the power source will use the local (internal) sense points at the output terminals instead to sense the output voltage. This means the sensed voltage may be higher than the voltage at the load as load wire voltage drops is not compensated when using internal sense.

The AGX, RGS and RLS Series uses a Push-in Spring connection type external voltage sense terminal that requires no mating connector. Use a small screwdriver² to push in the locking mechanism, push in the stripped sense wire ends and pull out the screwdriver to lock the wire in place. See for reference.



For three-phase sense connection wiring, refer to Figure 5-9 for 3 phase WYE load connections and Figure 5-11 for three phase DELTA load connections.

Note Load and sense wiring are **NOT** included with the power source and must be supplied by the end-user.

Note It is highly recommended to twist each phase and neutral sense wire and connect each neutral as the Vsense input neutrals are **not** shorted on the sense connector.

5.14.9 Powering Up

The following procedure should be followed before applying mains power:

1. Check that the front panel circuit breaker is in the OFF (O) position.
2. Verify that the model nameplate AC input specification match the local utility power.
3. Make sure that nothing is connected to any of the OUTPUT terminals on the rear panel.
4. Connect the correct AC mains line to the AGX Series® AC input terminal using a suitable three phase AC mains disconnect switch.
5. Close the AC mains disconnect to apply utility power.

² Actuation tool, bladed screwdriver, size: 0.6 x 3.5 x 100 mm

6. Turn on the front panel circuit breaker by pulling the lever upward to the “I” position.

Note: Allow about 3 to 5 seconds for the unit to fully initialize.

7. If the instrument does not turn on for some reason, turn OFF the front panel circuit breaker and verify the presence of the correct AC line input voltage using appropriate safety measures.

Note: For information on turning on cabinet systems, refer to Section 5.16, “Cabinet Systems Turn ON and Turn OFF Procedures” instead.

5.14.10 In Case of Malfunction

In the unlikely event of an instrument malfunction or if the instrument does not turn on despite the presence of the correct AC line voltage, please attach a warning tag to the instrument to identify the owner and indicate that service or repair is required. Contact Pacific Power Source or its authorized representative to arrange for service.

5.15 Cabinet Systems Installation

Parallel power sources or loads (-KITs) are available pre-installed and pre-wired in a 19-inch cabinet. These cabinet systems include all internal AC input and AC or DC output wiring. Several options can be added to these AGX cabinet systems as well.

Note AC Mains input cable, AC Load and sense wiring to the load are **NOT** included with the power source Cabinet and must be supplied by the end-user. Only internal cabinet wiring and terminal blocks are included.

5.15.1 Standard Cabinet Sizes

All standard cabinet systems feature the same depth and width, but height may vary by power level to accommodate more or less units.

The following three sizes are typically offered:

- 18U For power levels from 42kVA (2 units) to 63kVA (3 units)
- 32U For power levels from 84kVA (4 units) to 105kVA (6 units) per cabinet
- 42U For power levels from 126kVA (6 units) to 189kVA (9 units) per cabinet

Note that alternative cabinet sizes and power levels may be supported for other power requirements. Refer to cabinet dimension drawings shown below for the two available cabinet dimensions.

5.15.2 Standard Cabinet Features

Standard cabinets are equipped with an E-Stop button that will disconnect the cabinet power from the Mains. Also included is a signal output to drive an added light and two redundant outputs for additional external E-Stop button or PLC Control.

5.15.3 Cabinet Safety Level D Redundant Contactor Option - RCxx

This option (-RC18, -RC32 or -RC42 depending on cabinet height) provides these additional Level D safety provisions:

- Remote Reset – The cabinets circuit breaker will not trip, it can be reset with an external 24Vdc signal.
- No Idle power consumption.
- Built-in redundant contactor turn-off as required by PL class D.
- Parallel safety connection. Emergency shutoff will turn off the entire system.

Note: This cabinet interlock system is compatible with the safety system available on AZX/GSZ and ELZ Series units that have option D.

5.15.4 Tools Required

Installing AC Input and AC/DC Output cable connections to the terminal blocks furnished with cabinet systems may require the use of a Phillips screwdriver to remove the rear panel screen. #2 x 6 Phillips Screwdriver. Not included in Cabinet ship kit.



5.15.5 Dimensions 19" Racks

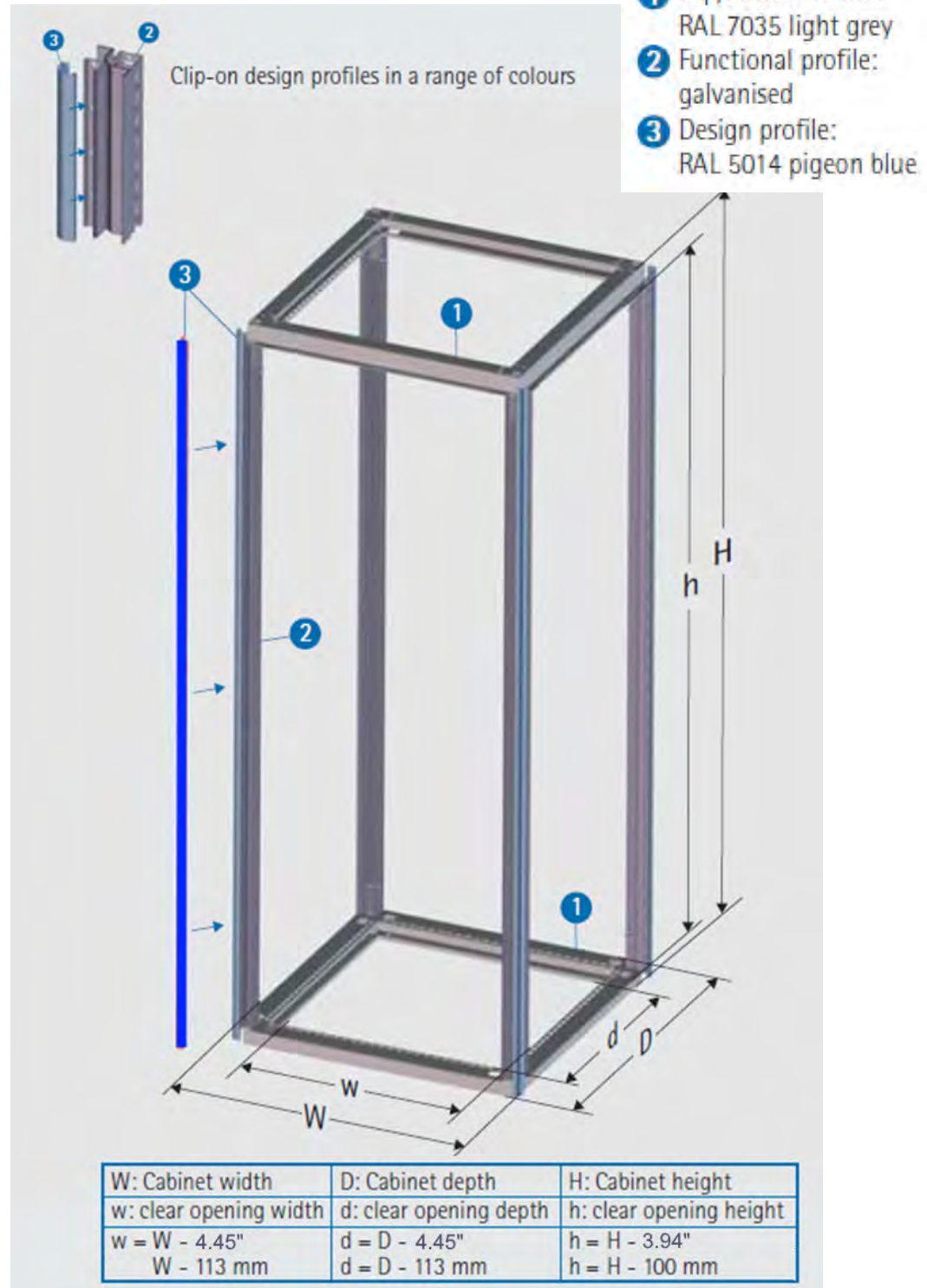
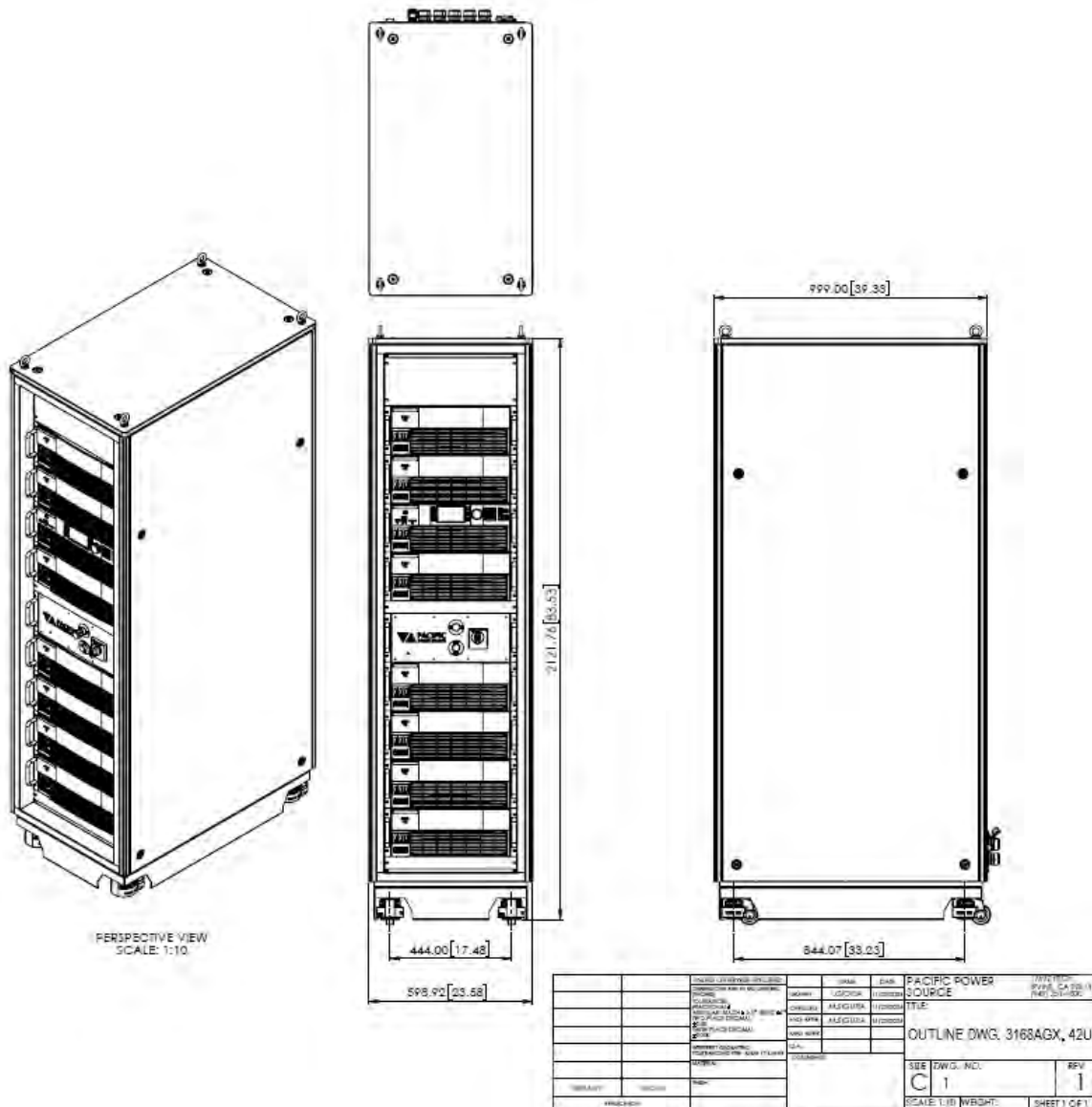


Figure 5-17; Cabinet Dimensions (Shown without side panels)

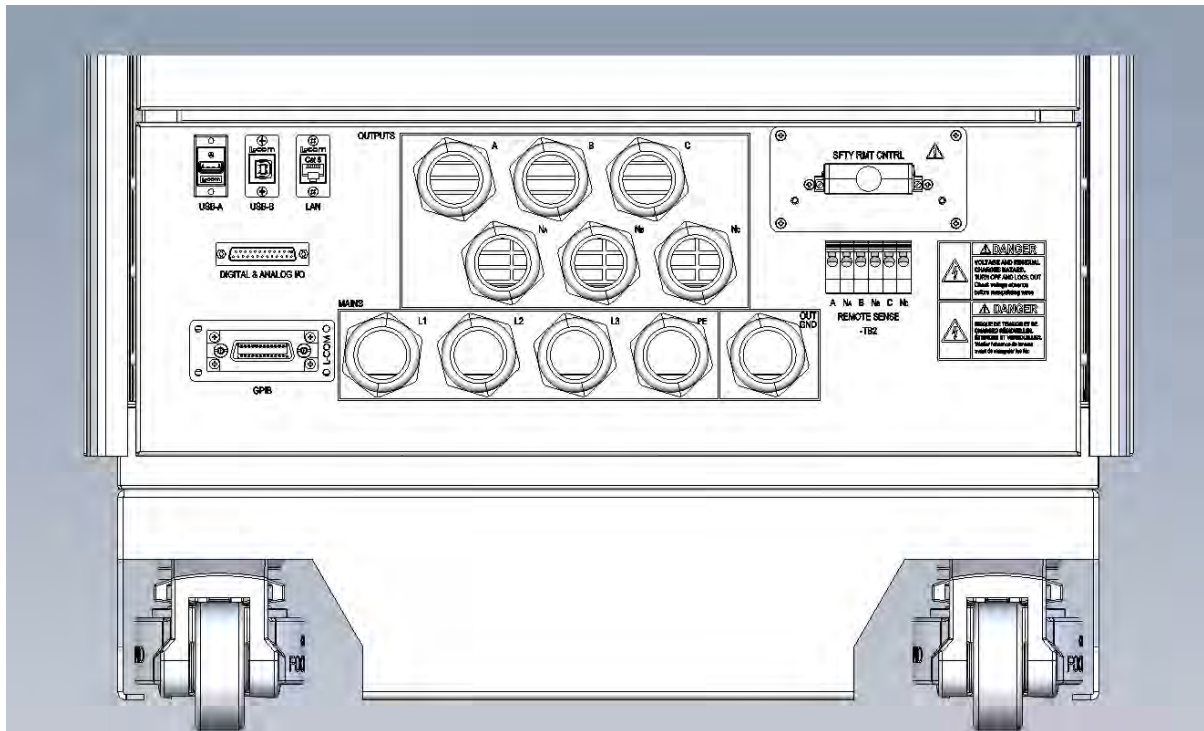
Cab Size	Height	Width	Depth
18U	35.4" / 900 mm	23.6" / 600 mm	39.4" / 1000 mm
32U	63.0" / 1600 mm	23.6" / 600 mm	39.4" / 1000 mm
42U	78.7" 2000 mm	23.6" / 600 mm	39.4" / 1000 mm

Figure 5-18: Cabinet Dimensions – Subject to Change

Dimension drawing for 42U Cabinet Size.



5.15.6 Cabinet System AC Input Connections



All input and output connections are located at the lower rear of the back of the cabinet. To access the internal terminal blocks, the rear panel must be removed temporarily by removing the screws that hold it to the cabinet's rear. User cabling pass throughs and strain reliefs for both input and output cables are provided on the lower rear filler panel.



Figure 5-19: Standard Cabinet Rear Panel Pass-thru

Note: Input and /or Output cables for grid power and load connections are **NOT** included with cabinets.

AC input ratings for Cabinet systems are the same as for individual units. The AC input rating is listed on the cabinet serial tag, which is located on the side of the cabinet. As sample Cabinet System label is shown below. Maximum AC input current rating is shown per phase for the entire cabinet at low line conditions.

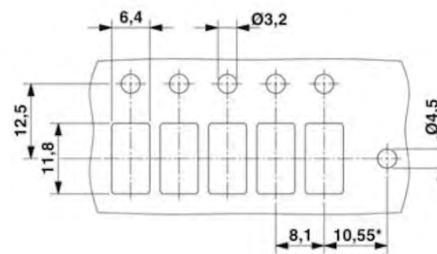
Note: The grid panel **MUST** be re-installed after all input and output wiring is installed.

5.15.7 Rear panel Items List

Remote sense TB2: PHOENIX CONTACT 3056925

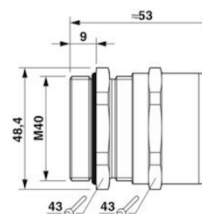
Panel feed-through External Voltage Sense terminal block, connection method: Push-in spring connection, Spade connection, number of positions:

1, load current: 18 A, cross section: 0.2 mm^2 - 4 mm^2 , connection direction of the conductor to plug-in direction: 45° , width: 8.1 mm, color: gray.



G-INS-M40-M68N-NNES-S - Cable gland pass-thru

Cable gland, material for screw connection: Brass, nickel-plated, application: Standard, external cable diameter 19 mm ... 28 mm, shielding: no, connecting thread: M40 x 1.5, color: silver, with O-ring.



RBO 10-HC - Bolt connection Input terminal block

Bolt connection terminal block, nom. voltage: 1500 V, nominal current: 309 A, number of connections: 2, number of positions: 1, connection method: Bolt connection, 1 level, Rated cross section: 150 mm^2 , mounting type: NS 35/7,5, NS 35/15, direct screw connection, color: gray.



MSTB 2,5/10-STF-5,08 - PCB Safety Remote Control Connector

PCB connector, nominal cross section: 2.5 mm^2 , color: green, nominal current: 12 A, rated voltage (III/2): 320 V, contact surface: Sn, contact connection type: Socket, number of potentials: 10, number of rows: 1, number of positions: 10, number of connections: 10, product range: MSTB 2,5/..-STF, pitch: 5.08 mm, connection method: Screw connection with tension sleeve, screw head form: L Slotted, conductor/PCB connection direction: 0° .



INPUT VOLTAGE RATING ON SYSTEM LABEL

AGX SERIES CABINET SYSTEM DATA				AC INPUT VOLTAGE	
MODEL	3630AGX-4			VOLTAGE	380 Vac-480 Vac, 3~
S/N		CABINET	1 OF 1	AMPS MAX	120A FREQ 47 - 63 Hz
IWA		W/O			
MOD		CAB. SIZE	27U		
UNIT#	MODEL	TYPE	S/N		
1	3210AGX-4	MASTER	105564002		
2	3210AGX-4NC	AUX	105684004		
3	3210AGX-4NC	AUX	105624005		
4					



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CAUTION: GRID DISCONNECT REQUIRED

Note that a suitable grid power disconnect switch must be provided between the grid connection and the AGX Cabinet AC input terminal block. Consult an electrician to ensure proper local electrical codes are used at all times.



ATTENTION : DÉCONNEXION DU RÉSEAU REQUISE

Notez qu'un sectionneur d'alimentation réseau approprié doit être fourni entre la connexion au réseau et le bornier d'entrée CA de l'armoire AGX. Consultez un électricien pour vous assurer que les codes électriques locaux appropriés sont utilisés à tout moment.

5.15.8 Recommended AC Input Wire Strip Lengths

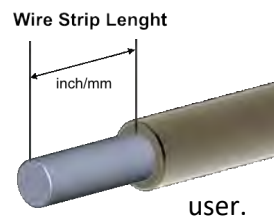
The following wire strip lengths are required for the AC input wires listed.

L1, L2, L3 Wires: 11/16", 17 mm

Neutral, Ground Wires: 3/4", 19 mm

Note AC input, AC Load and sense wiring are **NOT** included with the power source Cabinet and must be supplied by the end-Only internal cabinet wiring and terminal blocks are included.

Connect AC power as shown in the diagram below.



5.15.9 Cabinet System AC Input Neutral

These power sources/loads DO NOT require an input neutral connection as they operate from a Delta AC input of 380 to 480V L-L. However, some available cabinet options may

operate from Line to Neutral input voltage only. If so, a neutral must be brought into the cabinet (Wye). Refer to Section 5.17, “Cabinet System Options” for more details.

5.15.10 Cabinet System Grounding

All cabinet systems **MUST** be properly grounded using the provided GROUND terminal on the AC Input terminal block located inside the cabinet.



SAFETY NOTICE: GROUNDING

This product is a Safety Class 1 instrument (provided with a protective earth terminal). To minimize shock hazard, the instrument chassis or cabinet must be connected to an electrical safety ground. The instrument must be connected to the AC power supply mains through a properly rated three-phase power cable with protective earth (L1-L2-L3-E). 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.

This instrument may be equipped with a line filter to reduce electromagnetic interference and must be properly grounded to minimize electric shock hazard. Operation at line voltages or frequencies in excess of those stated on the model type plate may cause leakage currents in excess of 5.0 mA peak.

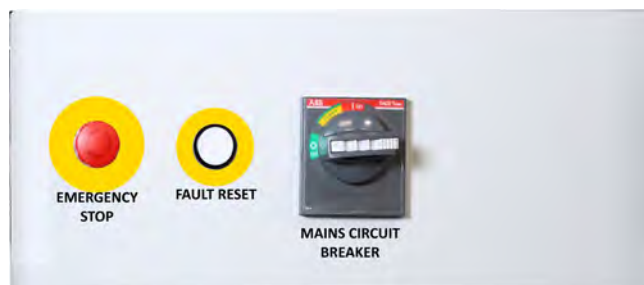


REGLE DE SECURITE: MISE A LA TERRE

Ce produit est un équipement de Classe 1 (muni d’une borne de mise à la terre). Pour minimiser le risque de choc électrique, le châssis de l’appareil ou de l’armoire/rack doit impérativement être relié à une terre de sécurité électrique. L’appareil doit être branché sur le secteur d’alimentation électrique à courant alternatif par un câble d’alimentation triphasé approprié avec terre de protection (L1-L2-L3-PE). Toute interruption de la mise à la terre de protection ou de déconnexion de la borne de terre causera un risque de choc électrique qui pourrait entraîner des blessures.

Cet appareil peut être équipé d’un filtre secteur pour réduire les interférences électromagnétiques et doit être correctement mis à la terre afin de minimiser le risque de choc électrique. Le fonctionnement sous tensions et fréquences supérieures à celles indiquées sur l’étiquette peut provoquer des courants de fuite de plus de 5,0 mA peak.

Standard cabinets are equipped with a Mains Input circuit breaker and Emergency Stop. To re-enable the cabinet after an energy off, use the FAULT RESET pushbutton.



5.15.11 Standard Cabinets Internal Connections

Standard 19" racks are typically equipped with individual per unit protective circuit breakers and internal AC bus bars to distribute Mains power to all installed power sources. This provides individual unit protection. →

Outputs for all installed power sources are routed to the rear bottom terminals in the cabinet using an internal shielded output bus bar system. (For Loads, these act as inputs). Both AC mains and power source/load output/input are connector based. This setup allows individual units to be installed or removed as needed without the need to disconnect internal wiring.

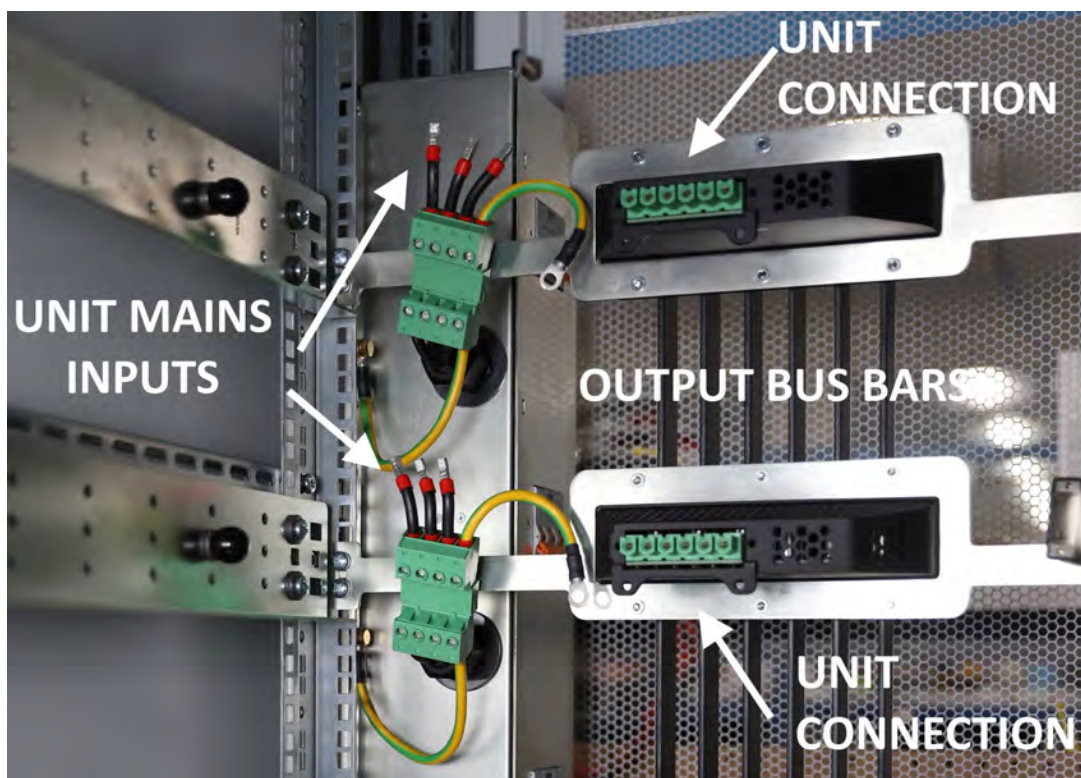


Figure 5-20: Cabinet Systems Internal Bus Bars

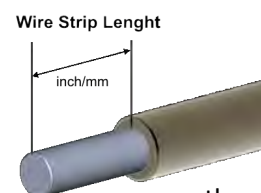
5.15.12 Recommended AC Output Wire Strip Lengths

The following wire strip lengths are required for the output wires listed.

Phase A, B & C Wires: 11/16", 17 mm

Neutral Wire: 1 9/16", 40 mm

Note AC input, AC Load and sense wiring are **NOT** included with the power source Cabinet and must be supplied by the end-user. Only internal cabinet wiring and terminal blocks are included.



5.16 Cabinet Systems Turn ON and Turn OFF Procedures

Cabinet systems can be turned on using one of two methods:

1. By using the centrally mounted Cabinet Mains Circuit breaker. This requires that the front panel breakers for all units mounted in the cabinet are in the ON Position (Level Up).
2. By using the front panel mounted circuit breakers on the master and auxiliary units. Turn On and Turn Off sequence recommendations are listed below and illustrated in Figure 5-20. The sequence is not critical as long as units are turned on within 15 seconds of each other. If more time elapses, an error may be displayed and the master/aux discovery process should be restarted from the PARALLEL UNITS screen in the SYSTEM menu. Refer to section 6.8.7, "PARALLEL UNITS Screen".

The figure below shows the position of the cabinet control panel that includes the Mains Circuit Breaker.

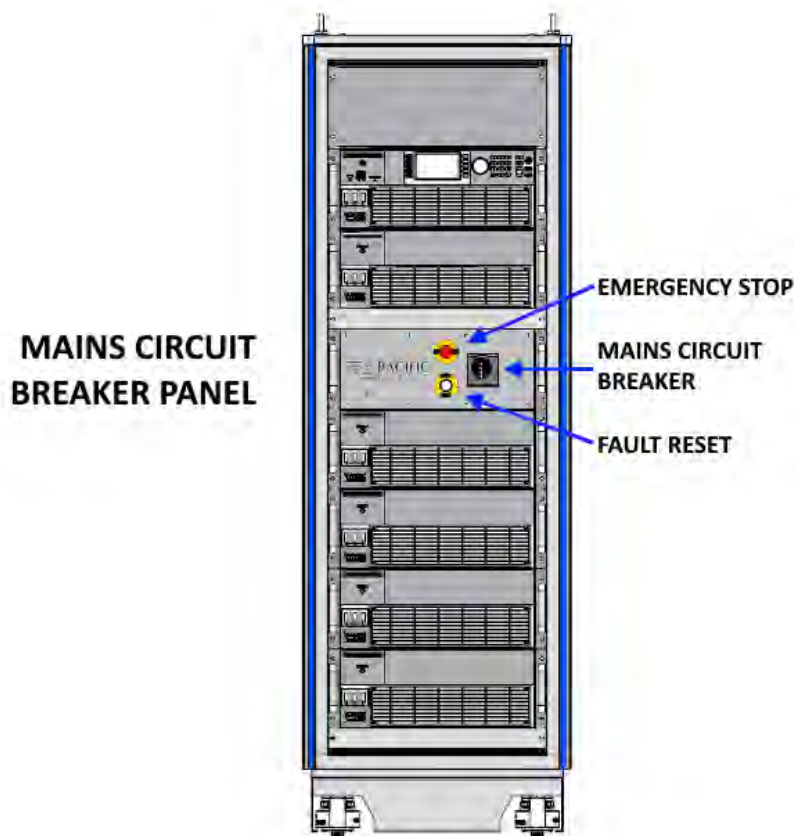


Figure 5-21: Cabinet System Mains CB Panel Location

5.16.1 Cabinet Power Turn ON using Circuit Breakers

The following turn on sequence is recommended:

1. Turn **ON** bottom auxiliary unit **first** by pulling its front panel circuit lever to the upward (ON) position.
2. Turn **ON** any additional auxiliary units between the bottom auxiliary unit and the top Master unit by pulling each front panel circuit lever to the upward (ON) position.
3. Turn **ON** the Master unit **last** by pulling its front panel circuit lever to the upward (ON) position.

This will ensure all auxiliary units are up and will be found when the master starts the discovery process.

5.16.2 Cabinet Power Turn OFF using Circuit Breakers

The turn off procedures is the reverse of the turn on one as follows:

1. First, turn **OFF** System output using the OUTPUT button on the Master unit front panel first to make sure any load is powered down first.
2. Then, turn **OFF** the Master unit **first** by flipping its front panel circuit lever to the down (OFF) position.
3. Turn **OFF** the first auxiliary unit located below the master unit by flipping the front panel circuit lever to the down (OFF) position.
4. Turn **OFF** the bottom auxiliary unit **last** by flipping its front panel circuit lever to the down (OFF) position.

Note: Turning off all units in a cabinet DOES NOT remove MAINS power from it. If any service is to be performed on the cabinet, make sure the MAINS power (grid power) is disconnected first.

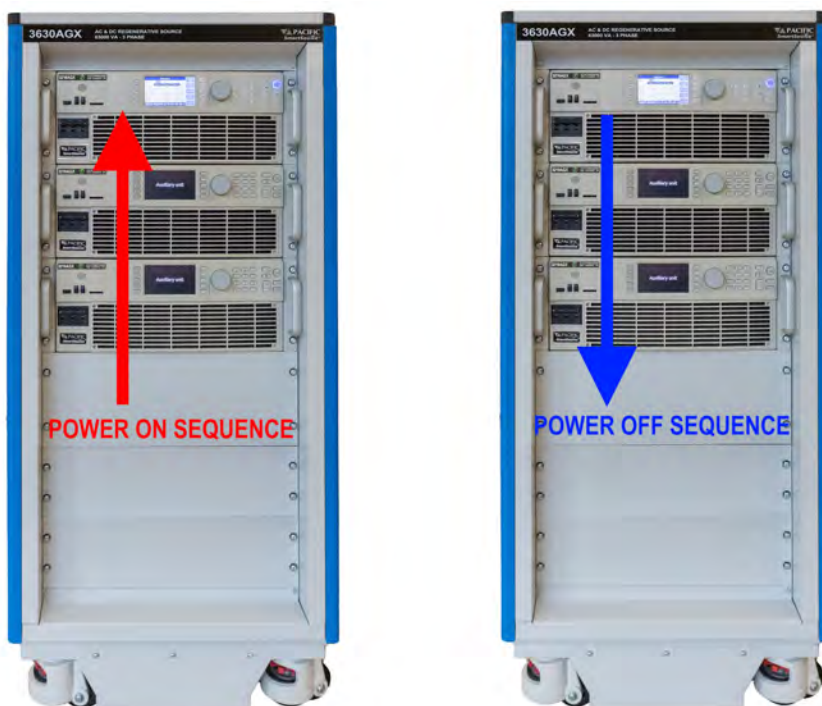


Figure 5-22: Cabinet System Power ON and OFF Sequences

5.17 Interface Options

All models support four different remote-control interface options; USB, LAN, RS232 or GPIB. All remote control interface connectors are located at the rear panel as shown in the illustration below.

5.17.1 Rear Panel Connector Locations

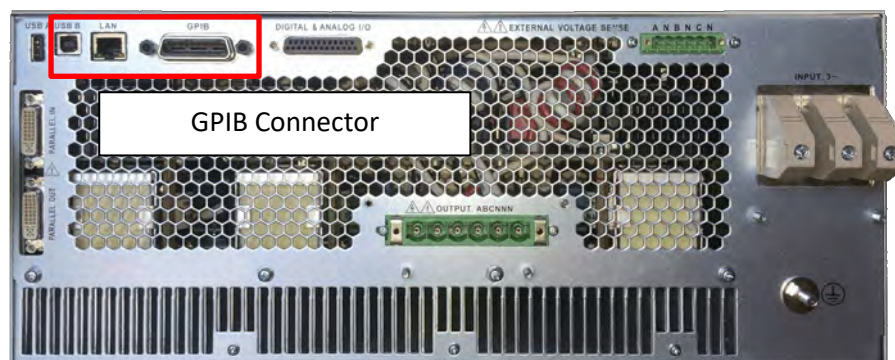


Figure 5-23: Remote Control Interface Connector Locations on Rear Panel

5.17.2 USB Device Interface

The USB DEVICE interface (USB Type B connector on the rear panel) provides a virtual COM port for the PC. Via this port, the unit can be controlled as a normal RS232 interface, e. g. with a terminal program or user application program. Refer to the section 9, “USB Driver Installation” for further setup and configuration information.

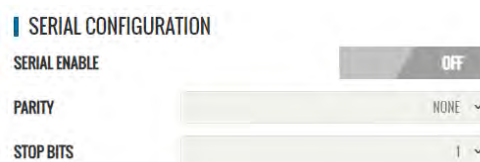
Refer to the section 9, “USB Driver Installation” for further setup and configuration information.

5.17.3 RS232 Serial Interface

5.17.3.1 RS232 Interface and Remote Inhibit Function

On Series models with firmware revision numbers lower than 2.0.13, there is a conflict between the RS232 interface and the Remote Inhibit function. Both cannot be used at the same time. To enable the Remote Inhibit input control line, the RS232 interface must be disabled. This can be done using the browser interface over LAN or USB or from the front panel. If the Remote Inhibit function is needed, use the USB interface instead of RS232.

To disable RS232 from Web browser, select **SYSTEM** Menu -> **INTERFACE SETUP** and move the SERIAL CONFIGURATION ENABLE position to OFF.



To disable RS232 from the front panel, press the CONFIGURATION key to the left of the LCD, select Interfaces, then select RS232 Interface and set the Status field to **Disabled**. Refer to section 6.8.5.4 on page 193.

5.17.4 GPIB Device Interface

The GPIB interface uses the IEEE488.1 standard 24-pin D-Shell Amphenol micro ribbon connector. Using a standard GPIB cable, the cable will break out to the left of the unit when facing the rear. This will typically obstruct USB and LAN interface connector access. Reverse GPIB cables are available but using these will obstruct the Auxiliary I/O connector.

The GPIB pin assignments are per the IEEE488.1 standard and listed in the table below.

PIN	Signal	Description
Pin 1	DIO1	Data input/output bit.
Pin 2	DIO2	Data input/output bit.
Pin 3	DIO3	Data input/output bit.
Pin 4	DIO4	Data input/output bit.
Pin 5	EOI	End-of-identify.
Pin 6	DAV	Data valid.
Pin 7	NRFD	Not ready for data.
Pin 8	NDAC	Not data accepted.
Pin 9	IFC	Interface clear.
Pin 10	SRQ	Service request.
Pin 11	ATN	Attention.
Pin 12	SHIELD	
Pin 13	DIO5	Data input/output bit.
Pin 14	DIO6	Data input/output bit.
Pin 15	DIO7	Data input/output bit.
Pin 16	DIO8	Data input/output bit.
Pin 17	REN	Remote enable.
Pin 18	GND	(wire twisted with DAV)
Pin 19	GND	(wire twisted with NRFD)
Pin 20	GND	(wire twisted with NDAC)
Pin 21	GND	(wire twisted with IFC)
Pin 22	GND	(wire twisted with SRQ)
Pin 23	GND	(wire twisted with ATN)
Pin 24	Logic ground	

Table 5-2: GPIB Interface Connector Pin Assignments

5.17.5 Remote Inhibit or Enable Input

The remote inhibit may be used to provide output shut down if a rear panel rack door is opened while the output is on. A contact closure between pins 6 (RI) a 15 (+12Vdc) on the rear panel DB25 Aux I/O connector (or an external 5Vdc supply if MODE RELAY CONTROL is enabled) will allow control of the output relay from either the front panel or a remote control interface.

There are three modes of operation for this input:

1. **Disable mode:** In his mode, the Remote Inhibit inputs are not active so this function is turned off. No short between the RI pins is required to enable the output in this mode.
2. **Remote Inhibit mode:** The two pins have to be shorted for the output to be enabled from the front panel or remote command. This is a necessary but not a sufficient condition to enable the output. If the output is enabled and the remote inhibit connection is open, a fault is generated.
3. **Remote Enable mode:** The output can be enabled by shorting these two pins, regardless of the output enable command/button. It is a sufficient condition to enable the output.

The mode can be selected from the SYST (SYSTEM) menu screen using the Interfaces, Remote Inhibit selection as shown below.

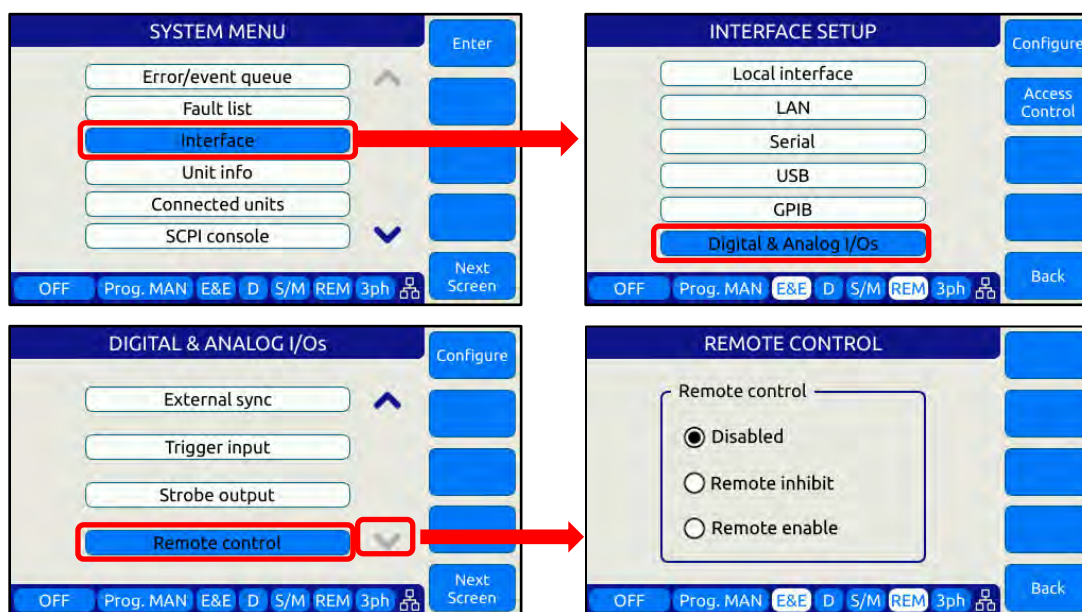


Figure 5-24: Remote Inhibit Control Screen

Note: If the Remote Inhibit function is enabled, the RS232 interface is still available but no hardware handshaking is available. (Xon/Xoff RS232 control only). Alternatively, the USB interface can be used instead.

Note: Units are shipped default with the Remote Inhibit state Disabled. Thus, no shorting jumper is needed to operate the power source. Changes to the remote inhibit configuration are retained after power down (Non-volatile).

Note: Master AGX units installed in cabinet systems shipped with the –OCS (Output Control Switch) option are configured with the RI function permanently set to **Remote inhibit** mode (mode 2). This prevents an operator from accidentally disabling this switch. The master AGX model number will show an “O” (letter O) postfix to indicate this configuration.

5.17.6 External MODE Relay Control

The RS232 connector also contains a relay control output pin that may be used in combination with suitable additional hardware to control a single phase mode shorting relay between phases A, B and C in cabinet systems.

This mode must be enabled in the SYSTEM screen. This control line (pin 8 and 5 on DB9 connector) puts out +5Vdc when the AGX is in FORM1 (single phase) and -5Vdc when the unit is in FORM2 (split) or FORM3 (three phase) mode.

5.17.7 LAN Interface

The LAN interface connector is located on the rear panel. The MAC address label for the unit can be found near the LAN connector.



CAUTION



Do NOT connect the RJ45 LAN (Ethernet) connector of the power source to a PoE (Power over Ethernet) port as the DC voltage will damage the LAN interface.

No special device drivers are required to use the LAN interface as it uses TCP/IP protocol but the IP address needs to be configured to operate on the user’s local area network or private network.



MAC Address

Figure 5-25: All Models Rear Panel Layout

5.17.8 System Interface Bus Connectors



CAUTION

SHOCK HAZARD: DO NOT remove safety covers from the two System Interface DVI Connectors.



AVERTISSEMENT

RISQUE DE CHOC: NE PAS retirer les capots de sécurité des deux connecteurs d'interface DVI

The system interface bus is not user accessible. It consists of two Digital Visual Interface (DVI-I dual link) connectors that are covered by a protective cover. There are no user accessible signals on the system interface bus. It is used for system configuration cabinet systems only.

5.18 Multi-Unit Parallel Operation

Two or more units can be configured as a parallel system to create a high power system. This requires at least one Master unit and one or more Auxiliary units or Master units that will be used as Auxiliaries to the first Master.

Note: Auxiliary units or Master units used in an auxiliary position must be of the same power output as the Master unit so each unit delivers the same amount of current /power into the load.

5.18.1 Load Connections on Parallel Systems

Paralleling two or more units requires that their outputs are tied together using equal length load cables from each unit to the load. A common coupling terminal block may be used to combine outputs in combination with larger size load wires to the load. Make sure the appropriate size wiring is used for the higher current levels obtained by paralleling two or more units.

5.18.2 Parallel System Bus Connection

For both units to operate correctly, the system bus connections between the master and auxiliary units **MUST** be made. This is done by daisy chaining the master to the first auxiliary and that auxiliary to the next one.

The system interface connectors are located on the left hand side of the rear panel and marked as follows:

PARALLEL IN On the MASTER unit, this connector is NOT CONNECTED. This causes the unit to become a master for other parallel units at power on. On an AUX unit, this connector is connected to a MASTER unit or an AUX unit that precedes this unit in the parallel chain.

PARALLEL OUT On the MASTER unit, this connector is connected to the first AUX unit. On the last AUX unit in the parallel chain, this connector is NOT CONNECTED signifying the end of the parallel chain.

The system bus uses a DVI-I Dual Link Male to Male interconnect cable with noise suppression ferrite beads. Cable length for paralleling units that are stacked in a 19" cabinet with no more than 1U space between units is 1 foot (0.3 m). Use of longer cables than 1 foot /30 cm is not recommended. If units cannot be installed in a cabinet, a longer DVI cable up to 3 feet in length may be used as an exception.

An example of the interconnect between one MASTER and one AUX is shown in the figure below.

Note: Any unused Parallel bus connector must be covered by the included safety covers.

Note AC input, AC Load and sense wiring are **NOT** included with the power source and must be supplied by the end-user.

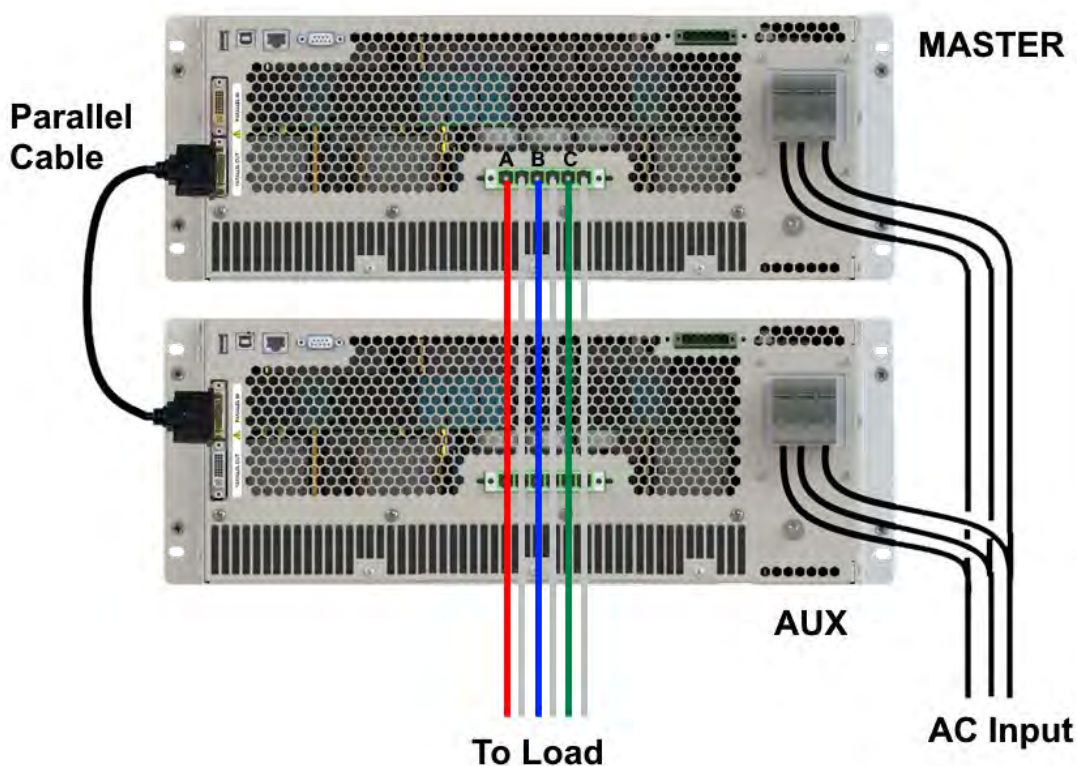


Figure 5-26: Parallel Mode Bus Connections using parallel bus cable

5.18.3 Master / Master Paralleling

Two or more masters can be paralleled as well. This allows AGX units to be used separately or as part of a larger power source system. This operation is the same paralleling using auxiliary units but only the first Master on the system bus will have an active front panel. All other Masters will display the fact that they are operating in Auxiliary mode with an inactive front panel. No re-configuration of the Master unit used in an auxiliary position is needed.

5.19 Multi-Cabinet Parallel Operation Guidelines

Please adhere to the following guidelines when paralleling two or more AGX Cabinet Systems. Unless these guidelines are followed, optimal current sharing between cabinets cannot be guaranteed.

5.19.1 Output Wiring

1. All output wires (Neutral, Phase A, Phase B and Phase C) from each cabinet must be in parallel. Each individual output wire from each Cabinet to the output load connection **MUST BE THE SAME LENGTH AND WIRE SIZE**.
2. **DO NOT** connect any power wiring between the cabinets. The output wiring from each cabinet must be brought to a common load termination point.
3. Keep all power connections between the AGX cabinet and the load termination point as short as possible.

Note AC input, AC Load, sense wiring and output junction terminal blocks are **NOT** included with the power source cabinet and must be supplied by the end-user. Only internal cabinet wiring and terminal blocks are included.

See diagram below for three phase output configuration parallel cabinets.

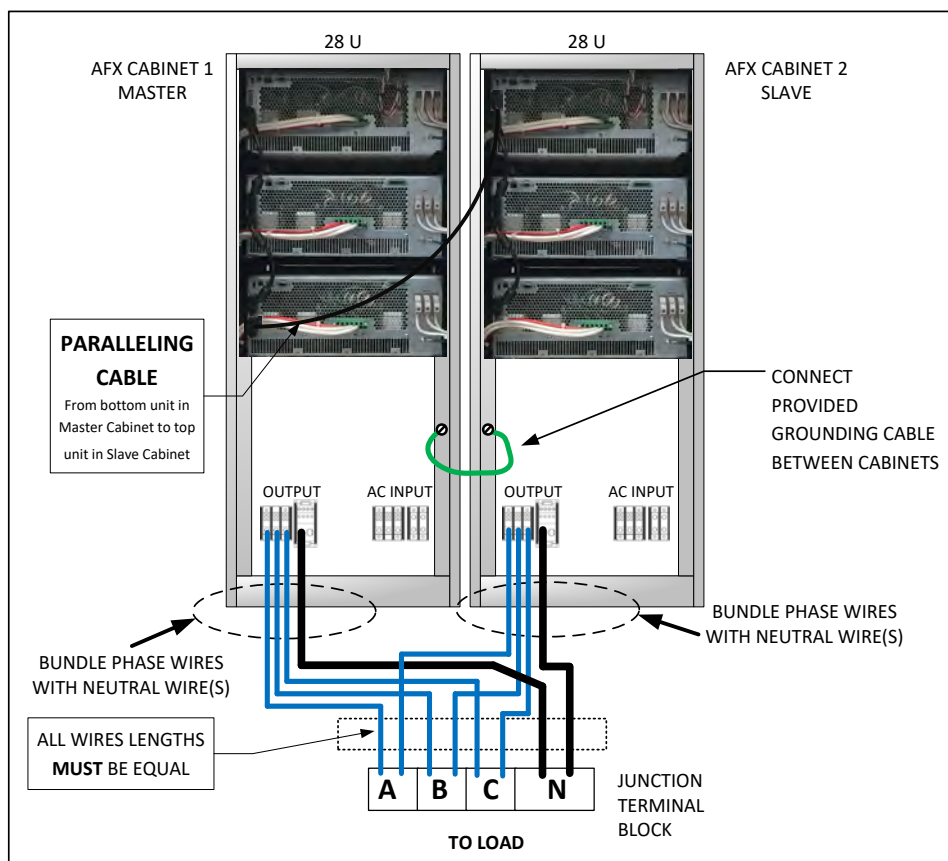


Figure 5-27: Multi-Cabinet Parallel Configuration Output Wiring - 3 Phase

5.19.2 System Grounding

1. All Cabinet systems **MUST** be properly grounded to the local facility ground using the provided **GROUND** terminal on the AC input terminal block located inside the cabinet.
2. In addition to individual facility ground connections, Multi-Cabinet units must be grounded to each other. This may be accomplished by connecting a ground cable to the rear of the cabinet rack on the designated Master Cabinet, passing the cable through the Input / Output power strain reliefs, and terminating the cable on the rear of the cabinet rack of the designated Auxiliary cabinet.

Refer to diagram above for suggested ground wire routing between two cabinets.

NOTE: Each cabinet should still be ground to facility ground.

6 Front Panel Operation

This Chapter provides an overview of front panel operation for the AGX, RGS and RLS Series® AC power sources. For remote control operation, refer to Section 8 “Remote Control Programming” of this manual for an overview of available programming commands.

6.1 Front Panel Layout

The front panel layout is shown in Figure 6-1 below. The number of buttons is kept to a minimum to ensure simple front panel operation for casual and experienced users alike. The shuttle knob is used to slew parameter values and move through menus to make selections.

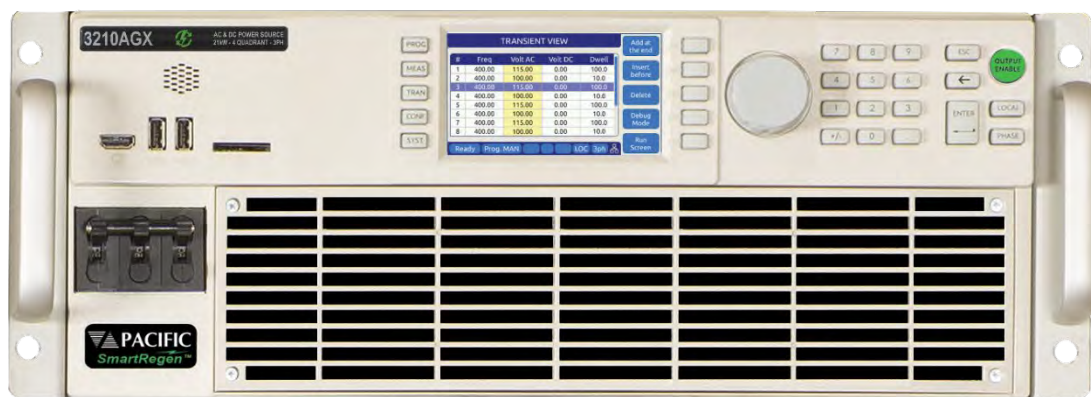
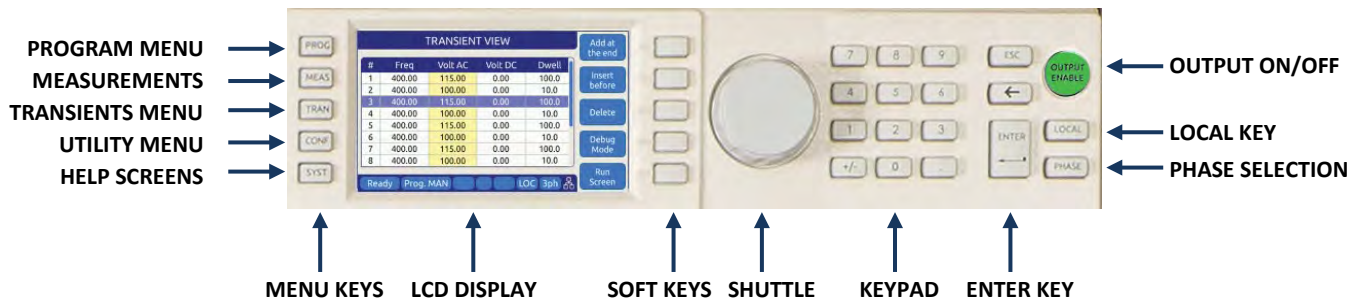


Figure 6-1: Front Panel View

A large backlit LCD display is in the center. Most user controls are located directly to the right of the display. The power ON/OFF circuit breaker is in the lower left corner of the front panel.

6.1.1 Keyboard Buttons

There are several groupings of push buttons that make up the front panel. They are grouped as follows:



Group	Function
Menu Selection Keys	These keys select the available top-level menus. Sub menus may be accessible using any of the available soft keys within each top-level menu.
Soft Keys	Soft keys change function as indicated by the decal directly to the left of the soft key on the LCD display.
Shuttle	See next section for details on shuttle operation.
Decimal Key Pad	The decimal key pad is used to enter parameter values directly. Values may also be set using any available soft key or the shuttle.
ENTER Key	The ENTER key confirms a selection or setting made with the decimal key pad. Until confirmed by pressing the ENTER key, selections and values will be shown grayed out on the LCD display to indicate they have been edited/changed but have not yet taken effect. This allows multiple parameters in the same screen to be edited with all new setting values taking effect at once when the ENTER or UPDATE ALL soft key is pressed.
ESC Key	The escape key backs out of a menu or selection and returns to a previous level.
Back Space Key (←)	This key backs up one position erasing the last digit value entered.
OUTPUT ENABLE	The OUTPUT ENABLE key is used to toggle the output on or off. If the output is ON, this key will be lit.
LOCAL	Returns the instrument to local control mode allowing front panel operation. This key may be disabled over one of the remote control interfaces. While in REMOTE, the keyboard is locked out. The LOCAL key can also be used to capture an LCD Image and store it as a .png image file in internal memory. To do so press and hold the LOCAL key, then press the 1 key. Screen images are saved in folder "internal/screenshots".
PHASE	The PHASE key is used to select a specific phase on three phase models. On single phase models, the selected phase is always A and this key has no function.

6.1.2 Shuttle Knob

The shuttle knob or rotary digital encoder is used to navigate (scroll) through menus and select fields to modify settings. The shuttle knob also includes a SELECT push button function. Pushing in the shuttle knob (SELECT) while on a data field will allow the value to be slewed up or down.

NOTE: Unlike when using the decimal keypad to enter a value, the SELECT shuttle mode will cause the output to change immediately. This allows slewing of the output value.

Once the final value is reached, pressing the shuttle again will take it out of slew mode and back into scroll mode.

6.1.3 PC Monitor Output

A PC monitor output connector is located on the front panel's left side. This connector is marked with a monitor icon as shown here. This allows connection of a computer monitor. When connected, the monitor will display the information otherwise shown on the front panel LCD screen and the LCD screen itself will be off.



This feature allows for the connection of a touch enabled LCD monitor to the Video Output on the front panel as well. When detected by the AGX, a message will pop-up asking the operator to change to the external screen. If accepted, the front panel LCD will turn off and the AGX screen will be displayed on the monitor along with a touch panel to operate the unit. The actual front panel keypad will remain active as well. This feature is useful for operator training or in control rooms where being able to read the measurement screen from across the room is required. A USB connection to one of the AGX USB ports is required to use the monitor's touch feature.

To return the display to the LCD screen, unplug the monitor.

6.1.4 USB Host Ports

Two USB host ports are located on the left-hand side of the front panel. These ports will accept a USB memory device up to 32GB capacity or a USB peripheral such as a mouse or keyboard. These USB ports are marked with the standard USB symbol as shown here.



6.1.5 SD Card Memory Slot

A SD Card memory device slot is located on the left-hand side of the front panel. This slot will accept a standard SD memory card up to 32GB capacity. The SD Card slot is marked with the symbol shown to the right here.



6.2 OUTPUT ENABLE Button

The circular Output Enable (On/Off) button is located on the right hand side of the front panel keypad. Its unique circular shape makes it easy to find so the output can be turned off quickly if needed.

6.2.1 OUTPUT State Indication

The state of the output is indicated by the back light color of the Output On/Off button. A blue color indicates the output is OFF, a green color indicates the output is ON.

6.2.2 Energy Savings Modes

The AGX Series® was designed to conserve energy when powered on but not in actual use to power a load. This situation is common as adjustments are being made to the setup or the load before any power is applied. This mode is controlled by the state of the Output. If the output is off, the AGX will enter one of two energy savings modes:

1. **SLEEP MODE** In sleep mode, all three inverter stages are switched off. If the internal heatsink is sufficiently cool, all fans are turned off as well. This essentially means the power source draws almost no power at all yet the front panel controls, displays and all digital control interfaces remain operational so any required program changes can be made.
2. **STANDBY MODE** In standby mode, only the output inverter stage for each phase is turned off. This means the first two stages remain on while the output is off. This means the fan will run at its lowest speed setting for quieter operation. This mode is considered a fast startup mode.

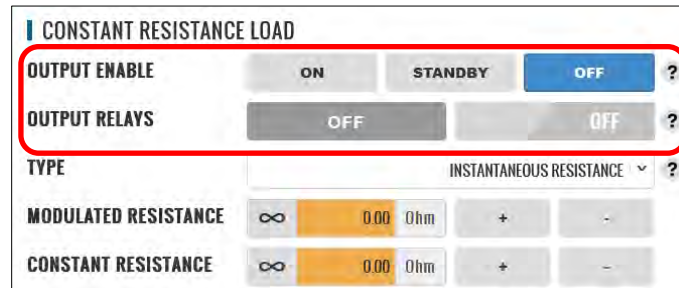
The desired energy savings mode can be selected from the front panel or via one of the remote-control interfaces using the OUTP:FAST command (See section 8.5, “Output Control Commands” on page 297).

6.2.3 Output On Response Times

Turning the output ON means that any power stage that was disabled for energy conservation purposes will be started and allowed to settle. This includes the output inverters. Once all power stages are up and running, the output relays are closed and whatever programmed output mode, voltage and frequency (if not in DC mode) will be applied to the load. If all stages were off – power source in sleep mode – this process can take up to 2.2 seconds. If the output control mode is set to FAST mode however, only the inverters are ever turned off and output can be applied within 200 msec, which is typical for older design power source with no energy saving features or sleep mode capability.

6.2.4 Output ON Operation in Load Mode

On the AGX-L, RGS-L and RLS in electronic load mode, the ON/OFF button takes on the function of Load Enable On/Off control. In load mode, it allows measuring, closing relays and synchronizing the load to the EUT frequency before enabling.



The functions are:

State	Operation
OUTPUT ENABLE OFF	Load is off and not synchronized to EUT.
OUTPUT ENABLE STANDBY	Load is off but synchronized to the EUT. Relays must be closed to allow synchronization to the EUT.
OUTPUT ENABLE ON	Load in active (ON).

6.3 Menu Keys

The various menus and settings available to the user from the front panel are detailed in this section of the manual.

All available menus can be accessed using the Menu keys to the left of the LCD display. The following five keys are available.

MENU KEY	MENU SCREEN	Description
PROG	PROGRAM	Programming of output parameters
MEAS	MEASUREMENTS	Measurements
TRAN	TRANSIENTS	Transient programming and execution
CONF	CONFIGURATION	Configuration Screens
SYST	SYSTEM	System Settings, Interface Configuration and Calibration

Table 6-1: Available Menu Keys

The following sections cover each aspect of the front panel screen and parameters in more detail.

6.4 PROG – PROGRAM Screens

All output parameters can be set from the PROGRAM screen. This screen has a list of available parameters on the main PROGRAM screen. Each parameter can be changed by highlighting the field and either slewing the value using the shuttle knob or entering a value using the numeric keypad. The difference between these two data entry modes is that slewing causes the output to change as the knob is turned while using the keypad allows one or more parameters to be preset to a new value which won't become active until the "Apply All" soft key or the ENTER key is pressed.

Thus, to slew a value, proceed as follows:

1. Use shuttle to move the active field to the parameter you want to slew.
2. Press the shuttle once to enter the slew mode. The selected field will be highlighted.
3. Use the shuttle to increment (*clockwise*) or decrement (*counterclockwise*) the selected parameter. Note that these changes take effect immediately resulting in the active output slewing up or down.

Note: This assumes the output is ON. If the output is OFF, the new value will be in effect and apply at the output as soon as the output is turned ON.

To slew a parameter while observing the MEASUREMENT screen, proceed as follows:

1. Use shuttle to move the selected field to the parameter you want to change.
2. While on the desired parameter (e.g. Voltage or Frequency), DOUBLE-PRESS the shuttle (similar to double clicking a mouse button).
3. The MEASUREMENT screen will appear with the parameter to be slewed visible in the header bar.
4. Use the Shuttle to slew the parameter up or down. The value will be displayed in the header bar of the measurement menu.
5. When done, press the PROGRAM key to return to the regular PROGRAM screen and exit this interactive mode.

With the parameter field selected, enter a new value using the numeric keypad.

To change one or more values but not change the actual output till all parameters are preset, proceed as follows:

6. Use shuttle to move the selected field to the parameter you want to change.
7. With the parameter field selected, enter a new value using the numeric keypad. Note that all fields are now shown with a gray background (Edit mode active)
8. Once satisfied with the new value, move to the next parameter you want to change.
9. Once all values are set to the new desired set value, press the ENTER key or the "Apply All" soft key.

6.4.1 Power On Settings

The power source or load will normally power up with the last settings in effect at turn-off. This behavior is determined by the “SOURce:INITial” command. This feature is active by default. This makes the unit “remember” all the settings after cycling power.

This mode can be disabled by using the remote-control command:

SOURce:INITial 0

This setting is retained in non-volatile (FLASH) memory.

6.4.2 PROGRAM Parameters – Voltage Source Mode (AGX, RGS)



PROGRAM				VOLT SRC	Change Style
Freq.	50.00	Hz			
	Phase A	Phase B	Phase C		Link Phases
Volt. AC	230.00	230.00	230.00	V _{RMS}	
Volt. DC	0.00	0.00	0.00	V _{DC}	Protection
Curr. lim.	42.00	42.00	42.00	A _{RMS}	
Pow. lim.	7.00	7.00	7.00	kW	Peak Control
kVA lim.	7.00	7.00	7.00	kVA	
Phase	0.0	120.0	240.0	Deg	More
Enabled Prog. MAN S/M LOC 3ph					

Figure 6-2: PROGRAM Screen - Voltage Source Mode

The Change Style (SK1) soft key toggles the PROGRAM Screen to a combination Setting and Measurement screen as shown below (example with Voltage Mode selected).



PROGRAM & MEAS.				VOLT SRC	Change Style
	Settings ABC	Measurements A B C			
Phase	0.0	n/a		Deg	Link Phases
Volt. AC	230.00	230.00	230.00	230.00	V _{RMS}
Volt. DC	0.00	0.00	0.00	0.00	V _{DC}
Curr.	42.00	32.70	32.20	32.74	A _{RMS}
Pow.	7.00	6.670	6.521	6.626	kW
kVA	7.00	7.521	7.406	7.530	kVA
Enabled Prog. MAN S/M LOC ABC					

This mode only applies when all phases are LINKED as there is only one column for changing settings (Column 1). The Measurements are updated continuously.

The two data entry methods described apply to the parameters on the main PROGRAM screen. This includes those shown in the table below.

PARAMETER	Range	Unit	Description
Frequency	15 - 1000	Hz	Output frequency
Phase	0.0 – 359.0	Degrees	Phase angles for phase B and C Voltage
Voltage AC	0 – 440	V rms	AC output
Voltage DC	0 - 650	Vdc	DC output
Current limit	0 to Max	A rms	RMS Current Limit
Power limit	0 to Max	W	True Power Limit
kVA limit	0 to Max	VA	Apparent Power Limit

Table 6-2: Available Voltage Source Mode Parameters on PROGRAM screen

Each screen has up to five soft keys on the right-hand side of the display. These may change as the selected parameter changes. To move between parameter fields in any screen, use the shuttle knob. To change a parameter, press the shuttle knob and then adjust the value by turning the shuttle. When done, press the shuttle to exit edit mode.

Negative AC RMS set values: Depending on the firmware revision, the unit may accept negative RMS set values. A negative value setting means the AC waveform will be inverted. This feature is also available in Transient modes.

There are three program screens like this, each with some different soft keys. To access the second and third program screen, use the More (SK3) soft key on the left side of each screen. This will toggle through the three available PROGRAM screens.



PROGRAM screen two allows access to the Protection and Peak Control screens.



Note: The same Program screens and soft keys are available in Current Source Mode (AGX) or in Programmable Load mode.

6.4.3 PROGRAM Parameters – Current Source Mode (AGX)



Figure 6-3: PROGRAM Screens Current Source Mode

The Current Source Mode (AGX) functions in much the same way as the Voltage Source mode, except for:

- The current is now a set point, not a protection limit
- The Voltage setting is now a protection level.
- The peak voltage protection becomes a level only protection.
- The peak current becomes a level and/or margin protection.
- Slew rates and transient programming now applies to current iso voltage settings.

The two data entry methods described apply to the parameters on the main PROGRAM screen. This includes those shown in the table below.

PARAMETER	Range	Unit	Description
Frequency	15 - 1000	Hz	Output frequency
Curr. AC	0 – ± 440	Arms	AC current set point ³ .
Curr. DC	0 - ± 650	Adc	DC current set point ¹
Volt. limit	0 to Max	Vrms	RMS Voltage Input Limit
Pow. limit	0 to Max	W	True Power Limit
kVA limit	0 to Max	VA	Apparent Power Limit
Phase	0.0 – 359.0	Degrees	Phase angles for phase B and C Current

Table 6-3: Available Current Source Mode Parameters on PROGRAM screen

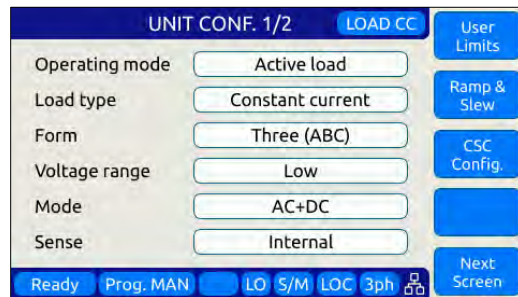
Each screen has up to five soft keys on the right hand side of the display. These may change as the selected parameter changes. To move between parameter fields in any screen, use the shuttle knob. To change a parameter, press the shuttle knob and then adjust the value by turning the shuttle. When done, press the shuttle to exit edit mode.

³ Negative current settings apply in Current Source & Active Load modes only and indicate sinking of current (Regen).

6.4.4 PROGRAM Parameters – Load Mode (Option)

The LOAD mode is an optional feature on AGX and RGS. If the Load option is not installed on either AGX or RGS units, these screens will not be visible and you can skip this section of the manual. The RLS supports LOAD mode only. The Load mode is described in more detail section 3.7 on page 29. This section covers the front panel PROGRAM screens for each of the Load operating modes.

The load mode can be set from the UNIT CONFIGURATION screen available from the CONF key. The modes are shown in the screens below.

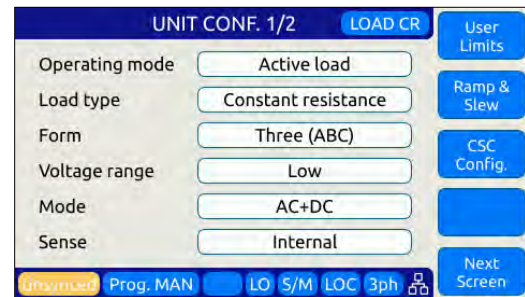


UNIT CONF. 1/2 **LOAD CC** User Limits

Operating mode	Active load	User Limits
Load type	Constant current	Ramp & Slew
Form	Three (ABC)	CSC Config.
Voltage range	Low	
Mode	AC+DC	
Sense	Internal	

Ready Prog. MAN LO S/M LOC 3ph Next Screen

Constant current mode



UNIT CONF. 1/2 **LOAD CR** User Limits

Operating mode	Active load	User Limits
Load type	Constant resistance	Ramp & Slew
Form	Three (ABC)	CSC Config.
Voltage range	Low	
Mode	AC+DC	
Sense	Internal	

Unsym Prog. MAN LO S/M LOC 3ph Next Screen

Constant resistance mode



UNIT CONF. 1/2 **LOAD CP** User Limits

Operating mode	Active load	User Limits
Load type	Constant power	Ramp & Slew
Form	Three (ABC)	CSC Config.
Voltage range	Low	
Mode	AC+DC	
Sense	Internal	

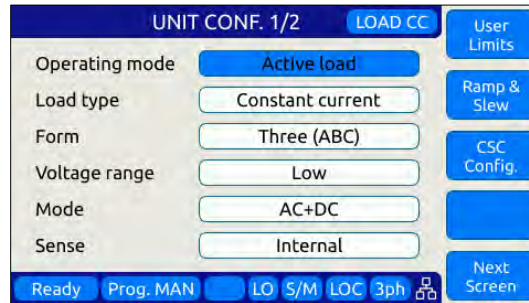
Unsym Prog. MAN LO S/M LOC 3ph Next Screen

Constant Power mode

Front panel operation for each Load mode is covered in the following four sections in the order shown above.

6.4.4.1 Constant Current Mode Program Screens

To operate the unit in Load mode, press the CONF menu key and set the Operating mode to “Active load” as shown below. Then set the Load type field to “Constant Current”. This enables the constant current load mode. Sinking current and power is achieved by entering negative set values for current settings and power limits.



Next Press the PROG menu key to display the PROGRAM screen. The mode indicator in the upper right corner will show “LOAD CC” to indicate the operating mode.

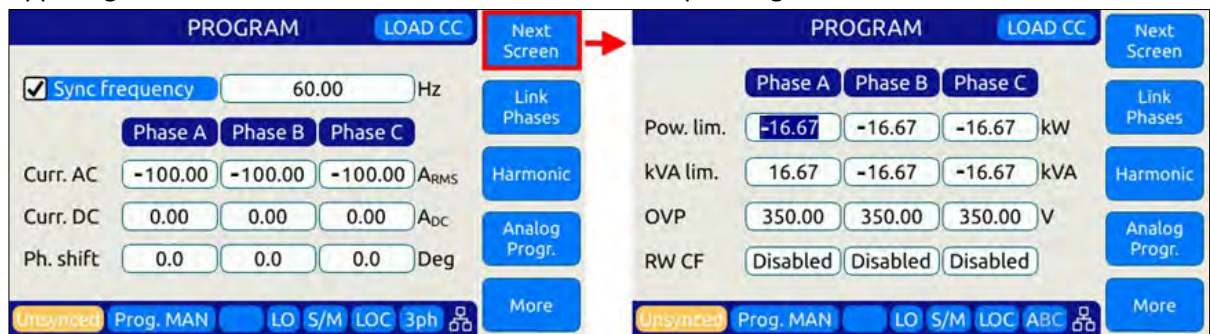


Figure 6-4: PROGRAM Screens Constant Current Load Mode

In CC mode there are two PROGRAM screens as shown above. This first one allows programming of the AC and/or DC current to be drawn from the EUT as well as the phase angle of the AC current with respect to the AC input voltage from the EUT.

Press the Next Soft key to select the second screen to set Power and VA limits and OVP trip levels for each phase. The number of phases displayed is a function of the selected phase mode, one phase, split phase, or three-phase.

The available setting parameters in this load mode are shown in the table below.

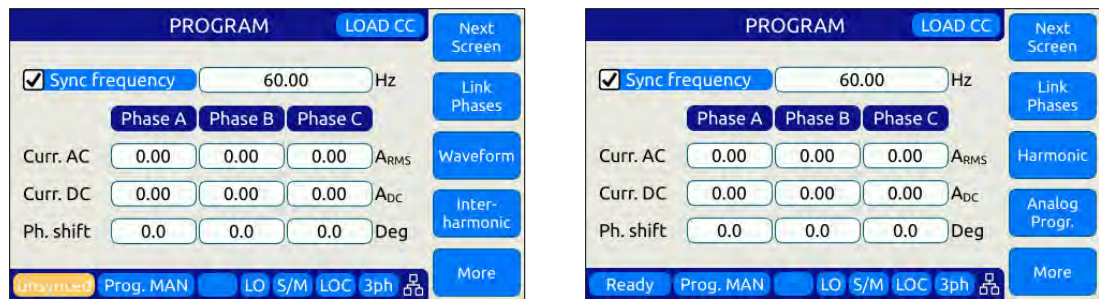
PARAMETER	Range	Unit	Description
Sync freq.	15 - 1000	Hz	Expected Load input Frequency
Curr. AC	0 – ± 130	A rms	Max AC current sink depends on selected range ⁴ .
Curr DC	0 – ± 100	Adc	Max DC current sink depends on selected range ²

⁴ Sum of AC peak + DC Current cannot exceed max rating of unit. Negative value indicates sinking current.

PARAMETER	Range	Unit	Description
Phase Shift	0 – 359.9	Degrees	Phase angle between input AC voltage and AC load current
Pow. limit	0 to ± Max	W	True Power Limit
kVA limit	0 to ± Max	VA	Apparent Power Limit
OVP.	0 to Max	V	Maximum Input Voltage limit
RW CF	Enabled/Disabled		Rectifier Waveform Crest Factor

Table 6-4: Available Load CC Setting Parameters on PROGRAM screen

Each screen has up to five soft keys on the right-hand side of the display. These may change as the selected parameter changes. To move between parameter fields in any screen, use the shuttle knob. To change a parameter, press the shuttle knob and then adjust the value by turning the shuttle. When done, press the shuttle to exit edit mode.



The following soft keys are available in the Load Program screens:

- Waveform** Allows selection of standard or custom waveforms
- Interharmonic** Allows programming of an interharmonics amplitude and frequency for current in Current Source or Load modes.
- Harmonic** Allows programming of up to five regulated harmonics for current in Current Source or Load modes
- Analog Progr.** Allows programming of Analog input functions.

Note: See section 6.4.4.3, “Active Load Sync Operation and Crest Factor Settings” on page 130 for Crest Factor Current modes.

6.4.4.2 Constant Resistance Mode Program Screens

To operate the unit in Load mode, press the CONF menu key and set the Operating mode to “Active load” as shown below. Then set the Load type field to “Constant Resistance”. This enable the constant current load mode.

UNIT CONF. 1/2 **LOAD CR**

Operating mode: Active load

Load type: Constant resistance

Form: Three (ABC)

Voltage range: Low

Mode: AC+DC

Sense: Internal

Buttons: User Limits, Ramp & Slew, CSC Config., Next Screen

Footer: Unsynced Prog. MAN LO S/M LOC 3ph

Next Press the PROG menu key to display the PROGRAM screen. The mode indicator in the upper right corner will show “LOAD CR” to indicate the operating mode.

PROGRAM **LOAD CR**

Type: Resistance RMS

Mod.: ☐ AC ☐ DC ☒ AC&DC ☐ AC=DC

☒ Sync frequency: 60.00 Hz

Phase A Phase B Phase C

Res. AC: 10.00 10.00 10.00 Ohm

Res. DC: 10.00 10.00 10.00 Ohm

Ph. shift: 0.0 0.0 0.0 Deg

Buttons: Link Phases, Protection, Peak Control, More

Footer: Ready Prog. MAN LO S/M LOC 3ph

PROGRAM **LOAD CR**

Type: Conductance RMS

Mod.: ☐ AC ☐ DC ☒ AC&DC ☐ AC=DC

☒ Sync frequency: 60.00 Hz

Phase A Phase B Phase C

Cond. AC: 0.00 0.00 0.00 mS

Cond. DC: 0.00 0.00 0.00 mS

Ph. shift: 0.0 0.0 0.0 Deg

Buttons: Link Phases, Waveform, Analog Progr., More

Footer: Ready Prog. MAN LO S/M LOC 3ph

PROGRAM **LOAD CR**

Type: Instantaneous resistance

Mod.: ☐ AC ☒ DC ☐ AC&DC

☒ Sync frequency: 60.00 Hz

Phase A Phase B Phase C

Res. DC: 10.00 10.00 10.00 Ohm

Buttons: Link Phases, Waveform, Analog Progr., More

Footer: Unsynced Prog. MAN LO S/M LOC 3ph

PROGRAM **LOAD CR**

Type: Instantaneous conductance

Mod.: ☐ AC ☒ DC ☐ AC&DC

☒ Sync frequency: 60.00 Hz

Phase A Phase B Phase C

Cond. DC: 0.00 0.00 0.00 mS

Buttons: Link Phases, Waveform, Analog Progr., More

Footer: Unsynced Prog. MAN LO S/M LOC 3ph

The PROGRAM screens allow selection of four different CR Load Types:

- Resistance RMS
- Conductance RMS
- Instantaneous Resistance
- Instantaneous Conductance

The second screen available by pressing the Next Screen Soft key is the same for all four CR models and is shown below.



All four primacy CR Mode program screens offer similar parameters but two operate in RMS mode while the other two operate in instantaneous mode. This latter mode causes the current to track the Voltage waveform.

Press the Next Soft key to select the second screen to set Current, Power and VA limits and OVP trip levels for each phase. The number of phases displayed is a function of the selected phase mode, one phase, split phase or three-phase. The second program screen also allows the user to set the maximum current slew rate in A/ μ sec.

The available setting parameters in this load mode are shown in the table below.

PARAMETER	Range	Unit	Description
Type	Resistance RMS Conductance		Resistance or Conductance mode
Modulation	AC, DC, AC & DC or AC = DC		Separate AC and DC set values. No AC=DC selection for instantaneous modes.
Sync freq.	15 - 1000	Hz	Expected Load input Frequency
Res. / Cond. AC	0 - 1000, Infinite	Ohm	AC resistance or conductance
Res. / Cond. DC	0 - 707, Infinite	mS	DC resistance or conductance
Phase Shift	0 – 359.9	Degrees	Phase angle between input AC voltage and AC load current. Applies to RMS CR modes only.
Curr. Limit	0 – 130A	A rms	Range depends on load model and selected voltage range
Pow. limit	0 to Max	W	True Power Limit
kVA limit	0 to Max	VA	Apparent Power Limit
OVP.	0 to Max	Vpk	Maximum Input Voltage Peak limit
Peak Curr. Limit	0 to Max	Ipk	Maximum Current Peak limit
Max Curr. Slew	0.001 – 100	A/ μ s	Current slew rate when input voltage changes.
RW CF	Enabled/Disabled		Rectifier Waveform Crest Factor

Table 6-5: Available Load CR Setting Parameters on PROGRAM screen

Each screen has up to five soft keys on the right-hand side of the display. These may change as the selected parameter changes. To move between parameter fields in any screen, use the shuttle knob. To change a parameter, press the shuttle knob and then adjust the value by turning the shuttle. When done, press the shuttle to exit edit mode.



The following soft keys are available in the Load CR Program screens:

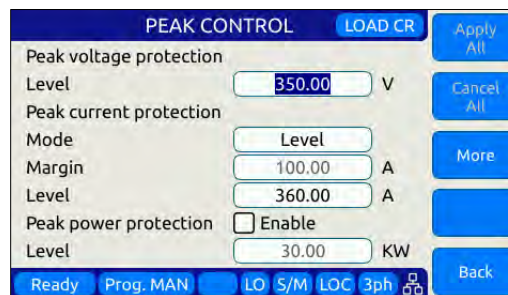
Protection

Allows programming of RMS protections for current, power, trip delay, OVP, UVP, OFP and UFP. These settings use three screens as shown below.



Peak Control

Peak Protection for Voltage, Current and Power.



Waveform Allows selection of standard or custom waveforms

Analog Progr. Allows programming of Analog input functions.

Note: See section 6.4.4.3, “Active Load Sync Operation and Crest Factor Settings” on page 130 for Crest Factor Current modes.

6.4.4.1 Constant Power Mode Program Screens

To operate the unit in Load mode, press the CONF menu key and set the Operating mode to “Active load” as shown below. Then set the Load type field to “Constant Power”. This enable the constant current load mode.



UNIT CONF. 1/2 LOAD CP

Operating mode: Active load

Load type: Constant power

Form: Three (ABC)

Voltage range: Low

Mode: AC+DC

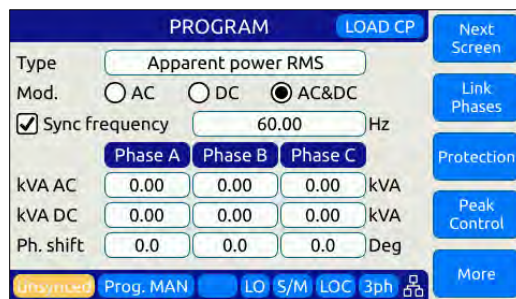
Sense: Internal

Buttons: User Limits, Ramp & Slew, CSC Config., Next Screen

Footer: Unsynced, Prog. MAN, LO, S/M, LOC, 3ph

Next Press the PROG meny key to display the PROGRAM screen. The mode indicator in the upper right corner will show “LOAD CP” to indicate the operating mode. This mode has two settings:

Apparent Power RMS in kVA



PROGRAM LOAD CP

Type: Apparent power RMS

Mod.: ☐ AC ☐ DC ☒ AC&DC

☒ Sync frequency: 60.00 Hz

Buttons: Phase A, Phase B, Phase C, Link Phases, Protection, Peak Control, More

Fields: kVA AC, kVA DC, Ph. shift

Footer: Unsynced, Prog. MAN, LO, S/M, LOC, 3ph



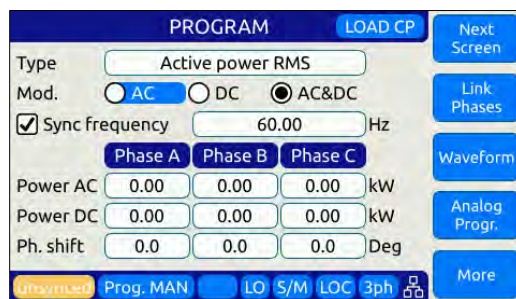
PROGRAM LOAD CP

Buttons: Phase A, Phase B, Phase C, Link Phases, Protection, Peak Control, More

Fields: Curr. lim., Pow. lim., OVP, Peak c. lim., Max c. slew, Rec. wave.

Footer: Ready, Prog. MAN, LO, S/M, LOC, ABC

Active Power RMS in kWatt



PROGRAM LOAD CP

Type: Active power RMS

Mod.: ☒ AC ☐ DC ☐ AC&DC

☒ Sync frequency: 60.00 Hz

Buttons: Phase A, Phase B, Phase C, Link Phases, Waveform, Analog Progr., More

Fields: Power AC, Power DC, Ph. shift

Footer: Unsynced, Prog. MAN, LO, S/M, LOC, 3ph



PROGRAM LOAD CP

Buttons: Phase A, Phase B, Phase C, Link Phases, Waveform, Analog Progr., More

Fields: Curr. lim., kVA lim., OVP, Peak c. lim., Max c. slew, Rec. wave.

Footer: Unsynced, Prog. MAN, LO, S/M, LOC, ABC

In each of these CP modes there are two PROGRAM screens as shown above. Both modes support selectable AC, DC or AC & DC settings.

Depending on the selected CP Mode, either kVA or kW for AC and DC can be set separately. The last setting on the first CP screen is for the phase angle of the AC current with respect to the AC input voltage from the EUT.

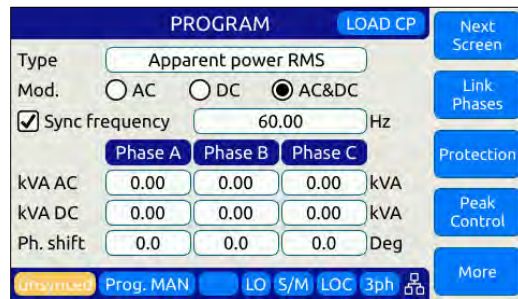
Press the Next Soft key to selected the second screen to set Current, Power and Power or VA limits and OVP trip levels for each phase. The number of phases displayed is a function of the selected phase mode, one phase, split phase or three-phase. The second program screen also allows the user to set the maximum current slew rate in A/usec.

The available setting parameters in this load mode are shown in the table below.

PARAMETER	Range	Unit	Description
Type	Active power Apparent power	VA or W	Power mode selection
Modulation	AC, DC, AC &DC or AC = DC		Separate AC and DC set values.
Sync freq.	15 - 1000	Hz	Expected Load input Frequency
KVA / Power AC	0 to Max	kVA or W	Power setting AC
kVA / Power DC	0 to Max	kVA or W	Power setting DC
Phase Shift	0 – 359.9	Degrees	Phase angle between input AC voltage and AC load current
Curr. Limit	0 – 130A	A rms	Range depends on load model and selected voltage range
Pow. / VA Limit	0 to Max	W	True Power Limit
OVP.	0 to Max	Vpk	Maximum Input Voltage Peak limit
Peak Curr. Limit	0 to Max	Ipk	Maximum Current Peak limit
Max Curr. Slew	0.001 - 100	A/us	Current slew rate when input voltage changes.
Rec. wave.	Enabled/Disabled		Rectifier Waveform Crest Factor

Table 6-6: Available Load CP Setting Parameters on PROGRAM screen

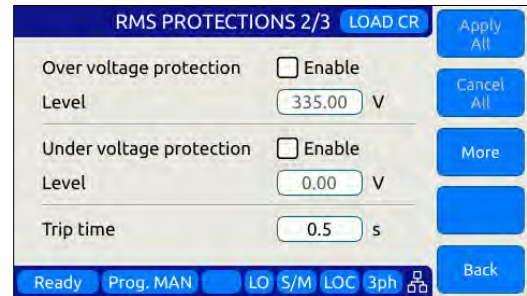
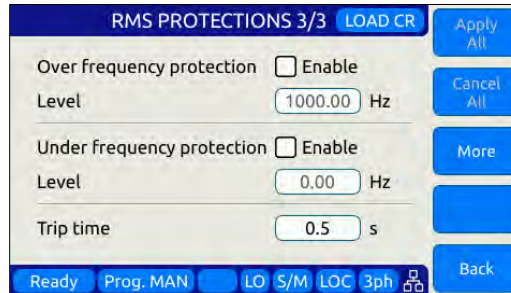
Each screen has up to five soft keys on the right-hand side of the display. These may change as the selected parameter changes. To move between parameter fields in any screen, use the shuttle knob. To change a parameter, press the shuttle knob and then adjust the value by turning the shuttle. When done, press the shuttle to exit edit mode.




The following soft keys are available in the Load CP Program screens:

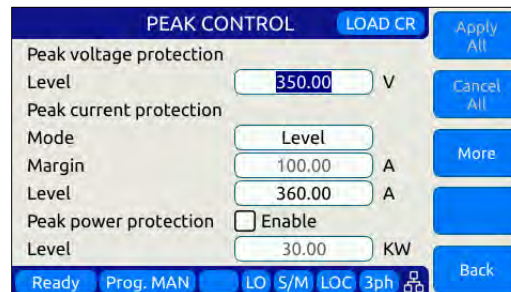
Protection

Allows programming of RMS protections for current, power, trip delay, OVP, UVP, OFP and UFP. These settings use three screens as shown below.

Peak Control

Peak Protection for Voltage, Current and Power.



Waveform

Allows selection of standard or custom waveforms

Analog Progr.

Allows programming of Analog input functions.

Note: See section 6.4.4.3, “Active Load Sync Operation and Crest Factor Settings” on page 130 for Crest Factor Current modes.

6.4.4.2 Active Load Sync Operation and Crest Factor Settings

In Load mode, the programmed current can be synced to the AC input voltage or the unsynced mode can be selected.

When the SYNC is enabled the unit tries to sync the current with the voltage present at the output. There is a status indication in the lower left corner of the display if it is synced or unsynced. The sync frequency control is the center frequency of the PLL and a phase shift that controls the phase shift between the voltage and the generated current. The PLL is able to lock in the full range of frequency, but it will be faster if it is near the output frequency. In SYNC mode, the phase of the current can be shifted with respect to the AC input voltage.

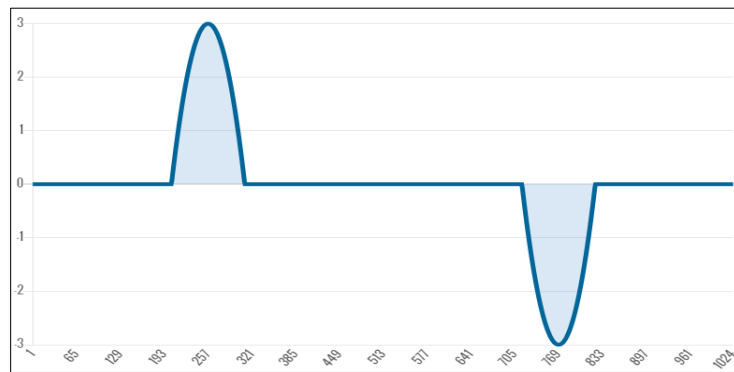
When the SYNC is disabled it is very similar to a current source. It is useful to generate AC+DC current with DC input voltages for example. The frequency and phases can be controlled just as a current source.

Power and KVA limits act at RMS level, behaves as in voltage source.

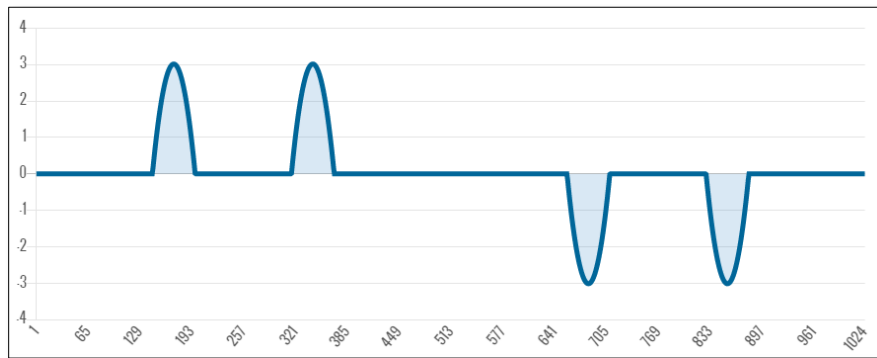
The OVP is the OVP protection level also available in protections screen. As the voltage is not governed by the unit it is useful to set these as appropriate for the application.

When the rectifier waveform is enabled it will generate a waveform with the desired crest factor. To obtain different power factors the phase shift must be controlled.

For single phase form the waveform with CF 3 looks like:



For three phase form the waveform with CF 3 looks like:



When the rectifier waveform is disabled the waveform is controlled as always. The waveform corresponds to the waveform of the current. Arbitrary waveforms are allowed as well.

6.4.5 Phase Rotation / Phase Sequence

Phase rotation(aka sequence) in three-phase mode is determined by the programmed phase angles for phase B and C. Phase A is always the 0° reference and this value can only be changed when an external phase sync. Input mode is used. For normal operation, the internal phase A is used as the phase reference for B and C so phase A is fixed at 0° and the field is disabled. (Light grey instead of black text).

The default phase rotation of the AGX is the same as that of legacy PPS UPC controllers. This phase rotation is positive so when driving AC motors, the motors will turn forward.

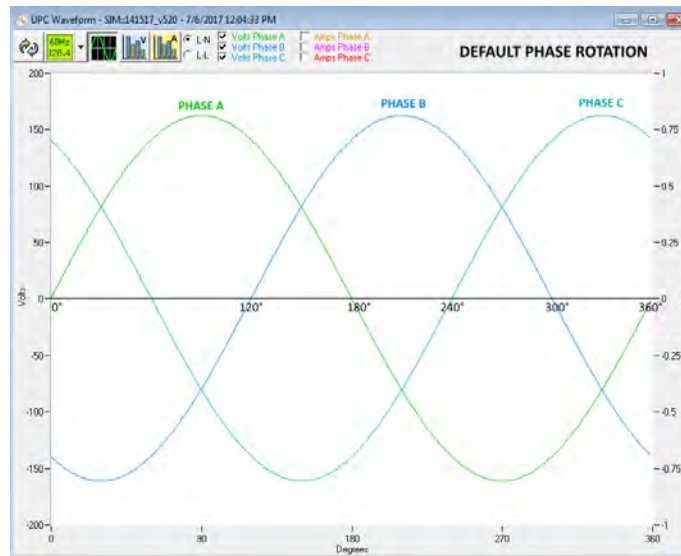


Figure 6-5: Three Phase AC mode Default Phase Rotation

Phase rotation in three-phase mode can be reversed if needed in one of three ways:

1. By swapping output connection wires B and C to the load.

2. By reprogramming the default phase setting for B to 240° and for C to 120°.
3. By selecting “Positive (Phase B leading A)” under “**Phase Rotation**” in the source configuration screen.

The reversed phase rotation is shown in the figure below for reference.

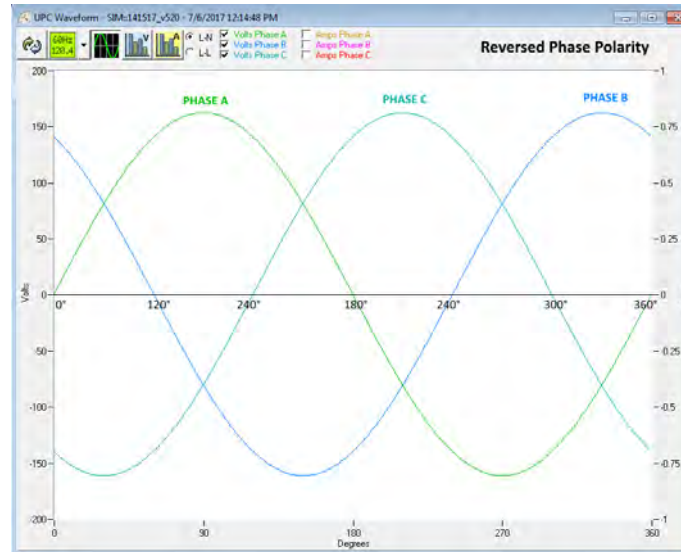


Figure 6-6: Three Phase AC mode Reversed Phase Rotation

6.4.6 Direct Data Entry - Presets

Values for Frequency, Voltage, Current, Phase and Power can be entered directly using the numeric keypad. Position the flashing cursor on the field for which you want to enter a new setting value. Once a field is selected, press the first key of the value you want.

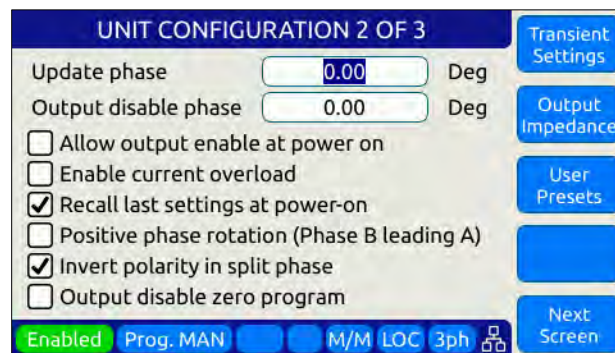
As soon as you enter the first digit, the soft keys will display commonly used values for the parameter you are changing. For example, if you are on the Frequency fields, presets for 50 Hz, 60 Hz, 400 Hz and 800 Hz will appear.

If you are on the Voltage AC field, presets for 115 V, 230 V and 300 V will appear. A Low Voltage Range selection will be offered as well allowing you to lock in the virtual low range, which limits AC voltage entry to no more than 150 Vac. This is illustrated on the image below.



6.4.7 Customizing Output Programming Preset Soft Key Values

The power source allows the user to set up his own preferred or often used output programming values in place of the factory default selections. This can be done from the SYST menu by selecting the UNIT CONFIGURATION 2 OF 3 screen and pressing the “User Presets” soft key.



For details on change any available pre-set soft key value, refer to Section 6.7.8, “USER PRESETS Screen” on page 181.

6.4.8 Changing Shuttle Programming Resolution

Once entering EDIT mode on any programmable field – by double clicking the shuttle knob – the parameter value can be slewed by turning the knob. The setting resolution can be changed as needed. If a large value change is needed, a lower resolution will result in a faster change, e.g. changing voltage 10V per click or 1V per click. For a very small change, a 0.1V or 0.01V change per click may be more appropriate.

The selected resolution is reflected by the blinking character when in edit slew mode. To change the position and thus resolution, use the keypad numeric keys. The lowest number keys will select the smallest increment/decrement setting. The higher number keys will select a larger increment/decrement setting.

The table bellows maps the keypad keys to the resolution setting.

Key Pad Key #	Position	Resolution
1 or 2		0.01
3		0.1
4		1
5		10
6, 7, 8 or 9		100
7, 8, 9		1000

Table 6-7: Changing Programming Resolution

6.4.9 Phase Mode Selection

Setting output parameters when the AC power source is in single-phase mode (FORM1) is straightforward as there is only one phase to program. Thus, all fields displayed in the PROGRAM screen apply to phase A.

In three-phase mode, there are two ways to program most parameters other than the Frequency:

- Coupled
- Uncoupled

Coupled mode means all phases are set and changed to the same value. Thus, Voltage AC when set or changed applies to all three output phases. This method ensures output phase voltages are always balanced and is convenient for driving normal three phase loads. Coupled mode is indicated by the “ABC” status indicator on the right-hand side of the status bar as highlighted below.

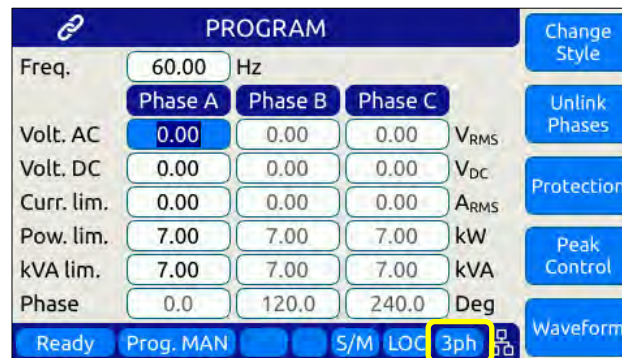
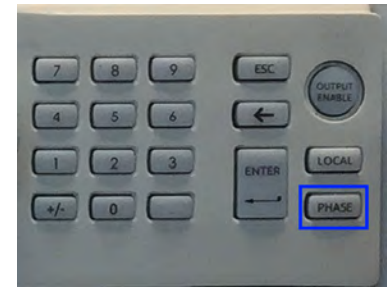


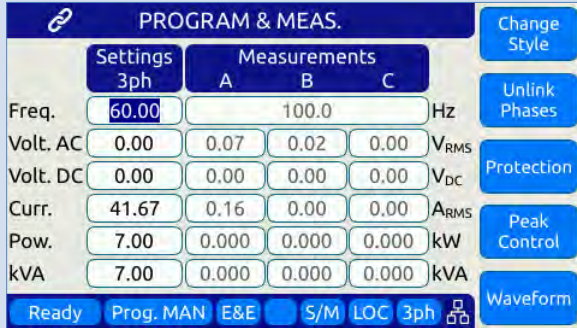
Figure 6-7: Phase Mode Data Entry Status Field

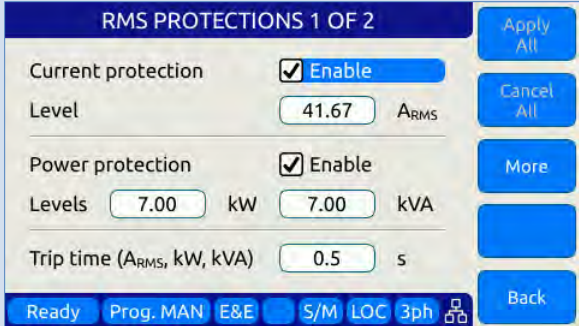
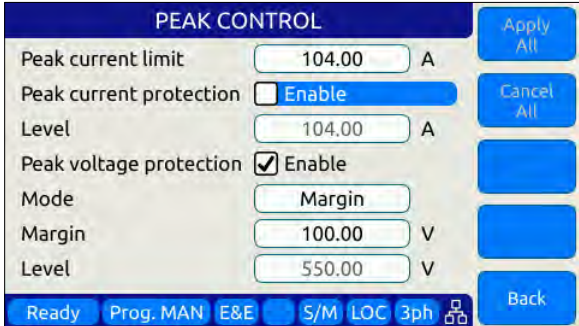
Uncoupled means each phase can be set individually. To do so, the phase to be set or changed must be selected first using the **PHASE** key located on the right-hand side of the front panel keyboard. The selected phase (A, B or C) is displayed in the status bar as either “A”, “B” or “C” when in SINGLE phase mode or “3ph” will be displayed when in THREE phase mode.



6.4.10 PROGRAM Soft Keys

The following five soft keys are available on the main PROGRAM screen.

SOFT KEY	Description
Change Style (SK1)	This softkey toggles between the two available program screens. The first screen shows setting for all phases but no measurements. If may be used to set different values for individual phases.  The second program screen shows setting values that apply to all phases (Coupled phase settings). Next to the settings, the measurements for phases are displayed in the same screen. 
Unlink Phases (Sk2)	This softkey serves a similar purpose as the front panel “PHASE” key. It changes the phase coupling between LINKED and UNLINKED. The link (chained) symbol is displayed in the upper left corner of the LCD.

SOFT KEY	Description
Protection (SK3)	Displays the POWER AND CURRENT PROTECTIONS screen shown below.  There are two check box options and one data field on this screen that can be set as needed: Enable RMS current protection Activates the programmable current limit function at the value set in the main program screen Enable power protection Activates power protection at W and kVA set points. Trip time: Determines how long the power source will allow the power level setting to be exceeded before tripping off.
Peak Control (SK4)	Displays the Peak Control protection screen for both Voltage and Current. These protection functions are separate from the RMS current limit function. By setting the peak current protection mode, the maximum peak current is limited by the power source to the programmed level. This is done on a cycle-by-cycle basis. Note that a minimum setting applies as described in section 6.4.9, next page.  The level can be set using the shuttle or key pad. To enable or disable this function, scroll to the “Enable peak current protection” check box and press the shuttle to toggle on or off.

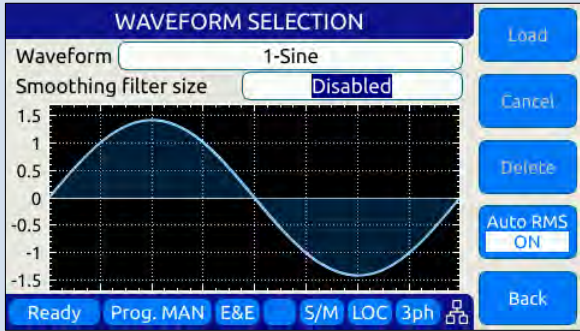
SOFT KEY	Description
Waveform (SK5)	Displays the Waveform selection screen. This function allows the active waveform shape to be changed. Available waveform selections are: Sinewave, Clipped Sinewave 1% THD, Clipped Sinewave 2% THD, Clipped Sinewave 5% THD, Clipped Sinewave 10% THD, Square and Triangle.  Select waveform using the shuttle. Each waveform can be previewed. With the desired waveform displayed, press the “Apply” soft key to confirm. This will take you back to the PROGRAM screen.
Apply All (SK5)	The “Apply all” soft key is used to confirm all presets made to program parameters in the PROGRAM screen. When pressed, all newly set values are applied to the output and the parameter background colors revert back to white.

Table 6-8: PROGRAM screen soft keys

6.4.11 Peak Current Protection Minimum Setting

The programmable peak current protection feature allows the user to limit the peak current that is applied to the EUT. To do this, the power source must clamp the output voltage. The power source will do so when the set limit is exceeded on a switching cycle by switching cycle bases. There are some practical considerations as some of the current delivered by the power source can be absorbed by the internal output filters.

If the peak current limit value is set too low, it may prevent the power source from delivering the programmed output voltage at higher frequencies. Even if no load is connected to the power source, some reactive power is required to generate the output voltage. This reactive current will be limited by the peak protection level set point, so a minimum value applies. The formula that determines the minimum set value for peak current protection is:

$$I_{pk} > 1 A + Vac\_setpoint * 0.09 * Freq\_setpoint \text{ (in kHz)}.$$

This formula applies in three phase mode. For example, with an output AC voltage setting of 230Vac and a frequency setting of 1000 Hz, the minimum set value would be:

$$I_{pk} \text{ min} = 1 + 230 * 0.09 * 1 = 21.7 A_{peak}$$

If the set value is below this level, the following two conditions will occur:

A) The voltage measured at the output will be less than desired.

Example 1:

- Frequency 400Hz.
- Voltage 120Vac.
- Peak current limit 1A.
- The voltage measured at the output will be limited to 25.6Vrms

Example 2:

- Frequency 400Hz.
- Voltage 120Vac.
- Peak current limit 2A.
- The voltage measured at the output will be 54.6Vrms

Example 3:

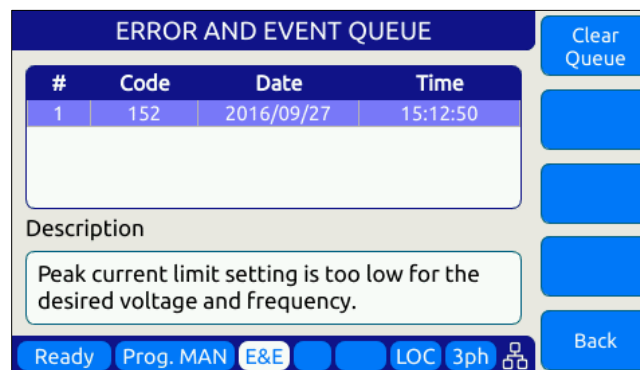
- Frequency 400Hz.
- Voltage 120Vac.
- Peak current limit 3A.
- The voltage measured at the output will be 83.22Vrms

The higher the frequency and the AC voltage set points are, the lower the measured voltage at the output will be unless the peak current protection level is set high enough to prevent this condition.

B) An Error event will be triggered in the error and event queue in order to notify the user.
 The error message is:

"Peak current limit setting is too low for the desired voltage and frequency."

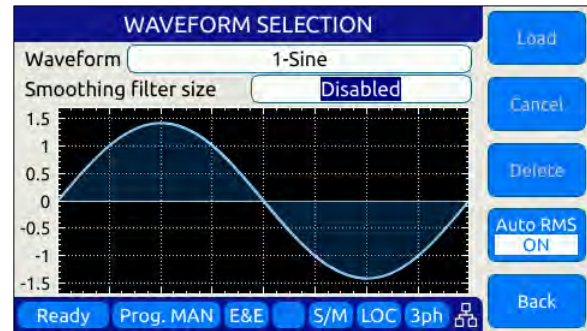
as shown in the screen capture below.

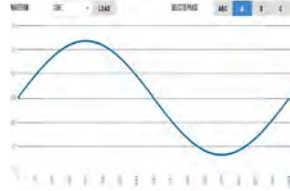
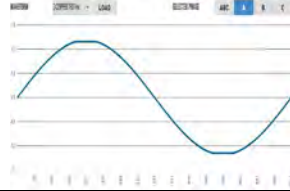
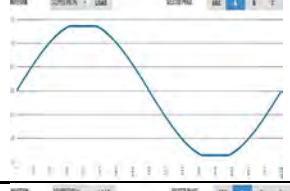
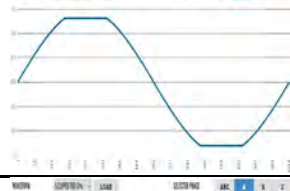
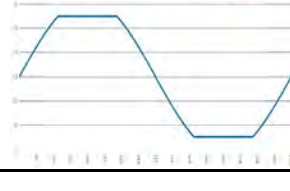


6.4.12 Available Waveforms

All models are supplied with 10 pre-loaded waveforms but can hold a total of 200. The default content of the first 10 registers are shown in the table below. Also shown are the waveform number names and the waveform description of each waveform.

For waveforms with high harmonic content – e.g. sharp transition or fast edges – the smoothing filter feature can be used to smooth out these high frequency events to reduce over/undershoot as needed. The value entered indicates the number of waveform data points that will be averaged to obtain a smoother wave shape. Preview of the resulting smoothed waveform is shown on the LCD screen.



Name	Description	Image	Notes
1	SINE		Standard sine wave. No harmonic content ¹ . This is also the default selected waveform at power on unless a power-on setup is recalled. Waveform 1 is fixed and CANNOT be changed! Note 1: See SOURce:WAVEFORM:SINEwave command
2	CLIPPED THD 1%		Clipped sine with 1% total harmonic voltage distortion due to flat topping of sinewave peaks.
3	CLIPPED THD 2%		Clipped sine with 2% total harmonic voltage distortion due to flat topping of sinewave peaks.
4	CLIPPED THD 5%		Clipped sine with 5% total harmonic voltage distortion due to flat topping of sinewave peaks.
5	CLIPPED THD 10%		Clipped sine with 10% total harmonic voltage distortion due to flat topping of sinewave peaks.

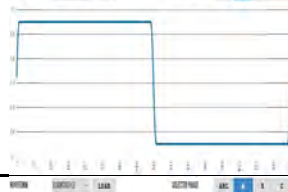
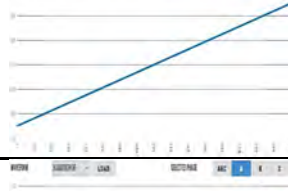
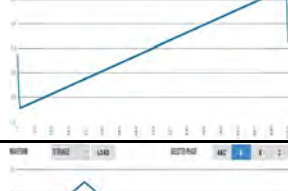
Name	Description	Image	Notes
6	SQUARE LF		Square wave. Consists of fundamental and all odd harmonics. The LF (low frequency) version is recommended for use below 100Hz.
7	SQUARE HF		Square wave. Consists of fundamental and all odd harmonics. The HF (high frequency) version is recommended for use above 100Hz.
8	SAWTOOTH LF		Saw tooth. Consist of fundamental and both odd and even harmonics. Note: Not recommended for conventional power applications. LF use < 100Hz.
9	SAWTOOTH HF		Saw tooth. Consist of fundamental and both odd and even harmonics. Note: Non-linear! Not recommended for conventional power applications. HF use > 100Hz.
10	TRIANGLE		Triangle. Similar to saw tooth but at same fundamental as a sine wave. Contains fundamental and odd harmonics with amplitudes that roll off as the inverse square of the harmonic number. (1/3, 1/9, 1/25 etc.).
11 ~ 200	User Defined		Waveforms 17 through 200 can be added as needed.

Table 6-9: Available Included Waveforms

6.4.13 Waveform Smoothing Filter

User defined or arbitrary waveforms can contain sudden transients, which equates to high order harmonics. Such types of waveforms can result in over or undershoot when applied at higher frequencies (i.e. 400Hz to 800Hz). An extreme example of this is a pure square wave, which would require infinite output bandwidth to accurately reproduce.

To mitigate this effect, the AGX Series® offers a smoothing filter feature (*FW rev 1.3.3. or higher required*) that may be used to smooth these transient. This filter uses a moving average method over 1 to 101 samples to reduce the slew rates of these abrupt transitions. A value of 1 represents Disabled (default setting) so no smoothing takes place.

The two samples below show the same square waveform with no smoothing (disabled) and smoothing over 100 waveform data points (max.).

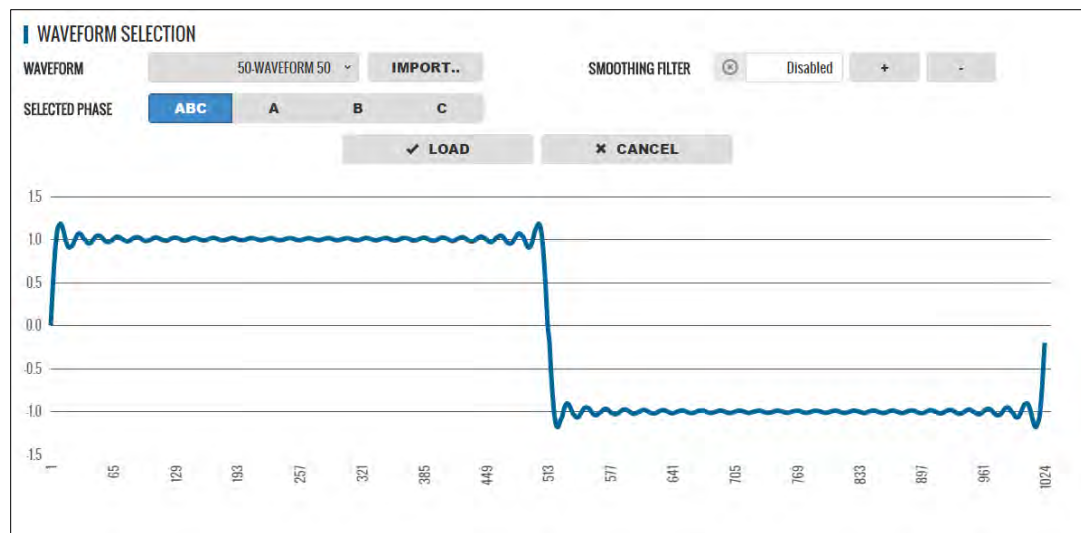


Figure 6-8: Waveform with no Smoothing Filter Applied



Figure 6-9: Same Waveform with maximum smoothing Filter Applied

6.4.14 AUTO RMS Function – Steady State

The AUTO RMS mode, if enabled, causes the AC voltage output value to be calculated as a true RMS voltage of the waveform selected. This means the output RMS voltage will remain at the programmed level regardless of a change in waveform shape. This may or may not be what the user intends. For example, adding a transient spike on a sine wave as part of a user defined waveform will cause the overall RMS value to increase so the sinewave portion of this user defined waveform will be attenuated somewhat when used.

When AUTO RMS is disabled, RMS calculation of substituted waveforms does not occur so the output RMS voltage may change from the set value if the waveform selected for output is not a sine wave. This mode is preferred if switching to a user waveform that has a different mathematical RMS value from a sine wave should NOT result in the output voltage amplitude being adjusted to maintain the same RMS level as with a sine wave. As in the previous example, adding a spike or a dip in part of the sinewave will not affect the output amplitude of the sinewave portion.

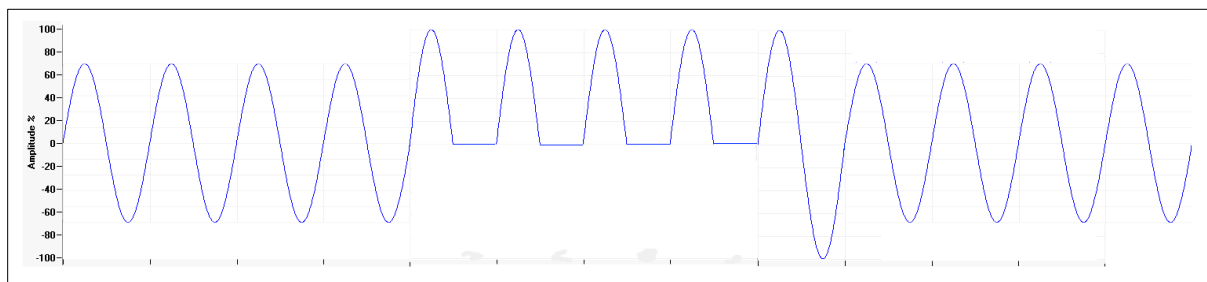
Note: The setting of the AUTO RMS mode is important when CSC mode is used as CSC mode uses the measured output RMS voltage to adjust the output to maintain voltage regulation.

This mode can be set by sending the **[SOURCE:]WAVEFORM:AUTORMS** command over one of the Digital control interfaces.

The following examples illustrate the different behaviors between AUTO RMS mode ON and OFF.

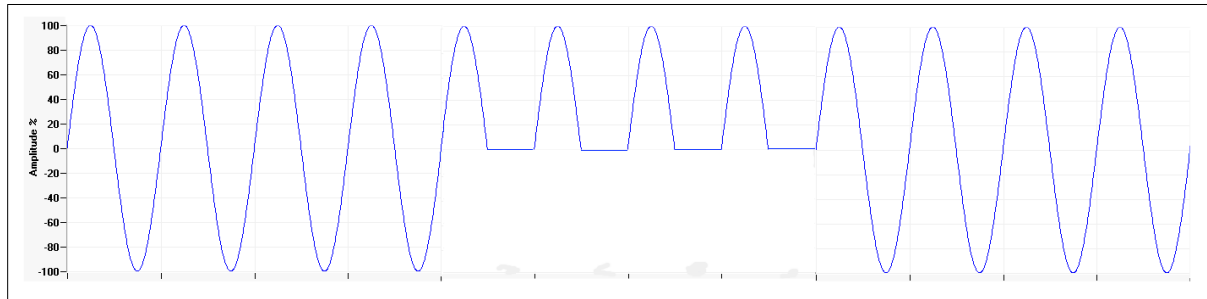
AUTO RMS ON Mode:

In the example below a, 100Vrms sine wave is swapped for a half wave rectified ac waveform. The RMS value of this non-sinusoidal waveform is 1.414x that of a sine wave so the peak value is increased to maintain a 100Vrms output voltage with this wave shape. Note that there is a considerable amount of DC offset present as well due to this non-symmetrical waveform.



AUTO RMS OFF Mode:

Same waveform example but this time with AUTO RMS mode OFF results in no change to output peak voltage but the actual RMS voltage during these four cycles is only 70.7Vrms instead of the 100Vrms programmed setting.



Note: In UPC Compatibility mode, this mode is always enabled.

6.4.15 PROGRAM Harmonics

The Harmonics programming screen is accessed from the PROGRAM screen using the “Harmonics” soft key (SK#4). Use the More softkey (SK#5) if the Harmonics soft key is not visible.

Harmonics can be generated using a harmonic waveform using the Arbitrary waveform capabilities of the power source as well but with that approach, only the RMS Voltage or Current Level is regulated, not the individual harmonic Voltage or Current Components. However, this method does support generation of harmonics numbers 2 through 50.

The Harmonics programming function allows up to five individual harmonic components to be defined. There is an independent load regulation loop for each of these five harmonics that results in more precise harmonic amplitude levels.



HARMONIC			
Harmonic	1 out of 5		
	Phase A	Phase B	Phase C
Number	3	3	3
Freq.	300.00	300.00	300.00 Hz
Volt. AC	0.0	0.0	0.0 V _{RMS}
Phase	0.0	360.0	720.0 Deg
Enabled Prog. MAN E&E HR M/M LOC ABC ⏏			

The five programmable harmonics can be anywhere from 2 to 50. For each harmonic, the frequency is automatically calculated and displayed as the multiple of the set fundamental frequency. Voltage or Current amplitude in Vrms / Arms or % of Fundamental Vrms / Arms can be set for each harmonic set. The same is true for phase angles.

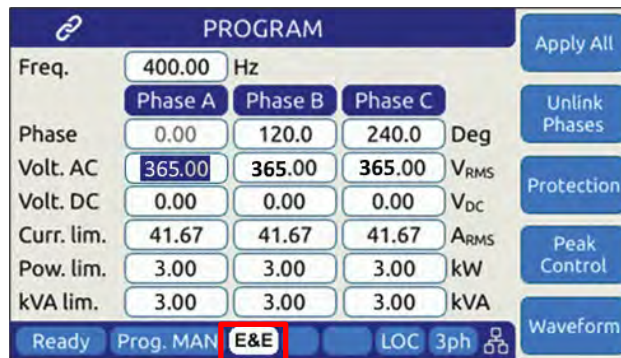
6.4.16 Extended AC Voltage Range Operation

To enable higher voltage operation, the user must first set the MAX USER LIMIT for Vac to more than 350.00V. Values from 351.00 to 365.00 will be accepted.



Figure 6-10: Enable Vac extended operating range to 312Vac

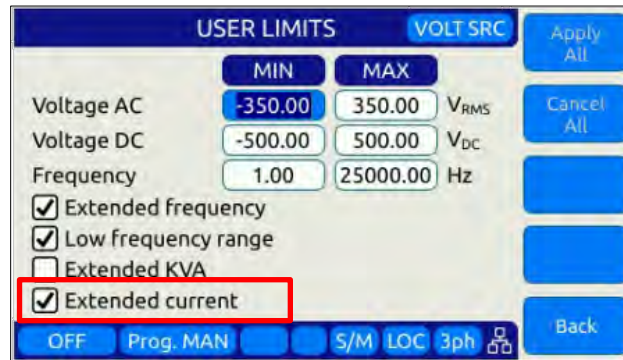
Once the Voltage AC MAX user limit has been set to a higher value, the PROGRAM screen will accept a Volt AC setting up to this new value as shown below.



When a value above 350 is entered in any of the available Vac setting fields, an Error & Event (E&E) message will be generated in the Error and Event Queue. The E&E field in the bottom status bar will blink to indicate a message is available. Note that the power limit fields will automatically update as needed to indicate the power limit.

6.4.17 Extended AC Current Range Operation

The way to enable the extended current mode – see section 4.3.4, “Extended AC Current Range” on page 47 - is through the user limits settings. From the front panel, this selection can be found in the USER LIMITS screen as shown below.



Note: This feature is only available on units with Firmware revision 5.6.10 or higher.

This mode is disabled by default so must be enabled by the user from the front panel or using the relevant SCPI command. Refer to section 8.8.4, “Current Programming Commands” on page 344.

Once enabled the current limit setpoints have to be increased as well. When using **current load mode of operation** (AGX or RGS with Load option or RLS models), the AC current user limit has to be increased, too. The increase in setting is persistent, so it needs to be increased once after the extended mode is enabled.

In this mode of operation, the AC RMS current range is increased by 15% for frequency settings up to 200Hz. From 200Hz to 1200Hz, the overload is derated by the unit to maintain thermally safe operating values along a pseudo quadratic decay curve.

6.5 MEAS – MEASUREMENTS Screens

The MEAS menu key displays the first of two measurement screens. Measurement screens are used to display measurement values taken at the output of the AC power source. The measurements screen layouts differ between single phase and multiphase mode. If the power source is configured for single-phase mode operation, only the single phase measurement screens are available. When in three phase mode, the user can change screens between all three phases or one phase at a time using the PHASE key located below the Output ON/OFF key or by pressing the “Individual Phase” soft key (SK5).

6.5.1 Measurements Screens

The different measurement screen layouts are shown below.



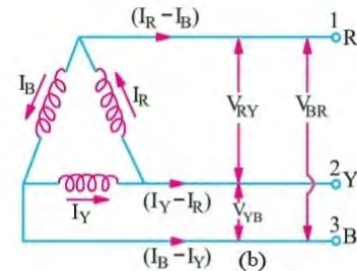
Figure 6-11: Measurement Screens 1 through 4

Measurement screen readout background color is normally white as shown in the examples above. Other background colors that may be used as appropriate are:

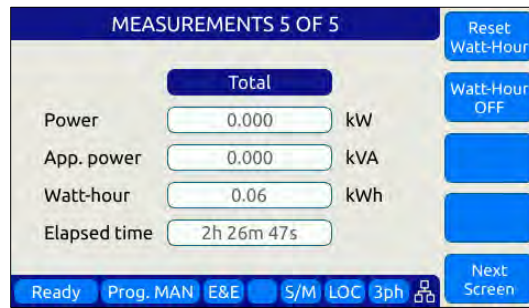
Green: Power and VA readings under conditions where power is returned to the power grid, i.e. under regenerative conditions.

Yellow: For current or other parameters in situations where the measurements may not be fully accurate. Example in load mode or current source load where line to line measurements assume sinusoidal waveforms and the programmed phase shifts between voltage and current, but the unit detects a load unbalance which invalidates that assumption.

For example, using a real delta connection, the phase currents are not the same as the current programmed in each amplifier. The example diagram to the right shows this. The current programmed in each amplifier is I_B , I_R , I_Y , and the phase currents seen by the AGX are $I_R - I_B$, $I_Y - I_R$, $I_B - I_Y$.



The fifth measurement screen shows the sum of all phases for Power, Apparent Power, Watt-hour and Elapsed time.



Phase selected Measurement Screens:

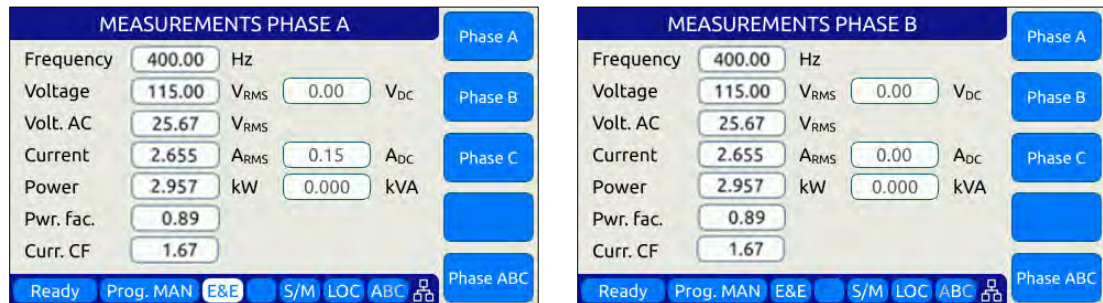
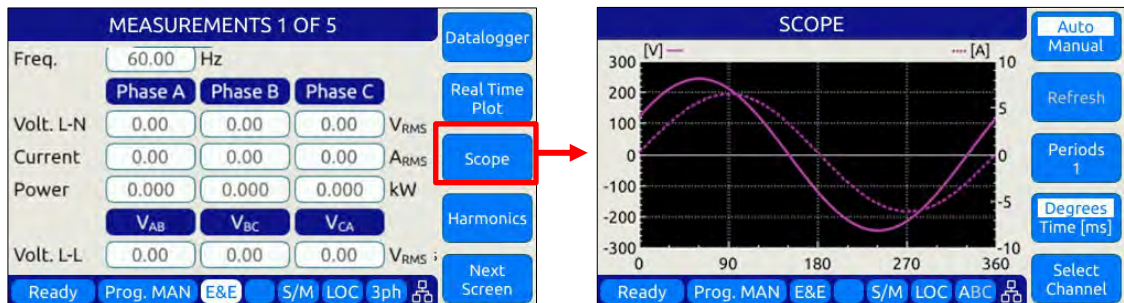


Figure 6-12: Single Phase Measurement Screens for Phase A and B

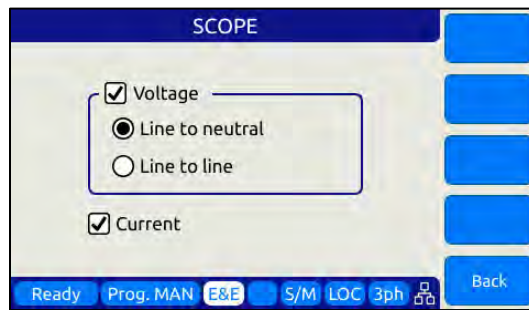
Note: The individual phase display screens contain all measurement parameters on one screen so there is one screen for each phase.

6.5.2 Scope Measurements

Scope measurements allow all voltage and current phases to be captured and displayed in the time domain. From one to four cycles of the fundamental frequency can be displayed. Display modes include all voltages, all currents, both voltage and current or individual phase selected voltage and current. Use the “Scope” soft key from the Measurement screen to select Scope measurements.



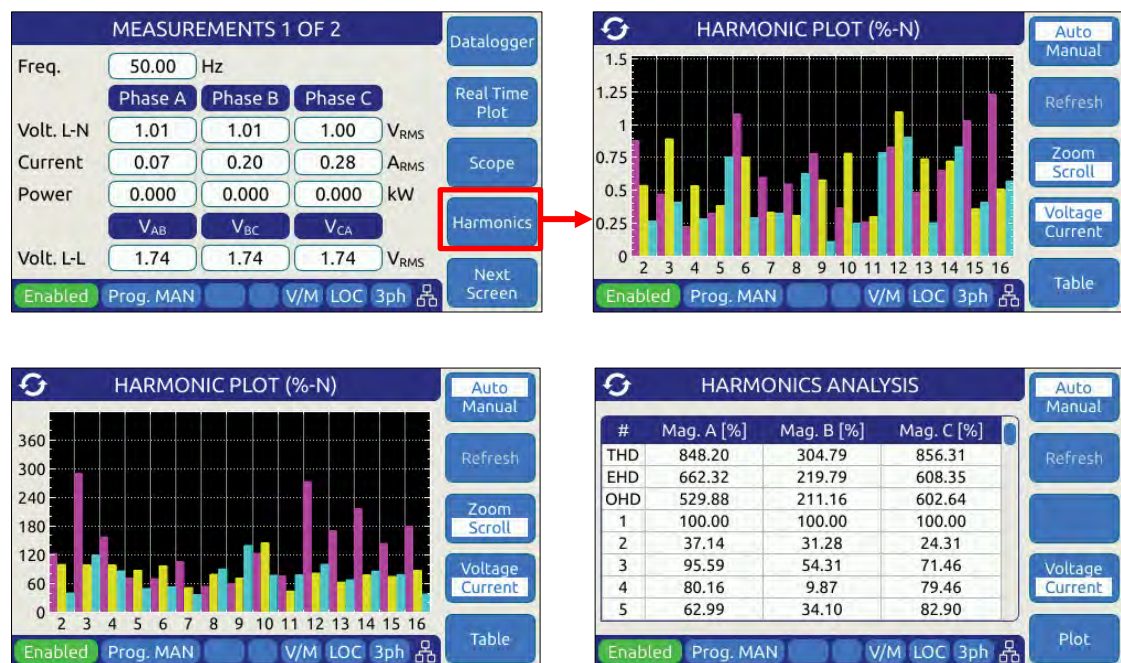
Note that voltage scope captures can be set for Line to Neutral voltage or Line to Line Voltage when in three phase mode. To select the desired mode, use the Select Channel soft key.



Note: The scope capture is triggered at the 0° phase internal waveform generator of the power source. This means the captured output waveform will have some phase delay resulting from the amplifier propagation delay which is function of the load. At higher frequency settings, this phase delay will be more pronounced.

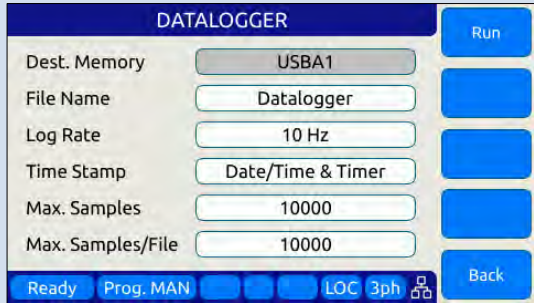
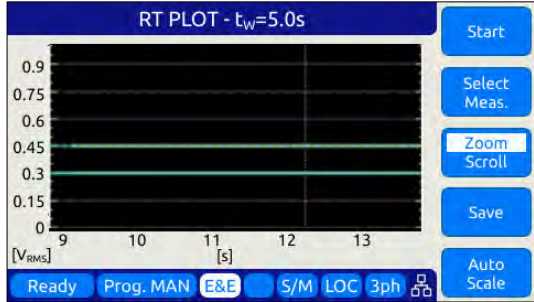
6.5.3 Harmonic Measurements

Harmonic measurements for all phase voltages and currents can be measured and displayed in either chart or table format. Use the “Harmonics” soft key from the Measurement screen to select Harmonics measurements.



6.5.4 Measurement Screen Soft Keys

The following five soft keys are available on the two three-phase measurement screens.

SOFT KEY	Description										
Datalogger (SK1)	The Datalogger soft key allows setting the measurement data logging memory type to be selected, sample rate and no. of samples to be logged to memory. To use a usb memory stick (32GB max), insert it in one of the two USB ports on the front panel and select either USBA1 or USBA2. Only memory devices found will be selectable in addition to the default internal RAM (volatile) memory. 										
Real Time Plot (SK2)	Display strip chart of voltage, current or both against time. This provides a trend plot of any available measured parameter.  The following soft keys are available to control the time plot: <table> <tr> <td>Start</td><td>Starts time plot.</td></tr> <tr> <td>Select Meas.</td><td>Select parameters to display</td></tr> <tr> <td>Zoom or Scroll</td><td>Zoom both X and Y axis</td></tr> <tr> <td>Save</td><td>Saves plot data to memory device</td></tr> <tr> <td>Auto Scale</td><td>Auto-scale the Y axis (Amplitude)</td></tr> </table>	Start	Starts time plot.	Select Meas.	Select parameters to display	Zoom or Scroll	Zoom both X and Y axis	Save	Saves plot data to memory device	Auto Scale	Auto-scale the Y axis (Amplitude)
Start	Starts time plot.										
Select Meas.	Select parameters to display										
Zoom or Scroll	Zoom both X and Y axis										
Save	Saves plot data to memory device										
Auto Scale	Auto-scale the Y axis (Amplitude)										

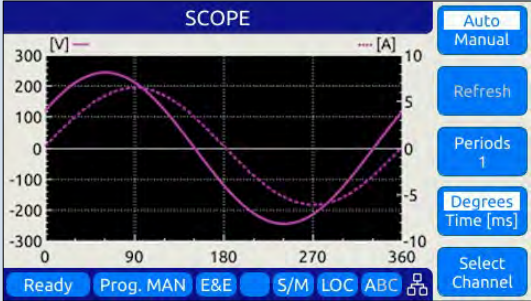
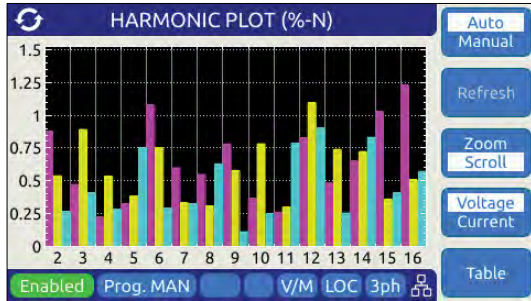
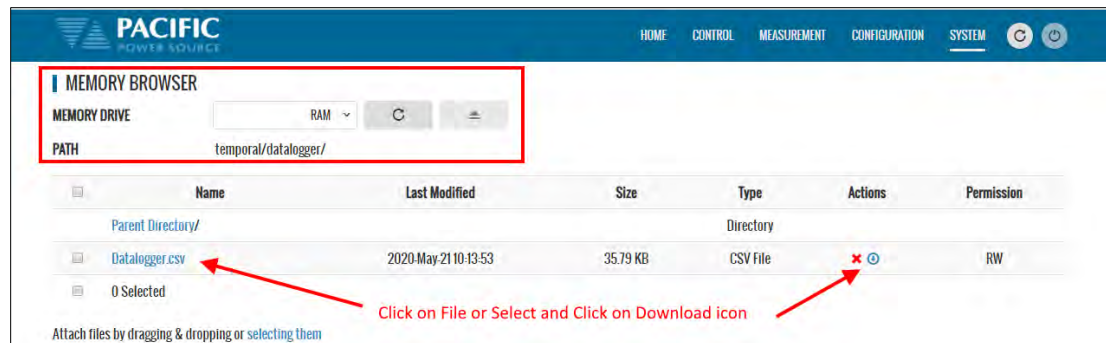
SOFT KEY	Description
Scope (SK3)	Toggles to the Scope Measurement display screen. 
Harmonics (SK4)	Toggles to the Harmonic Plot Measurement display screen. 
Next Screen (SK5)	This soft key allows toggling between the two available measurement screens. The same can be accomplished by pressing the MEAS button on the left hand side of the LCD display.

Table 6-10: Measurement Screen Soft Keys

6.5.5 Measurement Data Logging

Logging measurement data is easy to do using the Datalogging function. Files are saved in a comma separated value text file which is easily imported into MS Excel or other programs for analyzer and / or display purposes.

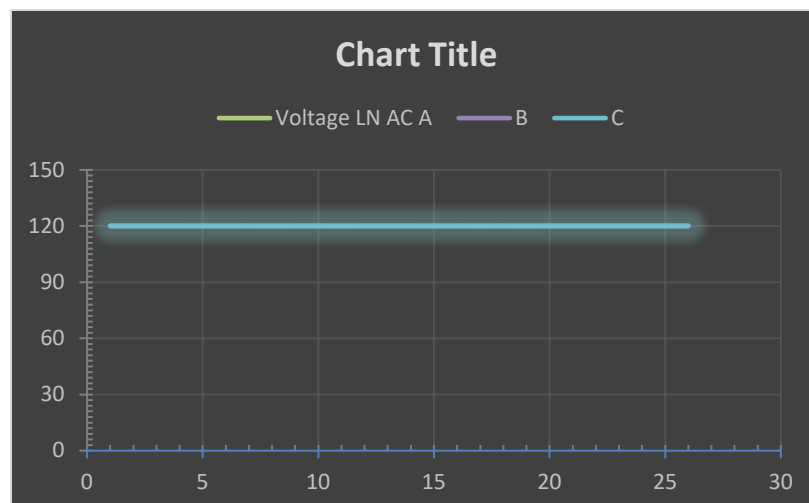
Destination memory defaults to internal RAM allowing log files to be downloaded to browsers or local drives using the web server SYSTEM -> MEMORY BROWSER menu entry.



A small datalogging file sample is shown here for reference.

```
Date & Time,Timer,Frequency,Voltage VLL ACDC A-B,B-C,C-A,Voltage VLL AC A-B,B-C,C-A,Voltage VLL DC A-B,B-C,C-A,Voltage LN ACDC A,B,C,Voltage LN AC A,B,C,Voltage LN DC A,B,C,Current RMS
A,B,C,Current DC A,B,C,Power A,B,C,App. Power A,B,C,Power Factor A,B,C,Peak Current A,B,C,Crest Factor A,B,C,
21/4/2020 10:13:17.647,0.00,60,207.846,207.845,207.846,207.846,207.846,0.0015717,0.000892723,0.000678978,120,120,120,120,5.74293e-
05,0.00162913,0.000736408,0.0961562,0.0658469,0.0389105,0.00917411,0.00100751,-
0.00516246,0.00012973,0.000672549,0.00066903,0.0115388,0.00790161,0.00466924,0,0,0,0.249016,0.199247,0.126655,0,0,0,
21/4/2020 10:13:17.748,0.101,60,207.845,207.846,207.847,207.845,207.846,207.847,0.000484911,0.000716525,0.000231614,120,119.999,120.001,120,119.999,120.001,0.000291418,-
0.000193493,0.000523032,0.0963041,0.0660525,0.0392375,0.00873799,0.000840356,-
0.0050699,0.000142419,0.000692023,0.000528912,0.0115565,0.0079262,0.00470855,0,0,0,0.245361,0.199247,0.126651,0,0,0,
21/4/2020 10:13:17.847,0.200,60,207.845,207.843,207.844,207.845,207.843,207.844,0.00195489,0.000834307,0.0027892,120,119.999,119.998,120,119.999,119.998,0.00201776,6.2867e-05,-
0.00077144,0.0957361,0.0658142,0.0392642,0.00805068,0.000924351,-0.00582215,0.000124226,0.000720164,0.000534704,0.0114883,0.00789763,0.00471161,0,0,0,0.249,0.195608,0.128863,0,0,0,
21/4/2020 10:13:17.947,0.300,60,207.844,207.847,207.846,207.844,207.847,207.846,7.05616e-
05,0.000486062,0.000556624,119.998,119.999,120.002,119.998,119.999,120.002,0.000496289,0.000425727,-6.03351e-05,0.0967671,0.0652786,0.0393575,0.00906719,0.000913487,-
0.0051749,0.000184154,0.00060259,0.00057676,0.0116118,0.00783339,0.00472296,0,0,0,0.252638,0.192,0.126645,0,0,0,
```

Using Excel to select several measurement columns allows for easy plotting of trends. For example, VLN for A, B and C (Y-axis) against no of samples (X-axis) as shown below.

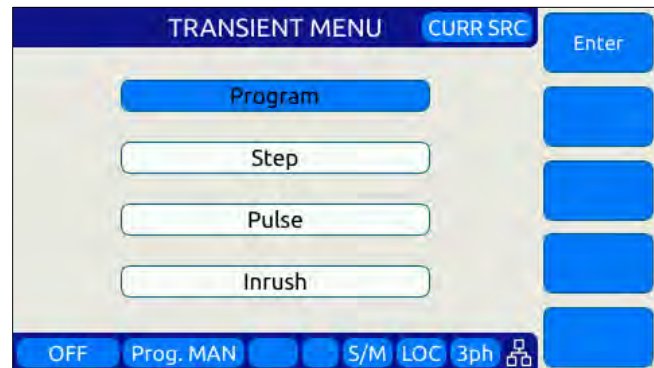


6.6 TRAN- TRANSIENTS Screens

Transient sequences allow precise time-controlled changes to be made to voltage (AC and DC mode) and frequency (AC mode only) under program control. A transient sequence consists of one or more list entries (or segments) that are executed in sequence.

There are three types of Transients modes:

- **Program Mode**
- **Step and Ramp Mode**
- **Pulse Mode**
- **Inrush Mode**



Note that Step and Pulse transients can be accomplished using LIST mode as well but STEP and PULSE data entry is more intuitive. INRUSH mode is supported in Current Source or Load Mode. Transients are created or edited in EDIT mode and can be saved to non-volatile memory as part of an instrument setup. They are executed in Execution mode. The following sections cover all available transient modes.

6.6.1 PROGRAM Mode

Program Mode (also referred to as List mode) is the most versatile transient data entry mode as it allows any of the other Transients types to be created as well. However, entering a long ramp or step transient consisting of many discrete steps in List mode is time consuming and tedious. It is also easier to make a mistake in PROGRAM mode than using the STEP or RAMP mode. Same is true for PULSE transients which can be created with a short transient list as well.

PROGRAM transients can be created from the front panel, using the LXI web server and a web browser or with Pacific's PPCS Manager Windows software.

An example Transient PROGRAM created from the front panel is shown below.

TRANSIENT VIEW					Add at the end Insert before Delete Debug Mode Run Screen
#	Freq	Volt AC	Volt DC	Dwell	
1	400.00	115.00	0.00	100.0	
2	400.00	100.00	0.00	10.0	
3	400.00	115.00	0.00	100.0	
4	400.00	100.00	0.00	10.0	
5	400.00	115.00	0.00	100.0	
6	400.00	100.00	0.00	10.0	
7	400.00	115.00	0.00	100.0	
8	400.00	100.00	0.00	10.0	
Ready Prog. MAN LOC 3ph					

6.6.2 PROGRAM / LIST Parameters

The following parameters are available in each Program / List transient step.

PARAMETER	Range	Unit	Description
#	1 - 199	-	Displays the row number in the transient table. These numbers are generated automatically.
Ramp	0.2 - 9999	msec.	Ramp time to slew from existing set point to new set point value. Applies to both Frequency and Voltage. If previous set value is the same as new value, the value is not slewed but rather stays at the same value for the duration of the ramp time.
Frequency	16 – 1200	Hz	New frequency value
Voltage AC	0 – 300	V rms	New AC voltage value
Voltage DC	0 – 425	V dc	New DC voltage value
Dwell	0.2 - 9999	msec.	Dwell time. At the end of the ramp time, the new set values remain in effect during the dwell period. At the end of the dwell time, the next list entry (if any) will be executed.

Table 6-11: Available LIST Transient Parameters

Voltage LIST Transient Example 1

The table and associated figure below illustrates the operation of a transient. The blue line represents the RMS value of the phase A output voltage.

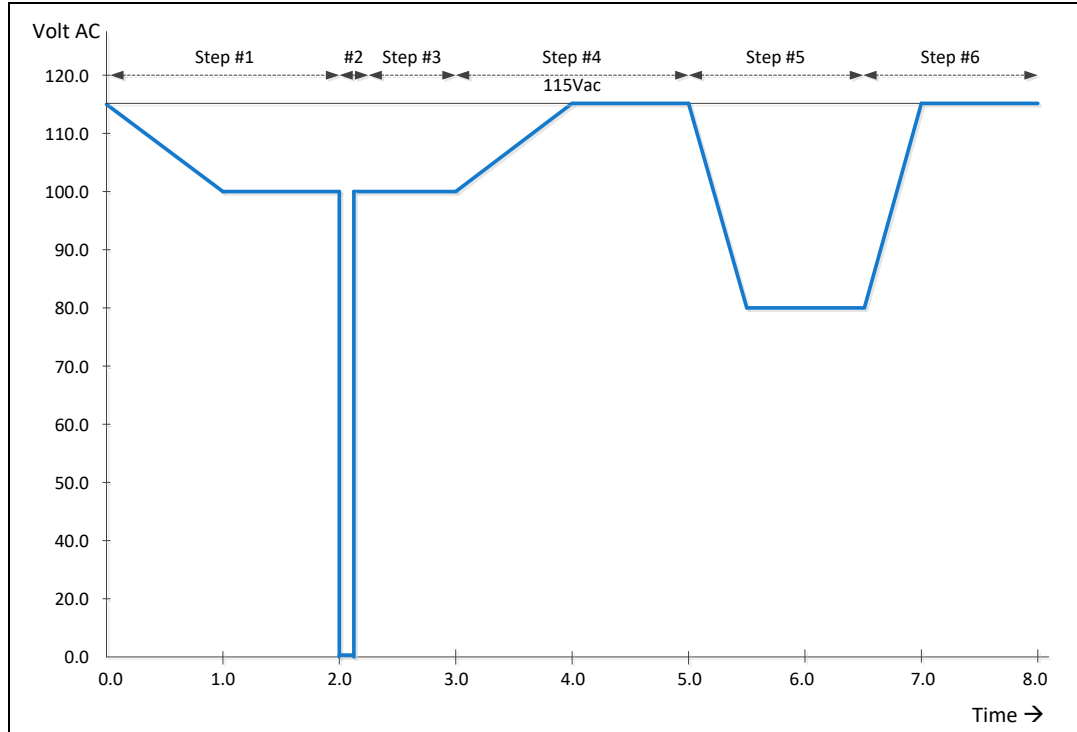


Figure 6-13: Voltage Transient Example 1

To generate this voltage versus time output sequence, the following transient list entries are required. (Ramp and dwell times shown in milliseconds using STEP mode.)

#	Ramp	Freq	Volt	Dwell
1	1000	400	100.00	1000
2	0.2	400	0.00	100
3	0.2	400	100.00	900
4	1000	400	115.00	1000
5	500	400	80.00	1000
6	0.5	400	115.00	1.00

Table 6-12: Voltage Transient List for Example 1

Voltage and Frequency LIST Transient Example 2

This example is based on an actual avionics test requirement from RTCA/DO160 Section 16 test number 16.5.2.1d. This is a single-phase abnormal voltage and frequency limit test for airborne equipment operated from 400Hz AC power.

The requirement from the test standard is shown in the table below:

TEST	VOLTAGE (V rms)	FREQUENCY (Hz)
1	122	430
2	100	430
3	122	370
4	100	370

Table 6-13: RTCA/DO160 Section 16 test number 16.5.2.1d

There are four tests, each runs for at least 5 minutes or 300 seconds. Each test step has a different voltage and frequency deviation from the nominal 115V and 400Hz. This is graphically illustrated by the image below.

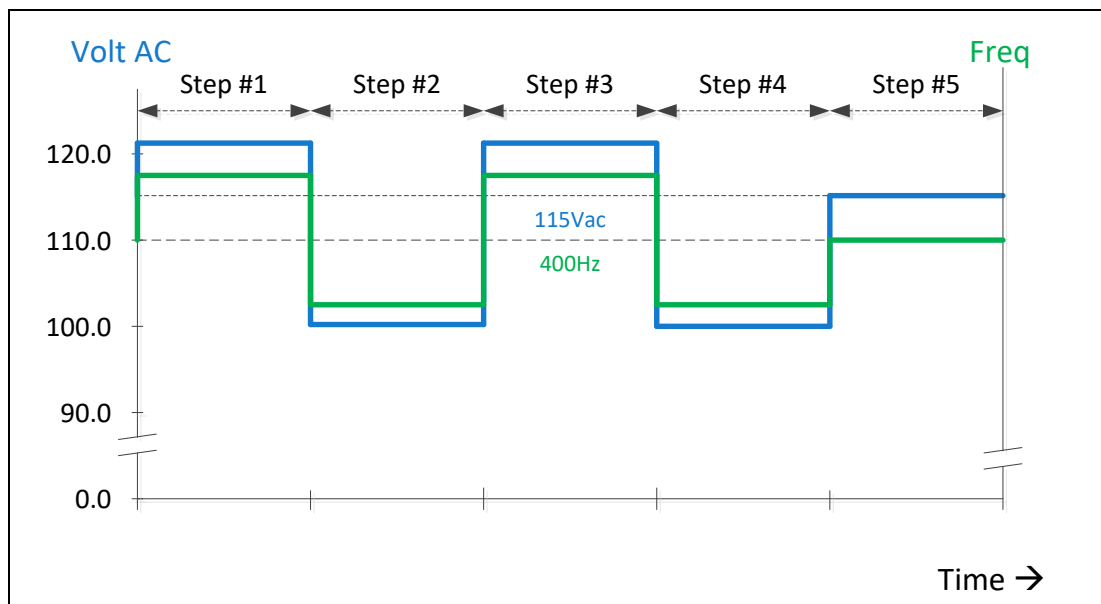


Figure 6-14: RTCA/DO160 Section 16 test number 16.5.2.1d

To generate this DO160 test sequence, the following transient list entries are required. Times shown in milliseconds.

#	Ramp	Freq	Volt	Dwell
1	0.2	430	122.00	300000
2	0.2	370	100.00	300000
3	0.2	430	122.00	300000
4	0.2	370	100.00	300000
5	1000	400	115.00	300000

Table 6-14: Voltage Transient List for Example 1

6.6.3 PROGRAM Transient Edit Mode

To create a new transient program, press the **TRAN** key to select the Transient screen and then select the preferred data entry mode, LIST, STEP/RAMP or PULSE. If no transients have been entered or recalled, the initial screen will be blank.

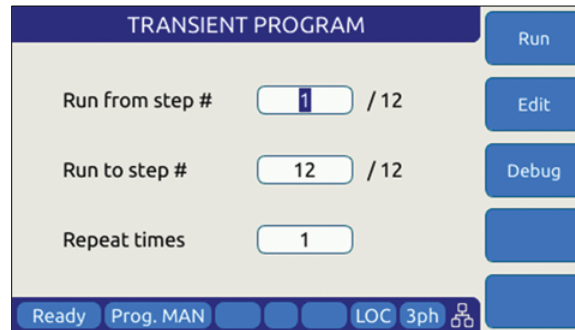
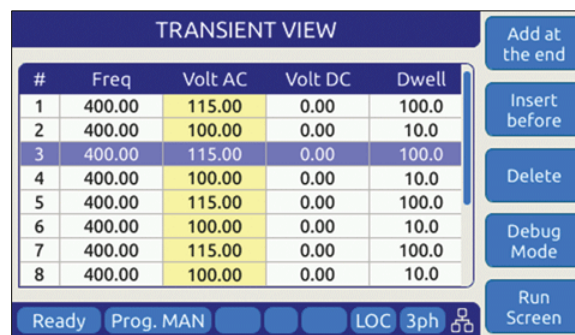


Figure 6-15: Blank TRANSIENT PROGRAM screen

The only available soft key is the “Create” key (SK1). Press the “Create” soft key to enter the Transient Edit mode. This will display the TRANSIENT VIEW screen.



#	Freq	Volt AC	Volt DC	Dwell
1	400.00	115.00	0.00	100.0
2	400.00	100.00	0.00	10.0
3	400.00	115.00	0.00	100.0
4	400.00	100.00	0.00	10.0
5	400.00	115.00	0.00	100.0
6	400.00	100.00	0.00	10.0
7	400.00	115.00	0.00	100.0
8	400.00	100.00	0.00	10.0

Figure 6-16: TRANSIENT VIEW Edit Mode

In Edit mode, a number of soft keys are available to aid in editing new or existing transient lists. They are defined in the following table.

SOFT KEY	Description
Add at the end (SK1)	Adds a new row entry at the bottom of the transient list table. If there are no table entries yet (new), pressing this key will add the first line of a new transient table.
Insert before (SK2)	Insert a new table row before the current selected row. The selected row and any rows below that are all pushed down one position.
Delete (SK3)	Deletes the current selected row. Any rows below the selected row are pushed up one position. Note: This action cannot be undone.

SOFT KEY	Description
Debug Mode (SK4)	Displays the Debug Execution mode screen. See section 6.6.4
Run Screen (SK5)	Returns to the regular TRANSIENT PROGRAM screen used for transient execution mode. See section 6.6.4.

Table 6-15: Available TRANSIENT EDIT screen soft keys

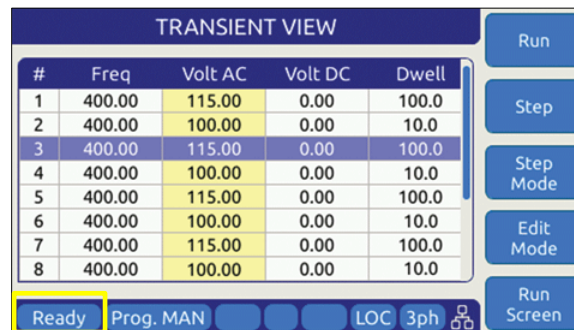
Once created, a transient sequence can be saved as part of the instrument setup. Refer to Section 6.7.4 for information on saving and recalling setups.

6.6.4 PROGRAM Transient Execution Modes

Transients can be executed as soon as they have been entered. To execute a transient, the output **must be ON**. Sometimes it is best to debug a new transient sequence to make sure it performs the intended test and all values were entered correctly. To do so, the DEBUG mode is provided.

DEBUG MODE

The debug mode can be selected from the TRANSIENT VIEW screen by pressing the “Debug Mode” soft key (SK4). This changes the TRANSIENT VIEW screen from EDIT to DEBUG mode and displays a different set of soft keys to control execution.



TRANSIENT VIEW				
#	Freq	Volt AC	Volt DC	Dwell
1	400.00	115.00	0.00	100.0
2	400.00	100.00	0.00	10.0
3	400.00	115.00	0.00	100.0
4	400.00	100.00	0.00	10.0
5	400.00	115.00	0.00	100.0
6	400.00	100.00	0.00	10.0
7	400.00	115.00	0.00	100.0
8	400.00	100.00	0.00	10.0

Ready Prog. MAN LOC 3ph

Run Step Step Mode Edit Mode Run Screen

Figure 6-17: TRANSIENT Debug mode screen

The following execution control soft keys are available.

SOFT KEY	Description
Run (SK1)	Starts the transient from the currently selected row number
Step (SK2)	Single steps one row at a time
Step Mode (SK3)	Executes one step at a time
Edit Mode (SK4)	Stops execution and reverts to Edit mode
Run Screen (SK5)	Returns to the regular TRANSIENT PROGRAM screen used for transient execution mode. See section 6.6.4.

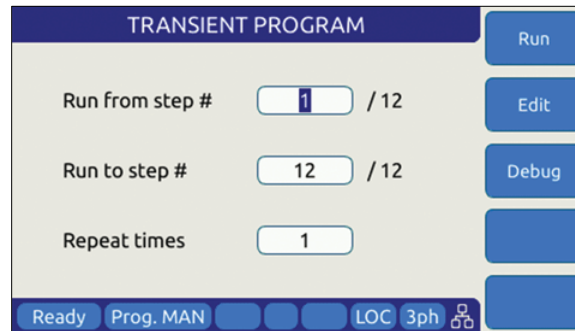
Table 6-16: Available TRANSIENT DEBUG screen soft keys

Note: The progress of the transient is indicated by the “Program” status bar at the bottom of the screen.

NORMAL EXECUTION MODE

Transient execution is controlled from the TRANSIENT PROGRAM screen. If no transient data has been entered, no run mode soft key will be visible. In that case, you must use the “Create” soft key to create a new transient sequence table.

The TRANSIENT PROGRAM screen for LIST mode is shown below.



There are three user settable parameters that control execution of the transient sequence. They are:

1. Run from step #
2. Run to step #
3. Repeat times

Transients will be executed when the “Run” soft key (SK1) is pressed. If the output is **OFF** however, a message will appear indicating the output must be turned **ON** first.

The transient execution will start at the step # set and run until the Run to step value is reached. In the example above, from step #1 through step #6 inclusive.

The “Repeat times” field determines how many times the same sequence will be repeated. To run a sequence indefinitely or until manually stopped, use the shuttle to scroll down to zero or enter zero in this field using the keypad. This will set the repeat field to “indefinitely”.

The following soft keys are available on the TRANSIENT PROGRAM screen.

SOFT KEY	Description
Run (SK1)	Starts the transient from the “Run from step#” row number
Edit (SK2)	Displays the TRANSIENT VIEW edit mode screen. See section 6.6.3
Debug (SK3)	Displays the TRANSIENT VIEW debug mode screen.
Stop (SK4)	Only appears if “Repeat time” value is set to “indefinitely”. Press to stop execution manually

Table 6-17: Available TRANSIENT PROGRAM screen soft keys

6.6.5 PROGRAM LIST Transient Entry Modes

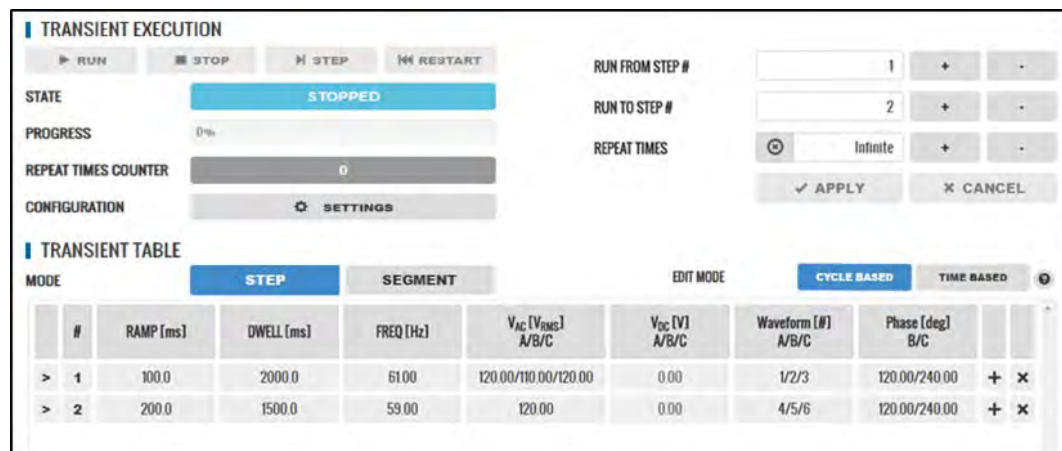
The AGX Series® supports two types of transient entry modes:

- LIST STEP Entry
- LIST SEGMENT Entry

Step mode is commonly used on AC and DC power sources that support the SCPI command language as the SCPI standard defines a LIST, STEP and PULSE command syntax.

Segment mode is used on all Pacific Power sources with UPC controllers such as ASX and AMX Series. Both modes support the same capabilities however.

Note that in STEP mode, two segment entries are combined so each STEP mode entry requires two SEGMENT entries. The two transient examples below represent the same transient display in either mode.



TRANSIENT EXECUTION

▶ RUN STOP H STEP H RESTART

STATE: STOPPED

PROGRESS: 0%

REPEAT TIMES COUNTER: 0

CONFIGURATION: SETTINGS

RUN FROM STEP #: 1

RUN TO STEP #: 2

REPEAT TIMES: Infinite

✓ APPLY ✕ CANCEL

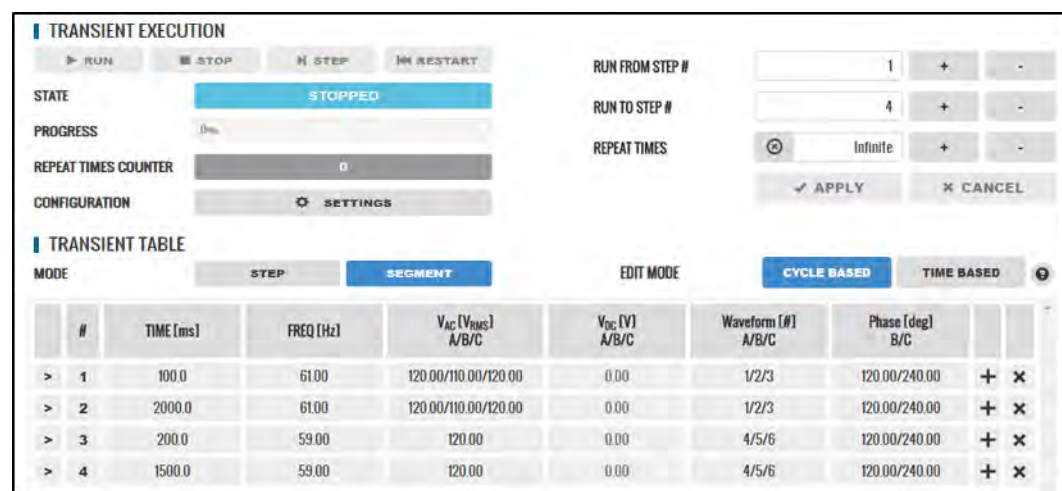
TRANSIENT TABLE

MODE: STEP SEGMENT

EDIT MODE: CYCLE BASED TIME BASED

#	RAMP [ms]	DWELL [ms]	FREQ [Hz]	V _{AC} [V _{RMS}] A/B/C	V _{DC} [V] A/B/C	Waveform [#] A/B/C	Phase [deg] B/C		
> 1	100.0	2000.0	61.00	120.00/110.00/120.00	0.00	1/2/3	120.00/240.00	+	✕
> 2	200.0	1500.0	59.00	120.00	0.00	4/5/6	120.00/240.00	+	✕

Figure 6-18: Transient shown in STEP Entry Mode



TRANSIENT EXECUTION

▶ RUN STOP H STEP H RESTART

STATE: STOPPED

PROGRESS: 0%

REPEAT TIMES COUNTER: 0

CONFIGURATION: SETTINGS

RUN FROM STEP #: 1

RUN TO STEP #: 4

REPEAT TIMES: Infinite

✓ APPLY ✕ CANCEL

TRANSIENT TABLE

MODE: STEP SEGMENT

EDIT MODE: CYCLE BASED TIME BASED

#	TIME [ms]	FREQ [Hz]	V _{AC} [V _{RMS}] A/B/C	V _{DC} [V] A/B/C	Waveform [#] A/B/C	Phase [deg] B/C		
> 1	100.0	61.00	120.00/110.00/120.00	0.00	1/2/3	120.00/240.00	+	✕
> 2	2000.0	61.00	120.00/110.00/120.00	0.00	1/2/3	120.00/240.00	+	✕
> 3	200.0	59.00	120.00	0.00	4/5/6	120.00/240.00	+	✕
> 4	1500.0	59.00	120.00	0.00	4/5/6	120.00/240.00	+	✕

Figure 6-19: Transient shown in SEGMENT Entry Mode

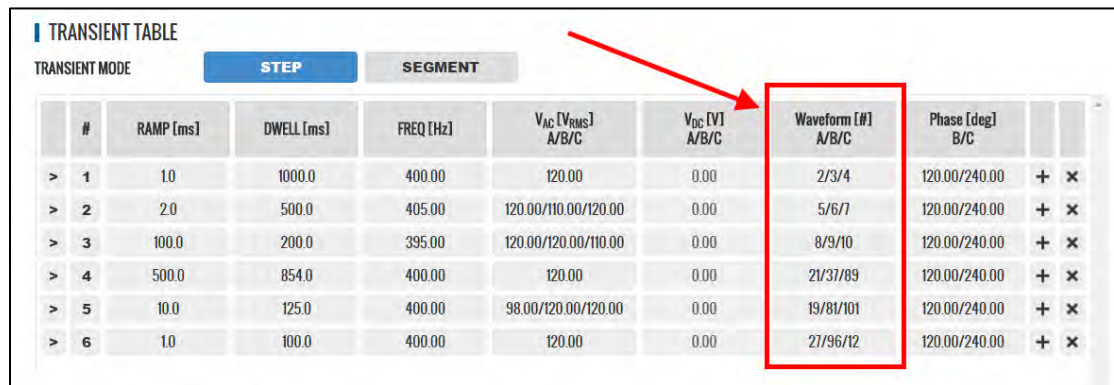
6.6.6 Multiple User Waveforms in PROGRAM LIST Transients

Transient programs are very useful to deliver precisely controlled transitions between different waveforms to a unit under test. This means transitions from a normal AC sine wave to a non-sinusoidal or distorted waveform can be accomplished by using different waveform at different segments or step entries.

Waveforms are numbered from 1 through 200 with 1 being a fixed sine wave. All other waveform registers are user defined arbitrary waveforms.

When in AC mode, transient segments or steps can called out different waveform numbers on each of up to three phases. For each segment, up to six different waveforms can be selected. The same waveform can be repeated as often as needed within the same transient program.

In three or split phase mode, each phase in a transient program can use its own set of up to six user-defined waveform. Thus, up to 18 different waveforms are available when in three-phase mode.



TRANSIENT TABLE									
TRANSIENT MODE		STEP		SEGMENT					
	#	RAMP [ms]	DWELL [ms]	FREQ [Hz]	V _{AC} [V _{RMS}] A/B/C	V _{DC} [V] A/B/C	Waveform [#] A/B/C	Phase [deg] B/C	
>	1	1.0	1000.0	400.00	120.00	0.00	2/3/4	120.00/240.00	+ x
>	2	2.0	500.0	405.00	120.00/110.00/120.00	0.00	5/6/7	120.00/240.00	+ x
>	3	100.0	200.0	395.00	120.00/120.00/110.00	0.00	8/9/10	120.00/240.00	+ x
>	4	500.0	854.0	400.00	120.00	0.00	21/37/89	120.00/240.00	+ x
>	5	10.0	125.0	400.00	98.00/120.00/120.00	0.00	19/81/101	120.00/240.00	+ x
>	6	1.0	100.0	400.00	120.00	0.00	27/96/12	120.00/240.00	+ x

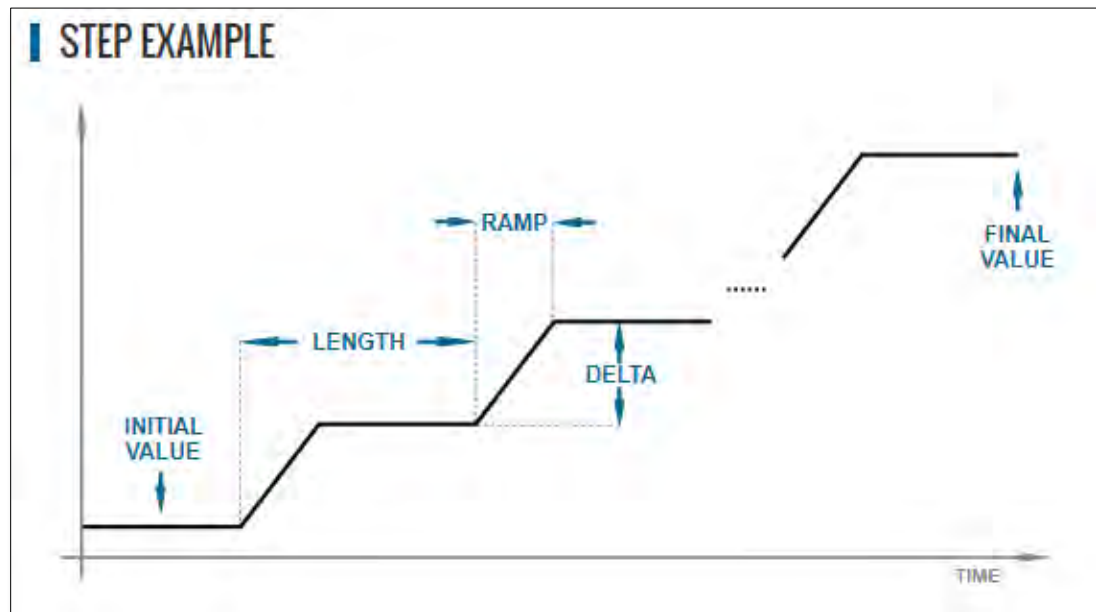
Figure 6-20: Available User Waveforms in Transients

6.6.7 STEP or RAMP Modes

STEP and RAMP transients are very similar except in RAMP data entry mode, each step duration is set to the minimum available time interval of 0.2 msec to obtain the smoothest possible ramp result.

In STEP mode, the user sets each increment/decrement and step dwell time.

Step transients are useful for testing over or under voltage protection circuits on AC or DC input supplies. They allow Voltage (AC or DC), Frequency and phase B or C to be steps at discrete intervals and times. An example STEP transient is shown in the screen capture below. It shows the relationship between the RAMP Parameters.



The LENGTH is the dwell time for each step level, including any ramp time. The first step starts from the INITIAL VALUE. The DELTA is the increment or decrement value for each step. The FINAL VALUE determines how many steps will be required to reach it.

Thus, the step COUNT will be:

$$\text{COUNT} = (\text{FINAL VALUE} - \text{INITIAL VALUE}) / \text{DELTA}$$

The total duration to complete the STEP transient depends on the repeat setting, length and if the Insert Initial Value check box is ON or OFF:

If Insert Initial Value = ON (default):

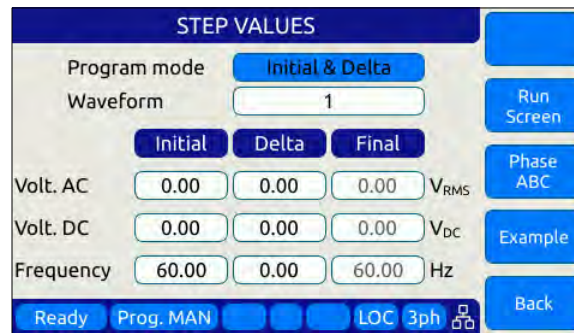
$$\text{DURATION} = \text{REPEAT TIMES} * (\text{COUNT} + 1) * \text{LENGTH}$$

If Insert Initial Value = OFF:

$$\text{DURATION} = \text{REPEAT TIMES} * \text{COUNT} * \text{LENGTH}$$

Step Transients can be programmed from the front panel or the LXI webserver.

6.6.8 STEP or RAMP Parameters



Step transients can be used to create discrete stair step like voltage and/or frequency changes or smooth ramps. The default ramp time is 0.2 msec.

Ramps can be programmed in three modes:

- INIDEL (0): Initial & Delta: Programmed by initial and delta values
- FINDEL (1): Final & Delta: Programmed by final and delta values
- INIFIN (2): Initial & Final: Programmed by initial and final values

Step transients can be used to step frequency, voltage AC, voltage DC, and phases.

The HOLD is ON, the last step values will be set as steady-state when the step execution ends. Duration of each step is determined by: $LENGTH = WIDTH + RAMP TIME$

The following parameters are available in a STEP VALUES screen.

PARAMETER	Range	Unit	Description
Program Mode	Initial & Delta Final & Delta Initial & Final	-	Program Entry Modes
Waveform	1 ~ 200		Waveform number
Voltage AC	0 ~ 300	Vrms	AC Voltage
Voltage DC	-425 ~ + 425	Vdc	DC Voltage
Frequency	15 ~ 1200	Hz	Frequency

Table 6-18: Available STEP Transient Parameters

The following soft keys are available on the STEP PROGRAM screen.

SOFT KEY	Description
(SK1)	
Run Screen(SK2)	Displays the STEP EXECUTION screen.
Phase ABC (SK3)	Toggles between phase A, B, C or Coupled ABC
Example (SK4)	Displays a graphical representation of the STEP parameters
Back (SK5)	Returns to previous screen

Table 6-19: Available STEP PROGRAM screen soft keys

6.6.9 STEP or RAMP Transient Execution Modes

STEP Transients can be executed as soon as they have been entered. To execute a transient, the output **must be ON**.

STEP or RAMP Transient execution is controlled from the STEP EXECUTION screen. If no STEP or RAMP transient data has been entered, no run mode soft key will be visible. In that case, you must back up to the STEP VALUES screen.

The STEP EXECUTION screen is shown below.

For STEP transients, Count and Length as well as Ramp time are available to be set. The “Hold final values” checkbox determines if the final state after the ramp completes remains at the final ramp values or returns the to settings before the ramp was executed.

Transients will be executed when the “Run” soft key (SK1) is pressed. If the output is **OFF** however, a message will appear indicating the output must be turned **ON** first.

The “Repeat times” field determines how many times the same STEPS or RAMPS will be repeated. To run a sequence indefinitely or until manually stopped, use the shuttle to scroll down to zero or enter zero in this field using the keypad. This will set the repeat field to “indefinitely”.

The “Count” field specifies how many steps will be taken and

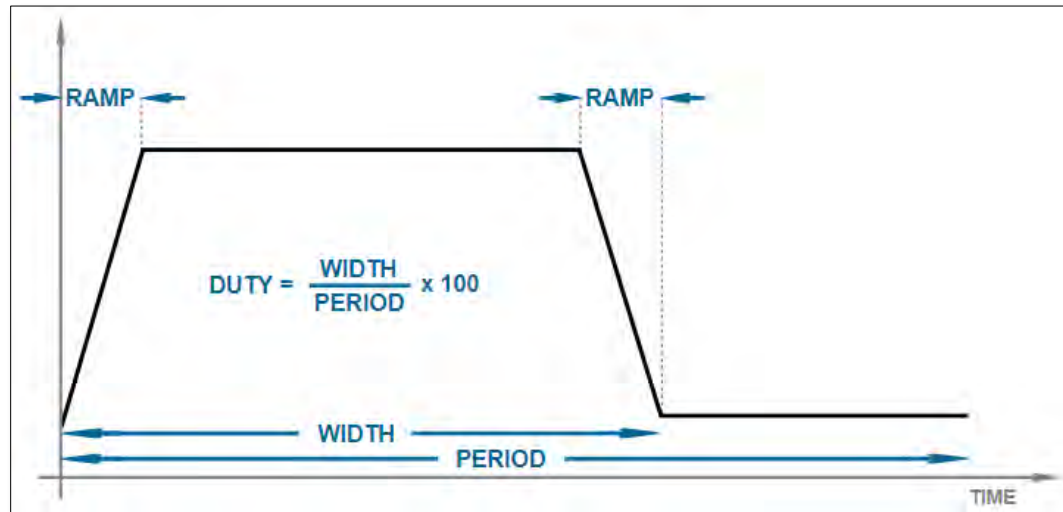
The following soft keys are available on the STEP PROGRAM screen.

SOFT KEY	Description
Run (SK1)	Starts the transient from the “Run from step#” row number
Step Values (SK2)	Displays the STEP VIEW edit mode screen.
Load (SK3)	Converts STEP transient definition to standard transient segments
Example (SK4)	Displays a graphical representation of the STEP parameters
Back (SK5)	Returns to previous screen

Table 6-20: Available STEP EXECUTION screen soft keys

6.6.10 PULSE Mode

PULSE transient mode provides a quick and easy way to enter repetitive pulsed output events. This applies to AC voltage, DC voltage and or Frequency. A sample of a PULSE transient definition is shown in the screen capture below.



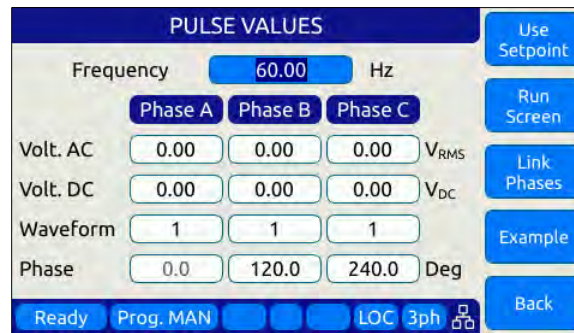
The parameters that define a PULSE transient are dependent of each other so changing one may force another to change. The semantics used for setting PULSE transients is as follows:

Parameter	Description
RAMP	Up or down ramp time
WIDTH	Duration of pulse including rising and failing ramp times
PERIOD	Total time duration for a single pulse
DUTY	Duty cycle of the pulse

The DUTY cycle is determined by the other three parameters as in:

$$\text{DUTY} = \text{WIDTH} \times 100 / \text{PERIOD}$$

6.6.11 PULSE Parameters



Pulse transients can be used to create repetitive events for endurance testing of AC and DC powered products.

The following parameters are available in a PULSE VALUES screen.

PARAMETER	Range	Unit	Description
Frequency	15 ~ 1200	Hz	Frequency
Voltage AC	0 ~ 300	Vrms	AC Voltage
Voltage DC	-425 ~ + 425	Vdc	DC Voltage
Waveform	1 ~ 200		Waveform number
Phase	0.0 ~ 359.9	Deg	Phase angle for phases B & C

Table 6-21: Available STEP Transient Parameters

The following soft keys are available on the PULSE VALUES screen.

SOFT KEY	Description
Use Setpoint (SK1)	Starts the transient from the “Run from step#” row number
Run Screen(SK2)	Displays the PULSE EXECUTION screen.
Link Phases (SK3)	Toggles between phase A, B, C or Coupled ABC
Example (SK4)	Displays a graphical representation of the STEP parameters
Back (SK5)	Returns to previous screen

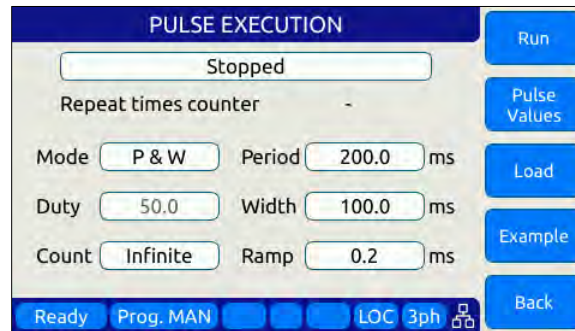
Table 6-22: Available STEP PROGRAM screen soft keys

6.6.12 PULSE Transient Execution Modes

PULSE Transients can be executed as soon as they have been entered. To execute a transient, the output **must be ON**.

PULSE transient execution is controlled from the PULSE EXECUTION screen. If no PULSE transient data has been entered, no run mode soft key will be visible. In that case, you must back up to the PULSE VALUES screen.

The PULSE EXECUTION screen is shown below.



For PULSE transients, there are three user settable parameters that control execution of the transient sequence. They are:

- P&W (0): Programmed by Period & Width
- P&D (1): Programmed by Period & Duty Cycle
- W&D (2): Programmed by Width & Duty Cycle

Depending on the data entry mode selected, one of the data entry fields will be disabled and calculated based on the other parameter settings.

Transients will be executed when the “Run” soft key (SK1) is pressed. If the output is **OFF** however, a message will appear indicating the output must be turned **ON** first.

The “Count” field determines how many pulses will be run. To run a sequence indefinitely or until manually stopped, use the shuttle to scroll down to zero or enter zero in this field using the keypad. This will set the repeat field to “Infinite”.

The following soft keys are available on the PULSE PROGRAM screen.

SOFT KEY	Description
Run (SK1)	Starts the transient from the “Run from step#” row number
Pulse Values (SK2)	Displays the PULSE edit mode screen.
Load (SK3)	Converts PULSE transient definition to transient segments
Example (SK4)	Displays a graphical representation of the PULSE parameters
Back (SK5)	Returns to previous screen

Table 6-23: Available STEP PROGRAM screen soft keys

6.6.13 AUTO RMS Function – Transients

The AUTO RMS mode⁵, if enabled, causes all transient voltages to be calculated as true RMS voltage of the waveforms used in any Segment of the Transient. This means the output voltage RMS level will remain the same, regardless of the wave shape.

When disabled, RMS calculation of substituted waveforms does not occur. Disabling AUTO RMS facilitates constant amplitude transients such as partial cycle dropouts or sub-cycle spike transients.

This mode is set by sending the **PROGram:TRANSient:AUTORMS** command over one of the Digital control interfaces.

Note: In UPC Compatibility mode, this mode is always enabled but applies to steady state only.

⁵ Requires Front Panel Firmware revision 1.3.3.

6.7 CONF – CONFIGURATION Screens

The CONFIGURATION screens 1 & 2 allow setting of secondary parameters functions.

Pressing the **CONF** key will display the CONFIGURATION screen as shown on the left below. If the master unit is an AGXT model, the transformer coupled output mode selection will be displayed at the bottom of the configuration screen. If the master unit is an AGXS model, the Series connection will be displayed instead.



The diagram illustrates the sequence of configuration screens accessible from the front panel. The sequence is as follows:

- UNIT CONF. 1/3**: This screen allows setting the operating mode (Voltage source), form (Three (ABC)), voltage range (High), and mode (AC+DC). It includes buttons for User Limits, Ramp & Slew, Program Memory, CSC Config., and Next Screen.
- USER LIMITS**: This screen allows setting voltage and frequency limits. It includes fields for Voltage AC (MIN: -350.00, MAX: 350.00 V_{RMS}), Voltage DC (MIN: -500.00, MAX: 500.00 V_{DC}), and Frequency (20.00 to 1200.00 Hz). It also has an option for Extended frequency.
- RAMP TIME & SLEW R.**: This screen allows setting ramp time and slew rates. It includes fields for Voltage AC (10.0000 V_{RMS}/ms), Voltage DC (10.0000 V_{DC}/ms), Frequency (5.0000 Hz/ms), and Phase (5.0000 Deg/ms).
- PROGRAM MEMORY**: This screen allows setting the current program register # (MANUAL) and recall settings. It includes fields for Recall from register # (1) and Power-on recall register # (Disabled).
- CSC CONFIGURATION**: This screen allows setting continuous self calibration, fault on saturation, constant power, and max CSC gain (1.15).

6.7.1 UNIT CONFIGURATION Screens 2

UNIT CONF. 2/3 VOLT SRC

Update phase Deg

Output disable phase Deg

☐ Allow output enable at power on

☐ Enable current overload

☒ Recall last settings at power-on

☐ Positive phase rotation (Phase B leading A)

☒ Invert polarity in split phase

☐ Output disable zero program

Transient Settings

Output Impedance

User Presets

Next Screen

OFF Prog. MAN S/M LOC 3ph

TRANSIENT SETTINGS VOLT SRC

☒ Continuous self calibration (CSC)

☒ Auto RMS

☐ Cycle reset

☐ Hold

Back

OFF Prog. MAN E&E S/M LOC 3ph

OUTPUT IMPEDANCE VOLT SRC

☐ Enable output impedance

Mode

Resistance Ohm

Inductance μ H

Apply All

Cancel All

Back

OFF Prog. MAN E&E S/M LOC 3ph

OUTPUT IMPEDANCE VOLT SRC

☐ Enable output impedance

Mode

Resistance Ohm

Inductance μ H

Apply All

Cancel All

Back

OFF Prog. MAN E&E S/M LOC 3ph

UNIT CONF. 3/3 VOLT SRC

Output relays

Output Cap. Value μ F

☒ Power saving mode

Time in minutes

☐ Delta mode

☐ Neutral connected

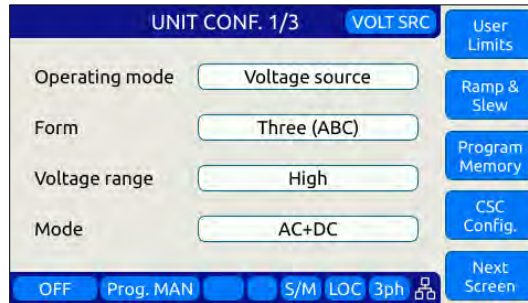
Next Screen

OFF Prog. MAN S/M LOC 3ph

All other system related screens can be accessed using the SYST menu key. (Refer to Section 6.7.7).

The following settings can be changed from the UNIT CONFIGURATION screens:

UNIT CONFIGURATION 1 OF 3-----



Operating Mode

Displays the selecting operating mode as either Voltage source, Current Source or Electronic Load.

Form

This field determines the phase mode of operation. Available settings are One, Split or Three. Note that for one phase mode, it is necessary to short the three output phases together using the optional single-phase output connector accessory. Alternatively, the user can use an external terminal block to tie the three phase outputs together.

Note: When switching from one phase to three or split phase modes, a warning will be displayed to make sure the end-user removes any common connections between the three outputs.

Voltage Range

Although the power source uses a constant power mode voltage range to allow operation using a single 350Vac/500Vdc voltage range only, the end user can simulate a low voltage range by setting this field to Low. Doing so limits programming of any output voltage to no more than 175Vac/250Vdc or half the available voltage range of the power source. If operation to 350Vac/500Vdc is desired, this field should be set to High. This effectively simulates a conventional dual voltage range model.

Mode

Sets the output mode to, AC, DC or AC+DC.

Coupling

This field selects the output coupling mode of the power source. Unless an optional output transformer is installed with the power source (T Option), this field is always fixed to DIRECT. Direct coupling output mode supports either AC mode, DC mode or a combination of AC and DC output to be programmed. If the optional transformer is installed, the AGX model number will show "AGXT" to indicate the presence of the output transformer. To use the output

transformer coupled range, selected XFMR (xxxV) in this field. The voltage indication may vary based on the transformer ratio of the installed output transformers.

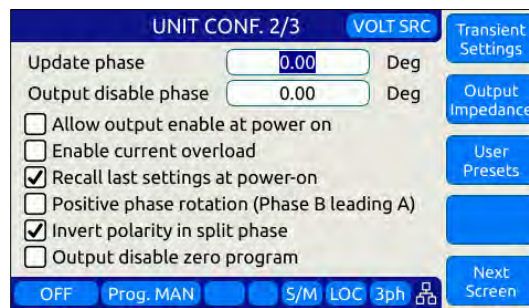
Note: While in XFMR coupled mode, only **AC** voltage programming is possible.

Access to other utility screens is available from the UNIT CONFIGURATION screen through the soft keys. The table below lists the available soft keys on the UNIT CONFIGURATION screen.

SOFT KEY	Description
User Limits (SK1)	Displays SETUP MENU screen. Refer to section 6.7.2
Ramp & Slew (SK3)	Displays SLEW RATE MENU screen. Refer to section 6.7.3
Program Memory (SK2)	Displays PROGRAM MEMORY screen. Refer to section 6.7.4
CSC Config. (SK4)	Display CSC setting screen
Next Screen (SK5)	Toggle to alternate UNIT CONFIGURATION screen

Table 6-24: Available UNIT CONFIGURATION 1 screen soft keys

UNIT CONFIGURATION 2 OF 3 -----



Update Phase

Sets the phase angle at which output voltage and frequency changes will take place on phase A. This setting applies to both steady state output changes and to the start of a transient program execution. It also applies to the OUTPUT ENABLE and DISABLE function key on the front panel. Changes on phases B and C will take place at the same moment in time but at phase angles that are shifted from phase A by the phase angles programmed for phase B and C.

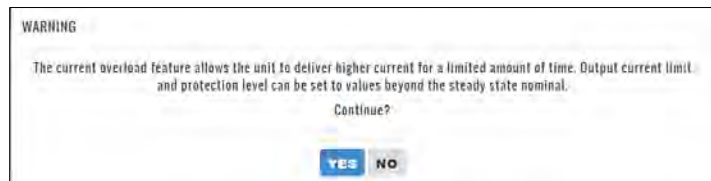
Output Disable Phase

This setting determines if the output off event at a specific phase angle of phase A voltage or randomly whenever the user presses the Output On/Off button or sends an output off command.

Allow output enable at power on This mode if set, causes the output to turn on at power up.

Enable Current Overload

Current Overload mode allows the power source to provide more than the nominal max. RMS current (around 30 percent more) for a short period (up to 2 seconds). When enabled, the user can set the CURR:LIM 30% higher than what this mode off. For example, in a stand-alone 3150AGX unit in three phase mode (FORM 3), RMS output current can be up to 55A when the continuous output limit is 41.7A. A warning message will be displayed notifying the user this mode is being enabled.


Recall last settings at power-on

When checked, this mode will cause the last settings that were in effect when the power source was last turned off to be recalled at power on. This allows a user to resume operation without having to set up again between power on/off events.

Positive phase rotation

When checked, the phase rotation in three phase mode will be set to A -> C -> B corresponding to positive phase rotation for three phase AC motors. To select negative phase rotation, uncheck this option.

Invert polarity in split phase

When checked, the AC waveform in split-phase mode of operation is shifted 180° (inverted).

Output disable zero program

When checked, the programmed voltage is first set to zero voltage when pressing the Output Enable button or executing the OUTP OFF command. This allows any energy stored in the EUT to dissipate into the low impedance output of the power source before the relay disconnects the load.

Access to other utility screens is available from the UNIT CONFIGURATION screen through the soft keys. The table below lists the available soft keys on the UNIT CONFIGURATION screen.

SOFT KEY	Description
Transient Settings (SK1)	Display Transient Configuration Settings
Output Impedance (SK2)	Program Output Impedance R and L values.
User Presets (SK3)	Access to user defined preset value settings for output programming soft keys

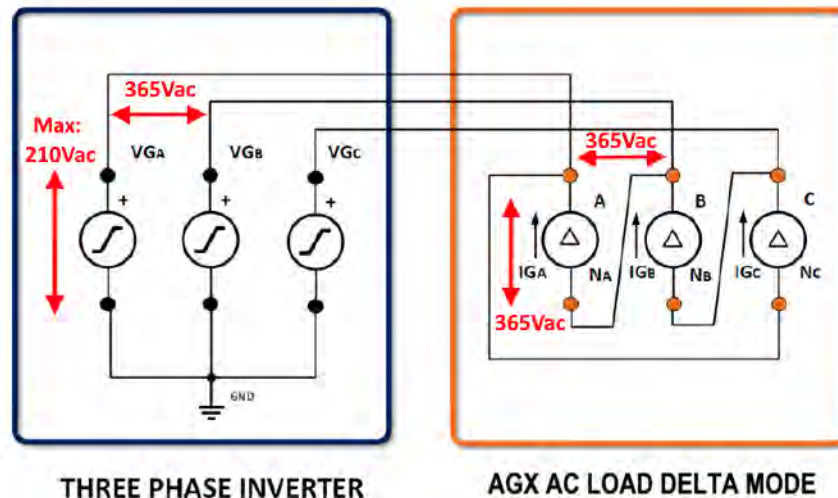
SOFT KEY	Description
Next Screen (SK5)	Toggle to alternate UNIT CONFIGURATION screen

Table 6-25: Available UNIT CONFIGURATION 2 screen soft keys

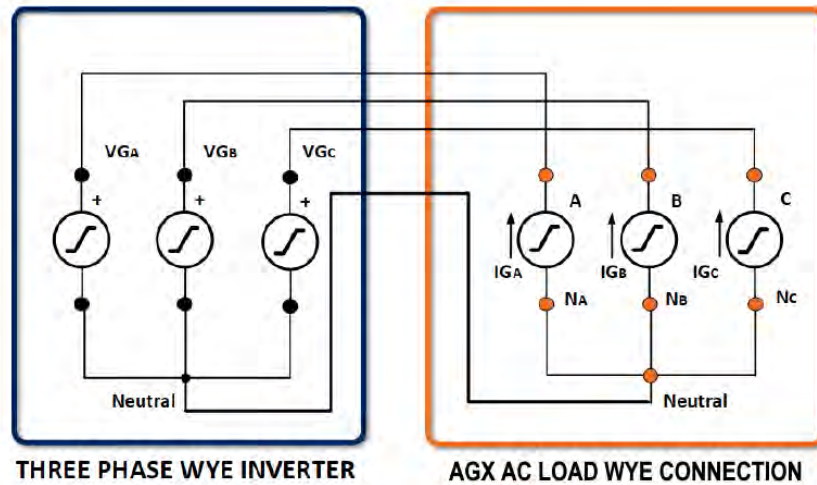
UNIT CONFIGURATION 3 OF 3

The third UNIT CONFIGURATION screen contains two check box settings, Delta mode and Neutral connected. These settings are related to operation in the Current Source or Electronic Load mode. If the unit is not in CURRENT SOURCE or LOAD mode, these controls are disabled.

Delta mode should be enabled if the AGX AC Load is connected to a Delta Source. In this case, there is no neutral connection so the “Neutral connected” setting should not be checked.



The **Neutral connected** selection should be checked if the AC load is connected to a WYE voltage source as shown below. If the voltage source is a Delta, leave this option unchecked so the AC load will try to maintain a virtual zero level at the neutral terminal.



SOFT KEY	Description
Next Screen (SK5)	Toggle to alternate UNIT CONFIGURATION screen

Table 6-26: Available UNIT CONFIGURATION 2 screen soft keys

6.7.2 USER LIMITS SETTINGS Screen

This screen allows programming user defined voltage and frequency upper and lower limits to prevent an operator from accidentally programming output settings that could be damaging to a unit under test.

For example, when testing a 50 Hz transformer, a lower frequency limit setting of 47 would prevent output frequency programming of values that could cause the transformer to saturate.

The same applies to voltage where a high voltage value could damage a unit under test that was not designed to handle a high AC or DC input voltage.

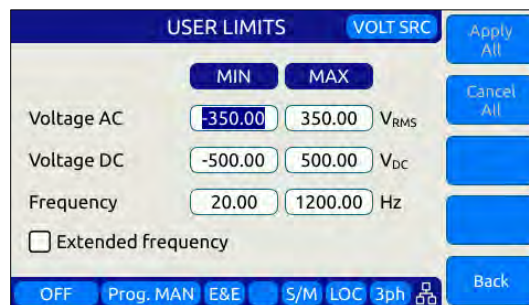


Figure 6-21: USER LIMIT SETTINGS Screen

The following parameters can be set from this screen:

Voltage AC	Lower and Upper Vrms set limits for AC programming.
Voltage DC	Lower and Upper Vdc set limits for DC programming.
Frequency	Lower and Upper limits for Frequency programming.

The soft keys on the USER LIMITS SETTINGS screen provide access to additional functionality as listed in the table below.

SOFT KEY	Description
Apply (SK1)	Accepts new settings and returns to previous screen.
Cancel (SK2)	Returns to the previous screen.
-	
-	
Back (SK5)	Returns to the previous screen.

Table 6-27: Available USER LIMITS SETTINGS screen soft keys

6.7.3 RAMP TIME & SLEW RATE SETTINGS Screen

This screen allows programming of the update ramp time or individual voltage and frequency slew rates, which are applied when changing output settings. Ramp time and slew rate settings are mutually exclusive so Ramp time must be disabled in order to program individual voltage, frequency and phase update rates. Setting a slew rate other than the maximum value allows voltage and frequency changes to occur at a controlled rate of change. The Ramp time when enabled applies to any setting change equally.

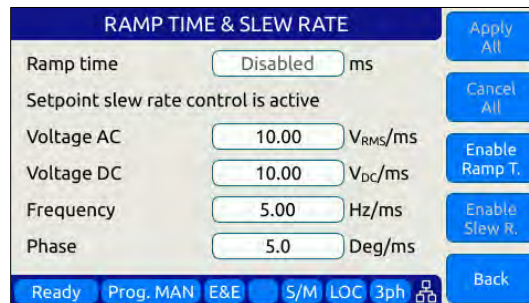


Figure 6-22: RAMP TIME & SLEW RATE SETTINGS Screen

The following parameters can be set from this screen:

Ramp time

Sets the time over which output changes will take place. For the time set, output changes will ramp from their previous set value to the new set value. When **DISABLED**, changes will occur at the programmed slew rate settings in the SLEW RATE SETTING screen, as both cannot be in effect at the same time. Settings Slew Rate settings provide control over individual parameters whereas the RAMP TIME setting applies to all parameters (F, Vac, Vdc and Phase) changes equally.

Voltage AC

AC Voltage slew rate in Vrms per msec. Available range is 0.01 Vrms/ms through 300 Vrms/ms.

Voltage DC	DC Voltage slew rate in Vdc per msec. Available range is 0.01 Vdc/ms through 850 Vdc/ms.
Frequency	Frequency slew rate in Hz per msec. Available range is 0.01 Hz/ms through 1200 Hz/ms.
Phase	Phase angle slew rate in Degrees per msec. Available range is 0.01 Deg/ms through 359.91 Deg/ms

NOTE: Programmed Slew Rate settings will only take effect when the RAMP TIME setting is **DISABLED**.

The soft keys on the SLEW RATE SETTINGS screen provide access to additional functionality as listed in the table below.

SOFT KEY	Description
Apply All (SK1)	Applies all changes made (highlighted in grey) and returns to previous screen.
Cancel All (SK2)	Cancels all changes (highlighted in grey), sets slew rates back to prior settings and returns to previous screen.
Enable Ramp T.	Enables Ramp time, disables Slew rate settings
Enable Slew R.	Enable Slew Rate settings, disables Ramp time
Back (SK5)	Returns to the previous screen.

Table 6-28: Available RAMP TIME & SLEW RATE SETTINGS screen soft keys

6.7.4 PROGRAM MEMORY Screen

The Program Memory menu allows saving and recalling of instrument setups in non-volatile memory registers. Setups include all steady state parameters, limits, operating modes and transient list if programmed.

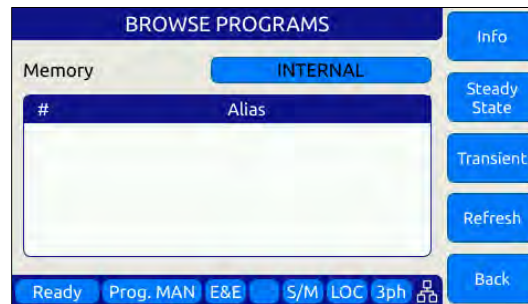


Figure 6-23: PROGRAM MEMORY screen

There are 10 setup registers numbered from 1 through 10. Use the shuttle to select either the Recall or Save field and press the shuttle to enter edit mode. Once the correct number is selected, press ENTER to confirm.

Browse

Enters the BROWSE PROGRAMS memory browser screen.



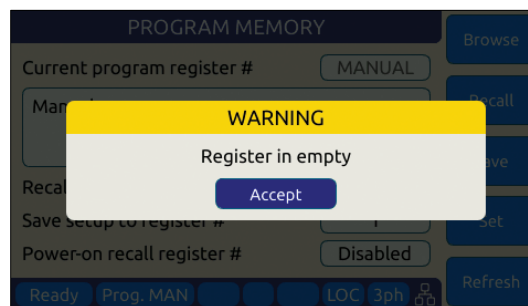
Recall

Recalls setup from selected register. If register is empty, an error message will be displayed and no setting will be recalled.

Note: If a register location is empty, an error message will be displayed.

Set Power-on

Sets recalled setup as power on condition.



Save setup to...

Saves setup in effect to selected register number. If this register already contained a saved setup, it will be over-written.

The soft keys on the PROGRAM MEMORY screen provide access to additional functionality as listed in the table below.

SOFT KEY	Description
Browse(SK1)	Allows browsing for a particular register's content.
Recall (SK2)	Recalls selected Register setup content
Set Power-on (SK3)	Saves setup to selected Register
Save to (SK4)	Sets output to selected Register content
Refresh (SK5)	Return to previous screen

Table 6-29: Available SLEW RATE SETTINGS screen soft keys

6.7.5 CSC CONFIGURATION Screen

The CSC CONFIGURATION menu allows the Continuous Self Calibration mode to be enabled. This feature is used to improve load regulation of the power source by continuous measurement of the output phase voltage(s) and adjusting the internal set points as needed to maintain close to zero load regulation. This feature is based on RMS measurements taken using 100ms windows resulting in a response time of around 500ms.

If the CSC is unable to get the output to the set point, an error will be generated. This error can be disabled by unchecking the "Fault on saturation" check box.

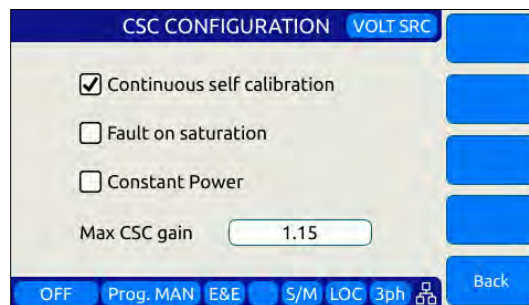


Figure 6-24: CSC CONFIGURATION screen

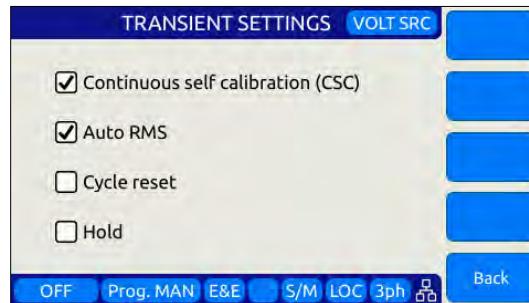
The soft keys on the CSC CONFIGURATION screen are listed in the table below

SOFT KEY	Description
-	
Back (SK5)	Return to previous screen

Table 6-30: Available CSC CONFIGURATION screen soft keys

6.7.6 TRANSIENT SETTINGS Screen

The TRANSIENT SETTINGS screen defines operation of transient execution.



Available settings are:

- Continuous Self Calibration** This CSC mode is similar to the CSC mode for steady state operation but applies to transient mode.
- Auto RMS** This field allows enabling or disabling of the Auto RMS mode for transient mode operation. Refer to section 6.6.13, “AUTO RMS Function – Transients” for further details.
- Cycle Reset** When enabled, the CYCLE RESET mode will cause repeated executions of the transient as determined by the repeat count or the continuous execution setting to re-sync to the start phase angle set for the start of each transient. When disabled, repeats of the transients start immediately after the previous execution completes with no resync. With Cycle Reset on, there may be up to one period of the AC frequency of delay added between successive runs.
Note: In UPC Compatibility mode, Cycle Reset is default on.

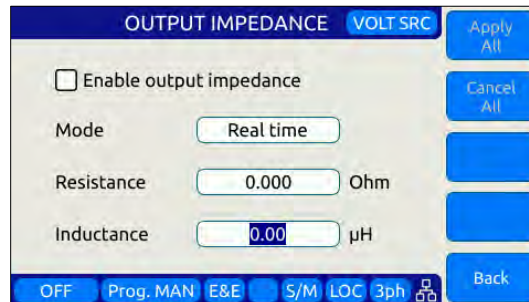
The soft keys on the TRANSIENT SETTINGS screen are listed in the table below

SOFT KEY	Description
-	
Back (SK5)	Return to previous screen

Table 6-31: Available TRANSIENT SETTINGS screen soft keys

6.7.7 OUTPUT IMPEDANCE Screen

The OUTPUT IMPEDANCE screen allows the output impedance of the power source to be programmed.



Following parameters can be set from this screen:

Mode: Selects between Real time or RMS mode.

- **Real time:** Real-time mode uses a fast responding method to control output impedance. This mode is faster but has a more limited programming range. It works at the signal level implanting a digital filter, equivalent to a resistor and an inductor, in series with the output. It emulates a phase shift and waveform distortion similar to an actual LR impedance at frequencies within the bandwidth of the output amplifier (around 3kHz). CSC must be disabled to use this mode.
- **RMS:** RMS Mode is slower as it relies on the measured RMS output voltages and currents to make adjustments, but it has a wider programming range. It is based on steady state RMS measurements, not on real-time signals, so it does not affect output waveform and phase shift. It allows higher impedance ranges while keeping the output stable. It also allows the CSC mode to remain enabled, so at a steady state level it provides a very accurate voltage drop (on an RMS measurement level).

Resistance: Sets the Resistive value for the programmable impedance.

Impedance: Sets the Inductive value for the programmable impedance.

The soft keys on the OUTPUT IMPEDANCE screen are listed in the table below

SOFT KEY	Description
-	
Back (SK5)	Return to previous screen

Table 6-32: Available PROGRAMMABLE IMPEDANCE screen soft keys

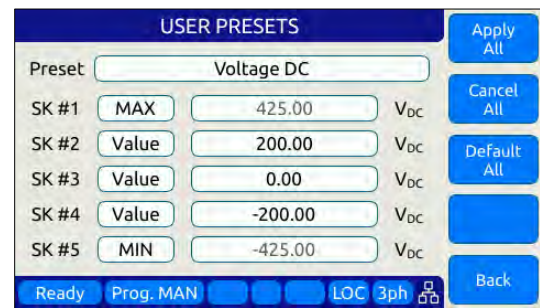
6.7.8 USER PRESETS Screen

The USER PRESETS screen allows the soft key set values for output programming that appear in the PROGRAM screen to be changed to setting values preferred by the user.

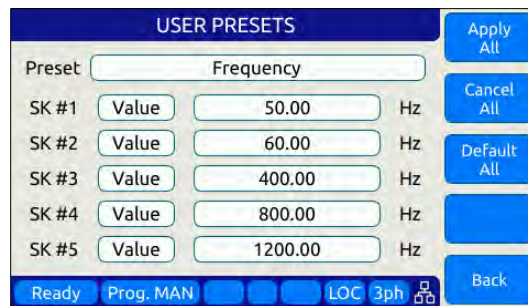
Presets can be defined for the following output settings:

- VOLTage[:AC]
- VOLTage:DC
- FREQuency
- PHASe
- CURRent:LIMit
- POWer:LIMit
- KVA:LIMit

6.7.8.1 AC and DC Voltage Soft keys

6.7.8.2 Frequency and Phase Soft keys



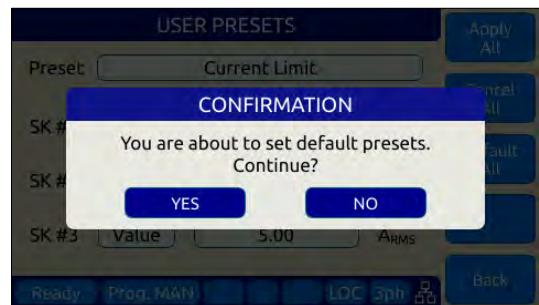

6.7.8.3 Current Limit Soft keys



6.7.8.4 Power and VA Limit Soft keys




For each parameter, the user will be prompted to confirm soft key value setting changes. See dialog to the right. ►



SOFT KEY	Description
Apply All (SK1)	Applies values entered by user.
Cancel All (SK2)	Cancel all changes made.
Default All (SK3)	Sets all soft key settings for selected parameter to factory defaults.
-	
Back (SK5)	Refreshes screen

6.8 SYST – SYSTEM Screens

The System screens allow setting of secondary system level functions that are used less often than the first four screens. This generally involves setting system level operation modes and parameters to tailor the instruments operation to the user's specific requirements and operating environment. These include the following areas:

- Remote Control Interfaces
- System level settings, logs and firmware updates
- Calibration
- Parallel Operation
- Options if any

Pressing the **SYST** key will display the first of two CONFIGURATION screens as shown below.

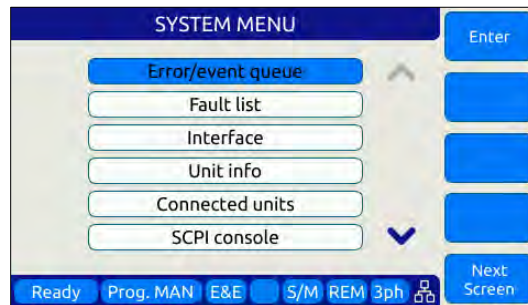


Figure 6-25: SYSTEM MAIN MENU 1

The **More** softkey will allow moving back and forth between the two main SYSTEM screens.



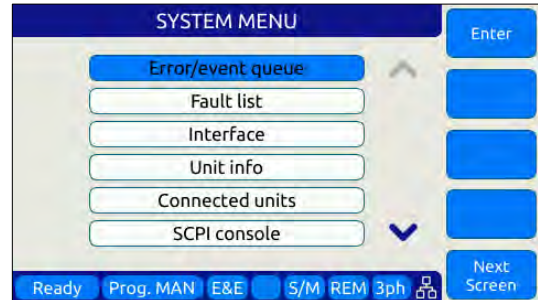
Figure 6-26: SYSTEM MAIN MENU 2

Selections on each screen are made by scrolling through the available entries using the shuttle knob. Pressing the **Enter** soft key, ENTER key or shuttle will display the selected highlighted entry screen.

6.8.1 SYSTEM MENU 1

The first SYSTEM MENU allows for selection of the following functions:

- Error/Event Queue Screen
- Fault Information Screen
- Interface Settings Screen
- Unit Information Screen
- Connected Units Screen
- SCPI Console

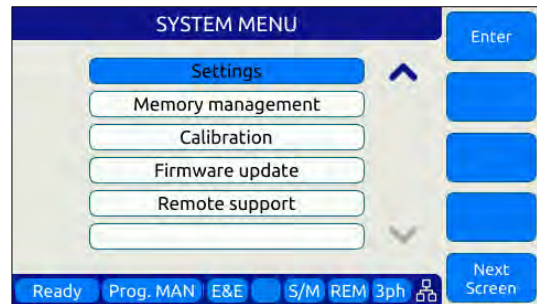


Each screen is covered in subsequent sections.

6.8.2 SYSTEM MENU 2

The second SYSTEM MENU allows for selection of the following functions:

- System Settings Screen
- Memory Management Screen
- Calibration Screen
- Firmware Update Screen
- Remote Support Screen



Each screen is covered in subsequent sections.

6.8.3 ERROR / EVENT QUEUE Screen

The Error and Event queue shows the history of any errors or events that have occurred since the last time the error queue was cleared.

The error queue can be cleared using a SCPI command over any of the remote control interfaces or by pressing the “Clear Queue” soft key while on this screen.

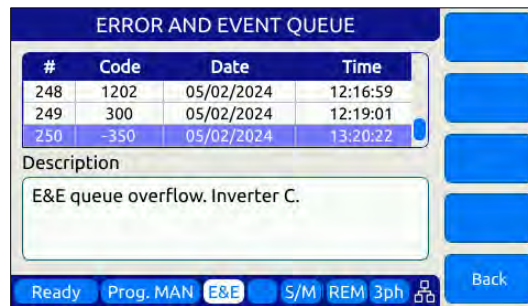


Figure 6-27: ERROR & EVENT QUEUE Screen

6.8.4 FAULT INFORMATION Screen

The fault list shows any logged internal operation faults. This information may be useful when trouble shooting any issues with the power source. In that even, customer service may request this information from the end user or request access to the instrument through the LAN interface for further diagnostics.

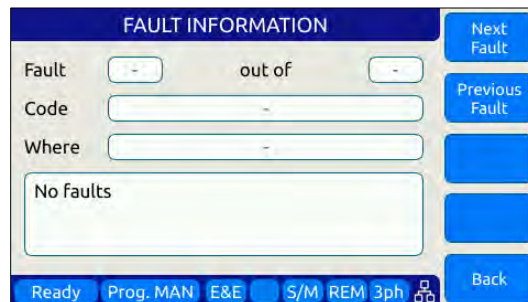


Figure 6-28: FAULT INFORMATION screen

6.8.5 INTERFACE Screen

The INTERFACE SETUP screen allows access to the setup parameter of any of the available remote control interfaces.

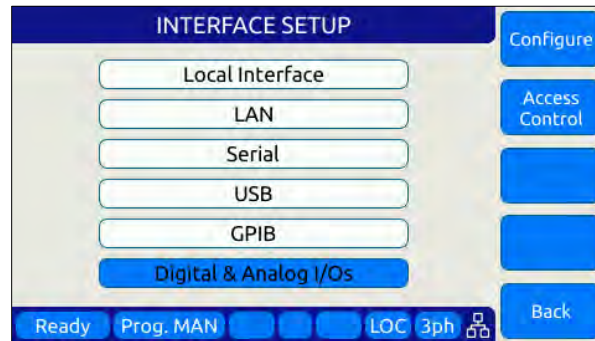


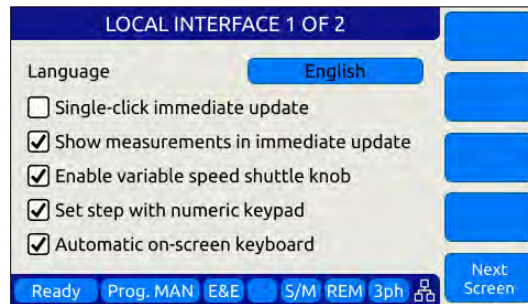
Figure 6-29: INTERFACE SETUP Screen

Available selections are:

- Local Interface (Relates to front panel operation)
- LAN – Ethernet Interface Setup
- Serial – RS232 Serial Interface Setup
- USB – USB Interface Setup
- GPIB – GPIB Interface Setup (Models with “G” option only)
- Digital & Analog I/O Setup

Each section is covered in subsequent sections.

6.8.5.1 LOCAL INTERFACE 1 OF 2



Several aspects of front panel operation can be configured by the user from this screen. This relates primarily to the language selection and operation of the shuttle knob, which has three distinct functions:

1. Scrolling values up or down
2. Single Click push function
3. Double Click push function

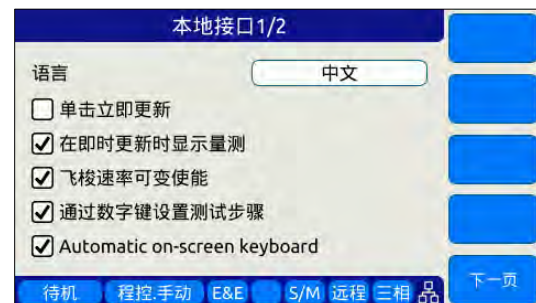
Parameters available to set are as follows:

Language

Available language selections are:

- English (default factory setting)
- Chinese.

Language can be switched by pressing the shuttle while on the language field and scrolling between available selections. Press ENTER to confirm selection.



Single-Click Immediate Mode

Enters Immediate Mode upon single depression of shuttle knob. Immediate mode means value changes occur immediately on the output of the power source. When unchecked, a double click of the shuttle knob is required to enter this mode.

Show Measurements in Immediate Mode

When checked, entering immediate mode will result in the Measurement screen being display with the changing parameter showing in the

	title bar. This allows monitoring of all output measurements while slewing voltage, current of frequency.
Enable variable speed shuttle knob	When selected, the speed of rotating the shuttle knob will increase the step size of the parameter being changed. If unchecked, changes occur at a fixed step size (resolution).
Set step with numeric keypad	When set, the numeric keypad can be used to increment or decrement the step size of the shuttle knob. Digits 9 to 1 our use to change from largest step size (9) to smallest step size (1) and any step size in between.
Automatic on-screen keyboard	This selection enables the on-screen Qwerty keyboard pop-up when the scroll knob is pressed once. When turned OFF, it is still available but requires double clicking the knob. This touch keyboard allows entering of alpha numeric parameters and also supports number value entries. See next section for details.

The following soft keys are available from the LOCAL INTERFACE setup screen:

SOFT KEY	Description
Local Inter. Page 2. (SK1)	Toggle to LOCAL INTERFACE 2 OF 2 screen
-	
-	
-	
Back (SK5)	Returns to previous screen

Table 6-33: Available USER INTERFACE screen soft keys

6.8.5.2 Automatic on-screen keyboard

The on-screen Touchscreen Keyboard features allow entry of alpha numeric values such as names in text entry fields from the front panel. It pops up when the scroll knob is pressed once is set to on or double clicked when set to off in the LOCAL INTERFACE 1 OF 2 Screen.

It is mainly intended for use in text entry fields as the numeric keypad is always available for numeric entries. These are several keyboards available, and the default type depends on the data entry field the cursor is on when the shuttle knob is pressed. The number of text characters in each keyboard is limited by the field type.

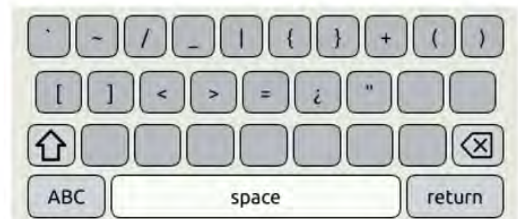
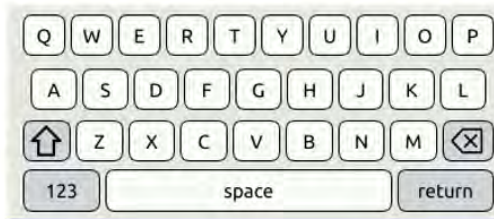
Key Descriptions

The following keys are supported:



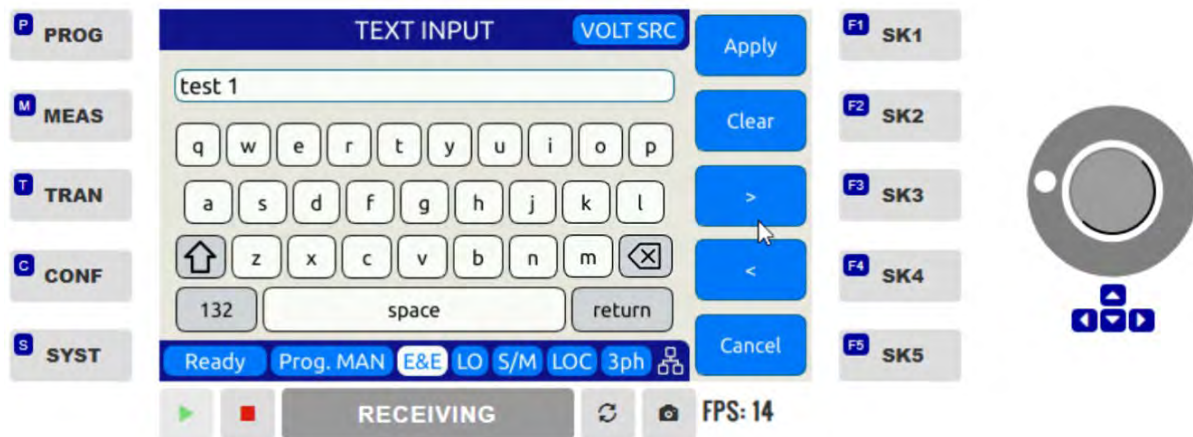
1. Shift: Allows switching between lowercase and uppercase letters, numbers and symbols.
2. 123/ABC: Allows switching from letters to numbers and symbols or vice versa.
3. Return: Places the cursor at the end of the text.
4. Backspace: Deletes the previous character depending on the cursor position
5. Apply: Closes the keyboard and apply text to the field.
6. Clear: Clears all text.
7. Arrows: Allows moving through the text.
8. Cancel: Discards text and close the keyboard

Available Qwerty keyboard Types:

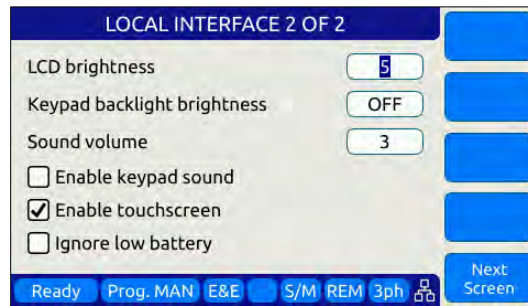


Web Browser Front Panel Mode.

The same on-screen keyboard functions are available from the Web browser interface via LAN or USB as shown below.



6.8.5.3 LOCAL INTERFACE 2 OF 2



Several aspects of front panel operation can be configured by the user from this screen. These setting relate primarily to visual and audible user interface aspects:

1. LCD brightness
2. Keyboard Backlight
3. Sound Levels

Parameters available to set are as follows:

LCD brightness	Adjusts the LCD display backlight brightness. Range is 0-9.
Keypad Backlight brightness	Adjusts the keyboard backlight brightness. Range is 0-9.
Sound Volume	Adjusts the loudness of the keyboard and message beeps.
Enable keypad sound	Enables or Disables audible beeps when operating the keyboard.
Enable touchscreen	Enables or Disables LCD touch screen.
Ignore low battery	Disables low NV RAM Battery warning. Unit will loose settings if battery dies.

The following soft keys are available from the LOCAL INTERFACE setup screen:

SOFT KEY	Description
Next Screen (SK5)	Goto next screen

Table 6-34: Available USER INTERFACE screen soft keys

6.8.5.4 LAN (ETHERNET) INTERFACE SETUP Screen

The LAN INTERFACE SETUP screen allows configuring the Ethernet interface for use with your local area network (LAN) and is accessed from the INTERFACE SETUP screen.




CAUTION

Do NOT connect the RJ45 LAN (Ethernet) connector of the power source to a PoE (Power over Ethernet) port as the DC voltage will damage the LAN interface.

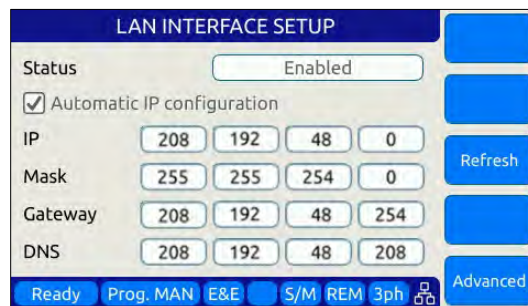


Figure 6-30: ETHERNET INTERFACE SETUP Screen

This screen is used to configure the Ethernet interface for your local area network.

Note: You may need to consult your network administrator to set up this interface correctly.

The following parameters can be set on this screen:

Automatic IP Configuration	Select this mode if your network has a domain name server running. An IP address will be assigned by the DNS each time the power source is turned on.
IP	IP address setting. This address must be unique to your network segment. Consult your network administrator if you are not sure about this setting.
Mask	IP mask setting. This mask must be correct for your network. Consult your network administrator if you are not sure about this setting.
Gateway	Gateway address setting. Consult your network administrator if you are not sure about this setting.
DNS	Domain Name Server address setting. Consult your network administrator if you are not sure about this setting.
Port	Port socket address. For message based instruments like this power source, this setting is typically 5025.

The following soft keys are available from the ETHERNET INTERFACE SETUP screen:

SOFT KEY	Description
Apply (SK1)	Accepts new settings and returns to previous screen.
Cancel (SK2)	Returns to the previous screen.
Refresh (SK3)	
-	
Advanced (SK5)	Access detailed LAN Interface Setting screen

Table 6-35: Available ETHERNET INTERFACE SETUP screen soft keys

6.8.5.5 SERIAL INTERFACE SETUP Screen

The SERIAL INTERFACE SETUP screen allows configuring the RS232 serial interface and is accessed from the “INTERFACE SETUP” screen.

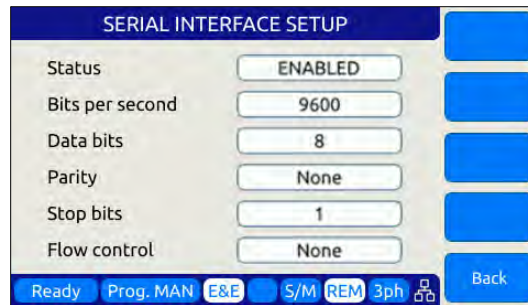


Figure 6-31: SERIAL INTERFCSE SETUP Screen

The following parameters can be set on this screen:

Bits per second	Sets the baud rate. Available settings are 9600, 14400, 19200, 38400, 57600 or 115200.
Data bits	Sets the number of bits per frame. Available settings are 7 or 8 bits
Parity	Sets parity check to either odd, even or none.
Stop bits	Sets the number of stop bits as either 1 or 2.
Flow control	Sets handshake mode to None or Xon/Xoff

The following soft keys are available from the SERIAL INTERFACE SETUP screen:

SOFT KEY	Description
Apply (SK1)	Accepts new settings and returns to previous screen.
Cancel (SK2)	Returns to the previous screen.
-	
-	

SOFT KEY	Description
Back (SK5)	Returns to the previous screen.

Table 6-36: Available SERIAL INTERFACE SETUP screen soft keys

6.8.5.6 USB INTERFACE SETUP Screen

The USB INTERFACE SETUP screen allows configuring the USB interface and is accessed from the INTERFACE SETUP screen.

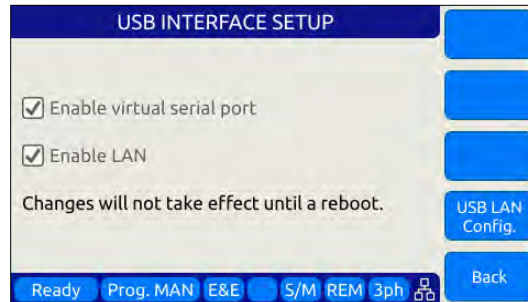


Figure 6-32: USB INTERFACE SETUP Screen

The following settings can be configured on this screen:

- Enable Virtual Serial Port** Enables or disables PC control using a virtual serial port driver.
- Enable LAN** Enables or disables the LAN (Ethernet) Interface IP emulation mode, which supports use of the embedded LXI web server. The virtual IP address of the USB-LAN emulation mode is fixed at 192.168.123.1.

Note: Any changes made to this screen will NOT take effect until the power source has been completely powered off and back on. (Re-boot).

The following soft keys are available from the USB INTERFACE SETUP screen:

SOFT KEY	Description
Enable All (SK1)	Set all check boxes
Disable All (SK2)	Clear all check boxes
-	
-	
Back (SK5)	Returns to the previous screen.

Table 6-37: Available USB INTERFACE SETUP screen soft keys

6.8.5.7 GPIB INTERFACE SETUP Screen

The GPIB INTERFACE SETUP screen allows configuring the GPIB interface and is accessed from the INTERFACE SETUP screen.

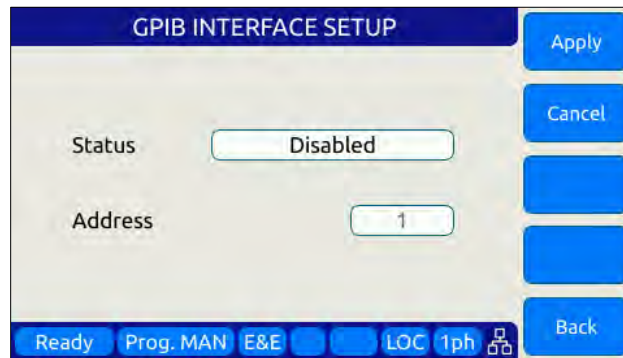


Figure 6-33: USB INTERFACE SETUP Screen

The following settings can be configured on this screen:

- Status** Enables or disables the GPIB interface. Disable when not in use to avoid erroneous interrupts.
- Address** Sets GPIB bus address. Available range is from 1 through 30. Default factory setting is address 1.

The following soft keys are available from the GPIB INTERFACE SETUP screen:

SOFT KEY	Description
Apply (SK1)	Accepts new settings and returns to previous screen.
Cancel (SK2)	Returns to the previous screen.
-	
-	
Back (SK5)	Returns to the previous screen.

Table 6-38: Available GPIB INTERFACE SETUP screen soft keys

6.8.5.8 DIGITAL & ANALOG I/Os SETUP Screen

The Digital & Analog I/Os SETUP screen allows configuring the auxiliary I/O interfaces and is accessed from the INTERFACE SETUP screen.

For further details, refer to Section 7.3, “Auxiliary I/O” on page 213.

6.8.5.9 REMOTE INHIBIT SETUP Screen

The REMOTE INHIBIT SETUP screen allows configuring the remote output control input for various modes of operation. Once set, this setting is retained in non-volatile memory, so the selection persists between input power cycles.

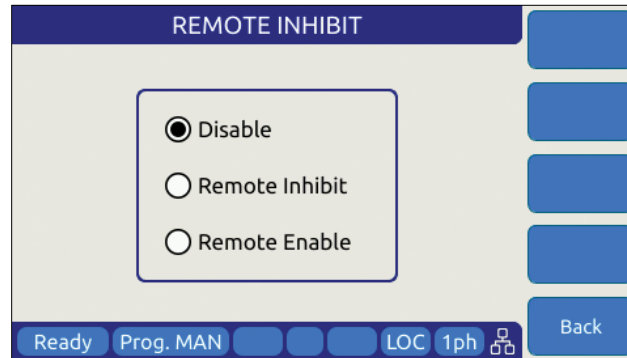


Figure 6-34: REMOTE INHIBIT Setup Screen

There are three modes of operation for this input: remote inhibit and remote enable.

1. **Disable mode:** In this mode, the Remote Inhibit inputs are not active so this function is turned off. No short between the RI pins is required to enable the output in this mode.
2. **Remote Inhibit mode:** The two pins have to be shorted for the output to be enabled from the front panel or remote command. This is a necessary but not a sufficient condition to enable the output. If the output is enabled and the remote inhibit connection is open, a fault is generated.
3. **Remote Enable mode:** The output can be enabled by shorting these two pins, regardless of the output enable command/button. It is a sufficient condition to enable the output.

6.8.5.10 REMOTE SHARING

Remote sharing of the power source is provided using one of two protocols:

Samba: Samba is a free software re-implementation of the SMB networking protocol. Server Message Block (SMB), also known as Common Internet File System (CIFS) operates as an application-layer network protocol for providing shared access to resources miscellaneous communications between nodes on a network.

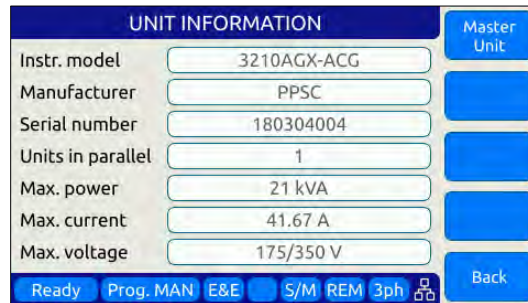
FTP: File Transfer Protocol. FTP is built on a client-server model architecture using separate control and data connections between the client and the server.

Note: Either one or both may be chosen. It is strongly recommended to set a custom password to prevent unauthorized access to the power source.

SHARING OPTIONS		Apply All
Username:	user	Cancel All
Samba	☒ Enable	
Password	password	
FTP	☒ Enable	
Password	password	
Ready Prog. MAN    LOC 3ph 		Next Screen

6.8.6 UNIT INFORMATION Screen

The UNIT INFORMATION screen is an information only screen that contains information about the power source and is accessed from the SYSTEM SETTINGS screen using the “Unit info” soft key (SK3).

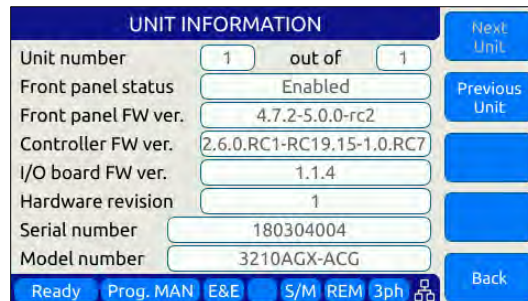


UNIT INFORMATION		Master Unit
Instr. model	3210AGX-ACG	
Manufacturer	PPSC	
Serial number	180304004	
Units in parallel	1	
Max. power	21 kVA	
Max. current	41.67 A	
Max. voltage	175/350 V	
Ready Prog. MAN E&E S/M REM 3ph		Back

Figure 6-35: UNIT INFORMATION Screen 1 of 2

The following information is provided on this screen:

Instr. Model	Model number, typically 3xxxAGX where xxx = power rating.
Manufacturer	PPSC (Pacific Power Source Corp.)
Serial number	Unit Serial number.
Units in parallel	Displays the number of units paralleled.
Max. power	Maximum power rating.
Max. current	Maximum RMS current rating per phase is 3 phase mode.
Max. voltage	Maximum voltage rating.



UNIT INFORMATION		Next Unit
Unit number	1 out of 1	Previous Unit
Front panel status	Enabled	
Front panel FW ver.	4.7.2-5.0.0-rc2	
Controller FW ver.	2.6.0.RC1-RC19.15-1.0.RC7	
I/O board FW ver.	1.1.4	
Hardware revision	1	
Serial number	180304004	
Model number	3210AGX-ACG	
Ready Prog. MAN E&E S/M REM 3ph		Back

Figure 6-36: UNIT INFORMATION Master Unit Screen 2 of 2

Unit Number	Shows the number of paralleled power sources. For a stand-alone power source, it will be 1 of 1.
Front panel status	Shows the status of the front panel. Only the MASTER unit in a multi-unit system will have its front panel enabled.
Front panel FW ver.	Firmware revision of the front panel control processor.
Controller FW ver.	Firmware revision of the power stage processors.
I/O Board FW ver.	Firmware revision of the Auxiliary I/O Board.
Hardware revision	Hardware build revision.

Serial Number Unit serial number.

Model Number 3210AGX-4UCL

Note: This information is for information purposes only and cannot be changed by the operator.

The following soft keys are available from the UNIT INFORMATION screen:

SOFT KEY	Description
Master Unit ./ Next Unit(/ Previous Unit SK1)	If this unit is the Master unit, the master unit info will be displayed. If this unit is part of a parallel system, information on the next unit in the chain will be displayed.
Previous Unit (SK2)	If this unit is part of a parallel system, information on the previous unit in the chain will be displayed.
-	
Back (SK5)	Returns to the previous screen.

Table 6-39: Available UNIT INFORMATION screen soft keys

6.8.7 CONNECTED UNITS Screen

The CONNECTED UNITS screen controls the behavior of this power source in a multi-unit parallel or series system where two or more power sources are either paralleled or in series (AGXS models) to provide higher power level systems.

This screen is accessed from the SYSTEM SETTINGS screen using the “Connected Units” entry.

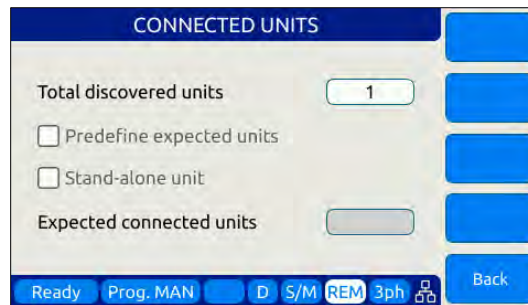


Figure 6-37: CONNECTED UNITS Screen

The first field shows the number of units found at power up on the system bus. A value of 1 means this is a stand-alone unit (not part of a larger system).

The following settings can be configured on this screen:

Predefine expected units Tells the power source how many total units to expect to find on the system interface bus at power up. If the number found is less than the number expected as set by the user, one or more units may not be powered up or missing. Leaving this check box off means the system will operate with the number of units found, regardless.

- Stand-alone unit** Set this check box if you want the power supply to operate as a stand-alone unit, even if it is connected to the system interface bus. To do so, you must make sure the outputs of this power source are not connected to any other units' outputs.
- Expected parallel units** Use this field to enter the number of expected units only if the "Predefine expected units" option is checked.

The following soft keys are available from the PARALLEL UNITS screen:

SOFT KEY	Description
Discover units (SK1)	Re-scan the system interface bus to determine how many units are on the bus. This also happens at power on.
Back (SK5)	Returns to the previous screen.

Table 6-40: Available PARALLEL UNITS screen soft keys

6.8.8 SCPI CONSOLE

The SCIP Console screen allows entry of remote control SPCI command directly from the front panel instead of one of the available remote-control interfaces. This feature is similar to the command line available at the bottom of the Web browser interface Home page.



The following softkeys are available to operate this feature:

- Query / Write** Sends the SCPI command shown in the command line on top. The default command is the *IDN? Query which returns the make and mode of the power source. This field will also retain the last command entered by the user.
- Clear** Clears the test in the command line and the response area below it.
- Scroll Up/Down** Allows scrolling of the text in the response area.
- Back** Returns to the System Menu page.

6.8.9 SYSTEM SETTINGS Screen

This screen allows system level settings such date and time to be changed. It also provides access to the UPC Compatibility mode setting.

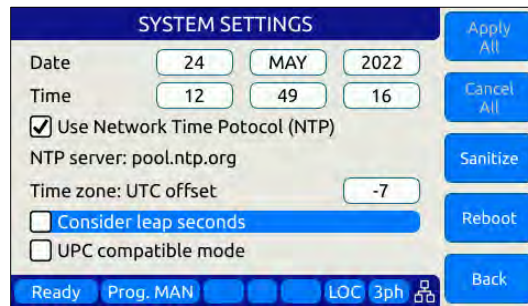


Figure 6-38: SYSTEM SETTINGS Screen

The following parameters can be set from this screen:

Date	Sets the date for the real-time clock.
Time	Sets the time for the real-time clock.
Use Network Time Protocol	When set, the time and date will be adjusted based on the NTP protocol. This requires the unit to be connected to a local area network.
Time zone UTC offset	This parameter sets the number of time zone from UTC where the unit is located to reflect local time. Coordinated Universal Time (UTC) is the primary time standard by which the world regulates clocks and time. It does not observe daylight saving time.
Consider Leap Seconds	When enabled, the time setting incorporated any lead seconds for the current year in the time setting.
UPC compatible mode	When enabled, the controller operates in UPC compatibility mode for backward compatibility with legacy PPS UPC controllers

The soft keys on the SYSTEM SETTINGS screen provide access to additional functionality as listed in the table below.

SOFT KEY	Description
Apply All (SK1)	Applies all changes made to this screen.
Cancel All (SK2)	Cancels any changes made and returns to previous screen
Sanitize	Erases all user settings from the unit and returns it to its factory default state.
Reboot	Reboot front panel controller without cycling AC input power.
Back (SK5)	Returns to the previous screen.

Table 6-41: Available SYSTEM SETTINGS screen soft keys

6.8.10 MEMORY MANAGEMENT Screen

The AGX Series® is able to use a wide variety of external storage devices such USB memory sticks and SD-Cards in addition to its internal storage memory. These devices may be used to store or load data, programs (setup + transient) etc.

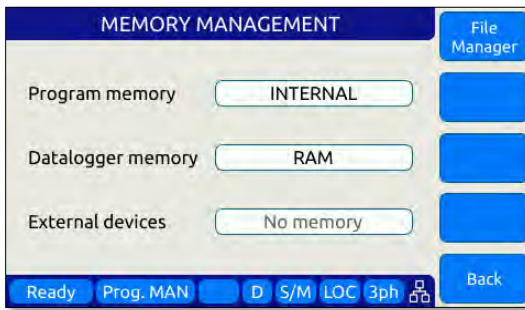


Figure 6-39: MEMORY MANAGMENT Screen

Program storage memory defaults to INTERNAL but can be changed to any available (inserted and mounted) external memory device if needed. The first parameter field is used to make this selection.

If any external memory devices are inserted, they will appear in the “External memories” field at the bottom of this screen.

Note: Maximum supported external memory device storage size is 32 GBytes.

The following files types can be located in each of these directories.

Subdirectory	File type and naming convention
plot	Measurement plots
sequences	Test sequences
screenshots	PNG image files captured from the LCD screen with filename convention screenshot_YYYY-MM-DD_HH-MM-SS.png where YYYY-MM-DD_HH-MM-SS is the time stamp.
waveforms	CSV comma separated waveform data files with filename convention X.csv where X is a number form 2 through 200.
program	Steady state + transient segment files using filename convention program_xx.xml where xx = 00 through 99 indicated program memory location #.

6.8.10.1 Loading Programs from a USB Drive.

Programs stored on a USB drive using the directory structure shown in the previous section can be loaded using the Browser interface – see section 10.7.4 on page 587– or from the front panel.

To load from the front panel USB ports, store the program_xx.xml file in the program subdirectory and insert in one of the two USB A ports on the front panel. After a short period of time, the drive will mount and will be visible in the CONF -> PROGRAM BROWSER screen.



Select the USBA1 drive in the upper right corner Memory field to see the available program files on the USB drive. Scroll down with the shuttle to select the desired program file to load.

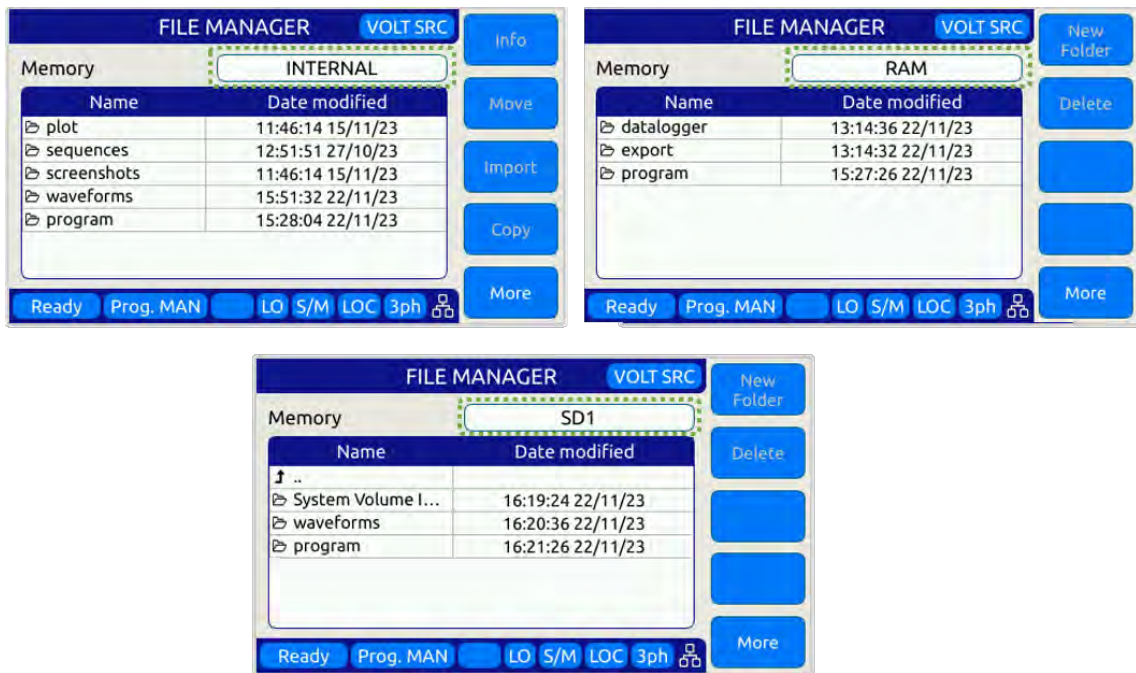
Then use the **Recall** Softkey to load the selected program file. The program will now be available in the assigned program memory location as determined by the XML file name.



Note: program_xx.xml files must have a Steady State section to be valid. The Transient section may be empty in which case no transient will be loaded.

6.8.10.2 File Manger Operation

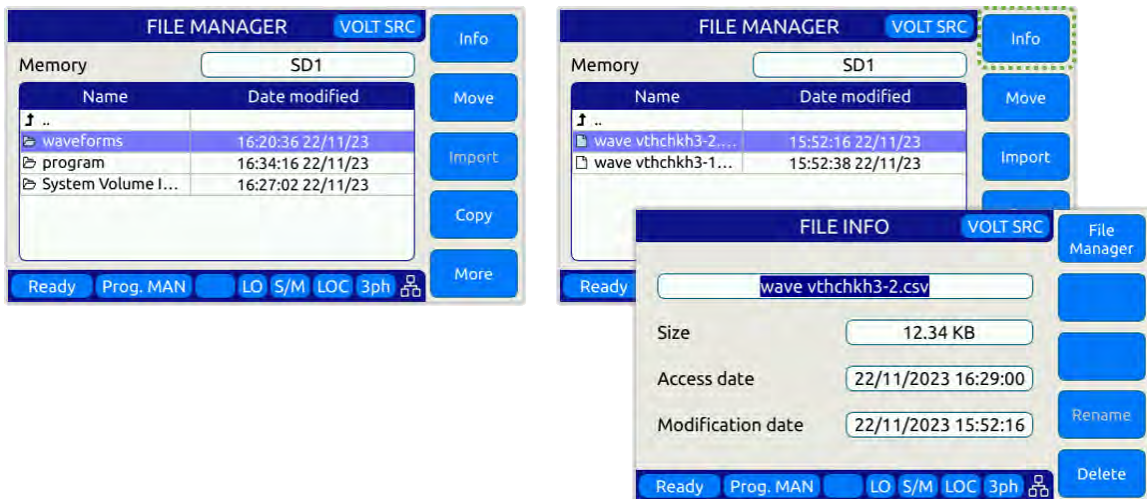
To access the File Manager functions, Press “**SYST**” -> **Memory management**” –(Sk1) **File Manager**”. The File Manager allows the user to browse through the directories and files stored on the selected memory type, INTERNAL, RAM or External media. Select the relevant memory type before entering this screen. See sample screens below.



This screen contains file info such as date/time, and supports the following functions:

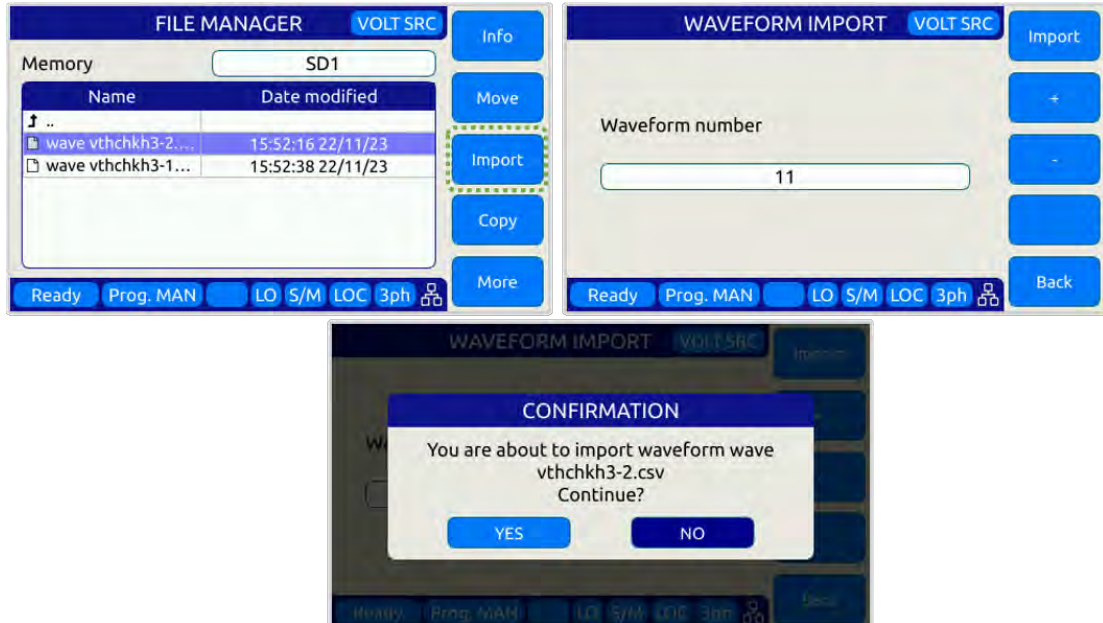
1. Move, Copy and Delete files.
2. Create new folders.
3. Import Waveforms.
4. Import Programs.

To navigate between files and folders, use the shuttle knob to select a folder and press to enter.



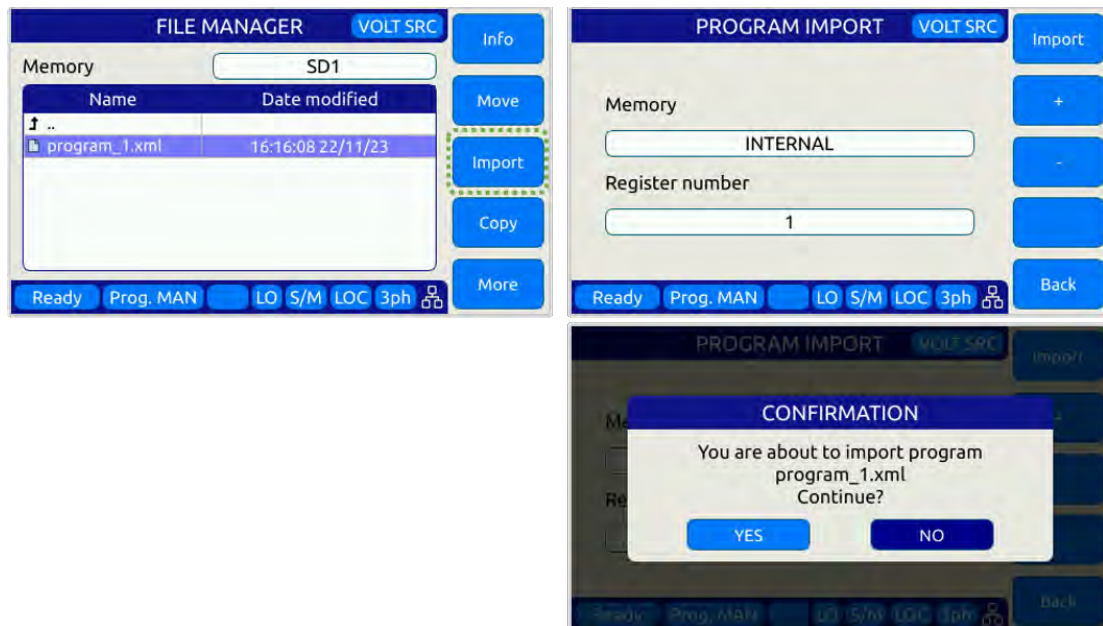
Importing Waveforms

The Import softkey allows importing of CSV format waveforms. Select the location to import the content of the waveform from. Use the +/- softkeys or the shuttle knob to scroll the waveform number. Press the Import (Sk1) softkey and YES to confirm when prompted.

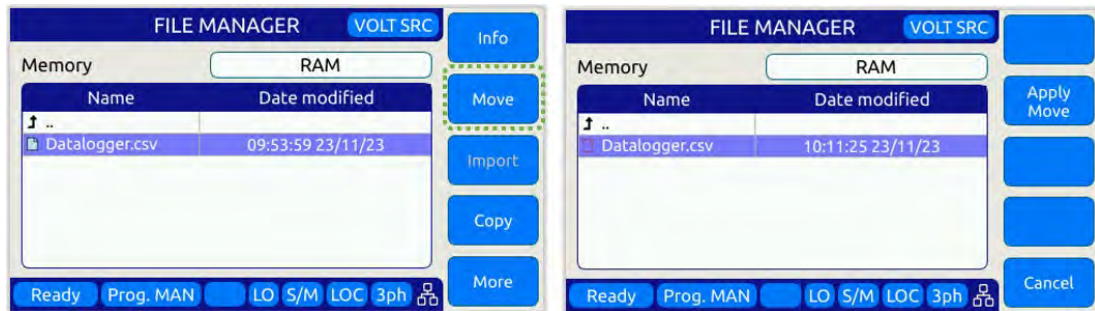


Importing Programs

Importing xml format program files uses a similar process except they are stored in a register location by number. Select the desired program file, select the memory type and register number and press Import (Sk1), the confirm when prompted.



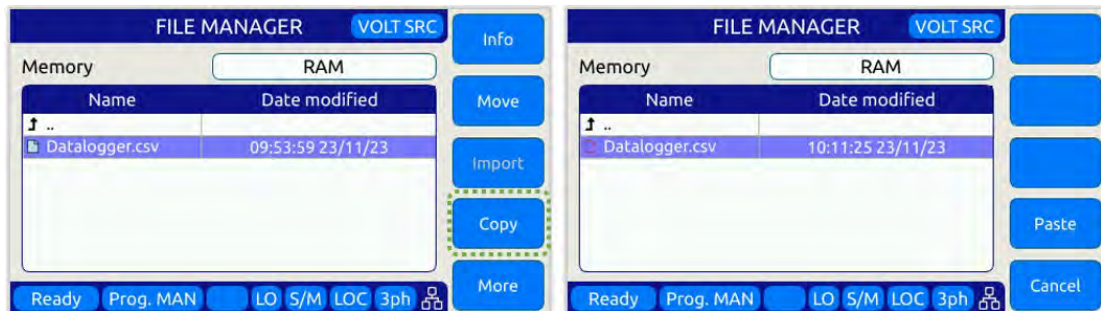
Moving Files



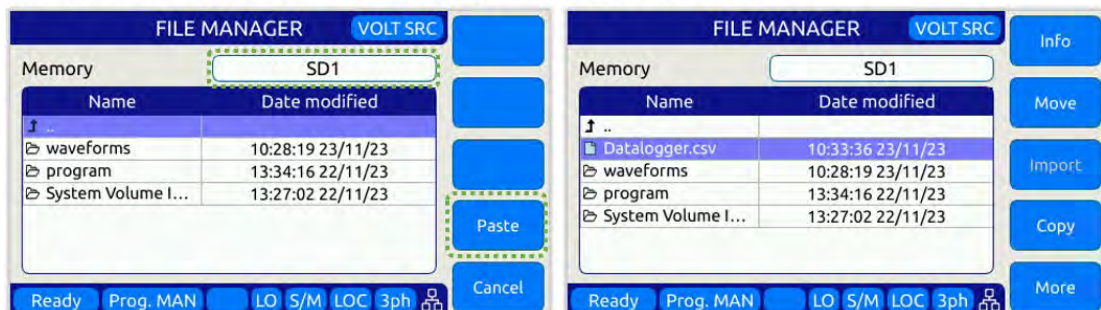
- Changes the directory and then press **“Apply Move”**



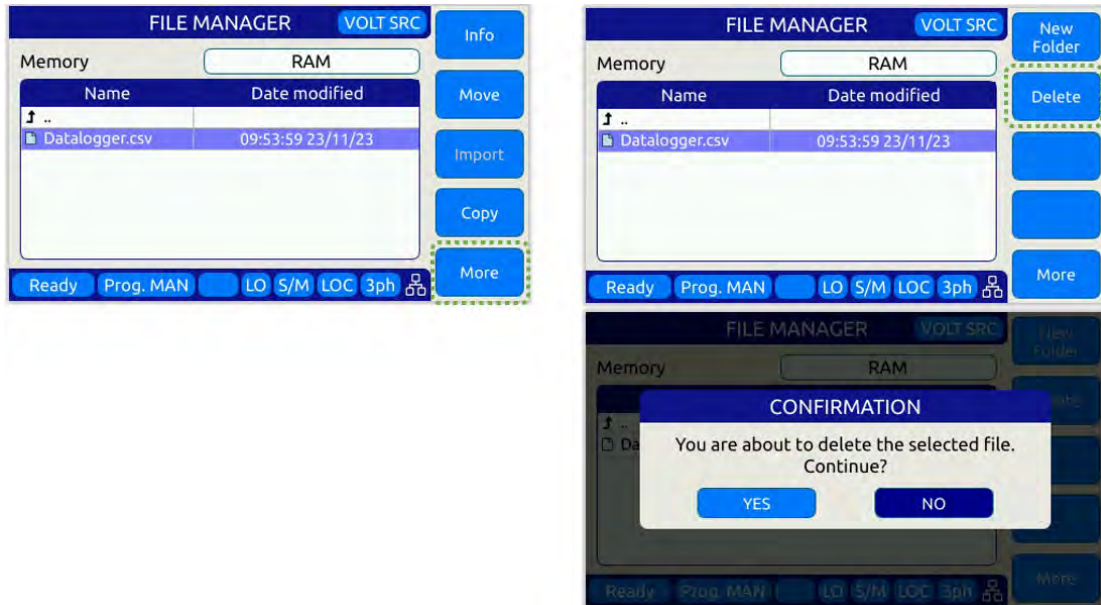
Copy and Pasting Files



Changes the directory (and/or Memory) and then press **“Paste”**



Deleting Files



6.8.11 CALIBRATION MENU Screen

All power sources are shipped with a Certificate of Compliance to NIST traceable standards ("CoC") from the factory. Output and Measurements are calibrated to an external reference DMM at the same time. A suitable current shunt or current transformer and a load will be required to perform calibration.

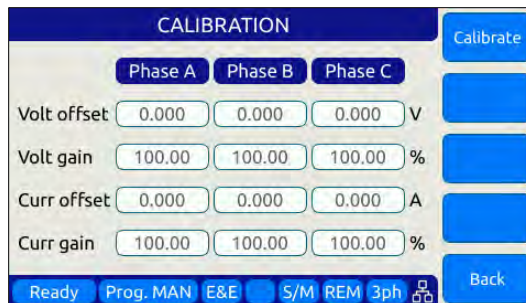


Figure 6-40: CALIBRATION MENU Screen

The following soft keys are available from the CALIBRATION MENU:

SOFT KEY	Description
Calibrate (SK1)	Enters calibration state
Reset (SK2)	Resets all calibration coefficients' previous values.
-	
-	
Back (SK5)	Returns to previous screen

Table 6-42: Available CALIBRATION MENU screen soft keys

For details on calibration requirements and procedures, refer to the Calibration section towards the end of this manual. (Section 11, “Calibration”).

6.8.12 FIRMWARE UPDATE Screen

Firmware updates may be distributed via different media such as SD-Card, USB memory stick or on-line through Pacific’s FTP site. The FIRMWARE UPDATE screen provides the means for the end user to perform a firmware update.

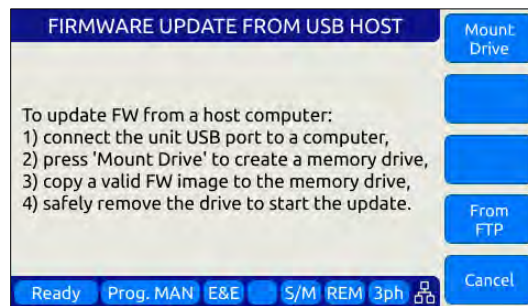


Figure 6-41: FIRMWARE UPDATE Screen

The following soft keys are available from the FIRMWARE UPDATE screen:

SOFT KEY	Description
Mount Drive (SK1)	Mount media that contains new firmware revision.
-	
-	
From FTP (SK4)	Install latest firmware from Pacific Power Sources’ FTP server.
Cancel (SK5)	Exit firmware update screen

Table 6-43: Available FIRMWARE UPDATE screen soft keys

6.8.13 REMOTE SUPPORT Screen

The REMOTE SUPPORT feature can be used to send information to customer support in case the user experiences an issue with the unit. It also provides a means to allow Pacific's technical support team to access the unit remotely assuming it is connected to a network with Internet access.

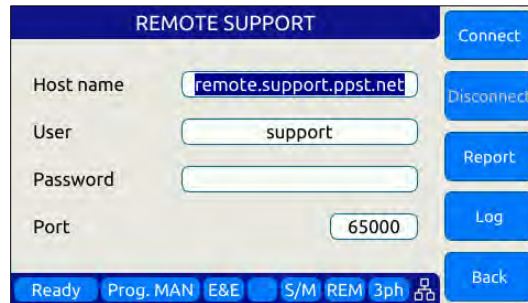


Figure 6-42: REMOTE SUPPORT Screen

The Report soft keys will cause a detailed report to be generated and sent to Pacific Power Source customer support so we can assist in resolving any technical support issues.

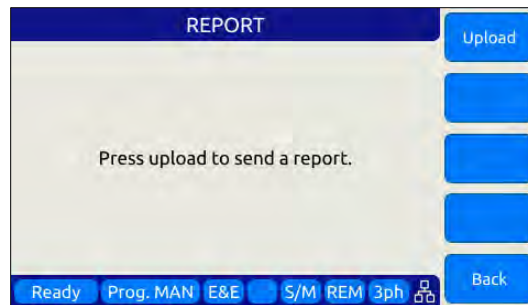


Figure 6-43: Remote Support REPORT Screen

The following soft keys are available from the LOGGING TOOL screen:

SOFT KEY	Description
Connect (SK1)	Connect to Pacific Power Support site
Disconnect (SK2)	Disconnect from Pacific Power Support site
Report (SK3)	Generates a report for Customer Support Department
Log (SK4)	Start Logging
Back (SK5)	Returns to the previous screen.

Table 6-44: Available LOGGING TOOL screen soft keys

7 Rear Panel, Connectors and Protection

This section describes the rear panel layout of the AGX Series® AC power source.

7.1 OUTPUT Terminals



CAUTION

HAZARDOUS OUTPUT: The power source output may be set to hazardous voltage levels. It provides basic isolation from the AC input mains. Therefore, the output must always be considered hazardous. Connections must be inaccessible to the operator in all situations when AC input mains voltage is applied.

Always disconnect power supply from the mains before connecting or disconnecting to the hazardous output terminals.



AVERTISSEMENT

SORTIE DANGEREUSE: La sortie de l'appareil peut être réglée à des niveaux de tension dangereux. L'appareil fournit une isolation de base du réseau d'entrée AC. Par conséquent, la sortie doit toujours être considérée comme dangereuse. Les connexions doivent être inaccessibles à l'opérateur dans toutes les situations où la tension d'entrée secteur est appliquée.

Toujours débrancher l'alimentation secteur avant de connecter ou déconnecter les bornes de sortie dangereuses.

The output terminal block for load connections is located near the center of the rear panel.

Note: Always refer to Section 2.3 “Safety Information” and Section 5.14, “Load Connections” on page 79 before making any load connections.

7.1.1 Output Power Connector Rating and Isolation

Maximum rated output voltage:	365V rms AC, ± 500Vdc
Maximum Current Rating:	60A
Connector Type:	Phoenix Contact SPC 16/ 6-STF-10, 16 - 1711417
Designated Use:	AC or DC Load Connection
Isolation Rating:	600V
Wire Stripping Length:	18 mm
Nominal Contact Cross Section	16 mm ²

7.1.2 Wire Size

A major consideration in making load connections is the wire size. The minimum wire size is required to prevent overheating and to maintain good regulation. It is recommended that the wires are sized large enough to limit the voltage drop at the maximum current rating of the AC power source to less than 0.5V per lead.

Wire size also depends on ambient temperature and total wires in the cable bundle. For example, for the full 41.7 amp current capability of a single output, at an ambient temperature of 30 °C, in a bundle of not more than three 75 °C rated wires, common electrical codes would recommend AWG 8 size (~10 mm²). However, maximum supported Wire Size for the output connector is AWG 6.

AWG	Diameter		Turns of wire, without insulation		Area	
	(in)	(mm)	(per in)	(per cm)	(kcmil)	(mm ²)
6	0.1620	4.115	6.17	2.43	26.3	13.3

7.1.3 Connecting a UUT

When setting up for a new test and connecting any equipment to the AC power source, proceed as follows:

1. Always make sure the AC power source is turned OFF at the POWER switch when making any wire connections.
2. Check that the output of the equipment under test is **OFF**.
Note: Some power equipment's output may still be energized even if the equipment has been turned off or its output is turned off. This is especially true for AC power sources.

Note: When working with batteries, it is recommended to provide a suitable disconnect relay or switch so the AC power source can be physically disconnected

from the battery for handling purposes.

3. Connect one end of the load wires to the output terminals on the rear panel.
4. Check the polarity of the connections and connect the other end of the load wires to the input terminals of the equipment under test.

7.2 External Voltage Sense Input Terminals



CAUTION

HAZARDOUS OUTPUT: The power source output may be set to hazardous voltage levels. It provides basic isolation from the ac input mains. Therefore, the external voltage sense must also always be considered hazardous. Connections must be inaccessible to operator in all situations when ac input mains voltage is applied.

Always disconnect power supply from the mains before connecting or disconnecting to the hazardous external voltage sense terminals.



AVERTISSEMENT

SORTIE DANGEREUSE: La sortie de l'appareil peut être réglée à des niveaux de tension dangereux. L'appareil fournit une isolation de base du réseau d'entrée AC. Par conséquent, la sortie doit toujours être considérée comme dangereuse. Les connexions doivent être inaccessibles à l'opérateur dans toutes les situations où la tension d'entrée secteur est appliquée.

Toujours débrancher l'alimentation secteur avant de connecter ou déconnecter les bornes de sortie dangereuses.

This section covers external voltage sensing. This feature improves voltage accuracy at the point of load when used correctly.

Note: External Voltage sense is sometimes referred to as Remote Voltage sense and Internal Voltage sense is sometimes referred to as Local Voltage sense. Both definitions are used in the industry. For consistency, External Voltage Sense and Internal Voltage Sense are used in this manual.

7.2.1 External Voltage Sense Connector Rating and Isolation

Maximum rated voltage:	400V rms AC, 425Vdc
Maximum Current Rating:	1A
Connector Type:	Phoenix Contact P/N SPT 5 / 6-H-7,5-ZB - 1719231
Designated Use:	AC or DC Load Connection
Isolation Rating:	600V
Wire Stripping Length:	10 mm

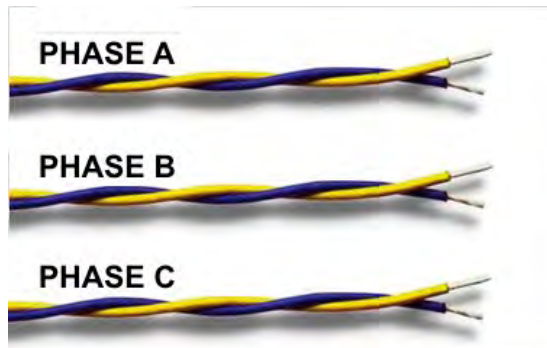
7.2.2 Load Connection without External Voltage Sense

AGX Series® power sources can be operated with internal voltage sense. For higher current loads, the voltage at the load will drop due to the load cable impedance. Using the proper wire gauge for the rated current of the AC source is required to minimize load cable impedance.

7.2.3 Load Connection with External Voltage Sense.

The following points must be considered, when existing sense cables are connected directly to the load or to the central load distribution point:

1. Minimize the distance between the AC power source and the load as much as possible to keep load wire length to a minimum.
2. Directly connect **A, B, C** and **N** with **correct phasing** to the load distribution point
3. Twist each phase sense wire with a neutral sense wire to minimize cross talk. Three neutral connection points are provided for this purpose.



4. Avoid overload of power wires

Note: External voltage sense connections are at the programmed output voltage when the output is on so DO NOT connect or disconnect the external voltage sense lines while the AC power source is in use.

7.3 Auxiliary I/O

The Auxiliary I/O functions are **only** available on 3xx0AGX-2**AG** and 3xx0AGX-4**AG** version power source models.

7.3.1 Auxiliary I/O Functions

The Auxiliary I/O board when added to an AGX Series power source adds the following functions and features:

- Digital Inputs for trigger functions and control.
- Digital Outputs for status indication and relay control.
- Analog Inputs for control of power source parameters.
- Analog Outputs for measurement monitoring.
- A 12Vdc power output to power external circuits.
- External RMS regulation loop using voltage or current feedback
- RS232 Serial Interface.
- Optional embedded GPIB Control Interface

The analog, digital and RS232 ports are accessible on a female DB25 connector located on the rear panel of the AGX master unit. This connector is mounted upside down so pin 1 is located in the lower right-hand corner when facing the back of the AGX master unit.

The USB, LAN and optional GPIB connectors are located to the left of the AUX I/O connector on the rear panel when facing the power source from behind.



Figure 7-1: Rear Panel AUX I/O DB25 Connector Location

7.3.2 DB25 Connector AUX I/O Pin locations

The pin locations for the various I/O signals on the DB25 connectors are shown in Figure 7-2 below. Note that the connector is installed “Upside” down due to mounting constraints.

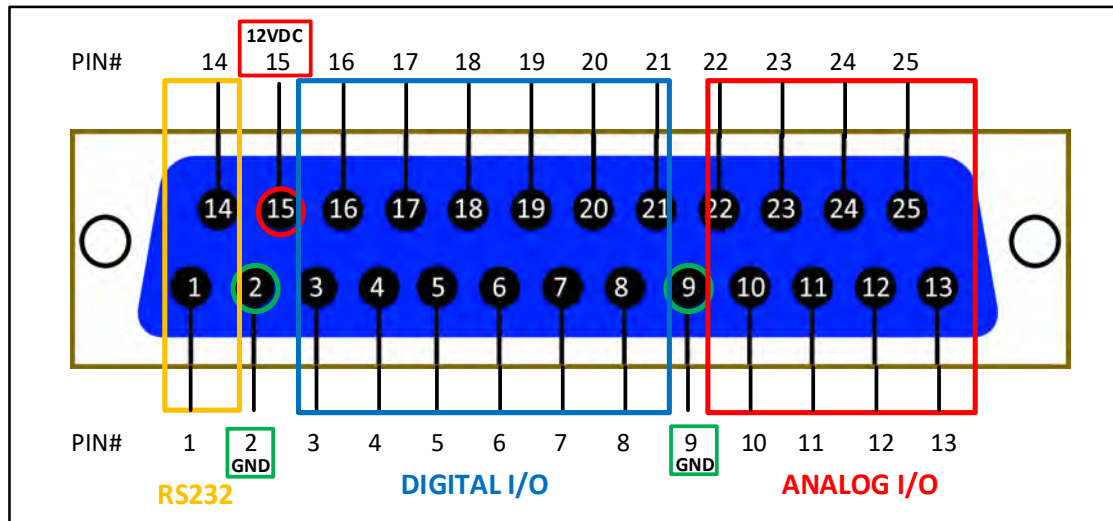


Figure 7-2: DB25 Connector AUX I/O Pin Locations

Functional grouping of pins by I/O function is done as shown in the figure above. The right hand side groups all **Analog I/O** signals on top on bottom row. The middle section is reserved for all **Digital I/O** pins. The **RS232** Transmit (Tx) and Receive (Rx) signals are located on the far left when facing the back of the unit.

7.3.3 I/O Signal Table by pin number

Pin assignments in order of pin number are shown in the table below.

Pin #	Name	Primary Function	Alternate Use / Comment	Type	Direction
1	RxD	RS232 Receive Data (Rx)		RS232	Input
2	GND	Chassis Ground		Ground	n/a
3	DI1	General Purpose Digital Input #1	Programmable	Digital	Input
4	DI2	General Purpose Digital Input #2	Programmable	Digital	Input
5	DI3	General Purpose Digital Input #3	Programmable	Digital	Input
6	RI	Remote Inhibit	Short to +12Vdc Pin 15	Digital	Input
7	TT	Transient Trigger Input		Digital	Input
8	Sync In	Phase Sync Input		Digital	Input
9	GND	Chassis Ground		Ground	n/a
10	AI1	Analog Input – Volt RMS Phase A	Any set point	Analog	Input
11	AI2	Analog Input – Volt RMS Phase B	Any set point	Analog	Input
12	AI3	Analog Input – Volt RMS Phase C	Any set point	Analog	Input
13	AI4	Analog Input – Current Limit RMS all phases	Any set point	Analog	Input
14	TxD	RS232 Transmit Data (Tx)		RS232	Output
15	12V	Output, 12Vdc	0.5 A max, current protected	Power	Output
16	DO3 /RC1	Relay Control #1 – FORM	Programmable, Open Collector, Current protected	Digital	Output
17	DO4 /RC2	Relay Control #2 - TRANSFORMER	Programmable, Open Collector, Current protected	Digital	Output
18	FS	Trigger Output / Function Strobe		Digital	Output
19	Sync Out	Phase Sync Output		Digital	Output
20	DO1	General Purpose Digital Output #1	Programmable	Digital	Output
21	DO2	General Purpose Digital Output #2	Programmable	Digital	Output
22	AO1	Analog output #1 – Volt RMS Measurements Phase A	Any other measurement	Analog	Output
23	AO2	Analog output #2 – Volt RMS Measurements Phase B	Any other measurement	Analog	Output
24	AO3	Analog output #3 – Volt RMS Measurements Phase C	Any other measurement	Analog	Output
25	AO4	Analog output #4 – Total Power (all phases combined)	Any other measurement	Analog	Output

Table 7-1: Auxiliary I/O DB25 Connector Pin numbers and Signals by DB25 pin number

7.3.4 I/O Signal Table by Function

Pin assignments in order of pin number are shown in the table below.

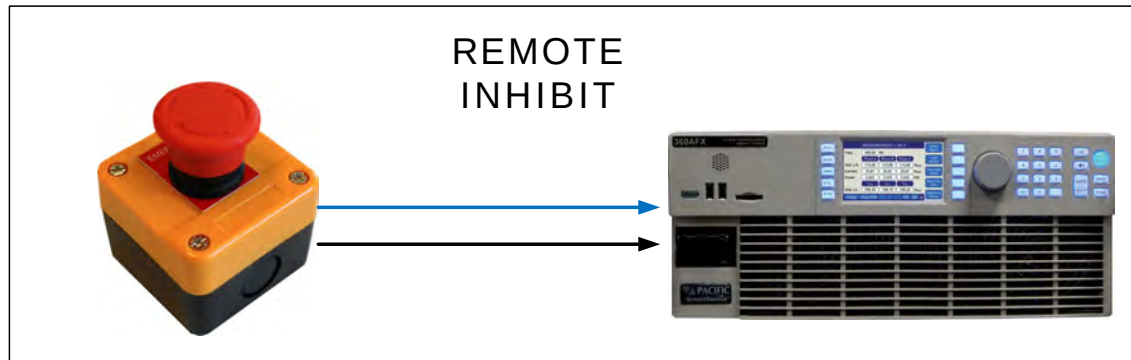
Pin #	Name	Primary Function	Alternate Use / Comment	Type	Direction
10	AI1	Analog Input – Volt RMS Phase A	Any set point	Analog	Input
11	AI2	Analog Input – Volt RMS Phase B	Any set point	Analog	Input
12	AI3	Analog Input – Volt RMS Phase C	Any set point	Analog	Input
13	AI4	Analog Input – Current Limit RMS all phases	Any set point	Analog	Input
22	AO1	Analog output #1 – Volt RMS Measurements Phase A	Any other measurement	Analog	Output
23	AO2	Analog output #2 – Volt RMS Measurements Phase B	Any other measurement	Analog	Output
24	AO3	Analog output #3 – Volt RMS Measurements Phase C	Any other measurement	Analog	Output
25	AO4	Analog output #4 – Total Power (all phases combined)	Any other measurement	Analog	Output
3	DI1	General Purpose Digital Input #1	Programmable	Digital	Input
4	DI2	General Purpose Digital Input #2	Programmable	Digital	Input
5	DI3	General Purpose Digital Input #3	Programmable	Digital	Input
20	DO1	General Purpose Digital Output #1	Programmable	Digital	Output
21	DO2	General Purpose Digital Output #2	Programmable	Digital	Output
18	FS	Trigger Output / Function Strobe		Digital	Output
16	DO3 /RC1	Relay Control #1 – FORM	Programmable, Open Collector, Current protected	Digital	Output
17	DO4 /RC2	Relay Control #2 - TRANSFORMER	Programmable, Open Collector, Current protected	Digital	Output
6	RI	Remote Inhibit	Short to +12Vdc Pin 15	Digital	Input
8	Sync In	Phase Sync Input		Digital	Input
19	Sync Out	Phase Sync Output		Digital	Output
7	TT	Transient Trigger Input		Digital	Input
15	12V	Output, 12Vdc	0.5 A max, current protected	Power	Output
2	GND	Chassis Ground		Ground	n/a
9	GND	Chassis Ground		Ground	n/a
1	RxD	RS232 Receive Data (Rx)		RS232	Input
14	TxD	RS232 Transmit Data (Tx)		RS232	Output

Table 7-2: Auxiliary I/O DB25 Connector Pin numbers and Signals by Signal Name

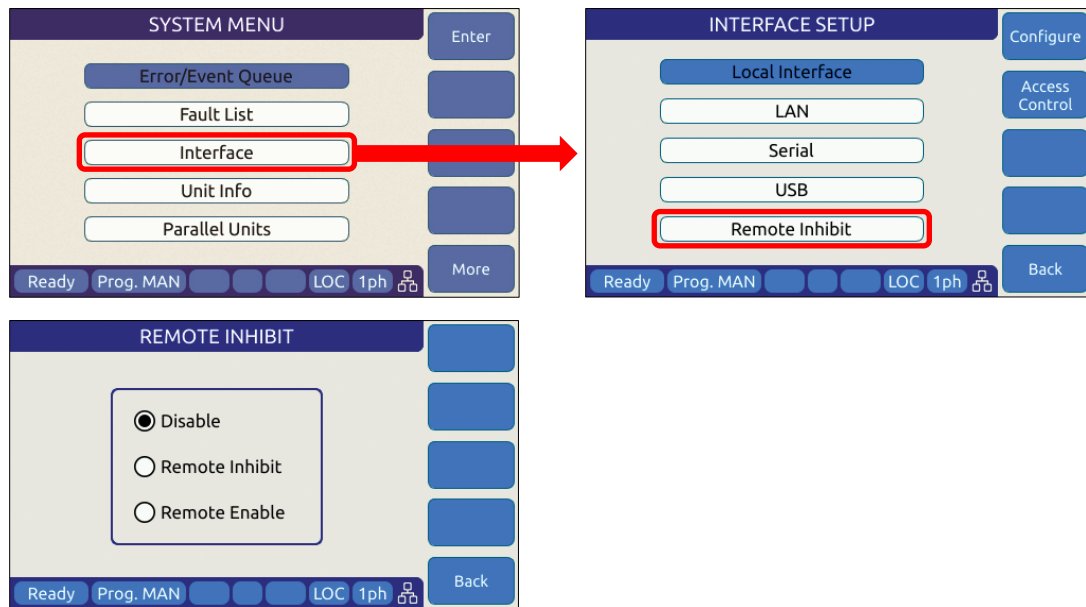
7.3.5 Dedicated Function Digital Inputs

- Remote Inhibit
- External Trigger Input
- External Phase Sync Input

7.3.5.1 Remote Inhibit



The mode can be selected from the SYST (SYSTEM) menu screen using the Interfaces, Remote Inhibit selection as shown below.



There are three modes of operation for this input:

4. **Disable mode:** In this mode, the Remote Inhibit inputs are not active so this function is turned off. No short between the RI pins is required to enable the output in this mode.

5. **Remote Inhibit mode:** The Remote Input pins 6 and 15 on the rear panel DB25 AUX I/O connector have to be shorted for the output to be enabled from the front panel or remote command. This is a necessary but not a sufficient condition to enable the output. If the output is enabled and the remote inhibit connection is open, a fault is generated.

Command: SYSTem:DIO:REMOte:INHibit 0 | 1

6. **Remote Enable mode:** The output can be enabled by shorting pins 6 & 15 on the rear panel DB25 AUX I/O connector, regardless of the output enable command/button. It is a sufficient condition to enable the output.

Command: SYSTem:DIO:REMOte:ENABle 0 | 1

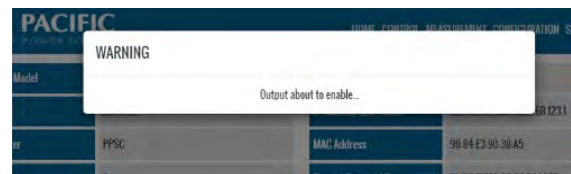
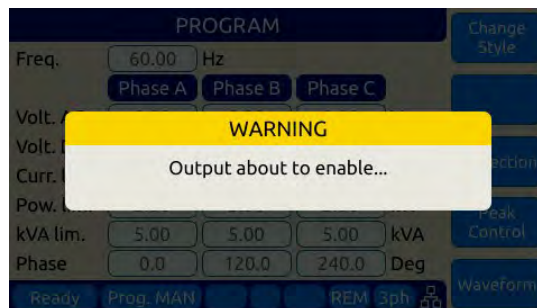
This function can be enabled or disabled at power on using

Command⁶: SYSTem:DIO:REMOte:ENABle:AUTO 0 | 1 (default = 1)

When AUTO is set to 1, output is enabled immediately after power up if the remote enable input is 1. When Auto is set to 0, output is enabled only when a 0 to 1 input level change is detected and disabled on a 1 to 0 level change.

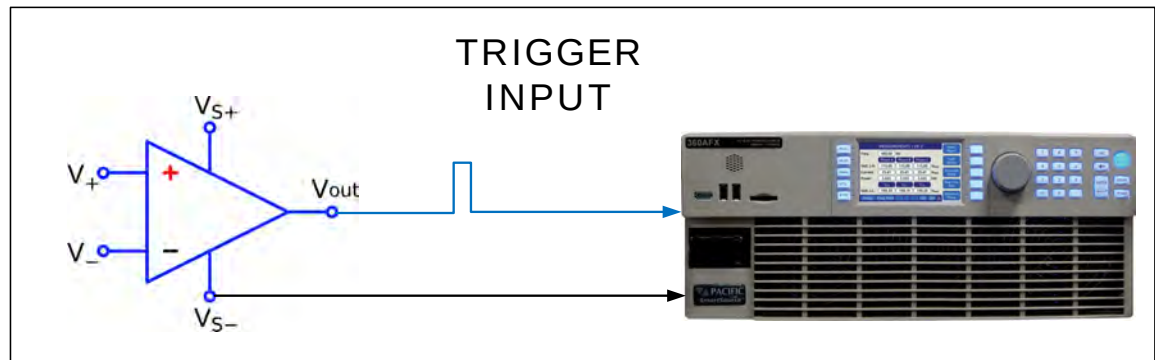
Both settings can be changed by the user. Sending a sanitize command returns both back to 1 and 0 respectively.

Countdown beeping warning before enabling output, like a time boom. The warning pop-ups messages below are shown on LCD and webpage before enabling the output.



⁶ This command is supported with firmware revision 2.2.48 or higher only.

7.3.6 Transient Trigger Input



The external trigger input can be programmed to trigger the start of a transient program. This allows the power source output sequence to be initialized by an external sync signal.

In order to use the trigger input, the mode has to be active (from any of the graphical interfaces or using the SCPI command `PROgram:TRANsient:TRIGger:INput`), and the transient program has to be executed first. The transient will wait and start execution when a rising edge is detected on this digital input.

The graphical interfaces (front panel and webpage) will show the state “Running” but with a progress of 0% until the transient program is actually started.

The following specifications apply to the external trigger input:

Input Voltage	Logic Low $V_{in} < 0.4 \text{ V}$ Logic High $V_{in} > 2.0 \text{ V}$
Impedance	10 k Ω
Edge Triggered	Rising edge

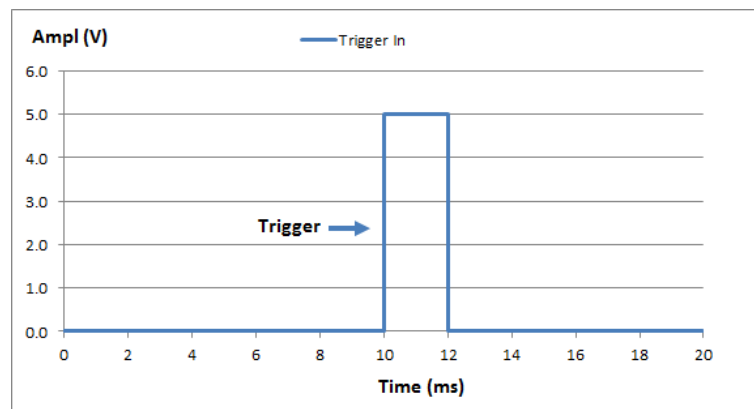
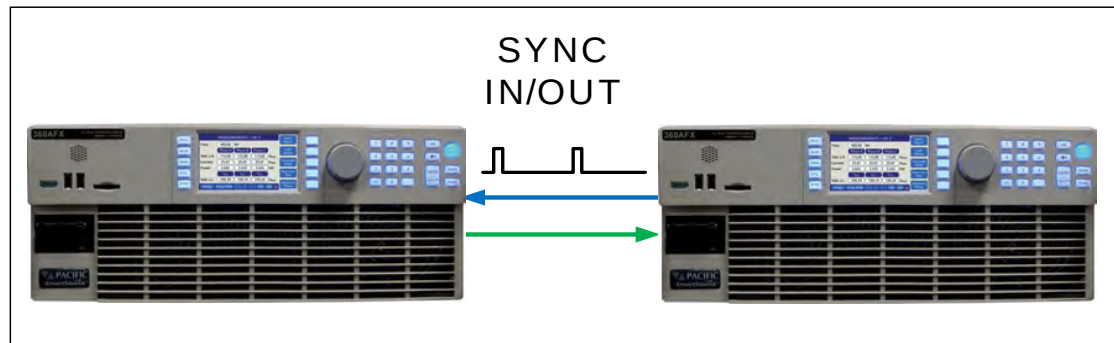


Figure 7-3: External Trigger Input Timing

7.3.7 External or Line Sync Input



The phase sync input can be used to synchronize in frequency and phase the internal waveform generation of the AGX to an external sync reference or to the AC mains. The reference must be within the specified frequency range of the power source and zero phase offset calibration for phase A may be required to compensate for any phase shifts. Note that Phase B and C are still phase related to A as programmed by B and C phase angles.

7.3.7.1 Principle of Operation

In AC Line sync mode, the AGX uses the L-L AC input voltage to generate the internal sync signal. The goal of the phase sync is to provide precise frequency synchronization, and consistent phase at a given operating point, but the phase shift between AC input and AC output is not automatically zero. A phase adjustment for Phase A must be made by the user to time-align the power source's phase A output voltage to the L1 leg of the actual three phase Grid voltage powering the AGX.

A couple of factors affect the phase shift:

- The internal AC sync circuits have some inherent delays. If more accuracy is required then the TTL input mode can be used instead using an external line sync circuit.
- Even if TTL input is used, there can be a phase shift that depends on the output load because of the finite bandwidth of the output inverter stages. This is particularly visible at higher frequencies. At 50Hz or 60Hz, the phase shift will be pretty small.

Note: When the sync input is enabled, the AGX frequency set point **must** be set to a value similar to the external sync signal. This minimizes the synchronization time and improves the stability of the generated frequency.

After the sync input is activated, or the external signal frequency/phase is changed, the Sync circuit's Phase-Locked Loop (PLL) requires a short time to "lock" to the external source. The AGX reports the status of the PLL in the external interfaces (front panel and webpage) by showing a "**Synced**" or "**Unsynced**" message in the status bars.

The status can also be queried with the SCPI command "SOURce:SYNChronize:STATe?".

The sync circuit is able to synchronize to any signal with a frequency if $F_{\text{SETPOINT}} \pm F_{\text{RANGE}}$, where F_{SETPOINT} is the normal frequency set point and F_{RANGE} is a configurable value (default is 10Hz)

The following specifications apply to the phase sync input at the DB25 port:

Input Voltage	Logic Low $V_{in} < 0.4 \text{ V}$ Logic High $V_{in} > 2.0 \text{ V}$
Impedance	10 k Ω
Frequency Range	15 Hz – 1200 Hz
Edge Triggered	Rising edge

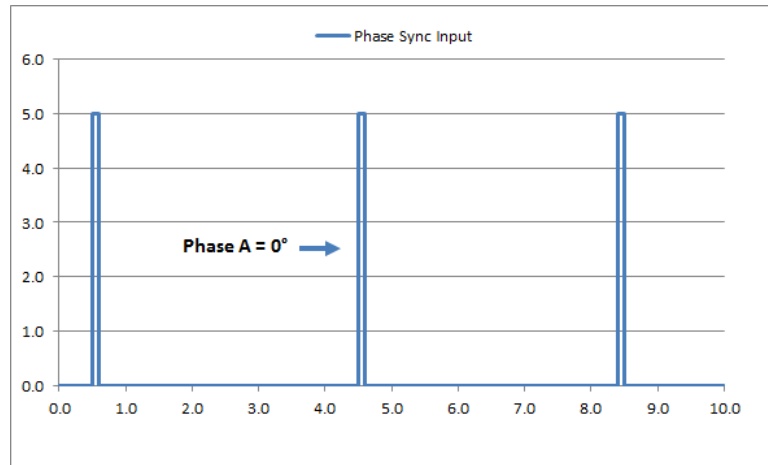


Figure 7-4: External Sync Input Pulses

The SYNC setting screens are available under INTERFACXE SETUP -> Digital & Analog I/Os -> External sync in the SYSTEM menu. This screen set/clears both SYNC output (Check box at the bottom) and SYNC input enable, source, phase shift, sync speed and sync frequency width (Range).

EXTERNAL SYNC

Status	-	Apply All
External sync	Disabled	Cancel All
Sync source	AC Line	Enable
Phase shift	0.00 Deg	[]
Speed	2.50 x	[]
Range	10.00 Hz	[]
☒ Enable sync output signal		

Fault
Prog. MAN
E&E
S/M
LOC
3ph
[Icon]
Back

7.3.7.2 SYNC Status Display

A “Synced” status field will be displayed in **Green** in the lower left corner of the LCD display. This field will toggle with the regular “Ready/Enabled/Fault” status field also shown in this location. The “Synced” status will be shown every 3 seconds for 1 second in place of the “Ready/Enabled/Fault” field. When the PLL is not locked to the external source, the unit will display an “Unsynced” status in **Orange**.

It is not recommended to enable the unit when it has not locked or synchronized to the external source because the frequency may be unknown.

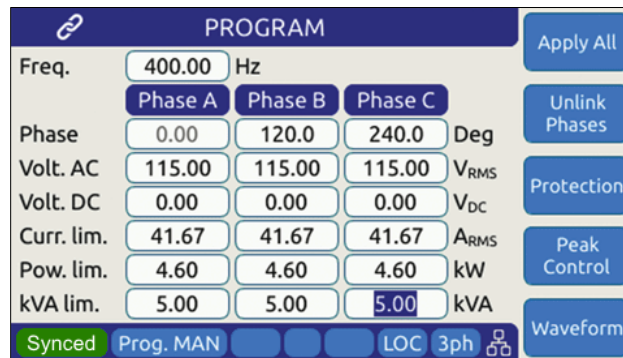


Figure 7-5: External Sync Input Sync Status Indication

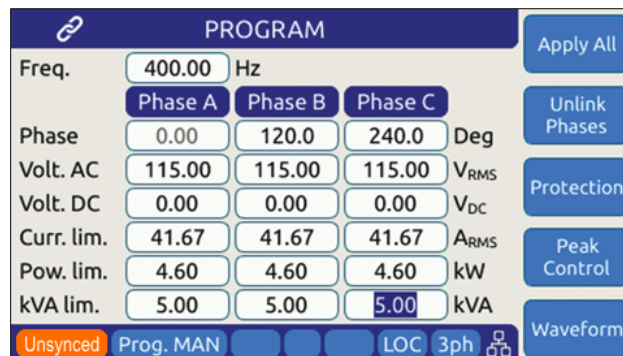


Figure 7-6: External Sync Input Sync Lost Status Indication

7.3.7.3 Sync Operation Settings

The AGX allows precise configuration of the synchronization parameters to optimize performance for each application. The parameters are:

- 1 **Phase shift:** Defines a fixed phase shift between phase A waveform generation and the external sync source. Used to calibrate any phase difference between the sync signal and the power source output on phase A.
Command: SOURce:SYNChronize:PHASEshift
- 2 **Speed:** Allows accelerating the speed of the internal synchronization engine (PLL) in case the external sync source is not constant and presents periodic or continuous

changes. A slower speed improves the stability of the waveform frequency, so it is recommended to use the smallest possible speed values.

Command: SOURce:SYNChronize:SPEED

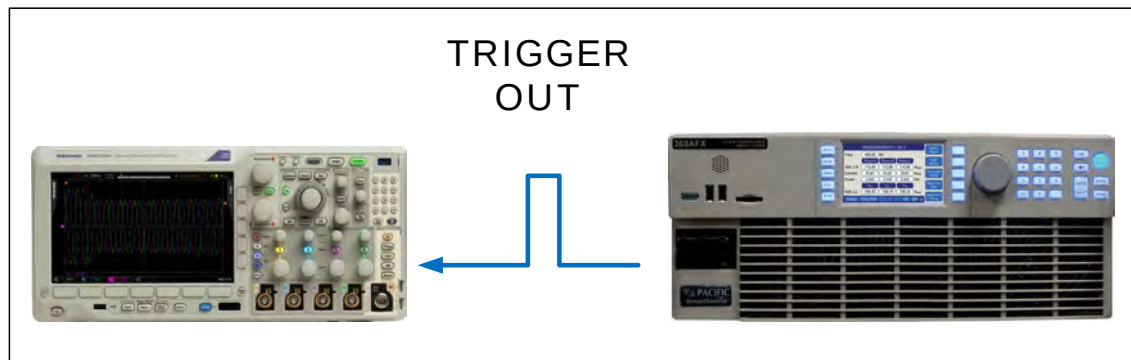
- 3 **Range:** Allows configuration of how much the synchronization engine is able to deviate from the AGX programmed frequency. This helps to keep the waveform frequency under control, even if the external source is not present all the time. The synchronization engine is limited to frequencies of FSETPOINT +/- FRANGE.

Command: SOURce:SYNChronize:RANGE

7.3.8 Digital Output control signals

- External Relay Control #1 - FORM
- External Relay Control #2 - TRANSFORMER
- Trigger Output / Function Strobe
- Phase Sync Output

7.3.8.1 Function Strobe / Trigger Out



The external trigger output can be programmed to generate an output pulse on the following events:

- a. The start of a transient program (Transient Trigger)
- b. Output Replay State Change
- c. Any parameter change. Parameter changes that generate an output function strobe pulse are:
 - i. Voltage on any phase
 - ii. Frequency
 - iii. Waveform on any phase
 - iv. Phase angle

The mode can be set from the front panel or by using the following SCPI commands:

Transient start mode:	SYSTEM:DIO:STROBE:TRANSient 0/1	
	PROGram:TRANSient:TRIGger:OUTput 0/1	(alias)
Output Relay mode:	SYSTEM:DIO:STROBE:OUTPutstate 0/1	
Program Change mode:	SYSTEM:DIO:STROBE:SOURce 0/1	

The following specifications apply to the external trigger output:

Output Voltage @ 0.4 mA	Logic Low Vout < 0.4 V	
	Log High Vout > 4.6 V	
Max. Current	± 10 mA	
Output Impedance	100 Ω	
Pulse Width	190 us ± 10 us	For Transient Trigger mode
	2.0 msec ± 10 μs	For OUTPutstate & SOURce modes

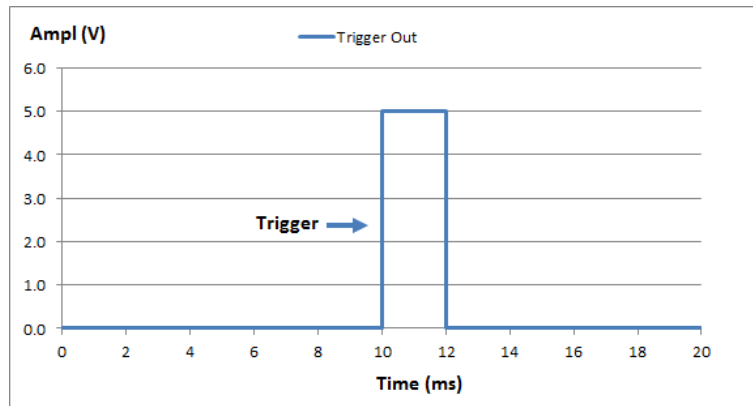


Figure 7-7: Transient Trigger Output Pulse

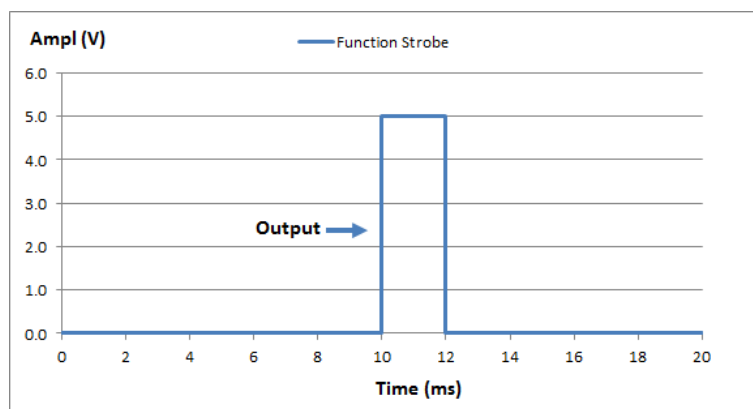
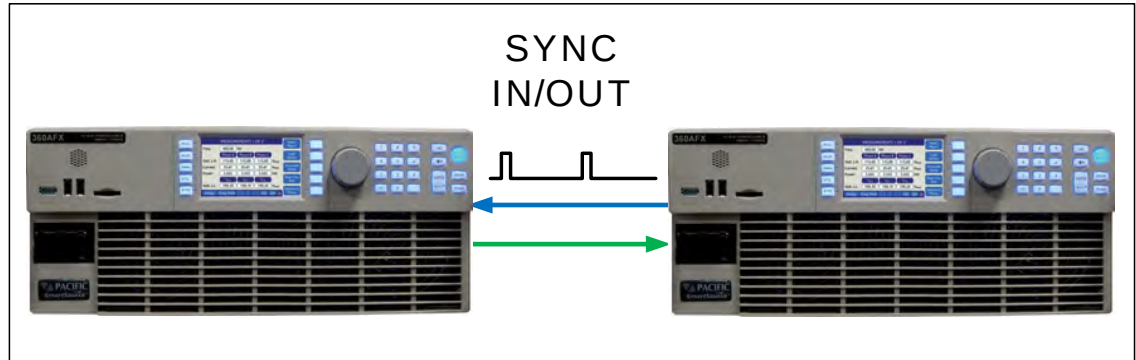


Figure 7-8: Function Strobe Output Pulse

7.3.8.2 Phase Sync Output



The phase sync output signal can be programmed to generate an output pulse at each zero crossing of the phase A voltage. This indicates the 0° phase angle output on Phase A.

The mode can be set from the front panel or by using the following SCPI commands:

The following specifications apply to the external trigger output:

Output Voltage @ 0.4 mA	Logic Low Vout < 0.4 V
	Logic High Vout > 4.6 V
Max. Current	± 10 mA
Output Impedance	100 Ω
Pulse Width	100 us ± 10 us

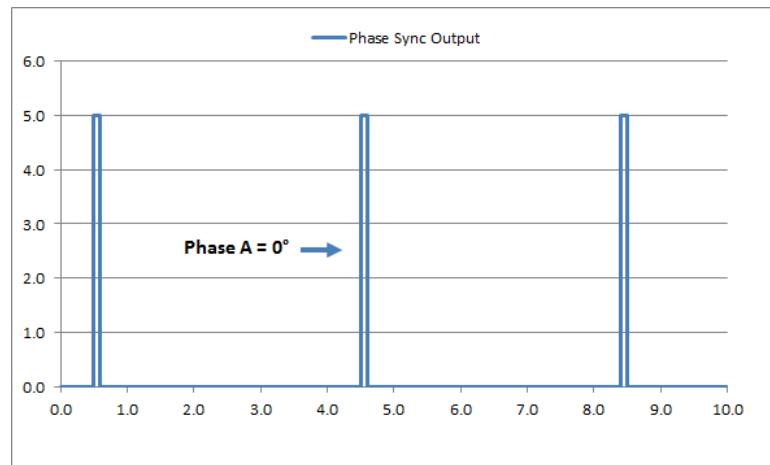
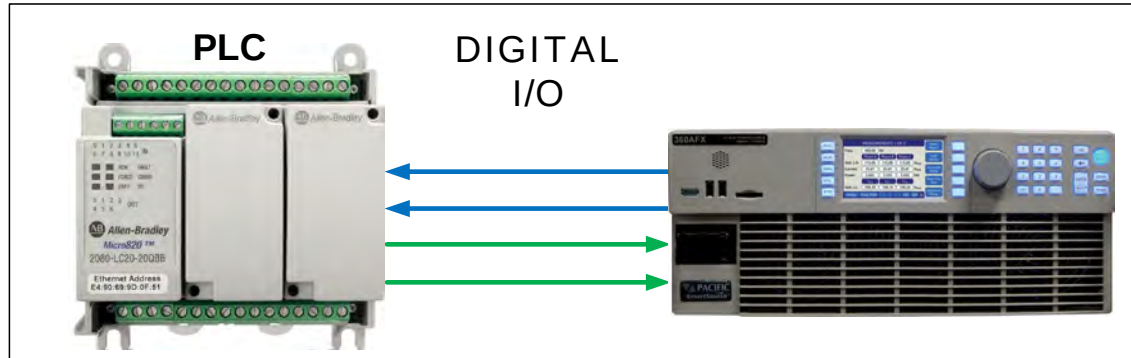


Figure 7-9: Phase A Zero Phase Sync Output Pulse

7.3.9 User Programmable Digital signals

Available user defined digital input and outputs are provided as part of the I/O feature. These signals may be assigned different purposes under software control.



User Programmable Digital Input signals functions are:

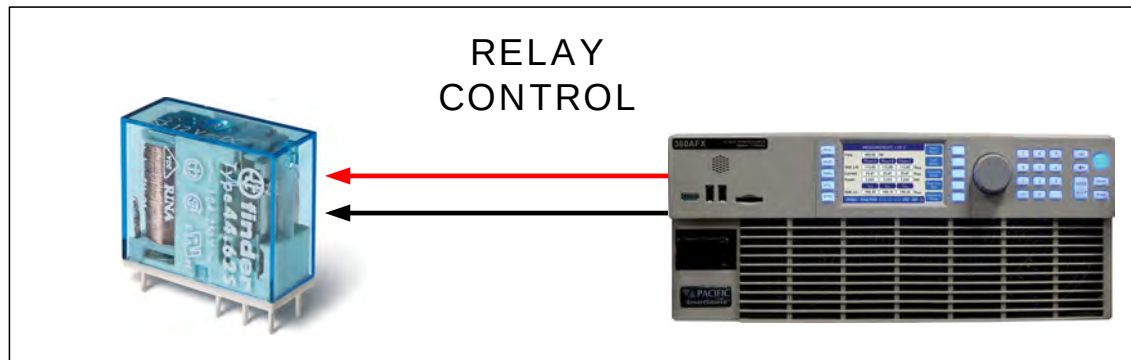
- DIO:INput1 - Digital Input #1
- DIO:INput2 - Digital Input #2
- DIO:INput3 - Digital Input #3

User Programmable Digital Output control signals are:

- DIO:OUTput1 - Digital Output – TTL level
- DIO:OUTput2 - Digital Output – TTL level
- DIO:OUTput3 - Digital Output – Open drain
- DIO:OUTput4 - Digital Output – Open drain

Digital outputs 3 and 4 are open drain with internal +5Vdc pull-ups.

7.3.9.1 Relay Control Outputs



The external relay control output signals DO3 and DO4 can be used to control external relays. These control lines are user programmable for difference functions such as FORM relay control and Transformer Option control.

These relays are used to either short all outputs together for single-phase output mode or to connect and disconnect and external transformer for a higher voltage AC output range.

- Relay signal #3 is normally used for the FORM (Mode Change) Relay option on AGX cabinet systems.
- Relay signal #4 is normally used for the Transformer Option.
- A 12V dc output is provided as well to drive a small signal relay to operate a large contactor.

7.3.9.2 Digital User Inputs

The digital inputs allow any action to be executed at the rising and/or falling edge of the signal, by simply assigning a SCPI command for execution to that event.

For example, a digital input can be configured to enable the output at the rising edge and disable it at the falling edge of the signal. Alternatively, it can be configured to change any set point and either of those 2 events.

A total of three digital inputs are available. These following input characteristics can be programmed for each digital input (1, 2 and 3):

- **Command** to execute (a SCPI command string) at each edge. Rising and falling edges can have different commands.
- **Filter** Setting, to reduce sensitivity to short pulses that can be caused by electrical noise or some mechanical switches.

See SCPI command section 8.10.1.3 for commands that configure and read digital inputs.

7.3.9.3 Digital User Outputs

There are four programmable digital outputs (1 to 4), which can be configured to change state based on different conditions:

- 1=ON, 0=OFF it is used as general-purpose digital output, with the value set with a SCPI command.
- OUTPUT_STATE indicates output enabled (1) or disabled (0).
- FORM indicates single (1) or split/three (0).
- FAULT indicates fault (1) or no fault (0).
- TRANSIENT indicates when a transient is running/paused/stepping (1) or stopped (0).
- PROGRAM indicates when a program is in execution at steady state level (1) or manual mode (0).
- REMOTE indicates remote (1) or local (0).
- XFMR_COUPLING indicates direct (0) or transformer (1) coupling. This output is relevant only when an output transformer option is installed and configured.

Note: Each output can be also configured to invert its logic.

User defined digital inputs can be queried using the SYSTEM:DIO:OUTput# command.

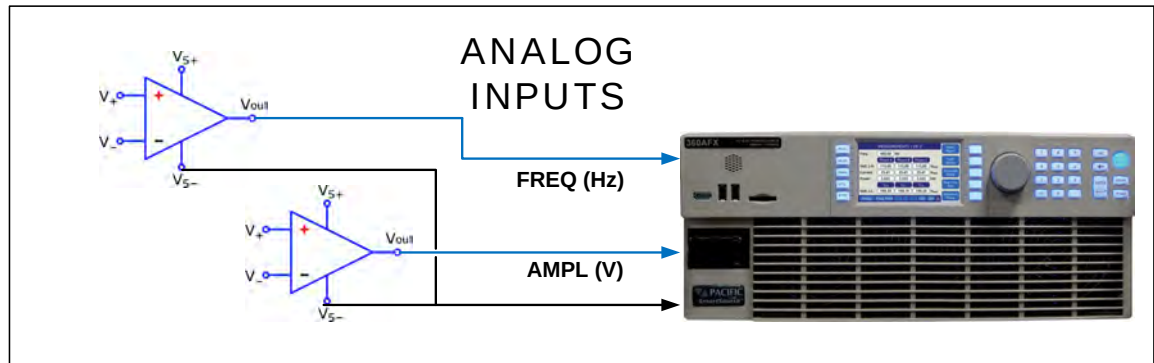
Digital outputs 1 and 2 are TTL level signals (0 to 5V), and digital outputs 3 and 4 are open-drain type outputs (with an internal pull-up) that can be used to drive external relays. Each open-drain output has a current protection of 0.5A and internal clamping diode prepared to drive a relay coil.

See section 8.10.1.4 for commands that configure and read digital outputs.

7.3.10 Analog I/O Descriptions

Both analog inputs and outputs are available on the AUX I/O feature. Analog inputs are used to change output parameters such as voltage or frequency. Analog outputs are provided to allow monitoring the AGX measurements using external equipment.

7.3.10.1 Analog Inputs



There are 4 analog inputs that accept DC signals up to 10Vdc and may be used to program the AGX output parameters such as voltage, frequency, current and power limits. Negative voltages of up to -10Vdc can be used to program DC voltage.

These inputs are sampled 20 times per second so updates of the assigned parameters occur at this rate. The full-scale range of the analog inputs can be programmed to be 5V, 10V or any value between 1 and 10V.

Note: Once enabled, make sure the input is not left floating or a small offset of about 2 to 3 % of full scale may be present affecting the programmed parameter. For example, when programmed to control AC voltage, no input on the analog input assigned will result in an output voltage of about 0.02 to $0.03 \times 300 = 6$ to 9 Vac.

The full-scale value for voltage programming depends on the selected operating mode. In AC and AC+DC modes, 10V input represents 300Vac RMS. In DC mode, ± 10 V input represents ± 425 Vdc.

For frequency programming, 0V represents 15Hz while 10V represents 1200Hz.

These analog inputs are all disabled by default. In order to use this feature, each analog input has to be assigned to an AGX parameter and phase, for example AC voltage of phase A.

7.3.10.2 Programming Analog Inputs

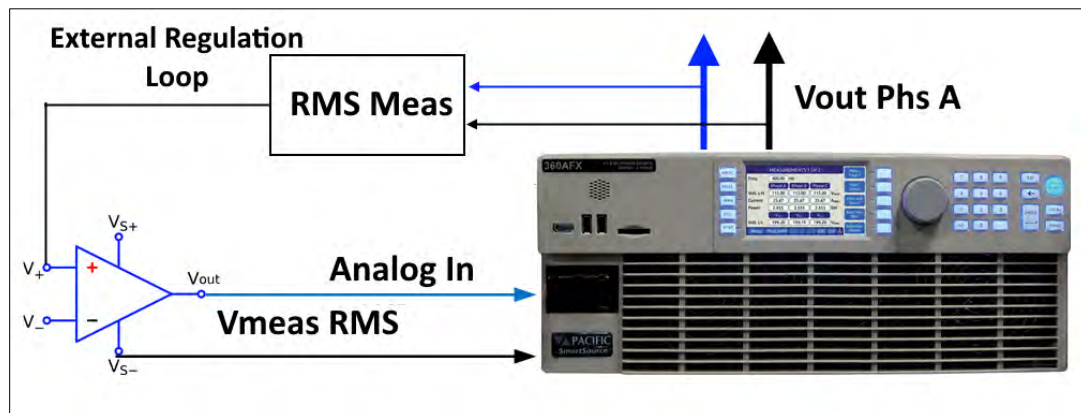
The range of the analog inputs can be changed with two parameters for each input, gain and offset. For example if an input is assigned to AC voltage programming the default gain is 300V and the offset is 0V. This means that 10V at the analog input port represents a programmed voltage of 300Vrms and 0V represents 0Vrms.

Different gain and offset combinations can be used to customize the range of the analog programming input, being the “gain” the programmed value that represents the maximum input at the analog port, and “offset” the value at 0V. For example, a gain of 150V and offset of 50V produce an output of 50V to 200V for analog programming signals of 0V to 10V.

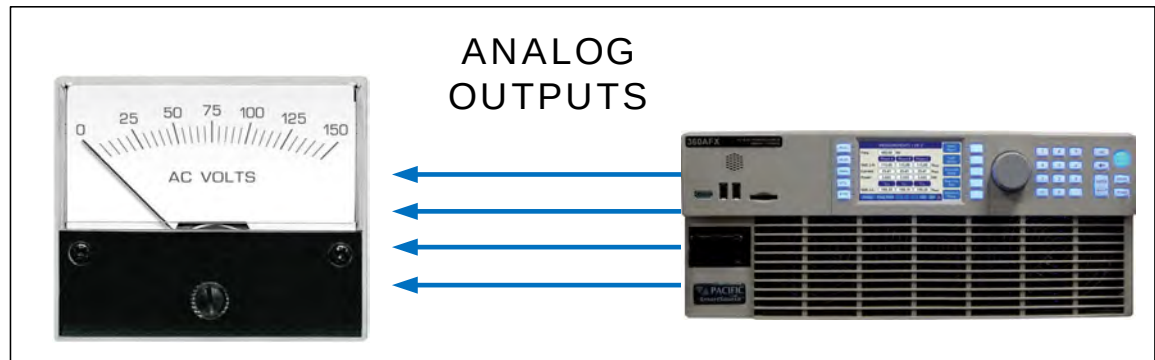
Note: Different AGX parameters have different units (Volts, Amperes, Watts, Hertz, etc.), so when an analog input parameter is changed, the gain and offset are reset to default values (zero for offset and max full-scale values for gain).

External RMS Regulation Loop Function

The analog input may be used to regulate the Voltage (in voltage source mode) or Current (in current source mode) based on customer provided measured signals to obtain voltage or current regulation feedback loops. This external input regulation loop is updated at 100 msec intervals and will adjust output RMS voltage or RMS current based on this customer provided analog input signal. The end user is responsible for providing the required feedback signals to this analog input. (Reference MOD 24018)



7.3.10.3 Analog Outputs



Analog outputs are available to monitor output values for voltage, current or power using external measurement equipment. A total of four analog outputs are provided, with an output voltage range of 0 to 5V. Output scaling is fully programmable for each measurement with an offset and gain.

For example, for RMS voltage measurements the default gain is 300V and offset is 0V. This means that measurements of 0 to 300V generate monitoring voltages of 0 to 5V. An offset of 50V and a gain of 150V will mean that measurements in the range of 50 to 200V will be mapped to the analog output range of 0 to 5V.

Analog outputs are available to monitor output values for voltage, current or power using external measurement equipment. A total of four analog outputs are provided. Output scaling is from 0 to 10V for zero to full scale.

Pin #	Signal	Programs
22	AO1	Volt RMS Measurements Phase A
23	AO2	Volt RMS Measurements Phase B
24	AO3	Volt RMS Measurements Phase C
25	AO4	Total Power (all phases combined)

Table 7-3: Default Analog Output Functions

7.3.11 Analog Input Modes

The analog inputs support the following operating modes:

- Input off – Input disabled. In this mode, these same inputs may be used for level input programming per section 7.8.1, “Analog Inputs”, see page **Error! Bookmark not defined.**
- Amplifier mode (AUX)– Fixed gain AC amplifier Mode
- Amplitude Modulation (AM) – Internal waveform amplitude is modulated with external analog signal.
- Analog Summing node (ADD) – Adds external input and internal waveform.

The gain of the analog input (one for each phase on three phase models) is as follows:

For AUX and ADD modes:

$$10V \text{ input} = 250V \times \text{xfmr-ratio} \quad (\text{Same gain as PPS AMX Series})$$

For AM mode:

$$\text{Gain} = 1.0$$

Each mode is explained in more detail below.

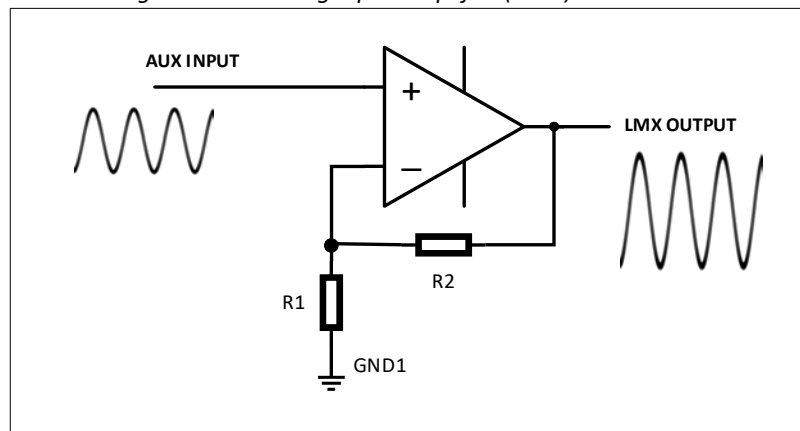
7.3.11.1 Analog Input OFF

If no external input signal is used or no signal, it is best to turn these inputs off in case any unintended noise pickup on these inputs affects the internal waveform.

7.3.11.2 Amplifier Mode (AUX)

In amplifier mode, any analog AC input signal is amplified by the LMX amplifier(s). Internal programming references are ignored and the output amplitude is a fixed ratio time the input signal amplitude. Signal input range is $\pm 10V_{pk}$.

Figure 7-10: Analog Input Amplifier (AMP) Mode



Frequency of the input signal must be controlled by the user to not exceed the maximum output frequency at full-scale voltage.

Note: Internal regulation functions based on the LMX controller such as CSC mode are not in effect in this mode of operation.

7.3.11.3 Amplitude Modulation Mode (AM)

In AM mode, the internal control waveform amplitude is modulated by the external input signal. The signal input range is $\pm 10\text{Vpk}$ and gain is 1.0 so max modulation depth is proportional to the analog input signal amplitude.

The AM formula is:

$$\text{Output} = \text{Reference} (\text{Offset} + \text{Gain} * \text{Input})$$

Where:

- Output: Power stage output
- Reference: Internal power supply reference generated based on the setpoints (freq, volt, phase, etc.) and arbitrary waveform
- Offset: Analog programming/input offset setting
- Gain: Analog programming/input gain setting
- Input: Input signal in volts (unipolar)

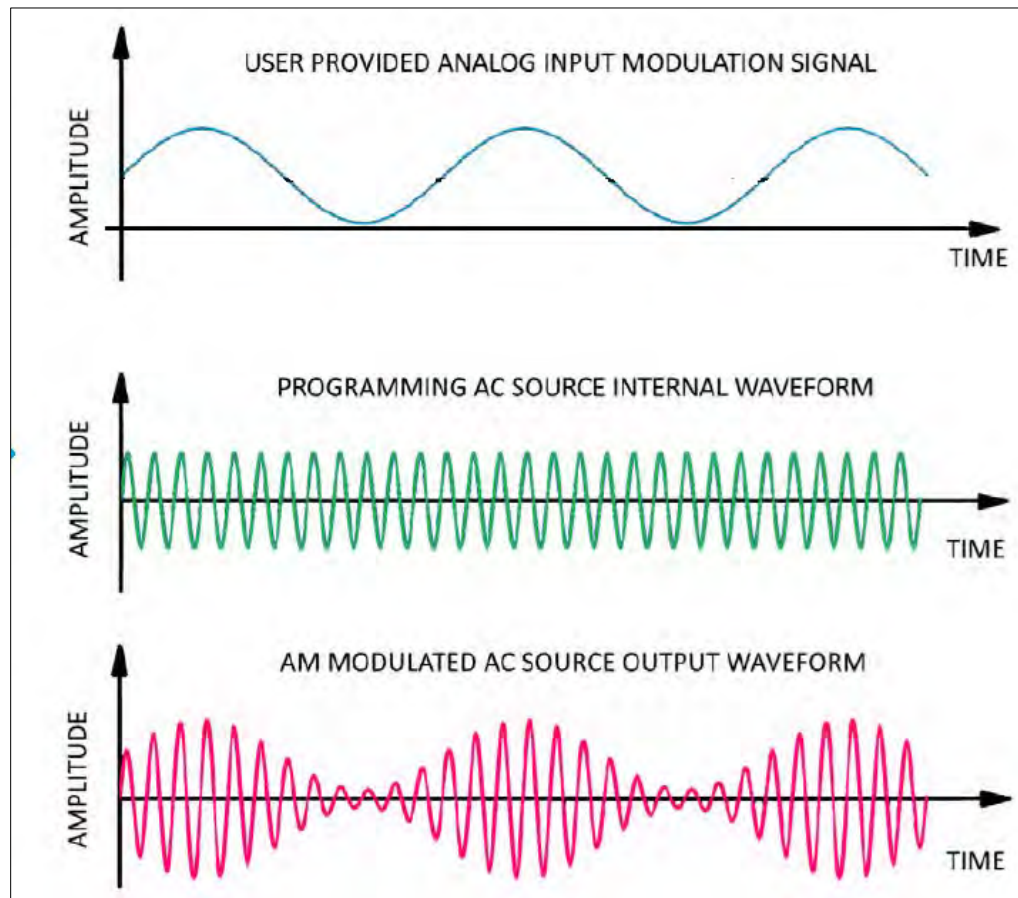


Figure 7-11: Analog Input Amplitude Modulation (AM) Mode

7.3.11.4 Analog Addition Mode (ADD)

In ADD mode, the external input signal is summed with the internal waveform reference and the sum of both signals is produced at the output of the LMX.

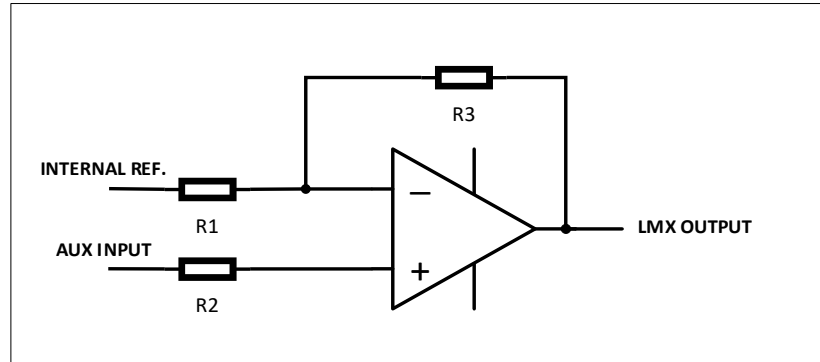


Figure 7-12: Analog Input ADD (Summation) mode

7.3.12 12V DC Power Supply

A pin in the DB25 port provides a current limited, regulated 12V supply. The maximum current capability is 0.5Adc.

There are no menus or commands associated with this output, as it is always active.

7.3.13 RS232 Description

The Tx and Rx signal on the AUX I/O connector may be used to connect to a serial port. Only Xon/Xoff handshake mode is supported on this RS232 port. For most situations, it is recommended to use the USB Device port for remote serial control applications.

7.3.14 External Feedback for Regulation of Voltage or Current

The feature provides the possibility of closing an “RMS loop” using Aux I/O analog inputs at. By connecting voltage or current sensor output to one of the analog inputs, the power source can use these signals to regulate the RMS value of its output. This is similar to the standard remote sensing but it works at an RMS level using a 100ms update window (10 Hz) and can be used for either voltage or current regulation depending on selected operating mode, voltage or current source mode. This feature is particularly useful to regulate the secondary side of an external output transformer that provides output voltages that exceed the normal voltage sense input levels of the power source. The next two figures illustrate the required setup for either voltage source or current source modes of operation respectively.

7.3.14.1 Voltage Mode Secondary Voltage Measurement Feedback

To use voltage mode, set the source to Voltage Source mode and connect a voltage signal to analog inputs 1, 2, 3 for each respective phase for three phase configurations or just input 1 for a single phase configuration. Refer to Figure 7-10 on the next page.

Next, the input must be programmed for the correct scaling as the max input accepted is 10V peak. To configure for voltage mode, send the following SCPI command from the power source home page using a web browser.

SYST:XFMRRATIO:EXT

RATIO,Gva,Gvb,Gvc,Ova,Ovb,Ovc,0,0,0,0,0,MAX_VOLT_RMS,MAS_CURR_RMS,MIN_FREQ,MAX_FREQ,DEF_XFMR

Where:

1. RATIO is N_s/N_p , it is higher than 1 if the transformer amplifies voltage
2. Gvx are the gains to convert the analog input from volts at the AUX to measurement volts at the secondary
3. Ovx are the offset to adjust any drift on the conversion for each phase, A, B and C.
4. MAX_VOLT_RMS is the maximum voltage RMS that the transformer produces at the secondary side
5. MAX_VOLT_CURR is the maximum current RMS that the transformer produces at the secondary side
6. MIN_FREQ is the minimum frequency in Hz that the transformer supports
7. MAX_FREQ is the maximum frequency in Hz that the transformer supports
8. DEF_XFMR if you want it to default to transformer coupling

First, turn on with CSC disabled to verify the measurements are all correct. Then set CSC gain to 1.05 and turn it on CSC mode to check the output regulates correctly. If that works fine, set the gain back to 1.15 or higher if needed.

CONTINUOUS SELF CALIBRATION	OFF
FAULT ON SATURATION	OFF
CONSTANT POWER	OFF
MAX CSC GAIN	1.05
APPLY CANCEL	

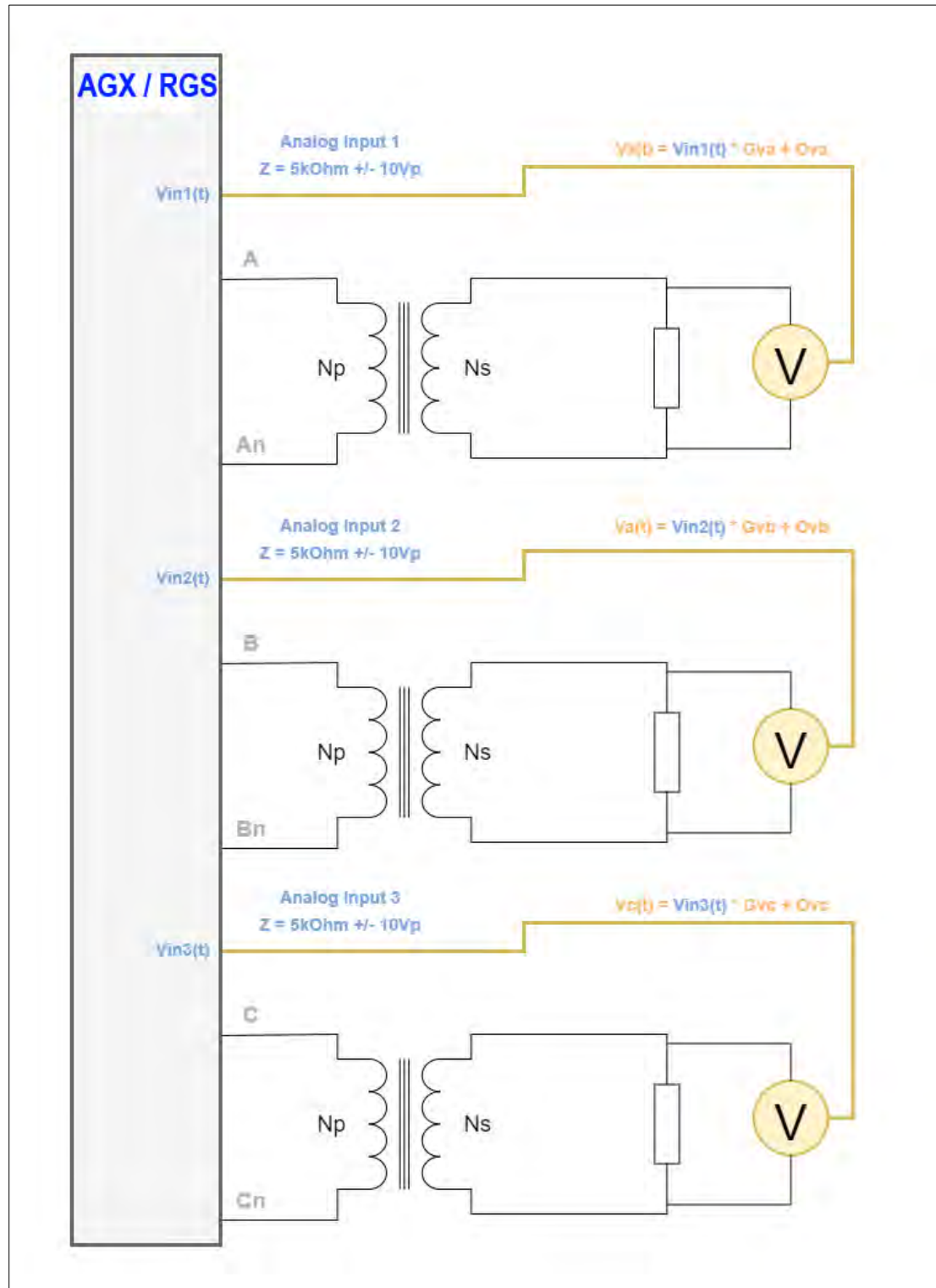


Figure 7-13: Analog IO Secondary Vsense Feedback diagram - Voltage 3 Phase

7.3.14.2 Current mode secondary current measurement feedback

To use current mode, set the source to Current Source mode and connect a voltage signal proportional to the current using a shunt resistor on the current sensor to analog inputs 1, 2, 3 for each respective phase for three phase configurations or just input 1 for a single phase configuration. Refer to Figure 7-11 on the next page.

Next, the input must be programmed for the correct scaling as the max input accepted is 10V peak. To configure for current mode, send the following SCPI command from the power source home page using a web browser.

SYST:XFMRRATIO:EXT

RATIO,0,0,0,0,0,0,Gia,Gib,Gic,Oia,Oib,Oic,MAX_VOLT_RMS,MAS_CURR_RMS,MIN_FREQ,MAX_FREQ,DEF_XFMR

Where:

1. RATIO is N_s/N_p , it is higher than 1 if the transformer amplifies voltage
2. Gvx are the gains to convert the analog input from volts at the AUX to measurement volts at the secondary
3. Ovx are the offset to adjust any drift on the conversion for each phase, A, B and C.
4. MAX_VOLT_RMS is the maximum voltage RMS that the transformer produces at the secondary side
5. MAX_VOLT_CURR is the maximum current RMS that the transformer produces at the secondary side
6. MIN_FREQ is the minimum frequency in Hz that the transformer supports
7. MAX_FREQ is the maximum frequency in Hz that the transformer supports
8. DEF_XFMR if you want it to default to transformer coupling

N_s/N_p is lower than 1 if the secondary is used to amplify current.

First, turn on with CSC disabled to verify the measurements are all correct. Then set CSC gain to 1.05 and turn it on CSC mode to check the output regulates correctly. If that works fine, set the gain back to 1.15 or higher if needed.

CONTINUOUS SELF CALIBRATION	CONTINUOUS SELF CALIBRATION	OFF
FAULT ON SATURATION	FAULT ON SATURATION	OFF
CONSTANT POWER	CONSTANT POWER	OFF
MAX CSC GAIN	105	APPLY CANCEL

Notes:

The unit can be sanitized and will not lose the settings.

The unit can be used in any mode with the transformer, but it will close the RMS loop when the mode matches.

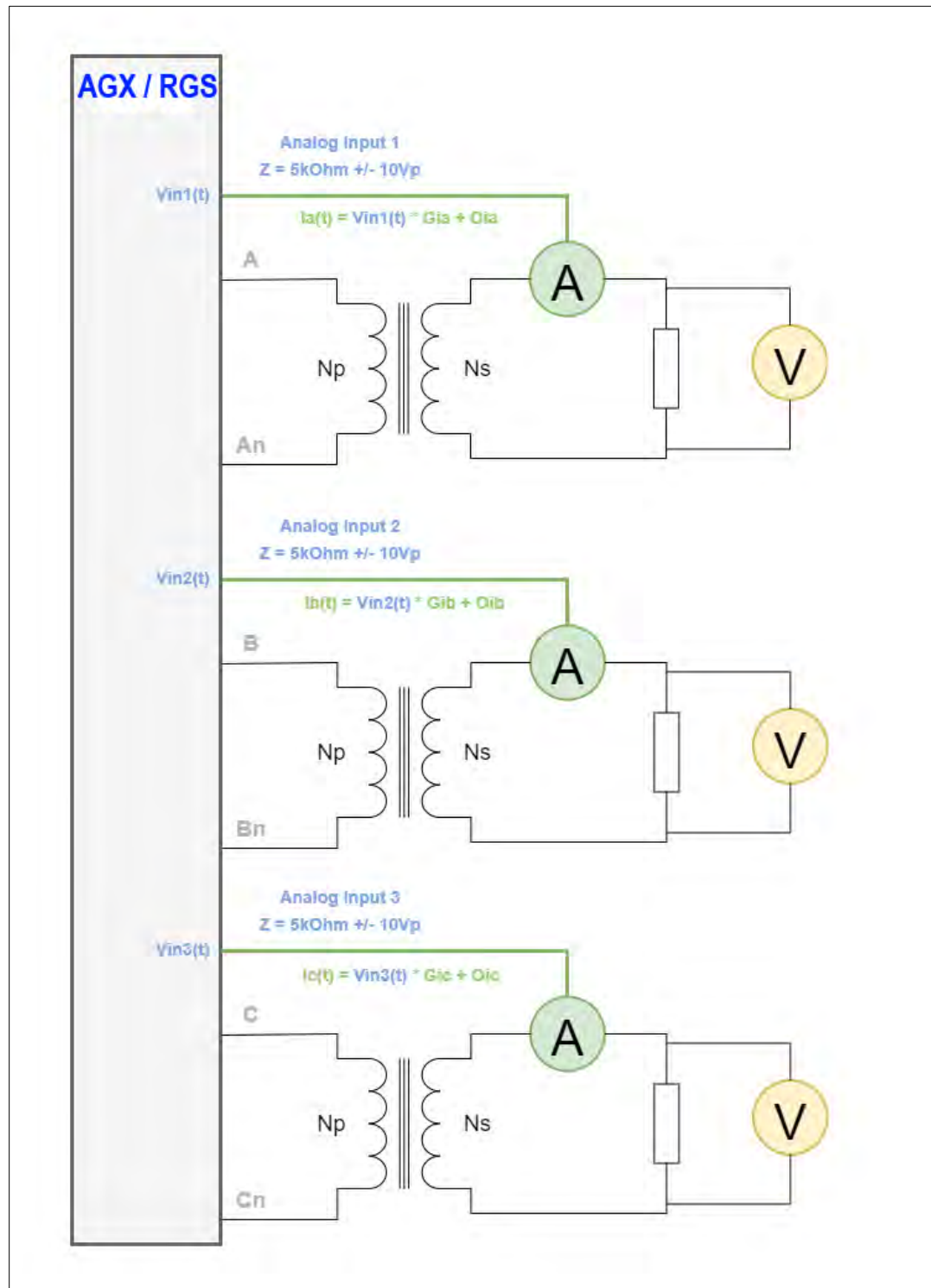


Figure 7-14: Analog IO Secondary Vsense Feedback diagram - Current 3 Phase

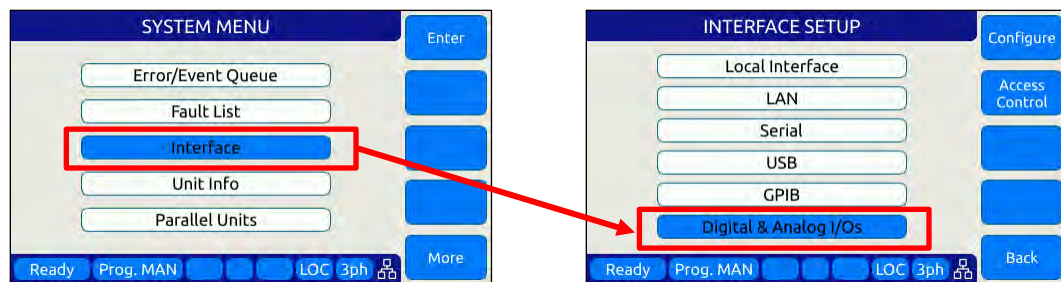
7.3.15 Front Panel Operation of AUX I/O Functions

The auxiliary I/O functions can be configured and programmed from the front panel using the SYSTEM menu (Press SYST key to left of the LCD screen). This section describes the available AUX I/O program screens and parameters for each function.

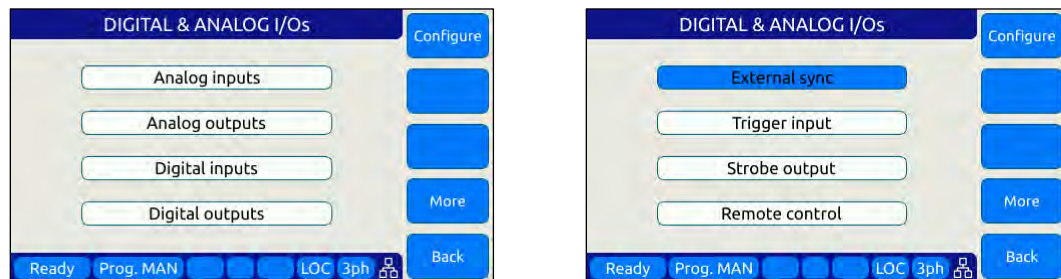
7.3.15.1 Accessing AUX I/O Screens.

From the SYSTEM MENU, scroll to the INTERFACE entry and press the shuttle or ENTER key as indicated below. If the Interface selection is not visible, press the “**More**” soft key to display the second System Menu screen.

Next, scroll to the “Digital & Analog I/Os” entry at the bottom of the INTERFACE SETUP screen.



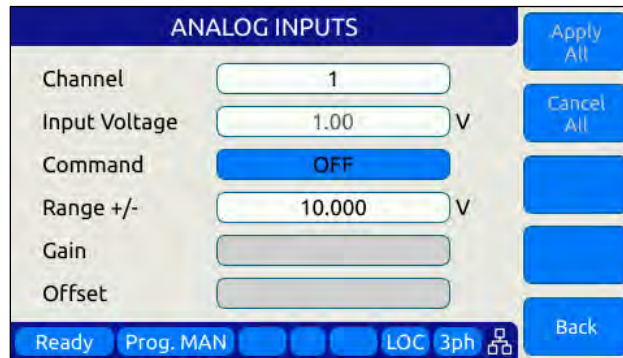
This will display a list of available Auxiliary I/O functions and features. To display the second of two DIGITAL & ANALOG I/Os screens, use the “**More**” soft key.



To select the desired function, use the knob to scroll up or down. Once selected, press the Shuttle knob or ENTER key to open the relevant I/O control screen.

Each screen is covered in the following sections in more detail.

7.3.15.2 Analog Inputs



Analog inputs allow parameters settings to be controlled using DC input signals. The parameter to be controller by each of four available analog inputs can be assigned from the front panel.

Available settings or read-outs and parameter ranges are:

- CHANNEL [1 | 2 | 3 | 4]
- INPUT VOLTAGE Displays read back voltage
- COMMAND Select command from dropdown list or OFF for none. See table below
- RANGE 0.0000 to 10.000 V
- GAIN Gain
- OFFSET Offset value

The **Command** parameter allows the user to assign the selected analog input to the parameter that will be controlled by it. The list of available commands for these inputs is shown below. **Note:** Some of these will require FW rev 5.6.4 or higher.

Analog Input Command Values						
VOLT:AC	VOLT:DC	CURR:AC	CURR:DC	FREQ	KVA:LIM	POW:LIM
VOLT:AC1	VOLT:DC1	CURR:AC1	CURR:DC1	PHAS2	KVA:LIM1	POW:LIM1
VOLT:AC2	VOLT:DC2	CURR:AC2	CURR:DC2	PHAS3	KVA:LIM2	POW:LIM2
VOLT:AC3	VOLT:DC3	CURR:AC3	CURR:DC3	OFF	KVA:LIM3	POW:LIM3
VOLT:LIM		CURR:LIM				
VOLT:LIM1		CURR:LIM1				
VOLT:LIM2		CURR:LIM2				
VOLT:LIM3		CURR:LIM3				

Table 7-4: AUX I/O Analog Input Assignable Commands

The Gain and Offset parameters can be used to scale and shift the input value to the desired range for min. and max. output.

For Load mode (AGX-L, RGS-L or RLS series), the following additional commands apply.

Analog Input Command Values Load Mode only			
LOAD:CR:RES:AC	LOAD:CR:CON:AC	LOAD:CP:POW:AC	LOAD:CP:KVA:AC
LOAD:CR:RES:AC1	LOAD:CR:CON:AC1	LOAD:CP:POW:AC1	LOAD:CP:KVA:AC1
LOAD:CR:RES:AC2	LOAD:CR:CON:AC2	LOAD:CP:POW:AC2	LOAD:CP:KVA:AC2
LOAD:CR:RES:AC3	LOAD:CR:CON:AC3	LOAD:CP:POW:AC3	LOAD:CP:KVA:AC3
LOAD:CR:RES:DC	LOAD:CR:CON:DC	LOAD:CP:POW:DC	LOAD:CP:KVA:DC
LOAD:CR:RES:DC1	LOAD:CR:CON:DC1	LOAD:CP:POW:DC1	LOAD:CP:KVA:DC1
LOAD:CR:RES:DC2	LOAD:CR:CON:DC2	LOAD:CP:POW:DC2	LOAD:CP:KVA:DC2
LOAD:CR:RES:DC3	LOAD:CR:CON:DC3	LOAD:CP:POW:DC3	LOAD:CP:KVA:DC3

Table 7-5: AUX I/O Analog Input Assignable Commands Load Mode only

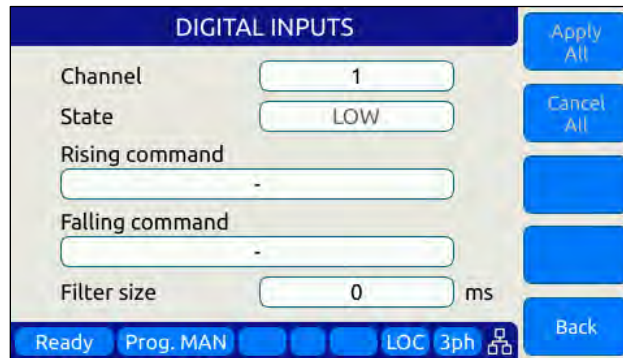
7.3.15.3 Analog Outputs

Analog outputs allow external equipment to monitor power source output values using an analog DC output signal. The assignment of measurement functions to each of four available outputs can be configured from the front panel.

Available settings are:

- CHANNEL [1 | 2 | 3 | 4]
- OUTPUT VOLTAGE Output setting
- MEASUREMENT Select measurement to be assigned to output
- RANGE 0.0000 to 5.000 V
- GAIN 0.000 to 1000
- OFFSET – 1000 to +1000

7.3.15.4 Digital Inputs

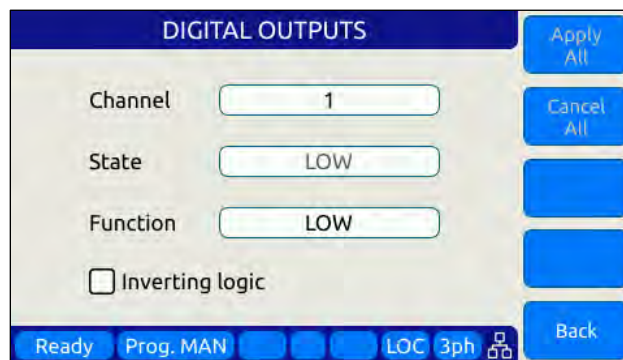


Digital Inputs allow external equipment such as PLCs. to control the power source operation. The assignment functions to each available input can be configured from the front panel.

Available settings are:

- CHANNEL [1 | 2 | 3]
- STATE Displays input state
- RISING CMD Set command string to execute on rising edge
- FALLING CMD Set command string to execute on falling edge
- FILTER SIZE 0 to 10,000,000 msec

7.3.15.5 Digital Outputs



Digital Outputs can be used to trigger or control external equipment. The events assignable to each digital output can be selected using the **Function** field.

Available settings are:

- CHANNEL [1 | 2 | 3 | 4]
- STATE Displays current state
- FUNCTION Assigns state to selected channel. Available states are:
- INV. LOGIC [ON | OFF] Reverses polarity

Events that can be assigned to digital outputs are listed in the table below and can be set using the **Function** field.

Digital Output Assignable Events		
EVENT	Description	Indication
FAULT	Output goes high on fault event	1 = Fault occurred, 0 = No Fault
FORM	Output FORM state	1 = SINGLE, 0 = SPLIT/THREE
HIGH	Fixed Output high	1 = ON
LOW	Fixed Output low	0 = OFF
OUTPUT STATE	Output Relay State	1 = ON (enabled), 0 = OFF (disabled)
PROGRAM	Output goes high when Program is selected	1 = Steady State Program, 0 = Manual mode
REMOTE	Output goes high when unit is in REMOTE state	1 = REMOTE state, -0 = LOCAL state
TRANSIENT	Output goes high when transient is running	1 = Running/Paused/Stepping, 0 = Stopped
XFMR_COUPLING	Indicates output coupling mode	1 = Transformer Coupled, 0 = Direct Coupled

Table 7-6: AUX I/O Digital Output assignable Events or Conditions

7.3.15.6 Polarity Selection for DO3 and DO4 vs DO1 and DO2

The two open drain outputs DO3 and DO4 have internal 1 kΩ pull-up resistors to +5.5V. These outputs can be used as regular digital outputs (open-drain type) if needed. However, the logic will be inverted because a “direct” logic for the relay drive means an “inverted” logic for the open drain output. The FET being on means the relay coil active, but with a pull-up the output goes to low.

DO3 and DO4 use direct logic for the relay drive, which means that if the inverting logic is not active and there is a “1” written to the digital output, an internal FET will be activated causing a “low” in the open drain output.

Each digital output can be configured to have separate inverting logic, so the user can configure these 2 to be inverting and have the normal direct logic when used as open-drain outputs.

7.3.15.7 External Sync

External sync is used to synchronize the power source's phase A output to an external frequency.

Available settings are:

- STATUS Display SYNC Status
- EXTERNAL SYNC [ON | OFF]
- SYNC SOURCE Select Sync source
- Available sync sources are:
 - External sync input on I/O connector
 - LINE (AC input to power source)
- PHASE SHIFT Offset Phase A angle
- SPEED 1.00 to 10.00
- RANGE 0.10 to 500 Hz
- EXTERNAL SYNC [ON | OFF]

7.3.15.8 Trigger Input

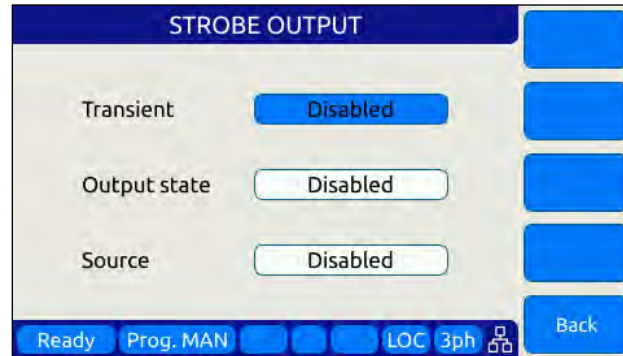
The External Trigger Input can be used to synchronize the power source's transient execution to external equipment. This

Available settings are:

- STATUS [ON | OFF] Enabled or disabled

- IMMEDIATE [ON | OFF] Ignore phase update setting if ON
- AUTORUN [ON | OFF] No RUN command required if ON

7.3.15.9 Strobe Output

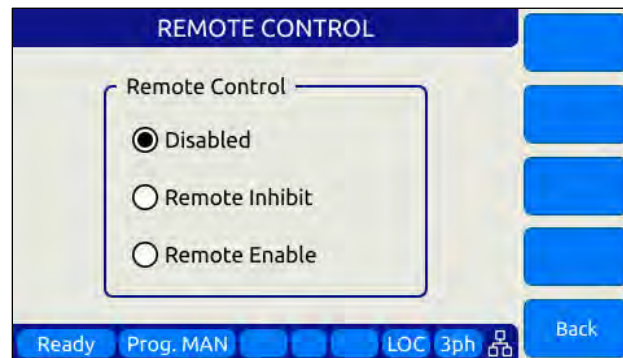


The Strobe Output is used to synchronize or trigger external equipment to an event occurring on the AC power source.

Available settings are:

- TRANSIENT ON = Strobe output on transient start
- OUTPUT STATE ON = Strobe output on relay close
- SOURCE ON = Strobe output on any program parameter change

7.3.15.10 Remote Control



The remote control input is used to control operation of the output relay.

Available settings are:

- DISABLED No remote output control
- REMOTE INHIBIT Contact closure needed to close output relay
- REMOTE ENABLE Contact closure or front panel can control output relay

See Section 6.8.5.6.

7.4 System Interface Bus Connectors



CAUTION

SHOCK HAZARD: DO NOT remove safety covers from the two System Interface DVI Connectors.



AVERTISSEMENT

RISQUE DE CHOC: NE PAS retirer les capots de sécurité des deux connecteurs d'interface DVI

The system interface bus is not user-accessible. It consists of two Digital Visual Interface (DVI-I dual link) connectors that are covered by a protective cover. There are no user accessible signals on the system interface bus. It is used for system configuration cabinet systems only.

8 Remote Control Programming

8.1 Overview

If your unit is fitted with a computer interface option then RS232, USB or LAN connector will be present on the rear panel based on the order configuration. The interface allows the power source settings to be configured remotely and measurement data to be retrieved for analysis and test report generation.

The front panel LOCAL key allows the user to restore LOCAL CONTROL unless the Bus controller has sent a LOCAL LOCKOUT (LLO) message. The Bus Controller may restore LOCAL CONTROL by sending a GOTO LOCAL (GTL) message.

8.1.1 Programming Conventions and Notations

The following conventions and notations are used in this section of the manual:

1. COMMANDS are shown in the left hand column in **BOLD** with NO underline.
2. Command DESCRIPTIONS appear in the right hand column.
3. SCPI is "Standard Commands for Programmable Instruments -1992". Refer to the SCPI 1992 standard for more information. The full standard publication is available from the IVI Foundation at <http://www.ivifoundation.org/>
4. Some SCPI keywords are optional, and are ignored by the device. Optional keywords are enclosed in [] brackets.
5. Lowercase letters of commands shown are also optional.
6. The SCPI standard requires uppercase text in all SCPI commands (start with :), however, the command parser is not case sensitive and will accept commands sent in lower case. It is recommended that programming formats follow the SCPI standard.
7. Some SCPI commands have query command counterparts as noted. A query command consists of the command with a question mark (?) appended at the end. Parameters cannot be sent with a query. IEEE-488.2 commands do not have query counterparts unless explicitly shown with a question mark appended.
8. IEEE488.2 common commands start with an asterisk (*) and are not case sensitive.
9. All required Functional Elements for devices are implemented.
10. All numerical values are ASCII encoded decimal strings consisting of 1 or more ASCII digits. 8 and 16 bit register values are binary weighted values represented by an ASCII string of 1 or more decimal digits. One exception, the Serial Poll byte, is an 8 bit hexadecimal byte.
11. Multiple Commands and Queries may be sent in one Program Message but each must be separated by a semicolon (;). The term 'Program Message' refers to one or more

commands and/or queries sent to the controller as one continuous string and is not to be confused with Stored Programs (1-99) within the controller.

12. Multiple data parameter names and values must be separated by commas.
13. Voltage and Waveform parameter names without a channel number suffix (1,2,3) may be used to set all 3 channels (phases) simultaneously, as an alternative to setting each separately to the same value.
14. Multiple keyword messages may be sent without duplicating the first level SCPI keyword i.e., SOURce).
e.g., :SOURce:VOLTage1,120; FREQuency 60 >> Space Char before parameters
Alternative allowed: :SOURce:VOLTage1,120; FREQuency,60 >> Comma
A keyword is a single word beginning with a colon (:).
15. Program Messages MUST be terminated with a LINE FEED (0Ahex, 10dec) or END (EOI) signal. This is referred to as an end-of-string <eos>. A Carriage Return character (0Dhex, 13dec) is converted to a LINE FEED by the power source. Further SCPI commands shall begin with a first level keyword (i.e.,:SOURce:).
16. All values shown in angle brackets <> are examples of real values used with commands but labels are sometimes used to indicate a variable which is not known until actual time of use. e.g., <AMPS meter range> might actually be <50>.
Units such as AAC, Hz. or % shown after the angle bracketed value are not to be included inside the value, but are shown as a reference to the units. The angle brackets are not part of the value.
17. The controller data input buffer is 8k bytes, as is its data output buffer. No program message may exceed this length.
18. All :SOURce: commands also support queries. An alternate method of writing or reading the presently active :SOURce:FORM, COUPLing, VOLTage, FREQuency, and CURRent:LIMit values is to use PROGram 0 (see examples). PROGram 0 contains the MANUAL MODE parameters.

NOTE: Sending any :SOURce: command invokes MANUAL MODE and REMOTE CONTROL.

19. Command strings may contain spaces.
20. The controller interface accepts IEEE-488.2 <nr1>, <nr2> and <nr3> numeric formats. Most query responses are <nr1> or <nr2> types. i.e., <nr1>=120, <nr2>=120.0, <nr3>=1.2E+02.
21. Follow any command (in the same Program Message) with *OPC to detect completion of the command or termination of a Transient event. An SRQ occurs when the command or Transient is complete (if ESB bit is set in SRE and OPC bit is set in ESE).
*OPC? may be used in the same manner.

8.1.2 Command Terminators

Allowable terminator characters are:

Character	ASCII	Dec value	Hex value
Carriage Return	<CR>	13	0x0d
Line Feed	<LF>	10	0x0a

8.2 Remote Control Command Descriptions by Subsystem

This section covers detailed description of the available commands by category. The following command categories are defined.

Command Subsystem	Description
CALIBRATE	These commands perform calibration functions
MEASURE	These commands are used to measure voltage, current, power and any other measurement parameters from the instrument.
OUTPUT	These command control the power source output
PROGRAM	These commands control programmed settings and transient segments
SENSE	These commands control the voltage sense modes
SOURCE	These commands are used to set instrument settings
STATUS	These commands are used to control or query status and error messages.
SYSTEM	These commands are used to control system level setting such as interfaces, special operating modes or other special instrument specific functions.

Table 8-1: Available SCPI Command Subsystems

8.3 Calibration Commands

Calibration commands allow for fully automated calibration of the power source.

Note: It is not recommended for the end user to use these command unless calibration must be automated. Any errors in using these commands could invalidate user calibration data. Pacific Power Source recommends the use of a competent and authorized calibration lab to perform routine calibration.

The following calibration commands are supported. Commands marked “UPC” are provided for backward compatibility with UPC controller based PPS power sources.

8.3.1 AGX Calibration Commands

Command Syntax	CALibrate:COEFFicients:OFFSET:VOLTage
Description	Calibrates output DC voltage offset to lowest possible level.
Parameters	None
Parameter Format	n/a
Example	CAL:OFFSET:VOLT
Command Syntax	CALibrate:COEFFicients:OFFSET:CURREnt
Description	Calibrates output DC current offset to lowest possible level
Parameters	None
Parameter Format	n/a
Example	CAL:OFFSET:CURREnt
Command Syntax	CALibrate:COEFFicients:NOISE:VOLTage
Description	Calibrates output voltage noise to lowest possible level.
Parameters	None
Parameter Format	n/a
Example	n/a
Command Syntax	CALibrate:COEFFicients:NOISE:CURREnt
Description	Calibrates output current noise to lowest possible level.
Parameters	None
Parameter Format	n/a
Example	n/a

Command Syntax	CALibrate:COEFFicients:GAIN:VOLTage[:AC] <cr>
Description	Loads values measured with an external DVM for calibration of AC voltage output and metering. The first 3 values are Voltages measured at the output relay of the power source for each phase. The second set of 3 values are Voltages measured at the external voltage sense points (at the load) for each phase.
Parameters	External reference voltage readings for each phase
Parameter Format	n/a
Example	n/a
Command Syntax	CALibrate:COEFFicients:GAIN:CURREnt[:AC] <cr>
Description	Loads values measured with an external shunt and DVM for calibration of AC current metering. The first 3 values are currents measured at the output of the power source for each phase.
Parameters	External reference current reading
Parameter Format	n/a
Example	n/a
Query Format	No
Returned Data Format	n/a
Query Example	n/a
Command Syntax	CALibrate:COEFFicients:GAIN:VOLTage:DC <cr>
Description	Loads values measured with an external DVM for calibration of DC voltage output and metering. The first 3 values are Voltages measured at the output relay of the power source for each phase. The second set of 3 values are Voltages measured at the EXternal Sense point (at the load) for each phase
Parameters	None
Parameter Format	n/a
Example	n/a
Command Syntax	CALibrate:COEFFicients:GAIN:CURREnt:DC <cr>
Description	Loads values measured with an external shunt and DVM for calibration of DC current metering. The first 3 values are currents measured at the output of the power source for each phase.
Parameters	None
Parameter Format	n/a
Example	n/a

Command Syntax	CALibrate:RESET
Description	Clears all calibration coefficients. Sending this command resets all calibration factors to defaults. After sending this command, programming and metering remains functional and will still meet spec.
Parameters	None
Parameter Format	n/a
Example	CAL:RESET
Query Format	CALibrate:COEFFicients:ALL?
Description	Returns all eighteen calibration factors as a comma delimited list.
Returned Data Format	<nr1>,...,<nr1>
Query Example	CAL:FACT:ALL? 0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
Command Syntax	CALibrate:UPDATE
Description	Transfers cal factors from XML Calibration file to NVM. Required only if calibration.xml has been modified. Alternatively, the unit can be power cycled.
Parameters	None
Parameter Format	n/a
Example	n/a

8.3.2 UPC Mode Specific commands.

Following commands are included for UPC compatibility mode only and don't perform any function other than providing query responses for use with legacy software programs.

Query Format	CALibrate:VALue:XFMRRATIO?
Query Format	CALibrate:VALue:AMPLIFIERS?
Command Syntax	CALibrate:KFACTORS <k_int_Va, k_int_Vb, k_int_Vc, k_ext_Va, k_ext_Vb, k_ext_Vc, k_la, k_lb, k_lc, k_oscA, k_oscB, k_oscC>
Query Format	CALibrate:KFACTors:ALL?

8.3.3 AUX I/O Interface Calibration Commands

For a list of AUX I/O calibration commands, see Section 8.12.4, "AUX I/O Calibration Command" on page 546.

8.4 Measurement Commands

Measurement commands are typically queries only and return power source measurement data values. This section is broken down into the commands for each measurement parameter.

The following measurement commands are supported.

8.4.1 Voltage Measurement Commands

Query Format	MEASure:VOLTage[:ACDC]#?
Description	Returns the measured RMS voltage for the selected phase #. If no phase number is specified, returns the reading for all phases.
Returned Data Format	<nr2>
Query Example	MEAS:VOLT:ACDC2? 230.0000
Query Format	MEASure:VOLTage:DC#?
Description	Returns the measured DC voltage for the selected phase #. If no phase number is specified, returns the reading for all phases.
Returned Data Format	<nr2>
Query Example	MEAS:VOLT:DC1? 2.2500
Query Format	MEASure:VOLTage:AC#?
Description	Returns the measured RMS voltage for the selected phase #. If no phase number is specified, returns the reading for all phases. This command is equivalent to “MEASure:VOLTage[:ACDC]#?” and is provided for backward compatibility with the UPC controllers.
Returned Data Format	<nr2>
Query Example	MEAS:VOLT:AC3? 230.0000
Query Format	MEASure:VLL#?
Description	Returns the measured RMS Line-to-Line voltage ¹ for the selected phase #. If no phase number is specified, returns the reading for all phases. Phase reference applies as follows: # = 1 V _{AB} , # = 2 V _{AC} , # = 3 V _{BC}
Returned Data Format	
Query Example	MEAS:VLL2? 398.3780

Note 1: Line to Line voltage measurements are calculated based on VLN and phase angles and are valid only for sinusoidal voltage waveforms with low levels of distortion and under balanced three phase load conditions. If these conditions are not met, an error message may result when sending the MEAS:VLL? Command. Available in Split or Three phase modes only.

8.4.2 Frequency Measurement Commands

Query Format	MEASure:FREQuency?
Description	Returns the fundamental frequency.
Returned Data Format	<nr2>
Query Example	MEAS:FREQ? 50.0000

8.4.3 Current Measurement Commands

Query Format	MEASure:CURRent[:ACDC]#?
Description	Returns the measured RMS current for the selected phase #. If no phase number is specified, returns the reading for all phases.
Returned Data Format	<nr2>
Query Example	MEAS:CURR:ACDC? 21.1587

Query Format	MEASure:CURRent:PEAK#[:ABSolute]?
Description	Returns the measured peak current value for the selected phase #. If no phase number is specified, returns the reading for all phases.
Returned Data Format	<nr2>
Query Example	MEAS:CURR:PEAK? 45.5845, 47.3213, 48,2234

Query Format	MEASure:CURRent:PEAK#[:ABSolute]:HOLD?
Description	Returns the measured peak hold current value for the selected phase #. If no phase number is specified, returns the reading for all phases. This reading accumulates the highest recorded absolute peak current until reset using the MEASure:CURRent:PEAK#:RESet command.
Returned Data Format	<nr2>
Query Example	MEAS:CURR:PEAK:HOLD? 58.5845, 57.3213, 58,2234

Query Format	MEASure:CURRent:PEAK#:MINimum?
Description	Returns the lowest measured peak current value for the selected phase #. If no phase number is specified, returns the reading for all phases.
Returned Data Format	<nr2>
Query Example	MEAS:CURR:PEAK:MIN? 1.0001, 0.8451, 0.4871

Query Format Description	MEASure:CURRent:PEAK#:MINimum:HOLD? Returns the lowest measured peak hold current value for the selected phase #. If no phase number is specified, returns the reading for all phases. This reading accumulates the lowest recorded absolute peak hold current until reset using the MEASure:CURRent:PEAK#:RESet command.
Returned Data Format Query Example	<nr2> MEAS:CURR:PEAK:MIN:HOLD? 1.0001, 0.8451, 0.4871
Query Format Description	MEASure:CURRent:PEAK#:MAXimum? Returns the highest measured peak current value for the selected phase #. If no phase number is specified, returns the reading for all phases.
Returned Data Format Query Example	<nr2> MEAS:CURR:PEAK:MAX? 45.5845, 47.3213, 48,2234
Query Format Description	MEASure:CURRent:PEAK#:MAXimum:HOLD? Returns the highest measured peak hold current value for the selected phase #. If no phase number is specified, returns the reading for all phases. This reading accumulates the highest recorded absolute peak hold current until reset using the MEASure:CURRent:PEAK#:RESet command.
Returned Data Format Query Example	<nr2> MEAS:CURR:PEAK:MAX:HOLD? 58.5845, 57.3213, 58,2234
Command Syntax Description	MEASure:CURRent:PEAK#:RESet This command resets all peak hold current readings for the selected phase # to zero. If no phase number is specified, returns the reading for all phases.to zero.
Parameters	None
Parameter Format Example	n/a MEAS:CURR:PEAK1:RES
Query Format Description	MEASure:CURRent:CREST#? Returns the measured current crest factor for the selected phase #. If no phase number is specified, returns the reading for all phases.
Returned Data Format Query Example	<nr2> MEAS:CURR:CREST1? 2.1544

Query Format	MEASure:CURRent:DC#?
Description	Returns the measured DC current for the selected phase #. If no phase number is specified, returns the reading for all phases.
Returned Data Format	<nr2>
Query Example	MEAS:CURR:DC1? 0.0000

Query Format	MEASure:CURRent:AC#?"
Description	Returns the measured RMS current for the selected phase #. If no phase number is specified, returns the reading for all phases. This command is equivalent to "MEASure:CURRent[:ACDC]#?" and is provided for backward compatibility with the UPC controllers.
Returned Data Format	<nr2>
Query Example	MEAS:CURR:AC1? 21.1587

8.4.4 Power Measurement Commands

Query Format	MEASure:POWer#?
Description	Returns the true power for the selected phase # in kW. If no phase number is specified, returns the reading for all phases.
Returned Data Format	<nr2>
Query Example	MEAS:POWer1? 4.4203

Query Format	MEASure:POWer:MAXimum:HOLD?
Description	Returns the highest total power reading obtained for all phases. The reset this track and hold value, use the MEASure:POWer:RESET command.
Returned Data Format	<nr2>, <nr2>, <nr2>
Query Example	MEAS:POW:MAX:HOLD? 4800.0000, 4780.0000, 4687.0000

Query Format	MEASure:POWer:MINimum:HOLD?
Description	Returns the lowest total power reading obtained for all phases. If this command returns a negative value, then power has been fed back into the power source. For non-regenerative power sources, the ability to absorb energy from the load is very limited and the unit may FAULT. The reset this track and hold value, use the MEASure:POWer:RESET command.
Returned Data Format	<nr2>, <nr2>, <nr2>
Query Example	MEAS:POW:MIN:HOLD? 200.0000, -190.0000, 230.0000

Command Syntax	MEASure:POWER:RESET
Description	Clear the track and hold MINimum and MAXimum power hold readings.
Returned Data Format	<nr2>
Query Example	MEAS:POWer1? 4.4203
Query Format	MEASure:KVA#?
Description	Returns the true apparent for the selected phase # in kVA. If no phase number is specified, returns the reading for all phases.
Returned Data Format	<nr2>
Query Example	MEAS:KVA1? 4.8665
Query Format	MEASure:PF#?
Description	Returns the true apparent for the selected phase # in kVA. If no phase number is specified, returns the reading for all phases.
Returned Data Format	<nr2>
Query Example	MEAS:PF1? 0.9083

8.4.5 KWh Measurement Commands

Query Format	MEASure:KWHour#?
Description	Returns the accumulated energy measurement for the selected phase # in kWh. If no phase number is specified, returns the total summed kWh for all phases.
Returned Data Format	<nr2>
Query Example	MEASure:KWHour? 12.4203
Command Syntax	MEASure:KWHour:RESET
Description	This command resets all energy measurements to zero and resets the time counter.
Parameters	None
Parameter Format	n/a
Example	MEAS:KWH:RESET
Query Format	MEASure:KWHour:ETIME?
Description	This command returns the accumulated energy measurement time in seconds.
Returned Data Format	<nr2>
Query Example	MEAS:KWH:ETIM? 120.5

Command Syntax	MEASure:KWHour[:STATe]
Description	This command enables or disables the KWh measurements. When enabled, the energy time counter starts till reset with the MEASure:KWHour:RESET command.
Parameters	< 1 ON 0 OFF >
Parameter Format	
Example	MEAS:KWH ON
Query Format	MEASure:KWHour[:STATe]?
Description	The query format of this command returns the setting of the KWh measurement as either 1 (ON) or 0 (OFF).
Returned Data Format	<nr1>
Query Example	MEAS:KWH? 1

8.4.6 Other Measurement Commands

Query Format	MEASure:TEMPerature:AMBient?
Description	Returns the ambient temperature of the power source in degrees celcius.
Returned Data Format	<nr1>
Query Example	MEAS:TEMP:AMB? 24

Query Format
Description

MEASure:ALL#?

Returns list of parametric measurements for the selected phase # as a comma delimited string. The # is used to specify phase A, B or C using 1, 2 or 3 respectively. If phase reference is omitted, measurement data for all three phases is returned as one single string.

MEAS:ALL#? return all measurements, a new firmware can add more measurements. It is possible for the number of responses to change after a firmware update/downgrade, so the return order is not warranted. To ensure compatibility, it is recommended to pass as an argument the measurements needed, the number of responses, and the order will be warranted in future versions. Available measurements are returned in the catalog command.

Example: *>MEAS:ALL1? "FREQUENCY,VOLT L-L RMS (ACDC),VOLT L-L RMS (AC)"*
60.000,0.000,0.000

For two or three phase modes, the use of the phase parameter is recommended.

MEAS:ALL1?;;MEAS:ALL2?;;MEAS:ALL3?

Returned fields will be separated with “,” and phase responses with “;”. Example (22 x 3 = 66):

MEAS:ALL1?;;MEAS:ALL2?;;MEAS:ALL3?
60.000,0.000,.....,0.0000,0.0;60.000,0.000,.....,0.0000,0.0;
60.000,0.000,.....,0.0000,0.0;

Value order for each phase is as shown in the table below as: position, :parameter, (unit) on next page.

	In Three or Split Phase mode //	In Single Phase mode
	FREQUENCY	FREQUENCY
	VOLT L-L RMS (ACDC)	VOLT L-N RMS (ACDC)
	VOLT L-L RMS (AC)	VOLT L-N RMS (AC)
	VOLT L-L DC	VOLT L-N DC
	VOLT L-N RMS (ACDC)	CURRENT RMS (ACDC)
	VOLT L-N RMS (AC)	CURRENT RMS (AC)
	VOLT L-N DC	CURRENT DC
	CURRENT RMS (ACDC)	PEAK CURRENT
	CURRENT RMS (AC)	PEAK CURRENT RECORDED
	CURRENT DC	POWER
	PEAK CURRENT	APP POWER
	PEAK CURRENT RECORDED	POWER FACTOR
	POWER	CURRENT CF
	APP POWER	CURRENT PHASE SHIFT
	POWER FACTOR	DISPLACEMENT FACTOR
	CURRENT CF	DISTORTION FACTOR
	CURRENT PHASE SHIFT	WATT-HOUR
	DISPLACEMENT FACTOR	WATT-HOUR ELAPSED TIME
	DISTORTION FACTOR	
	WATT-HOUR	
	WATT-HOUR ELAPSED TIME	
Returned Data Format	<nr2>,<nr2>,...,<nr2>,<nr2>	
Query Example	MEAS:ALL1? 50.000,208.644,208.644,0.107,295.321,- 298.405,120.466,120.466,0.004,0.000,-170.714,- 172.893,0.032,0.001,-0.032,0.000,- 0.038,0.000,0.0000,0.0038,0.000,0.000,0.031,0.000,0.000,0.000,0.000 ,0.0000,1001.6,-427477229,50.000,208.555,208.555,-0.135,-295.242,- 298.868,120.453,120.453,-0.010,0.000,-170.828,- 172.951,0.027,0.001,-0.027,0.000,- 0.032,0.000,0.0000,0.0033,0.000,0.000,0.024,0.000,0.000,0.000,0.000 ,0.0000,1001.6,-427477229,50.000,208.635,208.635,0.028,295.250,- 299.160,120.408,120.408,-0.014,0.000,-170.628,- 172.766,0.032,0.001,-0.032,0.000,- 0.039,0.000,0.0001,0.0039,0.000,0.000,0.025,0.000,0.000,0.000,0.000 ,0.0000,1001.6,-427477229	
Query Format	MEASure:ALL:CATALOG?	
Description	Returns a comma-separated human-readable list of available measurements in the same order as the command returns it. See MEASure:ALL#? Command for parameter list as a function of Firmware revision.	

Query Format	MEASure:ALL#? <OPTIONAL: List of measurements to return>
Description	Same as MEASure:ALL#? Command with optional user specified parameters list. Query command returns measurement parameters as included in list in the order they are specified by the list.

8.4.7 Measurement Data Logging Commands

Command Syntax	MEASure:LOGger:START
Description	Starts the logging of measurements process. The process consists of taking measurements and saving them in a file. The log file can be found in the “datalogger” folder and is a comma separated value format (.csv) file. Measurements will be taken while the output is enabled only.
Parameters	None
Parameter Format	n/a
Example	MEAS:LOG:START
Query Format	None
Command Syntax	MEASure:LOGger:STOP
Description	Stops the logging process that was started with MEASure:LOGger:START.
Parameters	None
Parameter Format	n/a
Example	MEAS:LOG:STOP
Query Format	None
Command Syntax	MEASure:LOGger:STATe?
Description	Returns the state of the measurement data logging process as a number as follows: 0 – Stopped 1 – Running 2 – Paused
Returned Data Format	<nr1>
Query Example	MEAS:LOG:STAT? 1

Command Syntax Description	MEASure:LOGger:LIMit <cr> Sets the number of samples to get. Once the logging process reach this limit it will stop.If the limit is set as OFF or 0 it will not stop unless MEAS:LOG:STOP is executed. The limit can be specified as a number of samples or in seconds if a character "S" is added to the number. If the limit is passed as seconds, the command will compute the number of samples based on the logging rate. The formula is: number of samples = seconds / rate. The rate can be set with: MEASure:LOGger:RATE <nr1> or queried with: MEASure:LOGger:RATE?.
Parameters	< OFF 0 > XS where X is a time limit in seconds X where X is the limit in number of samples
Parameter Format Examples	<cr> MEAS:LOG:LIM OFF MEAS:LOG:LIM 20S MEAS:LOG:LIM 100
Query Format	MEASure:LOGger:LIMit?
Returned Data Format	0
Query Example	MEAS:LOG:LIM? 10000
Command Syntax Description	MEASure:LOGger:FILELimit <nr1> Sets the limit of samples to save in the file. If the limit is reached and the logging process continues, a new file will be created.
Parameters	Limit in number of samples.
Parameter Format	<nr1>
Example	MEAS:LOG:FILEL 100
Query Format	MEASure:LOGger:FILELimit?
Returned Data Format	<nr1>
Query Example	MEAS:LOG:FILEL? 10000
Command Syntax Description	MEASure:LOGger:FILENAME <cr> Sets the data logging file name
Parameters	Filename between double quotes
Parameter Format	<cr>
Example	MEAS:LOG:FILEN "Measurement-AC+DC"
Query Format	MEASure:LOGger:FILENAME?
Returned Data Format	<cr>
Query Example	MEAS:LOG:FILEN? Measurement-AC+DC

Command Syntax	MEASure:LOGger:MEMory <cr>
Description	Select the memory where the logging files will be saved. By default it is RAM unless a memory stick or USB drive was inserted and selected with this command: MEAS:LOG:MEM:CAT? can be used to get the available memories. Memory name between double quotes.
Parameters	<cr>
Parameter Format	MEAS:LOG:MEM "USBA"
Example	MEASure:LOGger:MEMory?
Query Format	<cr>
Returned Data Format	MEAS:LOG:MEM?
Query Example	USBA
Query Format	MEASure:LOGger:MEMory:CATalog?
Description	Returns the catalog of available memory names.
Returned Data Format	<cr>
Query Example	MEAS:LOG:MEM:CAT? RAM, USBA
Command Syntax	MEASure:LOGger:RATE
Description	Sets the frequency at which the logging process will take measurements.
Parameters	Frequency in Hz. Range is 1 Hz through 10 Hz.
Parameter Format	<nr1>
Example	MEAS:LOG:RATE 5
Query Format	MEASure:LOGger:RATE?
Returned Data Format	<nr1>
Query Example	MEAS:LOG:RATE? 5
Command Syntax	MEASure:LOGger:TIMEstamp <cr>
Description	Sets the time stamp format that will be attached to every measurement record in the measurement log file.
Parameters	< DATE 0 TIME 1 ALL 2 >
Parameter Format	<cr>
Example	MEAS:LOG:TIME ALL
Query Format	MEASure:LOGger:TIMEstamp?
Returned Data Format	<nr1>
Query Example	MEAS:LOG:TIME? 2

8.4.8 Waveform Capture Commands

Waveform capture commands may be used to retrieve time domain voltage and current waveform captures similar to those of a digital oscilloscope.

Query Format	FETCH:WAVEform:VOLTage#?
Description	Returns time domain data for voltage on selected phase #. # = 1, 2 or 3. Returns a string of <nr2> type numbers, comma delimited. Only a single waveform may be queried in a command. Note: In UPC Compatibility mode, a total of 512 data points are returned. In AGX mode, 1024 data points are returned.
Returned Data Format	<nr2>, <nr2>, <nr2>....., <nr2>
Query Example	FETCH:WAVE:VOLT1? 0.000, 0.0001, 0.0003....., 0.000
Query Format	FETCH[:WAVEform]:VLL#?
Description	Returns time domain data for voltage on selected Line to Line voltage #. # = 1, 2 or 3. Returns a string of <nr2> type numbers, comma delimited. Only a single waveform may be queried in a command. Note: In UPC Compatibility mode, a total of 512 data points are returned. In AGX mode, 1024 data points are returned.
Returned Data Format	<nr2>, <nr2>, <nr2>....., <nr2>
Query Example	FETCH:WAVE:VLL1? 0.000, 0.0001, 0.0003....., 0.000
Query Format	FETCH:WAVEform:CURREnt#?
Description	Returns time domain data for current on selected phase #. # = 1, 2 or 3. Returns a string of <nr2> type numbers, comma delimited. Only a single waveform may be queried in a command. Note: In UPC Compatibility mode, a total of 512 data points are returned. In AGX mode, 1024 data points are returned.
Returned Data Format	<nr2>, <nr2>, <nr2>....., <nr2>
Query Example	FETCH:WAVE:CURREnt? 0.000, 0.0001, 0.0003....., 0.000
Query Format	FETCH:WAVEform:INFO?
Description	Returns the output measurement frequency, date and time of capture for the last waveform data fetched.
Returned Data Format	<nr2>, <dd/mm/yyyy>, <hh:mm:ss>
Query Example	FETCH:WAVE:INFO? 400.000, "05/21/2018", "14:34:20"

Query Format	FETCH:WAVEform:PERIOD?
Description	Returns the number of periods captured. Minimum period is 1, max no. of periods is 4.
Returned Data Format	<nr2>, <dd/mm/yyyy>, <hh:mm:ss>
Query Example	FETCH:WAVE:PERIOD? 400.000, "05/21/2018", "14:34:20"
Query Format	FETCH:WAVEform:START <nr1>, <nr2>
Description	Sets the number of waveform sample datapoints to return by the FETCH:WAVEform:VOLTage#? And . FETCH:WAVEform:CURRent#? Commands. Note: Send the START command before the FETCH command(s).
Parameters	<n1> = 0 1 2 0 = Apply to voltage waveforms only 1 = Apply to current waveforms only 2 = Apply to Voltage and Current waveforms both <n2> = number datapoints returned by FETC:WAVE:VOLT? And FETC:WAVE:CURR? commands.
Returned Data Format	<nr2>, <nr2>, <nr2>,....., <nr2>
Query Example	FETCH:WAVE:START 2,512 FETCH:WAVE:VOLT#? 512 FETCH:WAVE:CURR#? 512

8.4.9 Harmonic Measurements Commands

Harmonic Measurements commands may be used to retrieve harmonic analysis data for voltage and current. These measurements are returned using the SPECTrum commands.

Query Format	MEASure:SPECTrum:VOLTage#[:MAGnitude]?
Description	Returns harmonics spectrum for voltage on selected phase #. # = 1, 2 or 3. Returns a data set of 51, <nr2> type numbers, comma delimited. The 1 st element is the magnitude of the fundamental, for reference. The 2 nd element is the 2 nd harmonic, etc. Values represent % of fundamental (relative). Only a single spectrum may be queried in a command.
Returned Data Format	<nr2>, <nr2>, <nr2>,....., <nr2>
Query Example	MEAS:SPECT:VOLT1? 100.000, 0.001, 0.3...., 0.000

Query Format Description	MEASure:SPECTrum:VLL#[:MAGnitude]? Returns harmonics spectrum for three phase Line to Line voltage on selected phase #. # = 1, 2 or 3 (1 = Vab, 2 = Vbc, 3 = Vac). Returns a VLL data set of 51, <nr2> type numbers, comma delimited. The 1st element is the magnitude of the fundamental, for reference. The 2nd element is the 2nd harmonic, etc. Values represent % of fundamental (relative). Only a single spectrum may be queried in a command.
Returned Data Format Query Example	<nr2>, <nr2>, <nr2>,....., <nr2> MEAS:SPECT:VLL1? 207.000, 0.001, 0.3...., 0.000
Query Format Description	MEASure:SPECTrum:VLL#:ABSolute? Returns absolute harmonics spectrum for three phase Line to Line voltage on selected phase #. # = 1, 2 or 3 (1 = Vab, 2 = Vbc, 3 = Vac). Returns a VLL data set of 51, <nr2> type numbers, comma delimited. The 1st element is the magnitude of the fundamental, for reference. The 2nd element is the 2nd harmonic, etc. Values represent % of fundamental (relative). Only a single spectrum may be queried in a command.
Returned Data Format Query Example	<nr2>, <nr2>, <nr2>,....., <nr2> MEAS:SPECT:VLL1:ABS? 207.000, 0.001, 0.3...., 0.000
Query Format Description	MEASure:SPECTrum:CURRent#[:MAGnitude]? Returns harmonics spectrum for current on selected phase #. # = 1, 2 or 3. Returns a data set of 51, <nr2> type numbers, comma delimited. The 1st element is the magnitude of the fundamental, for reference. The 2nd element is the 2nd harmonic, etc. Values represent % of fundamental (relative). Only a single spectrum may be queried in a command.
Returned Data Format Query Example	<nr2>, <nr2>, <nr2>,....., <nr2> MEAS:SPECT:CURR1? 4.6300, 0.001, 0.23...., 0.000

Command Syntax	MEASure:SPECTrum:PHASe:REfERENCE
Description	This command sets the phase reference for the harmonic analysis measurement function.
Parameters	Available settings are: 0 None. 1 (DEFAULT) All phases measurements are referenced to phase A voltage. 2 Voltage and current phases measurements are referenced to the voltage of the same phase (A, B or C) 3 Voltage phase measurements are referenced to the voltage of the same phase (A, B or C). Current phase measurements are referenced to the current of the same phase (A, B or C)
Parameter Format	<nr1>
Example	MEAS:SPECT:PHAS:REF 2
Query Format	MEASure:SPECTrum:PHASe:REfERENCE?
Returned Data Format	<nr1>
Query Example	MEAS:SPECT:PHAS:REF? 2
Query Format	MEASure:SPECTrum:PHASe?
Description	Returns phase angles in degrees for the most recent voltage or current spectrum query. Returns a data set of 51, <nr2> type numbers, comma delimited. The 1 st element is the phase angle of the fundamental, for reference. The 2 nd element is the phase angle of the 2 nd harmonic, etc.
Returned Data Format	<nr2>, <nr2>, <nr2>,....., <nr2>
Query Example	MEAS:SPECT:PHAS? 0.000, 20.000, 30.000....., 0.000
Query Format	MEASure:SPECTrum:VOLTage#:PHASe?
Description	Same as "MEASure:SPECTrum:PHASe?" but selects voltage and phase #. Returns phase angles in degrees for the most recent voltage spectrum query. Returns a data set of 51, <nr2> type numbers, comma delimited. The 1 st element is the phase angle of the fundamental, for reference. The 2 nd element is the phase angle of the 2 nd harmonic, etc.
Returned Data Format	<nr2>, <nr2>, <nr2>,....., <nr2>
Query Example	MEAS:SPECT:VOLT1:PHAS? 0.000, 20.000, 30.000....., 0.000

Query Format Description	MEASure:SPECTrum:VLL#:PHASe? Same as "MEASure:SPECTrum:PHASe?" but selects Line to Line voltage and phase #. Returns phase angles in degrees for the most recent voltage spectrum query. Returns a data set of 51, <nr2> type numbers, comma delimited. The 1 st element is the phase angle of the fundamental, for reference. The 2 nd element is the phase angle of the 2 nd harmonic, etc.
Returned Data Format Query Example	<nr2>, <nr2>, <nr2>,....., <nr2> MEAS:SPECT:VLL1:PHAS? 0.000, 20.000, 30.000....., 0.000
Query Format Description	MEASure:SPECTrum:CURREnt#:PHASe? Same as "MEASure:SPECTrum:PHASe?" but selects current and phase #. Returns phase angles in degrees for the most recent current spectrum query. Returns a data set of 51, <nr2> type numbers, comma delimited. The 1 st element is the phase angle of the fundamental, for reference. The 2 nd element is the phase angle of the 2 nd harmonic, etc.
Returned Data Format Query Example	<nr2>, <nr2>, <nr2>,....., <nr2> MEAS:SPECT:CURR:PHAS? 0.000, 20.000, 30.000....., 0.000
Query Format Description	MEASure:SPECTrum:THD? Returns Total Harmonic Distortion of the most recent :MEASure:SPECTrum:parameter command
Returned Data Format Query Example	<nr2> MEAS:SPECT:THD? 2.5600
Query Format Description	MEASure:SPECTrum:VOLTage#:THD? Same as "MEASure:SPECTrum:THD?" but selects voltage and phase #.Returns Total Harmonic Distortion of the selected phase voltage.
Returned Data Format Query Example	<nr2> MEAS:SPECT:VOLT1:THD? 2.5600
Query Format Description	MEASure:SPECTrum:VLL#:THD? Same as "MEASure:SPECTrum:THD?" but selects Line to Line voltage #.Returns Total Harmonic Distortion of the selected Line to Line voltage.
Returned Data Format Query Example	<nr2> MEAS:SPECT:VLL1:THD? 2.5600

Query Format Description	MEASure:SPECTrum:CURRent#:THD? Same as "MEAS:SPECTrum:THD?" but selects current and phase #.Returns Total Harmonic Distortion of the selected phase currebt.
Returned Data Format	<nr2>
Query Example	MEAS:SPECT:CURR1:THD? 2.5600
Query Format Description	MEASure:SPECTrum:EHD? Returns Even Harmonic Distortion of the most recent :MEASure:SPECTrum:parameter command
Returned Data Format	<nr2>
Query Example	MEAS:SPECT:EHD? 3.5690
Query Format Description	MEASure:SPECTrum:VOLTage#:EHD? Same as "MEAS:SPECTrum:EHD?" but selects voltage and phase #.Returns Even Harmonic Distortion of the selected phase voltage.
Returned Data Format	<nr2>
Query Example	MEAS:SPECT:VOLT1:EHD? 10.5891
Query Format Description	MEASure:SPECTrum:VLL#:EHD? Same as "MEAS:SPECTrum:EHD?" but selects Line to Line voltage #.Returns Even Harmonic Distortion of the selected Line to Line voltage.
Returned Data Format	<nr2>
Query Example	MEAS:SPECT:VLL1:EHD? 10.5891
Query Format Description	MEASure:SPECTrum:CURRent#:EHD? Same as "MEAS:SPECTrum:EHD?" but selects current and phase #.Returns Even Harmonic Distortion of the selected phase currebt.
Returned Data Format	<nr2>
Query Example	MEAS:SPECT:CURR1:EHD? 22.5948
Query Format Description	MEASure:SPECTrum:OHD? Returns Odd Harmonic Distortion of the most recent :MEASure:SPECTrum:parameter command
Returned Data Format	<nr2>
Query Example	MEAS:SPECT:OHD? 3.5690

Query Format	MEASure:SPECTrum:VOLTage#:OHD?
Description	Same as "MEAS:SPECTrum:OHD?" but selects voltage and phase #.Returns Odd Harmonic Distortion of the selected phase voltage.
Returned Data Format	<nr2>
Query Example	MEAS:SPECT:VOLT1:OHD? 10.5891
Query Format	MEASure:SPECTrum:VLL#:OHD?
Description	Same as "MEAS:SPECTrum:OHD?" but selects Line to Line voltage #.Returns Odd Harmonic Distortion of the selected Line to Line voltage.
Returned Data Format	<nr2>
Query Example	MEAS:SPECT:VOLT1:OHD? 10.5891
Query Format	MEASure:SPECTrum:CURREnt#:OHD?
Description	Same as "MEAS:SPECTrum:OHD?" but selects current and phase #.Returns Odd Harmonic Distortion of the selected phase currebt.
Returned Data Format	<nr2>
Query Example	MEAS:SPECT:CURR1:OHD? 22.5948

8.4.10 Measurement Resolution Setting Commands

All SCPI measurement commands return measurement data in a format with a specific resolution, i.e. a certain number of digits after the decimal point. The default resolution (number of positions after the decimal point) for each parameter is chosen based on the dimension (VA or KVA) and measurement accuracy of that specific parameter.

The user can increase or decrease the number of digits for each measurement parameter if so desired by using the RESolution commands listed in this section⁷.

Note: Increasing the resolution of a measurement for any parameter does NOT improve the specified measurement's accuracy specification. As such, digits added for to any measurement may not represent meaningful information.

The generic format for this command is:

MEASure:MMMnnn:RESolution <RESOLUTION>

MEASure:MMMnnn:RESolution?

Where MMMnnn is the measurement command syntax of the measurement for which the resolution is to be set. The Query command can be used to query a command's active resolution setting.

<RESOLUTION> is a formatted number that specifies the number of digits to include in the query response. For example:

0.1	Only one digit behind the decimal point
0.0001	4 digits behind the decimal point
0.00001	6 digits behind the decimal point

Example:

MEASure:POWer:RESolution 0.00001

This changes the number of digits for True Power measurements from the default 4 to 5. Since Power measurements are reported in KW, this is equivalent to changing the measurement resolution from 0.1 W / 10mW to 0.01W / 10mW. All these settings are independent of each other so only the specified measurement command's resolution will be changed. To change multiple commands, send this command for each one.

Note: Changing the resolution for any measurement command does NOT affect the displayed resolution of measurements in any of the power sources' front panel display screen. This command only affects remote control bus measurement queries.

Note: Once a command's resolution has been changed using the MEASure:MMMnnn:RESolution <RESOLUTION> command, the new resolution format is persistent, i.e. it remains in effect between power on/off cycles. To change it back, a new RESolution command must be sent.

⁷ Requires Firmware Revision 2.2.11 or higher

The following table shows the available RESolution commands.

Measurement Resolution Command	Query Format
MEASure:VOLTage:RESolution <RESOLUTION>	MEASure:VOLTage:RESolution?
MEASure:VLL:RESolution <RESOLUTION>	MEASure:VLL:RESolution?
MEASure:FREQuency:RESolution <RESOLUTION>	MEASure:FREQuency:RESolution?
MEASure:CURRent:RESolution <RESOLUTION>	MEASure:CURRent:RESolution?
MEASure:CURRent:CREST:RESolution <RESOLUTION>	MEASure:CURRent:CREST:RESolution?
MEASure:POWer:RESolution <RESOLUTION>	MEASure:POWer:RESolution?
MEASure:KVA:RESolution <RESOLUTION>	MEASure:KVA:RESolution?
MEASure:PF:RESolution <RESOLUTION>	MEASure:PF:RESolution?
MEASure:TEMPerature:RESolution <RESOLUTION>	MEASure:TEMPerature:RESolution?
MEASure:SPECTrum:VOLTage:RESolution <RESOLUTION>	MEASure:SPECTrum:VOLTage:RESolution?
MEASure:SPECTrum:VLL:RESolution <RESOLUTION>	MEASure:SPECTrum:VLL:RESolution?
MEASure:SPECTrum:CURRent:RESolution <RESOLUTION>	MEASure:SPECTrum:CURRent:RESolution?
MEASure:SPECTrum:PHASe:RESolution <RESOLUTION>	MEASure:SPECTrum:PHASe:RESolution?
MEASure:SPECTrum:THD:RESolution <RESOLUTION>	MEASure:SPECTrum:THD:RESolution?
MEASure:SPECTrum:OHD:RESolution <RESOLUTION>	MEASure:SPECTrum:OHD:RESolution?
MEASure:SPECTrum:EHD:RESolution <RESOLUTION>	MEASure:SPECTrum:EHD:RESolution?
MEASure:KWHour:RESolution <RESOLUTION>	MEASure:KWHour:RESolution?
FETCH[:WAVEform]:VOLTage:RESolution <RESOLUTION>	FETCH[:WAVEform]:VOLTage:RESolution?
FETCH[:WAVEform]:VLL:RESolution <RESOLUTION>	FETCH[:WAVEform]:VLL:RESolution?
FETCH[:WAVEform]:CURRent:RESolution <RESOLUTION>	FETCH[:WAVEform]:CURRent:RESolution?

8.5 Measure All Commands

The measure ALL commands are recommended for queries of all available measurements using a single command. This allows high speed retrieval of measurement data without the need to send numerous SCPI commands. These measure ALL commands return large numbers of measurements for an individual phase or all phases as a comma delimited text strings which can be stored or parsed as needed.

The order in which measurements are returned in this test strings can be specified as a parameter when sending the command.

Note: It is highly recommended to avoid the use of these “...:ALL?” commands without specifying arguments, since the returned list/order may change in future firmware revisions as new values are added or existing ones change. The **recommended usage** is to always pass the exact list of required entries as arguments (and use the ...:CATalog? Queries (Section 8.5.2, page 294) to discover available names). For this reason, it is recommended **NOT** to use these commands without arguments, e.g. sending ‘MEASure:ALL#?’ only.

8.5.1 Measurement Queries

Query Format: SOURce:ALL#? <OPTIONAL: List of measurements to return>

Description: Returns a comma delimited string containing the complete set of source configuration/status values for the selected phase #. The # is used to specify phase A, B, or C using 1, 2, or 3 respectively. If # is omitted, source data for all three phases is returned as one single string. Value order for each phase is exactly as shown in the catalog, or in the order of the arguments passed.

Parameter (Unit) FORM (N/A), NEUTRAL CONNECTED (N/A), HIGH IMPEDANCE STATE (N/A), SYNC (N/A), FREQUENCY (Hz), FREQUENCY SATURATION LIMIT MAX (Hz), FREQUENCY SATURATION LIMIT MIN (Hz), FREQUENCY USER LIMIT MAX (Hz), FREQUENCY USER LIMIT MIN (Hz), FREQUENCY MAX (Hz), FREQUENCY MIN (Hz), WAVEFORM (N/A), VOLTAGE AC (Vrms), VOLTAGE AC SATURATION LIMIT MAX (Vrms), VOLTAGE AC SATURATION LIMIT MIN (Vrms), VOLTAGE AC USER LIMIT MAX (Vrms), VOLTAGE AC USER LIMIT MIN (Vrms), VOLTAGE AC RANGE LIMIT MAX (Vrms), VOLTAGE AC RANGE LIMIT MIN (Vrms), VOLTAGE AC MAX (Vrms), VOLTAGE AC MIN (Vrms), VOLTAGE AC MAX EXTENDED (Vrms), VOLTAGE AC MIN EXTENDED (Vrms), VOLTAGE AC MAX TRANSIENT (Vrms), VOLTAGE AC MIN TRANSIENT (Vrms), VOLTAGE DC (Vdc), VOLTAGE DC SATURATION LIMIT MAX (Vdc), VOLTAGE DC SATURATION LIMIT MIN (Vdc), VOLTAGE DC USER LIMIT MAX (Vdc), VOLTAGE DC USER LIMIT MIN (Vdc), VOLTAGE DC RANGE LIMIT MAX (Vdc), VOLTAGE DC RANGE LIMIT MIN (Vdc), VOLTAGE DC MAX (Vdc), VOLTAGE DC MIN (Vdc), VOLTAGE DC MAX TRANSIENT (Vdc), VOLTAGE DC MIN TRANSIENT (Vdc), CURRENT AC (Arms), CURRENT AC SATURATION LIMIT MAX (Arms), CURRENT AC SATURATION LIMIT MIN (Arms), CURRENT AC USER LIMIT MAX (Arms), CURRENT AC USER LIMIT MIN (Arms), CURRENT AC RANGE LIMIT MAX (Arms), CURRENT AC RANGE LIMIT MIN (Arms), CURRENT AC MAX (Arms), CURRENT AC MIN (Arms), CURRENT AC MAX EXTENDED (Arms), CURRENT AC MIN EXTENDED (Arms), CURRENT AC MAX TRANSIENT (Arms), CURRENT AC MIN TRANSIENT (Arms), CURRENT DC (Adc), CURRENT DC SATURATION LIMIT MAX (Adc), CURRENT DC SATURATION LIMIT MIN (Adc), CURRENT DC USER LIMIT MAX (Adc), CURRENT DC USER LIMIT MIN (Adc), CURRENT DC RANGE LIMIT MAX (Adc), CURRENT DC RANGE LIMIT MIN (Adc), CURRENT DC MAX (Adc), CURRENT DC MIN (Adc), CURRENT DC MAX TRANSIENT (Adc), CURRENT DC MIN TRANSIENT (Adc), VOLTAGE

Sine Wave,-,1,0,1,1,0,-

Query Format: SOURce:PROTect:ALL#? <OPTIONAL: List of measurements to return>

Description: Returns a comma delimited string containing the complete set of protection configuration/status values for the selected phase #. The # is used to specify phase A, B, or C using 1, 2, or 3 respectively. If # is omitted, protection data for all three phases is returned as one single string. Value order for each phase is exactly as shown in the catalog, or in the order of the arguments passed.

Parameter (Unit) CURRENT ENABLE (N/A), CURRENT LEVEL (Arms), CURRENT LEVEL MAX (Arms), CURRENT LEVEL MIN (Arms), POWER ENABLE (N/A), ACTIVE POWER LEVEL (kW), ACTIVE POWER LEVEL MAX (kW), ACTIVE POWER LEVEL MIN (kW), APPARENT POWER LEVEL (kVA), APPARENT POWER LEVEL MAX (kVA), APPARENT POWER LEVEL MIN (kVA), OVER VOLTAGE ENABLE (N/A), OVER VOLTAGE LEVEL (Vrms), OVER VOLTAGE LEVEL MAX (Vrms), OVER VOLTAGE LEVEL MIN (Vrms), UNDER VOLTAGE ENABLE (N/A), UNDER VOLTAGE LEVEL (Vrms), UNDER VOLTAGE LEVEL MAX (Vrms), UNDER VOLTAGE LEVEL MIN (Vrms), OVER FREQUENCY ENABLE (N/A), OVER FREQUENCY LEVEL (Hz), OVER FREQUENCY LEVEL MAX (Hz), OVER FREQUENCY LEVEL MIN (Hz), UNDER FREQUENCY ENABLE (N/A), UNDER FREQUENCY LEVEL (Hz), UNDER FREQUENCY LEVEL MAX (Hz), UNDER FREQUENCY LEVEL MIN (Hz), TRIP TIME (s), SHUTDOWN ENABLE (N/A), SHUTDOWN DELAY (ms), SHUTDOWN DELAY MAX (ms), SHUTDOWN DELAY MIN (ms), SHUTDOWN CONDITION (N/A), SHUTDOWN LEVEL (N/A), SHUTDOWN LEVEL MAX (N/A), SHUTDOWN LEVEL MIN (N/A), A ENABLE (N/A), A DELAY (ms), A DELAY MAX (ms), A DELAY MIN (ms), A CONDITION (N/A), A CONDITION LEVEL (N/A), A CONDITION LEVEL MAX (N/A), A CONDITION LEVEL MIN (N/A), A ACTION (N/A), A ACTION VALUE (N/A), A ACTION VALUE MAX (N/A), A ACTION VALUE MIN (N/A), B ENABLE (N/A), B DELAY (ms), B DELAY MAX (ms), B DELAY MIN (ms), B CONDITION (N/A), B CONDITION LEVEL (N/A), B CONDITION LEVEL MAX (N/A), B CONDITION LEVEL MIN (N/A), B ACTION (N/A), B ACTION VALUE (N/A), B ACTION VALUE MAX (N/A), B ACTION VALUE MIN (N/A), PEAK VOLTAGE ENABLE (N/A), PEAK VOLTAGE BLOCKED (N/A), PEAK VOLTAGE MODE (N/A), PEAK VOLTAGE AVAILABLE MODES (N/A), PEAK VOLTAGE MARGIN (V), PEAK VOLTAGE MARGIN MAX (V), PEAK VOLTAGE MARGIN MIN (V), PEAK VOLTAGE LEVEL (V), PEAK VOLTAGE LEVEL MAX (V), PEAK VOLTAGE LEVEL MIN (V), PEAK CURRENT ENABLE (N/A), PEAK CURRENT BLOCKED (N/A), PEAK CURRENT MODE (N/A), PEAK CURRENT AVAILABLE MODES (N/A), PEAK CURRENT MARGIN (A), PEAK CURRENT MARGIN MAX (A), PEAK CURRENT MARGIN MIN (A), PEAK CURRENT LEVEL (A), PEAK CURRENT LEVEL MAX (A), PEAK CURRENT LEVEL MIN (A), PEAK POWER ENABLE (N/A), PEAK POWER LEVEL (kW), PEAK POWER LEVEL MAX (kW), PEAK POWER LEVEL MIN (kW).

Note: The total number, order, and meaning of readings returned by this command without arguments may change in future firmware versions as new functions are added or existing ones are modified. For this reason, it is strongly recommended to always specify the exact values you require as arguments (example: SOURce:PROTect:ALL? "CURRENT ENABLE, CURRENT LEVEL, CURRENT LEVEL MAX"). A zero value is returned for an unrecognized argument.

Returned Data Format: <nr2>,<nr2>,...,<nr2>,<nr2>,

Query Example: SOURce:PROTect:ALL1?

0,15.000,15.000,0.000,0,1.8000,1.8000,0.0000,1.8000,1.8000,0.0000,0,1000.000,1000.000,0.000,0,0.000,1000.000,0.000,0,0.000,5000.000,0.000,0,0.000,5000.000,0.000,0.5,0,0,10000000,0,0,0.000,100

000.000,-100000.000,0,0,10000000,0,0,0.000,100000.000,-100000.000,0,0.000,100000.000,-
100000.000,0,0,10000000,0,0,0.000,100000.000,-100000.000,0,0.000,100000.000,-
100000.000,1,0,0,7,100.000,300.000,0.000,300.000,300.000,0.000,0,0,1,2,50.000,45.000,3.000,22.50
0,67.500,3.000,0,0.9000,1.8000,0.0000

Query Format: SOURce:PEAK:ALL#? <OPTIONAL: List of measurements to return>

Description: Returns a comma delimited string containing the complete set of peak configuration/status values for the selected phase #. The # is used to specify phase A, B, or C using 1, 2, or 3 respectively. If # is omitted, peak data for all three phases is returned as one single string. Value order for each phase is exactly as shown in the catalog, or in the order of the arguments passed.

Parameter (Unit) VOLTAGE LIMIT (V), VOLTAGE LIMIT MAX (V), VOLTAGE LIMIT MIN (V), CURRENT LIMIT (A), CURRENT LIMIT MAX (A), CURRENT LIMIT MIN (A), POWER LIMIT (kW), POWER LIMIT MAX (kW), POWER LIMIT MIN (kW)

Note: The total number, order, and meaning of readings returned by this command without arguments may change in future firmware versions as new functions are added or existing ones are modified. For this reason, it is strongly recommended to always specify the exact values you require as arguments (example: SOURce:PEAK:ALL? "POWER LIMIT, POWER LIMIT MAX, POWER LIMIT MIN"). A zero value is returned for an unrecognized argument.

Returned Data Format: <nr2>,<nr2>,...,<nr2>,<nr2>,

Query Example: SOURce:PEAK:ALL1?

680.000,350.000,0.000,360.000,360.000,1.000,55.0000,55.0000,0.0000

Query Format: SOURce:INTHarmonic:ALL#? <OPTIONAL: List of measurements to return>

Description: Returns a comma delimited string containing the complete set of interharmonic configuration/status values for the selected phase #. The # is used to specify phase A, B, or C using 1, 2, or 3 respectively. If # is omitted, interharmonic data for all three phases is returned as one single string. Value order for each phase is exactly as shown in the catalog, or in the order of the arguments passed.

Parameter (Unit) STATE (N/A), MODE (N/A), ROUND TO HARMONIC (N/A), MULTIPLE (N/A), MULTIPLE MAX (N/A), MULTIPLE MIN (N/A), MULTIPLE DEFAULT (N/A), FREQUENCY (Hz), FREQUENCY MAX (Hz), FREQUENCY MIN (Hz), FREQUENCY DEFAULT (Hz), VOLTAGE (Vrms), VOLTAGE MAX (Vrms), VOLTAGE MIN (Vrms), VOLTAGE DEFAULT (Vrms), CURRENT (Arms), CURRENT MAX (Arms), CURRENT MIN (Arms), CURRENT DEFAULT (Arms), PHASE (Deg), PHASE MAX (Deg), PHASE MIN (Deg), PHASE DEFAULT (Deg)

Note: The total number, order, and meaning of readings returned by this command without arguments may change in future firmware versions as new functions are added or existing ones are modified. For this reason, it is strongly recommended to always specify the exact values you require as arguments (example: SOURce:INTHarmonic:ALL? "FREQUENCY, FREQUENCY MAX, FREQUENCY MIN"). A zero value is returned for an unrecognized argument.

Returned Data Format: <nr2>,<nr2>,...,<nr2>,<nr2>,

Query Example: SOURce:INTHarmonic:ALL1?

0,0,1,10,10000,1,10,180.00,10000.00,15.00,180.00,0.00,240.00,0.00,0.00,0.00,130.00,0.00,0.00,0.0,1080.0,-1080.0,0.0

Query Format: SOURce:SLEW:ALL#? <OPTIONAL: List of measurements to return>

Description: Returns a comma delimited string containing the complete set of slew configuration/status values for the selected phase #. The # is used to specify phase A, B, or C using 1, 2, or 3 respectively. If # is omitted, slew data for all three phases is returned as one single string. Value order for each phase is exactly as shown in the catalog, or in the order of the arguments passed.

Parameter (Unit) RAMP TIME (ms), PHASE SLEW (Deg/ms), FREQUENCY SLEW (Hz/ms), VOLTAGE SLEW (V/us), VOLTAGE SLEW MAX (V/us), VOLTAGE SLEW MIN (V/us), CURRENT SLEW (A/us), CURRENT SLEW MAX (A/us), CURRENT SLEW MIN (A/us), VOLTAGE AC SLEW (V/ms) (RMS), VOLTAGE AC SLEW MAX (V/ms) (RMS), VOLTAGE AC SLEW MIN (V/ms) (RMS), VOLTAGE DC SLEW (V/ms) (DC), VOLTAGE DC SLEW MAX (V/ms) (DC), VOLTAGE DC SLEW MIN (V/ms) (DC), CURRENT AC SLEW (A/ms) (RMS), CURRENT AC SLEW MAX (A/ms) (RMS), CURRENT AC SLEW MIN (A/ms) (RMS), CURRENT DC SLEW (A/ms) (DC), CURRENT DC SLEW MAX (A/ms) (DC), CURRENT DC SLEW MIN (A/ms) (DC), RESISTANCE AC SLEW (Ohm/ms), RESISTANCE DC SLEW (Ohm/ms), CONDUCTANCE AC SLEW (S/ms), CONDUCTANCE DC SLEW (S/ms), ACTIVE POWER AC SLEW (kW/ms), ACTIVE POWER DC SLEW (kW/ms), APPARENT POWER AC SLEW (kVA/ms), APPARENT POWER DC SLEW (kVA/ms)

Note: The total number, order, and meaning of readings returned by this command without arguments may change in future firmware versions as new functions are added or existing ones are modified. For this reason, it is strongly recommended to always specify the exact values you require as arguments (example: SOURce:SLEW:ALL? "RAMP TIME, PHASE SLEW, FREQUENCY SLEW"). A zero value is returned for an unrecognized argument.

Returned Data Format: <nr2>,<nr2>,...,<nr2>,<nr2>,

Query Example: SOURce:SLEW:ALL1?

0.0001,5.0000,5.0000,100.0000,100.0000,0.0010,100.0000,100.0000,0.0010,10.0000,99999.0000,0.0001,10.0000,99999.0000,0.0001,10.0000,99999.0000,0.0001,10.0000,99999.0000,0.0001,1.0000,1.0000,1.0000,0.1000,0.1000,0.1000,0.1000

Query Format: SOURce:CSC:ALL#? <OPTIONAL: List of measurements to return>

Description: Returns a comma delimited string containing the complete set of Continuous Self Calibration configuration/status values for the selected phase #. The # is used to specify phase A, B, or C using 1, 2, or 3 respectively. If # is omitted, CSC data for all three phases is returned as one single string. Value order for each phase is exactly as shown in the catalog, or in the order of the arguments passed.

Parameter (Unit). STATE (N/A), TRANSIENT STATE (N/A), FAULT ON SATURATION (N/A), ACCELERATION (N/A), CONSTANT POWER (N/A), REGEN CONSTANT POWER (N/A), CONSTANT POWER AVAILABLE (N/A), REGEN CONSTANT POWER AVAILABLE (N/A), MAX GAIN (N/A), MAX GAIN MAX (N/A), MAX GAIN MIN (N/A), GAIN (N/A), GAIN MAX (N/A), GAIN MIN (N/A)

Note: The total number, order, and meaning of readings returned by this command without arguments may change in future firmware versions as new functions are added or existing ones are modified. For this reason, it is strongly recommended to always specify the exact values you require as arguments (example: SOURce:CSC:ALL? "STATE, ACCELERATION, MAX GAIN"). A zero value is returned for an unrecognized argument.

Returned Data Format: <nr2>,<nr2>,...,<nr2>,<nr2>,

Query Example: SOURce:CSC:ALL1?

1,1,0,1,0,0,1,1,1.150,2.000,1.000,1.000,10.000,0.000

Query Format: SOURce:ALL:USERlimits#? <OPTIONAL: List of measurements to return>

Description: Returns a comma delimited string containing the complete set of user limits configuration/status values for the selected phase #. The # is used to specify phase A, B, or C using 1, 2, or 3 respectively. If # is omitted, user limit data for all three phases is returned as one single string. Value order for each phase is exactly as shown in the catalog, or in the order of the arguments passed.

Parameter (Unit). FREQUENCY MAX (Hz), FREQUENCY MAX MAX (Hz), FREQUENCY MAX MIN (Hz), FREQUENCY MIN (Hz), FREQUENCY MIN MAX (Hz), FREQUENCY MIN MIN (Hz), VOLTAGE AC MAX (Vrms), VOLTAGE AC MAX MAX (Vrms), VOLTAGE AC MAX MIN (Vrms), VOLTAGE AC MIN (Vrms), VOLTAGE AC MIN MAX (Vrms), VOLTAGE AC MIN MIN (Vrms), VOLTAGE DC MAX (Vdc), VOLTAGE DC MAX MAX (Vdc), VOLTAGE DC MAX MIN (Vdc), VOLTAGE DC MIN (Vdc), VOLTAGE DC MIN MAX (Vdc), VOLTAGE DC MIN MIN (Vdc), CURRENT AC MAX (Arms), CURRENT AC MAX MAX (Arms), CURRENT AC MAX MIN (Arms), CURRENT AC MIN (Arms), CURRENT AC MIN MAX (Arms), CURRENT AC MIN MIN (Arms), CURRENT DC MAX (Adc), CURRENT DC MAX MAX (Adc), CURRENT DC MAX MIN (Adc), CURRENT DC MIN (Adc), CURRENT DC MIN MAX (Adc), CURRENT DC MIN MIN (Adc), RESISTANCE AC MAX (Ohm), RESISTANCE AC MAX MAX (Ohm), RESISTANCE AC MAX MIN (Ohm), RESISTANCE AC MIN (Ohm), RESISTANCE AC MIN MAX (Ohm), RESISTANCE AC MIN MIN (Ohm), RESISTANCE AC INF POS (Ohm), RESISTANCE AC INF NEG (Ohm), RESISTANCE DC MAX (Ohm), RESISTANCE DC MAX MAX (Ohm), RESISTANCE DC MAX MIN (Ohm), RESISTANCE DC MIN (Ohm), RESISTANCE DC MIN MAX (Ohm), RESISTANCE DC MIN MIN (Ohm), RESISTANCE DC INF POS (Ohm), RESISTANCE DC INF NEG (Ohm), CONDUCTANCE AC MAX (S), CONDUCTANCE AC MAX MAX (S), CONDUCTANCE AC MAX MIN (S), CONDUCTANCE AC MIN (S), CONDUCTANCE AC MIN MAX (S), CONDUCTANCE AC MIN MIN (S), CONDUCTANCE DC MAX (S), CONDUCTANCE DC MAX MAX (S), CONDUCTANCE DC MAX MIN (S), CONDUCTANCE DC MIN (S), CONDUCTANCE DC MIN MAX (S), CONDUCTANCE DC MIN MIN (S), ACTIVE POWER AC MAX (kW), ACTIVE POWER AC MAX MAX (kW), ACTIVE POWER AC MAX MIN (kW), ACTIVE POWER AC MIN (kW), ACTIVE POWER AC MIN MAX (kW), ACTIVE POWER AC MIN MIN (kW), ACTIVE POWER DC MAX (kW), ACTIVE POWER DC MAX MAX (kW), ACTIVE POWER DC MAX MIN (kW), ACTIVE POWER DC MIN (kW), ACTIVE POWER DC MIN MAX (kW), ACTIVE POWER DC MIN MIN (kW), APPARENT POWER AC MAX (kVA), APPARENT POWER AC MAX MAX (kVA), APPARENT POWER AC MAX MIN (kVA), APPARENT POWER AC MIN (kVA), APPARENT POWER AC MIN MAX (kVA), APPARENT POWER AC MIN MIN (kVA), APPARENT POWER DC MAX (kVA), APPARENT POWER DC MAX MAX

(kVA), APPARENT POWER DC MAX MIN (kVA), APPARENT POWER DC MIN (kVA), APPARENT POWER DC MIN MAX (kVA), APPARENT POWER DC MIN MIN (kVA)

Note: The total number, order, and meaning of readings returned by this command without arguments may change in future firmware versions as new functions are added or existing ones are modified. For this reason, it is strongly recommended to always specify the exact values you require as arguments (example: SOURce:ALL? "FREQUENCY MAX, VOLTAGE AC MAX, CURRENT DC MAX"). A zero value is returned for an unrecognized argument.

Returned Data Format: <nr2>,<nr2>,...,<nr2>,<nr2>,

Query Example: SOURce:ALL:USERlimits1?

```
1000.000,10000.000,60.000,15.000,60.000,15.000,480.0000,480.0000,0.0000,-480.0000,0.0000,-
480.0000,680.0000,680.0000,0.0000,-680.0000,0.0000,-680.0000,130.0000,130.0000,0.0000,-
130.0000,0.0000,-130.0000,100.0000,100.0000,0.0000,-100.0000,0.0000,-
100.0000,99999.0000,99999.0000,0.0000,-99999.0000,0.0000,-99999.0000,99999.0000,-
1000.0000,99999.0000,99999.0000,0.0000,-99999.0000,0.0000,-99999.0000,99999.0000,-
1000.0000,2.0000,2.0000,0.0000,-2.0000,0.0000,-2.0000,2.0000,2.0000,0.0000,-2.0000,0.0000,-
2.0000,18.3333,18.3333,0.0000,-18.3333,0.0000,-18.3333,18.3333,18.3333,0.0000,-18.3333,0.0000,-
18.3333,18.3333,18.3333,0.0000,-18.3333,0.0000,-18.3333,18.3333,18.3333,0.0000,-
18.3333,0.0000,-18.3333
```

Query Format: STATus:ALL#? <OPTIONAL: List of measurements to return>

Description: Returns a comma delimited string containing the complete set of status values for the selected phase #. The # is used to specify phase A, B, or C using 1, 2, or 3 respectively. If # is omitted, status data for all three phases is returned as one single string. Value order for each phase is exactly as shown in the catalog, or in the order of the arguments passed.

Bit Field Parameters: The following parameters are returned as bit fields in decimal format:

- STATUS BITS
- EXTENDED STATUS BITS
- FAULTS BITS
- WARNINGS BITS
- FEATURES BITS
- FEATURES EXTENDED BITS
- OUTPUT STATUS BITS

To query individual bit flag values within these bit fields, use the dedicated commands:

- STATus:ALL:BITS? – Query bits inside STATUS BITS bit field
- STATus:ALL:EXTended:BITS? – Query bits inside EXTENDED STATUS BITS bit field
- STATus:ALL:FAULTs:BITS? – Query bits inside FAULTS BITS bit field
- STATus:ALL:WARNings:BITS? – Query bits inside WARNINGS BITS bit field
- STATus:ALL:FEATures:BITS? – Query bits inside FEATURES BITS bit field
- STATus:ALL:FEATures:EXTended? – Query bits inside FEATURES EXTENDED BITS bit field
- STATus:ALL:OUTPut:BITS? – Query bits inside OUTPUT STATUS BITS bit field

You can also query specific flag values directly in STATus:ALL? by passing the flag name as an argument. They can also be mixed with other STATus:ALL entries. (example: STATus:ALL? "OUTPUT ENABLE" or STATus:ALL? "API MODE, FAULT DISCOVERY, FEATURE ANTI ISLANDING").

Parameter (Unit). STATUS BITS (N/A), EXTENDED STATUS BITS (N/A), FAULTS BITS (N/A), FORM (N/A), NEUTRAL MODE ONLINE ACTIVE (N/A), TRANSIENT STATUS (N/A), PROGRAM IN EXECUTION (N/A), RMS LOOP CONTROL STATUS (N/A), WARNINGS BITS (N/A), SETPOINT MODE (N/A), COMPATIBLE MODE (N/A), FEATURES BITS (N/A), FEATURES EXTENDED BITS (N/A), POWER STAGE MODEL (N/A), API MODE (N/A), IS AGX VARIANT (N/A), CURRENT DECIMALS (N/A), VOLTAGE DECIMALS (N/A), OPERATING MODE (N/A), LOAD TYPE (N/A), LOAD CONSTANT POWER TYPE (N/A), LOAD CONSTANT RESISTANCE TYPE (N/A), LOAD CIRCUIT EMULATION TYPE (N/A), LOAD CONSTANT RESISTANCE MODE (N/A), LOAD CONSTANT POWER MODE (N/A), SYNC (N/A), SYNCED (N/A), AUX LMX STATUS BITS (N/A), OUTPUT STATUS BITS (N/A), INTERFACE KEY BRIGHTNESS (N/A), INTERFACE LCD BRIGHTNESS (N/A), INTERFACE VOLUME (N/A), INTERFACE KEYS SOUNDS (N/A), INTERFACE SINGLE CLICK IMMEDIATE UPDATE (N/A), INTERFACE SHOW MEASUREMENTS IN IMMEDIATE UPDATE (N/A), INTERFACE VARIABLE SPEED KNOB (N/A), INTERFACE KEYPAD STEP (N/A), INTERFACE ONSCREEN KEYBOARD (N/A), OUTPUT ENABLE COLOR READY (N/A), OUTPUT ENABLE COLOR ENABLED (N/A), OUTPUT ENABLE COLOR FAULT (N/A), OUTPUT ENABLE COLOR STANDBY (N/A), OUTPUT ENABLE STATUS BAR COLOR FAULT (N/A), RESTRICTED ACCESS PASSWORD (N/A), CURRENT FW VERSION (N/A), AVAILABLE FW VERSION (N/A)

Note: The total number, order, and meaning of readings returned by this command without arguments may change in future firmware versions as new functions are added or existing ones are modified. For this reason, it is strongly recommended to always specify the exact values you require as arguments. A zero value is returned for an unrecognized argument.

Returned Data Format: <nr2>,<nr2>,...,<nr2>,<nr2>,

Query Example: STATus:ALL1?

```
576469548430033816,227643127942438912,0,3,0,0,0,0,320,2,0,2113814464,111,34,2,0,2,2,0,0,0,0,0,0,0,1,0,0,3375105,2,8,3,0,0,1,1,1,1,0|0|255,0|255|0,0|0|255,0|0|255,255|0|0,1234,5.6.2,5.6.2
```

Query Format: STATus:ALL:BITS? <OPTIONAL: List of measurements to return>

Description: Returns a comma delimited string containing the separate status of each bit of the STATUS BITS bit field in 'STATus:ALL?'.

Parameter (Unit). OUTPUT ENABLE, OUTPUT INACTIVE, FAULT, LOCAL REMOTE, POWER SAVE MODE ENABLE, PASSIVE MODE, SLAVE MODE, PRIMARIES OUTPUT ENABLE, LOW RANGE, LAN ACTIVE, AUTO DECREASING CURRENT LIMIT WITH VOLTAGE, DATALOGGER RUNNING, DHCP LEASERENUEW, STATIC IP, LAN IDENTIFY MODE, SYNC, COUPLING, CAN TUNNEILING ENABLE, USB RNDIS ACTIVE, CABINET, LOCAL LOCKOUT, PROGRAM TRIGGER OUTPUT, PROGRAM TRIGGER INPUT, PROGRAM TRIGGER INPUT IMMEDIATE, PROGRAM TRIGGER INPUT AUTO, WAVEFORM AUTORMS, DSP FIRMWARE UPDATING, DSP FIRMWARE UPDATE CONFIRMATION, DSP FIRMWARE UPDATE FAILED, DSP FIRMWARE UPDATE RECOVERY, CURRENT OVERLOAD, STROBE SOURCE, STROBE OUTPUT, SERIAL INTERFACE ENABLE IO BOARD ONLY, TRANSFORMER, COUPLING TRANSFORMER, SYNCHRONIZE ENABLED, SYNCHRONIZE SOURCE SELECT, SYNCHRONIZE STATE, SYNCHRONIZE OUTPUT ENABLED, SYNCHRONIZE OUTPUT HIGH RESOLUTION, FREQUENCY EXTEND, PHASE ROTATION, PHASE SPLIT, GPIB ENABLE, AIO ENABLE, DIO ENABLE, HOLDING FAULT, OUTPUT ENABLE CONFIRMATION,

TRANSIENT CYCLE RESET DSP, ECTS POPUP, ECTS, PROGRAMMABLE MESSAGE, RESTRICTED ACCESS, OUTPUT STANDBY FEATURE, OUTPUT STANDBY, OUTPUT RELAY FEATURE, OUTPUT RELAY CLOSED, OUTPUT CAPACITANCE FEATURE, OUTPUT CAPACITANCE DISPLAY, SYNCHRONIZE BY EXTERNAL INPUT ENABLED, HIGHIMPED VOLTAGE FEATURE, STROBE ANTI ISLANDING.

Note: The total number, order, and meaning of readings returned by this command without arguments may change in future firmware versions as new functions are added or existing ones are modified. For this reason, it is strongly recommended to always specify the exact values you require as arguments (example: STATus:ALL:BITS? "OUTPUT ENABLE, OUTPUT INACTIVE, FAULT"). A zero value is returned for an unrecognized argument.

Returned Data Format: <nr2>,<nr2>,,,,<nr2>,<nr2>,

Query Example: STATus:ALL:BITS?

[illegible]

Query Format: STATus:ALL:EXTended:BITS? <OPTIONAL: List of measurements to return>

Description: Returns a comma delimited string containing the separate status of each bit of the EXTENDED STATUS BITS bit field in 'STATUS:ALL?'.

Parameter (Unit). VERY LOW FREQUENCY, AUXILIARY ENHANCED MODE, AUXILIARY UPDATE REQUIRED, REMOTE INHIBIT AND SERIAL EXCLUSION, REMOTE ENABLE AND SERIAL EXCLUSION, REMOTE RELAY AND SERIAL EXCLUSION, REMOTE INHIBIT ON IO BOARD, REMOTE INHIBIT ON IO BOARD ACTIVE, REMOTE ENABLE BY IO BOARD PDO, REMOTE ENABLE BY IO BOARD PDO ACTIVE, DIGITAL INPUTS AND SERIAL EXCLUSION, ANALOG INPUTS AND SERIAL EXCLUSION, LOW BATTERY, WAVEFORM SINE COMPENSATION, ENABLE METER ACCUMULATION, SENSE FAULT DISABLE, EXTERNAL SENSE, FETCH FAST, SYNCHRONIZE OUTPUT MODE, STYLE STATUS ENABLE BLINK, INTERHARMONIC ENABLED, INTERHARMONIC ENABLED BLOCKED, INTERHARMONIC ROUND MODE, LMX EMERGENCY SHUTDOWN, LMX PROPAGATE FAULT, SERIES UNITS, LOCKED, UNIQUE SENSE PATH, DOUBLE RANGE, PEAK CURRENT LIMIT AVAILABLE, PEAK CURRENT LIMIT OUTPUT ENABLE BLOCKED, PEAK VOLTAGE LIMIT AVAILABLE, PEAK POWER LIMIT AVAILABLE, SHOW ALL COMMANDS, VAB AVAILABLE, VBC AVAILABLE, VCA AVAILABLE, VAB ESTIMATION WARNING, VBC ESTIMATION WARNING, VCA ESTIMATION WARNING, SERIES CONNECTION, SERIES CONNECTION STATE, SERIES CONNECTION PROTECTION ACTIVE, NEUTRAL NOT CONNECTED, SYNCHRONIZE INPUT FAULT, CTLOC, EXPORTED MODEL, OUTPUT ABOUT TO ENABLE, NEW LCD, ALLOWALL, OUTPUT IDLE, OUTPUT ENABLE TWO KEYS, VLL ESTIMATION WARNING, REPEATEAD WAVEFORM WARNING, DELTA MODE, SINGLE PHASE SENSING FAULT, OUTPUT INACTIVE AVAILABLE, KVA EXTENDED, REMOTE DISABLE BY IO BOARD PDO, REMOTE DISABLE BY IO BOARD PDO ACTIVE, REMOTE DISABLE AND SERIAL EXCLUSION

Note: The total number, order, and meaning of readings returned by this command without arguments may change in future firmware versions as new functions are added or existing ones are modified. For this reason, it is strongly recommended to always specify the exact values you require as arguments (example: STATus:ALL:EXtended:BITS? “VERY LOW FREQUENCY, AUXILIARY ENHANCED MODE, AUXILIARY UPDATE REQUIRED”). A zero value is returned for an unrecognized argument.

Returned Data Format: <nr2>,<nr2>,...,<nr2>,<nr2>,

Query Example: STATus:ALL:EXTended:BITS?

0,0,0,0,0,0,0,0,0,0,0,0,0,0,1,1,0,1,0,0,1,0,0,1,0,0,0,0,0,0,0,0,0,0,0,1,1,1,0,0,0,0,0,0,0,0,1,1,0,0,0,1,0,1,0,0,1,1,0,0,0,0

Query Format: STATus:ALL:FAULTs:BITS? <OPTIONAL: List of measurements to return>

Description: Returns a comma delimited string containing the separate status of each bit of the FAULTS BITS bit field in 'STATus:ALL?'.

Parameter (Unit). GLOBAL FAULT IN, FAULT NOT FOUND, FAULT DISCOVERY, FAULT UNDISCOVERED NODE, FAULT NODE NOT OPERATIONAL, FAULT POWER FAILURE, FAULT REMOTE INHIBIT, FAULT SYSTEM REBOOT, FAULT MISSED NODE, FAULT RTC ENABLE, FAULT INVERTERS ENABLE, FAULT PRIMARIES ENABLE, FAULT POWER STAGE NOT COMPATIBLE, FAULT FRONT PANEL NOT COMPATIBLE, FAULT PARALLEL UNITS NOT COMPATIBLE, FAULT DSP FW UPDATE, FAULT DSP FW UPDATE RECOVERY, FAULT GPIB NOT FOUND, FAULT GPIB VERSION MISMATCH, FAULT IO BOARD NOT FOUND, FAULT IO BOARD VERSION MISMATCH, FAULT CANNOT READ ANALOG INPUTS, FAULT TRANSFORMER VERSION MISMATCH, FAULT TEMPERATURE, FAULT RTC NOT FOUND, FAULT RTC VERSION MISMATCH, FAULT PARALLEL UNITS MODEL NOT COMPATIBLE, FAULT FRONT PANEL MODEL MISMATCH, FAULT CANNOT READ DIGITAL INPUTS, FAULT COMMUNICATION, FAULT SERIES CONNECTION VERSION MISMATCH, FAULT USER GENERATED, FAULT OVER NEUTRAL CURRENT, FAULT CANNOT READ EXTERNAL SENSE

Note: The total number, order, and meaning of readings returned by this command without arguments may change in future firmware versions as new functions are added or existing ones are modified. For this reason, it is strongly recommended to always specify the exact values you require as arguments (example: STATus:ALL:FAULTs:BITS? "GLOBAL FAULT IN, FAULT NOT FOUND, FAULT DISCOVERY"). A zero value is returned for an unrecognized argument.

Returned Data Format: <nr2>,<nr2>,...,<nr2>,<nr2>,

Query Example: STATus:ALL:FAULTs:BITS?

0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0

Query Format: STATus:ALL:WARNings:BITS? <OPTIONAL: List of measurements to return>

Description: Returns a comma delimited string containing the separate status of each bit of the WARNINGS BITS bit field in 'STATUS:ALL?'.

Parameter (Unit). WARNING POWER GOING DOWN, WARNING FIRMWARE UPDATING, WARNING FIRMWARE NEWER VERSION PENDING CONFIRMATION, WARNING FIRMWARE OLDER VERSION PENDING CONFIRMATION, WARNING FIRMWARE FTP DOWNLOADING, WARNING UNEXPECTED RESET, WARNING DISCOVERY NOT PERFORMED, WARNING DUPLICATED IP DETECTED, WARNING ERROR OR EVENT, WARNING NEW ERROR OR EVENT, WARNING REMOTE INHIBIT, WARNING FAULT DURING ENABLE, WARNING DHCP LEASEFAIL DETECTED, WARNING SYSTEM REBOOT, WARNING ADC LOCK UP

Note: The total number, order, and meaning of readings returned by this command without arguments may change in future firmware versions as new functions are added or existing

ones are modified. For this reason, it is strongly recommended to always specify the exact values you require as arguments (example: STATus:ALL:WARNings:BITS? "WARNING POWER GOING DOWN, WARNING FIRMWARE UPDATING, WARNING NEW ERROR OR EVENT"). A zero value is returned for an unrecognized argument.

Returned Data Format: <nr2>,<nr2>,...,<nr2>,<nr2>,

Query Example: STATus:ALL:WARNings:BITS?

0,0,0,0,0,0,1,0,1,0,0,0,0,0,0

Query Format: STATus:ALL:FEATures:BITS? <OPTIONAL: List of measurements to return>

Description: Returns a comma delimited string containing the separate status of each bit of the FEATURES BITS bit field in 'STATus:ALL?'.

Parameter (Unit). FEATURE TRIGGER OUTPUT, FEATURE TRIGGER INPUT, FEATURE STROBE SOURCE, FEATURE STROBE OUTPUT, FEATURE IO BOARD, FEATURE GPIB, FEATURE RTC, FEATURE SINGLE PHASE, FEATURE SPLIT PHASE, FEATURE THREE PHASE, FEATURE TWO INDEPENDENT OUTPUTS, FEATURE THREE INDEPENDENT OUTPUTS, FEATURE SPLIT PLUS ONE INDEPENDENT OUTPUT, FEATURE PROGRAMMABLE PHASE, FEATURE PROGRAMMABLE PHASE A, FEATURE EXTENDED VOLTAGE, FEATURE EXTENDED FREQUENCY, FEATURE LOW FREQUENCY RANGE, FEATURE TRANSIENT, FEATURE HARMONIC AND FETCH, FEATURE PROGRAMMABLE IMPEDANCE, FEATURE ARBITRARY WAVEFORMS, FEATURE DC SETPOINT, FEATURE AC PLUS DC SETPOINT, FEATURE ADF EXTENDED FREQUENCY, FEATURE TRUE LINE TO LINE MEASUREMENT, FEATURE TEST SEQUENCE, FEATURE WATT HOUR METER, FEATURE PEAK CURRENT REGISTER, FEATURE AC SETPOINT, FEATURE INTERHARMONIC, FEATURE HARMONIC GENERATION

Note: The total number, order, and meaning of readings returned by this command without arguments may change in future firmware versions as new functions are added or existing ones are modified. For this reason, it is strongly recommended to always specify the exact values you require as arguments (example: STATus:ALL:FEATures:BITS? "FEATURE GPIB, FEATURE RTC, FEATURE SINGLE PHASE"). A zero value is returned for an unrecognized argument.

Returned Data Format: <nr2>,<nr2>,...,<nr2>,<nr2>,

Query Example: STATus:ALL:FEATures:BITS?

0,0,0,0,0,0,1,1,1,1,1,1,1,0,0,0,1,1,1,1,1,1,1,0,1,1,1,1,1,0

Query Format: STATus:ALL:FEATures:EXTended:BITS? <OPTIONAL: List of measurements to return>

Description: Returns a comma delimited string containing the separate status of each bit of the FEATURES EXTENDED BITS bit field in 'STATus:ALL?'.

Parameter (Unit). FEATURE SPECTRUM ANALYZER, FEATURE VOLTAGE SOURCE, FEATURE CURRENT SOURCE, FEATURE ACTIVE LOAD, FEATURE HIL, FEATURE REMOTE INTERFACE, FEATURE ANTI ISLANDING

Note: The total number, order, and meaning of readings returned by this command without arguments may change in future firmware versions as new functions are added or existing ones are modified. For this reason, it is strongly recommended to always specify the exact values you require as arguments (example: STATus:ALL:FEATures:EXTended:BITS? "FEATURE HIL, FEATURE REMOTE INTERFACE, FEATURE ANTI ISLANDING"). A zero value is returned for an unrecognized argument.

Returned Data Format: <nr2>,<nr2>,...,<nr2>,<nr2>,

Query Example: STATus:ALL:FEATures:EXTended:BITS?

1,1,1,1,0,1,1

Query Format: STATus:ALL:AUXiliary:LMX:BITS? <OPTIONAL: List of measurements to return>

Description: Returns a comma delimited string containing the separate status of each bit of the AUX LMX STATUS BITS bit field in 'STATus:ALL?'.

Parameter (Unit). AUX LMX DISABLED, AUX LMX MASTER ENABLE, AUX LMX OUTPUT ENABLE, AUX LMX FAULT, AUX LMX WARNING, AUX LMX ERRORS, AUX LMX COUPLING, AUX LMX SLEEP ENABLE, AUX LMX 3PH, AUX LMX 1PH, AUX LMX SLEEP, AUX LMX TWO MASTER FAULT, AUX LMX SHUTDOWN, AUX LMX CONNECTED, AUX LMX FORM DELAY, AUX LMX COUPLING DELAY, AUX LMX OUTPUT ENABLE DELAY, AUX LMX SPARE, AUX LMX MASTER ENABLE GPIO, AUX LMX PARALLEL FAULT, AUX LMX TRIPPING EMERGENCY SHUTDOWN

Note: The total number, order, and meaning of readings returned by this command without arguments may change in future firmware versions as new functions are added or existing ones are modified. For this reason, it is strongly recommended to always specify the exact values you require as arguments (example: STATus:ALL:AUXiliary:LMX:BITS? "AUX LMX DISABLED, AUX LMX MASTER ENABLE, AUX LMX OUTPUT ENABLE"). A zero value is returned for an unrecognized argument.

Returned Data Format: <nr2>,<nr2>,...,<nr2>,<nr2>,

Query Example: STATus:ALL:AUXiliary:LMX:BITS?

0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0

Query Format: STATus:ALL#:OUTPut:BITS? <OPTIONAL: List of measurements to return>

Description: Returns a comma delimited string containing the separate status of each bit of the OUTPUT BITS bit field in 'STATus:ALL?' for the selected output #. The # is used to specify output A, B, or C using 1, 2, or 3 respectively. If the output reference is omitted, data for all three outputs is returned as one single string. Value order for each output is exactly as shown in the catalog.

Parameter (Unit). PEAK VOLTAGE PROTECTION ENABLE, PEAK CURRENT PROTECTION ENABLE, PEAK POWER PROTECTION ENABLE, RMS VOLTAGE PROTECTION ENABLE, RMS CURRENT PROTECTION ENABLE, RMS POWER PROTECTION ENABLE, RMS UNDER VOLTAGE PROTECTION ENABLE, RMS OVER

VOLTAGE PROTECTION ENABLE, RMS UNDER FREQUENCY PROTECTION ENABLE, RMS OVER FREQUENCY PROTECTION ENABLE, RMS SHUTDOWN PROTECTION ENABLE, RMS A PROTECTION ENABLE, RMS B PROTECTION ENABLE, OPEN LOOP, RMS LOOP SATURATION FAULT ENABLE, RMS LOOP IN TRANSIENT, RMS LOOP, RMS LOOP ACCELERATION, IMPEDANCE R SATURATED, IMPEDANCE ENABLE, IMPEDANCE CSC, SYNC ENABLE, SYNC FAST ENABLE, SYNCHRONIZE STATE, TRANSIENT CYCLE RESET, TRANSIENT HOLD, TRANSIENT HOLD DSP, PEAK VOLTAGE PROTECTION BLOCKED, PEAK CURRENT PROTECTION BLOCKED

Note: The total number, order, and meaning of readings returned by this command without arguments may change in future firmware versions as new functions are added or existing ones are modified. For this reason, it is strongly recommended to always specify the exact values you require as arguments (example: SOURce:ALL? "PEAK VOLTAGE PROTECTION ENABLE, PEAK CURRENT PROTECTION ENABLE, PEAK POWER PROTECTION ENABLE"). A zero value is returned for an unrecognized argument.

Returned Data Format: <nr2>,<nr2>,...,<nr2>,<nr2>,

Query Example: STATus:ALL1:OUTPut:BITS?

1,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,1,1,1,0,0,1,1,0,0,0,0,0,0,0

Query Format: OUTPut:ALL#? <OPTIONAL: List of measurements to return>

Description: Returns a comma delimited string containing the complete set of output configuration/status values for the selected phase #. The # is used to specify phase A, B, or C using 1, 2, or 3 respectively. If # is omitted, output data for all three phases is returned as one single string. Value order for each phase is exactly as shown in the catalog, or in the order of the arguments passed.

Parameter (Unit). ENABLED (N/A), PRIMARIES ENABLED (N/A), STANDBY (N/A), CANNOT ENABLE OUT OF SYNC (N/A), CANNOT ENABLE RELAY CANNOT CLOSE WITH VOLTAGE (N/A), TRYING TO CLOSE RELAYS (N/A), POWER SAVE MODE STATE (N/A), POWER SAVE MODE TIMEOUT (N/A), MODIFIERS HARMONIC (N/A), MODIFIERS INTERHARMONIC (N/A), MODIFIERS DEVIATION (N/A), MODIFIERS ANALOG INPUT (N/A), MODIFIERS DIGITAL INPUT (N/A), MODIFIERS NEUTRAL (N/A), MODIFIERS DELTA (N/A), MODIFIERS OUTPUT IMPEDANCE (N/A), MODIFIERS SYNC MODE FAST (N/A), MODIFIERS HIGH IMPEDANCE (N/A), OUTPUT RELAY CONTROL MODE (N/A), OUTPUT RELAY CONTROL (N/A), OUTPUT RELAY STATUS (N/A), OUTPUT CAPACITANCE STATE (N/A), OUTPUT CAPACITANCE STATE EFFECTIVE (N/A), OUTPUT CAPACITANCE VALUE (uF)

Note: The total number, order, and meaning of readings returned by this command without arguments may change in future firmware versions as new functions are added or existing ones are modified. For this reason, it is strongly recommended to always specify the exact values you require as arguments (example: OUTPut:ALL? "ENABLED, OUTPUT RELAY STATUS, STANDBY"). A zero value is returned for an unrecognized argument.

Returned Data Format: <nr2>,<nr2>,...,<nr2>,<nr2>,

Query Example: OUTPut:ALL1?

0,1,0,0,0,0,1,5,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,1,22.00

Query Format: LOAD:ALL#? <OPTIONAL: List of measurements to return>

Description: Returns a comma delimited string containing the complete set of load configuration/status values for the selected phase #. The # is used to specify phase A, B, or C using 1, 2, or 3 respectively. If # is omitted, load data for all three phases is returned as one single string. Value order for each phase is exactly as shown in the catalog, or in the order of the arguments passed.

Parameter (Unit). TYPE (N/A), SYNC (N/A), SYNC FAST (N/A), SYNC PLL SPEED (N/A), UNSYNC ACTION (N/A), WAVEFORM RECTIFIER STATE (N/A), WAVEFORM RECTIFIER CF (N/A), WAVEFORM RECTIFIER FORM (N/A), WAVEFORM RECTIFIER CF MAX (N/A), WAVEFORM RECTIFIER CF MIN (N/A), TRANSITION CV STATE (N/A), TRANSITION CV ACT (N/A), TRANSITION CV THRESHOLD (V), TRANSITION CV THRESHOLD MAX (V), TRANSITION CV THRESHOLD MIN (V), TRANSITION CV THRESHOLD REC (V), TRANSITION CV THRESHOLD REC MAX (V), TRANSITION CV THRESHOLD REC MIN (V), TRANSITION CV TIMER (ms), TRANSITION CV TIMER MAX (ms), TRANSITION CV TIMER MIN (ms), TRANSITION CV TIMER REC (ms), TRANSITION CV TIMER REC MAX (ms), TRANSITION CV TIMER REC MIN (ms), TRANSITION CV MEASURE TIME (ms), TRANSITION CV MEASURE TIME MAX (ms), TRANSITION CV MEASURE TIME MIN (ms), TRANSITION CV MEASURE TIME AVG (ms), TRANSITION CV MEASURE TIME RECOVERY (ms), TRANSITION CV MEASURE TIME RECOVERY MAX (ms), TRANSITION CV MEASURE TIME RECOVERY MIN (ms), TRANSITION CV MEASURE TIME RECOVERY AVG (ms), CR TYPE (N/A), CR MODE (N/A), CR RESISTANCE SAT (N/A), CR STABILIZATION FACTOR (N/A), CR STABILIZATION FACTOR MAX (N/A), CR STABILIZATION FACTOR MIN (N/A), CR FILTER FREQUENCY (Hz), CR FILTER FREQUENCY MAX (Hz), CR FILTER FREQUENCY MIN (Hz), CR RESISTANCE (Ohm), CR RESISTANCE MAX (Ohm), CR RESISTANCE MIN (Ohm), CR RESISTANCE INF POS (Ohm), CR RESISTANCE INF NEG (Ohm), CR RESISTANCE AC (Ohm), CR RESISTANCE AC MAX (Ohm), CR RESISTANCE AC MIN (Ohm), CR RESISTANCE AC USER LIMIT MAX (Ohm), CR RESISTANCE AC USER LIMIT MIN (Ohm), CR RESISTANCE AC RANGE MAX (Ohm), CR RESISTANCE AC RANGE MIN (Ohm), CR RESISTANCE AC TRANSIENT MAX (Ohm), CR RESISTANCE AC TRANSIENT MIN (Ohm), CR RESISTANCE DC (Ohm), CR RESISTANCE DC MAX (Ohm), CR RESISTANCE DC MIN (Ohm), CR RESISTANCE DC USER LIMIT MAX (Ohm), CR RESISTANCE DC USER LIMIT MIN (Ohm), CR RESISTANCE DC RANGE MAX (Ohm), CR RESISTANCE DC RANGE MIN (Ohm), CR RESISTANCE DC TRANSIENT MAX (Ohm), CR RESISTANCE DC TRANSIENT MIN (Ohm), CR CONDUCTANCE (S), CR CONDUCTANCE MAX (S), CR CONDUCTANCE MIN (S), CR CONDUCTANCE AC (S), CR CONDUCTANCE AC MAX (S), CR CONDUCTANCE AC MIN (S), CR CONDUCTANCE AC USER LIMIT MAX (S), CR CONDUCTANCE AC USER LIMIT MIN (S), CR CONDUCTANCE AC RANGE MAX (S), CR CONDUCTANCE AC RANGE MIN (S), CR CONDUCTANCE AC TRANSIENT MAX (S), CR CONDUCTANCE AC TRANSIENT MIN (S), CR CONDUCTANCE DC (S), CR CONDUCTANCE DC MAX (S), CR CONDUCTANCE DC MIN (S), CR CONDUCTANCE DC USER LIMIT MAX (S), CR CONDUCTANCE DC USER LIMIT MIN (S), CR CONDUCTANCE DC RANGE MAX (S), CR CONDUCTANCE DC RANGE MIN (S), CR CONDUCTANCE DC TRANSIENT MAX (S), CR CONDUCTANCE DC TRANSIENT MIN (S), CP TYPE (N/A), CP MODE (N/A), CP POWER AC WARN (N/A), CP POWER AC (kW), CP POWER AC MAX (kW), CP POWER AC MIN (kW), CP POWER AC USER LIMIT MAX (kW), CP POWER AC USER LIMIT MIN (kW), CP POWER AC RANGE MAX (kW), CP POWER AC RANGE MIN (kW), CP POWER AC TRANSIENT MAX (kW), CP POWER AC TRANSIENT MIN (kW), CP POWER DC WARN (N/A), CP POWER DC (kW), CP POWER DC MAX (kW), CP POWER DC MIN (kW), CP POWER DC USER LIMIT MAX (kW), CP POWER DC USER LIMIT MIN (kW), CP POWER DC RANGE MAX (kW), CP POWER DC RANGE MIN (kW), CP POWER DC TRANSIENT MAX (kW), CP POWER DC TRANSIENT MIN (kW), CP KVA AC WARN (N/A), CP KVA AC (kVA), CP KVA AC MAX (kVA), CP KVA AC MIN (kVA), CP KVA AC USER LIMIT MAX (kVA), CP KVA AC USER LIMIT MIN (kVA), CP KVA AC RANGE MAX (kVA), CP KVA AC RANGE MIN (kVA), CP KVA AC TRANSIENT MAX (kVA), CP KVA AC TRANSIENT MIN (kVA), CP KVA DC WARN (N/A), CP KVA DC (kVA), CP KVA DC MAX (kVA), CP KVA DC MIN (kVA), CP KVA DC USER LIMIT MAX

(kVA), CP KVA DC USER LIMIT MIN (kVA), CP KVA DC RANGE MAX (kVA), CP KVA DC RANGE MIN (kVA), CP KVA DC TRANSIENT MAX (kVA), CP KVA DC TRANSIENT MIN (kVA), CE TYPE (N/A), CE STATE (N/A), CE R (Ohm), CE R MAX (Ohm), CE R MIN (Ohm), CE RL (Ohm), CE RL MAX (Ohm), CE RL MIN (Ohm), CE L (H), CE L MAX (H), CE L MIN (H), CE RC (Ohm), CE RC MAX (Ohm), CE RC MIN (Ohm), CE C (F), CE C MAX (F), CE C MIN (F), CE C VINITIAL (V), CE C VINITIAL MAX (V), CE C VINITIAL MIN (V), CE FILTER FREQUENCY (Hz), CE FILTER FREQUENCY MAX (Hz), CE FILTER FREQUENCY MIN (Hz)

Note: The total number, order, and meaning of readings returned by this command without arguments may change in future firmware versions as new functions are added or existing ones are modified. For this reason, it is strongly recommended to always specify the exact values you require as arguments (example: LOAD:ALL? "SYNC PLL SPEED, CR TYPE, TYPE"). A zero value is returned for an unrecognized argument.

Returned Data Format: <nr2>,<nr2>,...,<nr2>,<nr2>,

Query Example: LOAD:ALL1?

```
0,1,0,0,0,0,1.0000,0,10.0000,1.0000,0,0,0.0000,1000.0000,0.0000,0.0000,1000.0000,0.0000,0.0000,1
000.0000,0.0000,0.0000,1000.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,0.000
0,0,0,0,1.0000,100.0000,0.0000,100000.0000,100000.0000,0.0000,0.000000,99999.000000,-
99999.000000,99999.000000,-1000.000000,0.000000,99999.000000,-99999.000000,99999.000000,-
99999.000000,99999.000000,-99999.000000,99999.000000,-
99999.000000,0.000000,99999.000000,-99999.000000,99999.000000,-
99999.000000,99999.000000,-99999.000000,99999.000000,-99999.000000,0.000000,2.000000,-
2.000000,0.000000,2.000000,-2.000000,2.000000,-2.000000,2.000000,-2.000000,2.000000,-
2.000000,0.000000,2.000000,-2.000000,2.000000,-2.000000,2.000000,-2.000000,2.000000,-
2.000000,0,0,0,0.0000,18.3333,-18.3333,18.3333,-18.3333,18.3333,-18.3333,18.3333,-
18.3333,0,0.0000,18.3333,-18.3333,18.3333,-18.3333,18.3333,-18.3333,18.3333,-
18.3333,0,0.0000,18.3333,-18.3333,18.3333,-18.3333,18.3333,-18.3333,18.3333,-
18.3333,0,0.0000,18.3333,-18.3333,18.3333,-18.3333,18.3333,-18.3333,18.3333,-
18.3333,0,0,10.000000,99999.992188,0.000000,0.100000,9999.999023,0.000000,0.00100000,99.999
99237,0.00000000,0.100000,9999.999023,0.000000,0.00100000,0.09999999,0.00000000,0.0000,200
0.0000,-2000.0000,1000.0000,100000.0000,10.0000
```

Query Format: SOURce:IMPEDance:ALL#? <OPTIONAL: List of measurements to return>

Description: Returns a comma delimited string containing the complete set of impedance configuration/status values for the selected phase #. The # is used to specify phase A, B, or C using 1, 2, or 3 respectively. If # is omitted, impedance data for all three phases is returned as one single string. Value order for each phase is exactly as shown in the catalog, or in the order of the arguments passed.

Parameter (Unit). STATE (N/A), EXTEND (N/A), R SATURATED (N/A), CSC (N/A), MODE (N/A), R (Ohm), R MAX (Ohm), R MIN (Ohm), L (H), L MAX (H), L MIN (H), G (S), G MAX (S), G MIN (S), C (F), C MAX (F), C MIN (F), STABILIZATION FACTOR (N/A), STABILIZATION FACTOR MAX (N/A), STABILIZATION FACTOR MIN (N/A), FILTER FREQUENCY (Hz), FILTER FREQUENCY MAX (Hz), FILTER FREQUENCY MIN (Hz)

Note: The total number, order, and meaning of readings returned by this command without arguments may change in future firmware versions as new functions are added or existing ones are modified. For this reason, it is strongly recommended to always specify the exact

values you require as arguments (example: SOURce:IMPEDance:ALL? "STATE, EXTEND, CSC"). A zero value is returned for an unrecognized argument.

Returned Data Format: <nr2>,<nr2>,...,<nr2>,<nr2>,

Query Example: SOURce:IMPEDance:ALL1?

0,0,0,1,0,0.000,10.000,-10.000,0.000000000,0.002000000,-0.002000000,0.000,10.000,-
10.000,0.000000000,0.002000000,-
0.002000000,1.0000,1000.0000,0.0100,100000.0000,100000.0000,1.0000

Query Format: SOURce:INRush:ALL#? <OPTIONAL: List of measurements to return>

Description: Returns a comma delimited string containing the complete set of transient inrush configuration/status values for the selected phase #. The # is used to specify phase A, B, or C using 1, 2, or 3 respectively. If # is omitted, transient inrush data for all three phases is returned as one single string. Value order for each phase is exactly as shown in the catalog, or in the order of the arguments passed.

Parameter (Unit). LOADED (N/A), STATUS (N/A), PROGRESS (N/A), CURRENT ELEMENT PROGRESS (N/A), CURRENT ELEMENT (N/A), CURRENT ELEMENT TIME (N/A), ELEMENT TO EXECUTE (N/A), TOTAL TIME (N/A), TOTAL ELEMENTS (N/A), REPEAT TIMES (N/A), HOLD (N/A), EDIT MODE (N/A), EDIT MODE MAX (N/A), EDIT MODE MIN (N/A), PROGRAM MODE (N/A), PROGRAM MODE MAX (N/A), PROGRAM MODE MIN (N/A), CYCLES (N/A), CYCLES MAX (N/A), CYCLES MIN (N/A), CYCLES MAX REASON (N/A), CYCLES MIN REASON (N/A), REPEAT (N/A), REPEAT MAX (N/A), REPEAT MIN (N/A), FORM MODE (N/A), FORM MODE MAX (N/A), FORM MODE MIN (N/A), DECAY FACTOR (N/A), DECAY FACTOR MAX (N/A), DECAY FACTOR MIN (N/A), STEADY STATE TIME (s), STEADY STATE TIME MAX (s), STEADY STATE TIME MIN (s), PFC SIMULATION (N/A), PFC TURN ON TIME (ms), PFC TURN ON TIME MAX (ms), PFC TURN ON TIME MIN (ms), PFC RAMP TIME (ms), PFC RAMP TIME MAX (ms), PFC RAMP TIME MIN (ms), PFC VALUE AC (N/A), PFC VALUE AC MAX (N/A), PFC VALUE AC MIN (N/A), PFC VALUE AC SAT (N/A), PFC VALUE AC MAX REASON (N/A), PFC VALUE AC MIN REASON (N/A), FREQUENCY INITIAL (Hz), FREQUENCY FINAL (Hz), FREQUENCY DELTA (Hz), FREQUENCY INITIAL MAX (Hz), FREQUENCY FINAL MAX (Hz), FREQUENCY DELTA MAX (Hz), FREQUENCY INITIAL MIN (Hz), FREQUENCY FINAL MIN (Hz), FREQUENCY DELTA MIN (Hz), FREQUENCY INITIAL MAX REASON (N/A), FREQUENCY FINAL MAX REASON (N/A), FREQUENCY DELTA MAX REASON (N/A), FREQUENCY INITIAL MIN REASON (N/A), FREQUENCY FINAL MIN REASON (N/A), FREQUENCY DELTA MIN REASON (N/A), PHASE INITIAL (Deg), PHASE FINAL (Deg), PHASE DELTA (Deg), PHASE INITIAL MAX (Deg), PHASE FINAL MAX (Deg), PHASE DELTA MAX (Deg), PHASE INITIAL MIN (Deg), PHASE FINAL MIN (Deg), PHASE DELTA MIN (Deg), CF INITIAL (N/A), CF FINAL (N/A), CF DELTA (N/A), CF INITIAL MAX (N/A), CF FINAL MAX (N/A), CF DELTA MAX (N/A), CF INITIAL MIN (N/A), CF FINAL MIN (N/A), CF DELTA MIN (N/A), CF INITIAL MAX REASON (N/A), CF FINAL MAX REASON (N/A), CF DELTA MAX REASON (N/A), CF INITIAL MIN REASON (N/A), CF FINAL MIN REASON (N/A), CF DELTA MIN REASON (N/A), VALUE AC INITIAL (N/A), VALUE AC FINAL (N/A), VALUE AC DELTA (N/A), VALUE AC INITIAL MAX (N/A), VALUE AC FINAL MAX (N/A), VALUE AC DELTA MAX (N/A), VALUE AC INITIAL MIN (N/A), VALUE AC FINAL MIN (N/A), VALUE AC DELTA MIN (N/A), VALUE AC INITIAL MAX REASON (N/A), VALUE AC FINAL MAX REASON (N/A), VALUE AC DELTA MAX REASON (N/A), VALUE AC INITIAL MIN REASON (N/A), VALUE AC FINAL MIN REASON (N/A), VALUE AC DELTA MIN REASON (N/A), VALUE AC INITIAL SAT (N/A), VALUE AC FINAL SAT (N/A), VALUE AC DELTA SAT (N/A), PEAK VALUE INITIAL (N/A), PEAK VALUE FINAL (N/A), PEAK VALUE DELTA (N/A), PEAK VALUE INITIAL MAX (N/A), PEAK VALUE FINAL MAX (N/A), PEAK VALUE DELTA MAX (N/A), PEAK VALUE INITIAL MIN (N/A), PEAK VALUE FINAL MIN (N/A), PEAK VALUE

DELTA MIN (N/A), PEAK VALUE INITIAL MAX REASON (N/A), PEAK VALUE FINAL MAX REASON (N/A),
PEAK VALUE DELTA MAX REASON (N/A), PEAK VALUE INITIAL MIN REASON (N/A), PEAK VALUE FINAL
MIN REASON (N/A), PEAK VALUE DELTA MIN REASON (N/A), PEAK VALUE INITIAL SAT (N/A), PEAK
VALUE FINAL SAT (N/A), PEAK VALUE DELTA SAT (N/A), WAVEFORM (N/A), WAVEFORM EXIST (N/A),
WAVEFORM MAX (N/A), WAVEFORM MIN (N/A)

Note: The total number, order, and meaning of readings returned by this command without arguments may change in future firmware versions as new functions are added or existing ones are modified. For this reason, it is strongly recommended to always specify the exact values you require as arguments (example: `SOURCE:INRUSH:ALL? "WAVEFORM, PEAK VALUE INITIAL MIN, PEAK VALUE INITIAL SAT"`). A zero value is returned for an unrecognized argument.

Returned Data Format: <nr2>,<nr2>,...,<nr2>,<nr2>,

Query Example: SOURce:INRUsh:ALL1?

0,0,0,0,0,0,0,0,0,0,0,1,0,2,0,2,2,0,10,10000,1,0,0,1,65535,0,0,2,0,1,0,50,0,0,0,0,1000,10000.0000,0.000
0,0,0,1000,10000.0000,0.0000,0.0001,10000.0000,0.0001,0.00000,230.00000,-
230.00000,0,3,3,60.0000,60.0000,0.0000,1000.0000,1000.0000,100000.0000,15.0000,15.0000,-
100000.0000,2,2,2,0,0,0,0.0000,0.0000,0.0000,99999.0000,99999.0000,99999.0000,-99999.0000,-
99999.0000,-99999.0000,1.0000,1.0000,0.0000,10.0000,10.0000,100000.0000,1.0000,1.0000,-
100000.0000,0,0,0,0,0,0,0.0000,0.0000,0.0000,230.0000,230.0000,100000.0000,-230.0000,-
230.0000,-100000.0000,3,3,3,3,3,0,0,0,0.0000,0.0000,0.0000,230.0000,230.0000,100000.0000,-
230.0000,-230.0000,-100000.0000,3,3,3,3,3,0,0,0,0,0,0,0

Query Format: SOURce:PULSe:ALL#? <OPTIONAL: List of measurements to return>

Description: Returns a comma delimited string containing the complete set of transient pulse configuration/status values for the selected phase #. The # is used to specify phase A, B, or C using 1, 2, or 3 respectively. If # is omitted, transient pulse data for all three phases is returned as one single string. Value order for each phase is exactly as shown in the catalog, or in the order of the arguments passed.

Parameter (Unit). LOADED (N/A), STATUS (N/A), PROGRESS (N/A), CURRENT ELEMENT PROGRESS (N/A), CURRENT ELEMENT (N/A), CURRENT ELEMENT TIME (N/A), ELEMENT TO EXECUTE (N/A), TOTAL TIME (N/A), TOTAL ELEMENTS (N/A), REPEAT TIMES (N/A), COUNT (N/A), COUNT MAX (N/A), COUNT MIN (N/A), DCYCLE (%), DCYCLE MAX (%), DCYCLE MIN (%), PERIOD (s), PERIOD MAX (s), PERIOD MIN (s), WIDTH (s), WIDTH MAX (s), WIDTH MIN (s), RAMP (s), RAMP MAX (s), RAMP MIN (s), MODE (N/A), MODE MAX (N/A), MODE MIN (N/A), FREQUENCY (Hz), FREQUENCY MAX (Hz), FREQUENCY MIN (Hz), FREQUENCY MAX REASON (N/A), FREQUENCY MIN REASON (N/A), VALUE (N/A), VALUE MAX (N/A), VALUE MIN (N/A), VALUE MAX REASON (N/A), VALUE MIN REASON (N/A), VALUE SAT (N/A), VALUE AC (N/A), VALUE AC MAX (N/A), VALUE AC MIN (N/A), VALUE AC MAX REASON (N/A), VALUE AC MIN REASON (N/A), VALUE AC SAT (N/A), VALUE DC (N/A), VALUE DC MAX (N/A), VALUE DC MIN (N/A), VALUE DC MAX REASON (N/A), VALUE DC MIN REASON (N/A), VALUE DC SAT (N/A), PHASE (Deg), PHASE MAX (Deg), PHASE MIN (Deg), WAVEFORM (N/A), WAVEFORM EXIST (N/A), WAVEFORM MAX (N/A), WAVEFORM MIN (N/A)

Note: The total number, order, and meaning of readings returned by this command without arguments may change in future firmware versions as new functions are added or existing

ones are modified. For this reason, it is strongly recommended to always specify the exact values you require as arguments (example: `SOURCE:PULSE:ALL? "LOADED, VALUE, VALUE MAX"`). A zero value is returned for an unrecognized argument.

Returned Data Format: <nr2>,<nr2>,,,,,<nr2>,<nr2>,

Query Example: SOURce:PULSe:ALL1?

0,0,0,0,0,0,0,0,0,0,1,65535,0,50.0000,100.0000,0.0000,0.2000,50000.0000,0.0008,0.1000,50000.0000,0.0006,0.0002,0.0500,0.0000,0,2,0,60.000,1000.000,15.000,2,0,0.00000,240.00000,-240.00000,0,0,0.00000,240.00000,-240.00000,0,0,0.00000,340.00000,-340.00000,1,1,0,0.000,1080.000,-1080.000,1,1,200,1

Query Format: SOURce:STEP:ALL#? <OPTIONAL: List of measurements to return>

Description: Returns a comma delimited string containing the complete set of transient step configuration/status values for the selected phase #. The # is used to specify phase A, B, or C using 1, 2, or 3 respectively. If # is omitted, transient step data for all three phases is returned as one single string. Value order for each phase is exactly as shown in the catalog, or in the order of the arguments passed.

Parameter (Unit). LOADED (N/A), STATUS (N/A), PROGRESS (N/A), CURRENT ELEMENT PROGRESS (N/A), CURRENT ELEMENT (N/A), CURRENT ELEMENT TIME (N/A), ELEMENT TO EXECUTE (N/A), TOTAL TIME (N/A), TOTAL ELEMENTS (N/A), REPEAT TIMES (N/A), HOLD (N/A), INIT (N/A), MODE (N/A), MODE MAX (N/A), MODE MIN (N/A), LENGTH (ms), LENGTH MAX (ms), LENGTH MIN (ms), DWELL (N/A), DWELL MAX (N/A), DWELL MIN (N/A), RAMP (ms), RAMP MAX (ms), RAMP MIN (ms), REPEAT (N/A), REPEAT MAX (N/A), REPEAT MIN (N/A), COUNT (N/A), COUNT MAX (N/A), COUNT MIN (N/A), COUNT MAX REASON (N/A), COUNT MIN REASON (N/A), FREQUENCY INITIAL (Hz), FREQUENCY FINAL (Hz), FREQUENCY DELTA (Hz), FREQUENCY INITIAL MAX (Hz), FREQUENCY FINAL MAX (Hz), FREQUENCY DELTA MAX (Hz), FREQUENCY INITIAL MIN (Hz), FREQUENCY FINAL MIN (Hz), FREQUENCY DELTA MIN (Hz), FREQUENCY INITIAL MAX REASON (N/A), FREQUENCY FINAL MAX REASON (N/A), FREQUENCY DELTA MAX REASON (N/A), FREQUENCY INITIAL MIN REASON (N/A), FREQUENCY FINAL MIN REASON (N/A), FREQUENCY DELTA MIN REASON (N/A), VALUE INITIAL (N/A), VALUE FINAL (N/A), VALUE DELTA (N/A), VALUE INITIAL MAX (N/A), VALUE FINAL MAX (N/A), VALUE DELTA MAX (N/A), VALUE INITIAL MIN (N/A), VALUE FINAL MIN (N/A), VALUE DELTA MIN (N/A), VALUE INITIAL MAX REASON (N/A), VALUE FINAL MAX REASON (N/A), VALUE DELTA MAX REASON (N/A), VALUE INITIAL MIN REASON (N/A), VALUE FINAL MIN REASON (N/A), VALUE DELTA MIN REASON (N/A), VALUE INITIAL SAT (N/A), VALUE FINAL SAT (N/A), VALUE DELTA SAT (N/A), VALUE AC INITIAL (N/A), VALUE AC FINAL (N/A), VALUE AC DELTA (N/A), VALUE AC INITIAL MAX (N/A), VALUE AC FINAL MAX (N/A), VALUE AC DELTA MAX (N/A), VALUE AC INITIAL MIN (N/A), VALUE AC FINAL MIN (N/A), VALUE AC DELTA MIN (N/A), VALUE AC INITIAL MAX REASON (N/A), VALUE AC FINAL MAX REASON (N/A), VALUE AC DELTA MAX REASON (N/A), VALUE AC INITIAL MIN REASON (N/A), VALUE AC FINAL MIN REASON (N/A), VALUE AC DELTA MIN REASON (N/A), VALUE AC INITIAL SAT (N/A), VALUE AC FINAL SAT (N/A), VALUE AC DELTA SAT (N/A), VALUE DC INITIAL (N/A), VALUE DC FINAL (N/A), VALUE DC DELTA (N/A), VALUE DC INITIAL MAX (N/A), VALUE DC FINAL MAX (N/A), VALUE DC DELTA MAX (N/A), VALUE DC INITIAL MIN (N/A), VALUE DC FINAL MIN (N/A), VALUE DC DELTA MIN (N/A), VALUE DC INITIAL MAX REASON (N/A), VALUE DC FINAL MAX REASON (N/A), VALUE DC DELTA MAX REASON (N/A), VALUE DC INITIAL MIN REASON (N/A), VALUE DC FINAL MIN REASON (N/A), VALUE DC DELTA MIN REASON (N/A), VALUE DC INITIAL SAT (N/A), VALUE DC FINAL SAT (N/A), VALUE DC DELTA SAT (N/A), PHASE INITIAL (Deg), PHASE FINAL (Deg), PHASE DELTA (Deg), PHASE INITIAL

MAX (Deg), PHASE FINAL MAX (Deg), PHASE DELTA MAX (Deg), PHASE INITIAL MIN (Deg), PHASE FINAL MIN (Deg), PHASE DELTA MIN (Deg), WAVEFORM (N/A), WAVEFORM EXIST (N/A), WAVEFORM MAX (N/A), WAVEFORM MIN (N/A)

Note: The total number, order, and meaning of readings returned by this command without arguments may change in future firmware versions as new functions are added or existing ones are modified. For this reason, it is strongly recommended to always specify the exact values you require as arguments (example: SOURce:STEP:ALL? "FREQUENCY INITIAL, FREQUENCY FINAL, FREQUENCY DELTA"). A zero value is returned for an unrecognized argument.

Returned Data Format: <nr2>,<nr2>,...,<nr2>,<nr2>,

Query Example: SOURce:STEP:ALL1?

```
0,0,0,0,0,0,0,0,0,1,1,0,2,0,0.1000,10000.0000,0.0002,0.0998,10000.0000,0.0002,0.0002,10000.0000
0,0.0000,1,65535,0,10,100,1,0,0,60.0000,60.0000,0.0000,1000.0000,1000.0000,94.0000,15.0000,15.
0000,-4.5000,2,2,2,0,0,0.000000,0.000000,0.000000,230.00000,230.00000,23.00000,-230.00000,-
230.00000,-23.00000,3,3,3,3,3,0,0,0.00000,0.00000,0.00000,230.00000,230.00000,23.00000,-
230.00000,-230.00000,-
23.00000,3,3,3,3,3,0,0,0.00000,0.00000,0.00000,340.00000,340.00000,34.00000,-340.00000,-
340.00000,-34.00000,1,1,1,1,1,0,0,0.0000,0.0000,0.0000,99999.0000,99999.0000,99999.0000,-
99999.0000,-99999.0000,-99999.0000,1,1,200,1
```

Query Format: SOURce:DEVIation:ALL#? <OPTIONAL: List of measurements to return>

Description: Returns a comma delimited string containing the complete set of deviation configuration/status values for the selected phase #. The # is used to specify phase A, B, or C using 1, 2, or 3 respectively. If # is omitted, deviation data for all three phases is returned as one single string. Value order for each phase is exactly as shown in the catalog, or in the order of the arguments passed.

Parameter (Unit). AC VALUE FACTOR (N/A), AC VALUE FACTOR MAX (N/A), AC VALUE FACTOR MIN (N/A), DC VALUE FACTOR (N/A), DC VALUE FACTOR MAX (N/A), DC VALUE FACTOR MIN (N/A), FREQUENCY FACTOR (N/A), FREQUENCY FACTOR MAX (N/A), FREQUENCY FACTOR MIN (N/A), PHASE FACTOR (N/A), PHASE FACTOR MAX (N/A), PHASE FACTOR MIN (N/A), AC VALUE VARIABLE CENTER (N/A), AC VALUE VARIABLE CENTER MAX (N/A), AC VALUE VARIABLE CENTER MIN (N/A), DC VALUE VARIABLE CENTER (N/A), DC VALUE VARIABLE CENTER MAX (N/A), DC VALUE VARIABLE CENTER MIN (N/A), FREQUENCY VARIABLE CENTER (N/A), FREQUENCY VARIABLE CENTER MAX (N/A), FREQUENCY VARIABLE CENTER MIN (N/A), PHASE VARIABLE CENTER (N/A), PHASE VARIABLE CENTER MAX (N/A), PHASE VARIABLE CENTER MIN (N/A), AC VALUE SLEW RATE (x/ms RMS), AC VALUE SLEW RATE MAX (x/ms RMS), AC VALUE SLEW RATE MIN (x/ms RMS), DC VALUE SLEW RATE (x/ms DC), DC VALUE SLEW RATE MAX (x/ms DC), DC VALUE SLEW RATE MIN (x/ms DC), FREQUENCY SLEW RATE (x/ms), FREQUENCY SLEW RATE MAX (x/ms), FREQUENCY SLEW RATE MIN (x/ms), PHASE SLEW RATE (Deg/ms), PHASE SLEW RATE MAX (Deg/ms), PHASE SLEW RATE MIN (Deg/ms), AC VALUE RANGE (N/A RMS), AC VALUE RANGE MAX (N/A RMS), AC VALUE RANGE MIN (N/A RMS), DC VALUE RANGE (N/A DC), DC VALUE RANGE MAX (N/A DC), DC VALUE RANGE MIN (N/A DC), FREQUENCY RANGE (Hz), FREQUENCY RANGE MAX (Hz), FREQUENCY RANGE MIN (Hz), PHASE RANGE (Deg), PHASE RANGE MAX (Deg), PHASE RANGE MIN (Deg), AC VALUE VARIABLE INDEX (N/A), DC VALUE VARIABLE INDEX (N/A), FREQUENCY VARIABLE INDEX (N/A), PHASE VARIABLE INDEX (N/A)

Note: The total number, order, and meaning of readings returned by this command without arguments may change in future firmware versions as new functions are added or existing ones are modified. For this reason, it is strongly recommended to always specify the exact values you require as arguments (example: SOURce:DEVIation:ALL? “AC VALUE FACTOR, AC VALUE FACTOR MAX, AC VALUE FACTOR MIN”). A zero value is returned for an unrecognized argument.

Returned Data Format: <nr2>,<nr2>,...,<nr2>,<nr2>,

Query Example: SOURce:DEVIation:ALL1?

```
0.000|0.000|0.000,999.999,-999.999,0.000|0.000|0.000,999.999,-
999.999,0.000|0.000|0.000,999.999,-999.999,0.000|0.000|0.000,999.999,-
999.999,0.000|0.000|0.000,999.999,-999.999,0.000|0.000|0.000,999.999,-
999.999,0.000|0.000|0.000,999.999,-999.999,0.000|0.000|0.000,999.999,-
999.999,0.100,1500.000,0.010,0.100,1500.000,0.010,0.050,1500.000,0.010,0.050,1500.000,0.010,10
00.000,1000.000,0.000,1000.000,1000.000,0.000,10000.000,1000.000,0.000,1000.000,1000.000,0.00
0,0|0|0,0|0,0|0|0,0|0|0
```

Query Format: TEST:AISLanding:ALL#? <OPTIONAL: List of measurements to return>

Description: Returns a comma delimited string containing the complete set of anti aislanding test configuration/status values for the selected phase #. The # is used to specify phase A, B, or C using 1, 2, or 3 respectively. If # is omitted, anti aislanding test data for all three phases is returned as one single string. Value order for each phase is exactly as shown in the catalog, or in the order of the arguments passed.

Parameter (Unit). RUNNING (N/A), DISCONNECTED (N/A), STROBE (N/A), DISCONNECTION TIME (N/A), DISCONNECTION WINDOW TIME (ms), DISCONNECTION WINDOW TIME MAX (ms), DISCONNECTION WINDOW TIME MIN (ms), DISCONNECTION WINDOW TIME DEFAULT (ms), DISCONNECTION CURRENT THRESHOLD (A), DISCONNECTION CURRENT THRESHOLD MAX (A), DISCONNECTION CURRENT THRESHOLD MIN (A), DISCONNECTION CURRENT THRESHOLD DEFAULT (A), MODE (N/A), R (Ohm), R MAX (Ohm), R MIN (Ohm), C (F), C MAX (F), C MIN (F), L (H), L MAX (H), L MIN (H), Q (VAR), Q MAX (VAR), Q MIN (VAR), P (W), P MAX (W), P MIN (W), VAC (V), VAC MAX (V), VAC MIN (V), VAL (V), VAL MAX (V), VAL MIN (V), CURR (A), CURR MAX (A), CURR MIN (A), CURR C (A), CURR C MAX (A), CURR C MIN (A), CURR L (A), CURR L MAX (A), CURR L MIN (A), VOLTAGE MARGIN (%), VOLTAGE MARGIN MAX (%), VOLTAGE MARGIN MIN (%), FILTER FREQUENCY (Hz), FILTER FREQUENCY MAX (Hz), FILTER FREQUENCY MIN (Hz), FILTER FREQUENCY DEFAULT (Hz), SCOPE TRIGGER (N/A), MEASURE FREQUENCY (Hz), MEASURE VOLTAGE (V), MEASURE CURR (A), MEASURE ACTIVE POWER (W), MEASURE APPARENT POWER (VA), MEASURE REACTIVE POWER (VAR), MEASURE POWER FACTOR (N/A), COMPUTED R (Ohm), COMPUTED L (H), COMPUTED C (F), COMPUTED Q (VAR), COMPUTED P (W), COMPUTED VAC (V), COMPUTED VAL (V), COMPUTED CURR (A), COMPUTED CURR C (A), COMPUTED CURR L (A)

Note: The total number, order, and meaning of readings returned by this command without arguments may change in future firmware versions as new functions are added or existing ones are modified. For this reason, it is strongly recommended to always specify the exact values you require as arguments (example: TEST:AISLanding:ALL? “MEASURE FREQUENCY, MEASURE VOLTAGE, MEASURE CURR”). A zero value is returned for an unrecognized argument.

Returned Data Format: <nr2>,<nr2>,...,<nr2>,<nr2>,

Query Example: TEST:AISLanding:ALL1?

0,0,0,0.00000,0.100,100.000,0.001,0.100,2.000,1000.000,0.000,2.000,0,0.000,500.000,0.000,0.000,9
999.000,0.000,0.000,9999.000,0.000,1.000,100.000,0.000,0.000,9999.000,0.000,0.000,9999.000,0.00
0,0.000,9999.000,0.000,0.000,9999.000,0.000,0.000,9999.000,0.000,0.000,9999.000,0.000,1.250,100
.000,0.000,100000.0,100000.0,100.0,100000.0,3,60.000,5.000,0.035,-
0.0000,0.0000,0,0.000,0.000,0.000,0.000,1.000,0.000,0.000,0.000,0.000,0.000,0.000

8.5.2 Measurement Catalog Query Commands

Query Format: SOURce:ALL:CATalog?

Description: Returns a comma-separated human-readable list of available measurements in the same order as the commands returns it if no arguments are specified. See SOURce:ALL#? Command for parameter list as a function of Firmware revision.

Query Format: SOURce:WAVEFORM:ALL:CATalog?

Description: Returns a comma-separated human-readable list of available measurements in the same order as the commands returns it if no arguments are specified. See SOURce:WAVEFORM:ALL #? Command for parameter list as a function of Firmware revision.

Query Format: SOURce:PROTect:ALL:CATalog?

Description: Returns a comma-separated human-readable list of available measurements in the same order as the commands returns it if no arguments are specified. See SOURce:PROTect:ALL#? Command for parameter list as a function of Firmware revision.

Query Format: SOURce:PEAK:ALL:CATalog?

Description: Returns a comma-separated human-readable list of available measurements in the same order as the commands returns it if no arguments are specified. See SOURce:PEAK:ALL#? Command for parameter list as a function of Firmware revision.

Query Format: SOURce:INTHarmonic:ALL:CATalog?

Description: Returns a comma-separated human-readable list of available measurements in the same order as the commands returns it if no arguments are specified. See SOURce:INTHarmonic:ALL#? Command for parameter list as a function of Firmware revision.

Query Format: SOURce:SLEW:ALL:CATalog?

Description: Returns a comma-separated human-readable list of available measurements in the same order as the commands returns it if no arguments are specified. See SOURce:SLEW:ALL#? Command for parameter list as a function of Firmware revision.

Query Format: SOURce:CSC:ALL:CATalog?

Description: Returns a comma-separated human-readable list of available measurements in the same order as the commands returns it if no arguments are specified. See SOURce:CSC:ALL#? Command for parameter list as a function of Firmware revision.

Query Format: SOURce:ALL:USERlimits:CATalog?

Description: Returns a comma-separated human-readable list of available measurements in the same order as the commands returns it if no arguments are specified. See SOURce:ALL:USERlimits#? Command for parameter list as a function of Firmware revision.

Query Format: STATus:ALL:CATalog?

Description: Returns a comma-separated human-readable list of available measurements in the same order as the commands returns it if no arguments are specified. See STATus:ALL#? Command for parameter list as a function of Firmware revision.

Related Catalogs: STATus:ALL:BITS:CATalog?, STATus:ALL:EXTended:BITS:CATalog?, STATus:ALL:FAULTs:BITS:CATalog?, STATus:ALL:WARNings:BITS:CATalog?, STATus:ALL:FEATures:BITS:CATalog?, STATus:ALL:FEATures:EXTended:CATalog?, STATus:ALL:AUXiliary:LMX:BITS:CATalog?, STATus:ALL:OUTPut:BITS:CATalog?

Query Format: OUTPut:ALL:CATalog?

Description: Returns a comma-separated human-readable list of available measurements in the same order as the commands returns it if no arguments are specified. See OUTPut:ALL#? Command for parameter list as a function of Firmware revision.

Query Format: LOAD:ALL:CATalog?

Description: Returns a comma-separated human-readable list of available measurements in the same order as the commands returns it if no arguments are specified. See LOAD:ALL#? Command for parameter list as a function of Firmware revision.

Query Format: SOURce:IMPEDance:ALL:CATalog?

Description: Returns a comma-separated human-readable list of available measurements in the same order as the commands returns it if no arguments are specified. See SOURce:IMPEDance:ALL#? Command for parameter list as a function of Firmware revision.

Query Format: SOURce:INRUsh:ALL:CATalog?

Description: Returns a comma-separated human-readable list of available measurements in the same order as the commands returns it if no arguments are specified. See SOURce:INRUsh:ALL#? Command for parameter list as a function of Firmware revision.

Query Format: SOURce:PULSe:ALL:CATalog?

Description: Returns a comma-separated human-readable list of available measurements in the same order as the commands returns it if no arguments are specified. See SOURce:PULSe:ALL#? Command for parameter list as a function of Firmware revision.

Query Format: SOURce:STEP:ALL:CATalog?

Description: Returns a comma-separated human-readable list of available measurements in the same order as the commands returns it if no arguments are specified. See SOURce:STEP:ALL#? Command for parameter list as a function of Firmware revision.

Query Format: SOURce:DEVlation:ALL:CATalog?

Description: Returns a comma-separated human-readable list of available measurements in the same order as the commands returns it if no arguments are specified. See SOURce:DEVlation:ALL#? Command for parameter list as a function of Firmware revision.

Query Format: TEST:AISLanding:ALL:CATalog?

Description: Returns a comma-separated human-readable list of available measurements in the same order as the commands returns it if no arguments are specified. See TEST:AISLanding:ALL#? Command for parameter list as a function of Firmware revision.

8.6 Output Control Commands

The output command subsystem is used to control the output state of the power source or the input contactor in load mode.

Command Syntax
Description

OUTPut:[STATe]

Enables or Disables power output or load input depending on operating mode. When enabled, all output relays are closed. When disabled, all output relays are open. The time it takes for the output to turn on is determined by the status of the OUTP:FAST setting. If the power source is in sleep mode (all power stages are off), it will take about 2.2 seconds before the output relays are closed. This is required to let all stages settle. If the power source is in standby mode, it will only take 200 msec to close the output relay as only the second (inverter) stage needs to settle.

Note: Sending the OUTP OFF command will only cause the second stage to be turned off. The primary stages remain on and thus the AC source will be in standby mode. If OUTP:FAST = 0, the primary stages will turn off after 5 minutes of non-use and the AC source will enter sleep mode.

Refer to section 6.2.2, “Energy Savings Modes” for more details.

< 0 | OFF | 1 | ON >

Parameters

Parameter Format

Example

Query Format

Returned Data Format

Query Example

OUTP ON

OUTPut:[STATe]?

OUTP?

1

Command Syntax
Description

OUTPut[:STATe]:ALL

This command enables or disables the output and is similar to the OUTPut[:STATe] command but always turns off all power stages, regardless of the energy savings mode set with the OUTP:FAST command. Thus, the OUTP:ALL OFF command will turn off all power stages and put the AC source in sleep mode.

Note: The OUTP:ALL ON command has the same effect as the OUTP ON command.

< 0 | OFF | 1 | ON >

Parameters

Parameter Format

Example

OUTP:ALL OFF

Query Syntax
Description

Parameters
Parameter Format
Example

OUTPut:ALL?

This command returns the state of the unit. The order in which parameters for each phase are returned by be obtained using the OUTPut:ALL:CATalog? Query command. For data per phase use the phase specifier, 1, 2 or 3.

Comma separated list

OUTPut:ALL?

0,0,0,0,0,0,1,30,0,0,0,0,0,0,0,0,0,0,1,0,0,1,1,10.00,0,0,0,0,0,0,1,30,0,0,0,0,0,0,0,0,0,1,0,0,1,1,10.00,0,0,0,0,0,0,1,30,0,0,0,0,0,0,0,0,0,1,0,0,1,1,10.00

Query Syntax
Description

Parameters
Parameter Format
Example

OUTPut:ALL:CATalog?

This command returns the list of parameters and the order in which they are returned by the OUTput:ALL? Command..

Comma separated list

<string>

OUTPut:ALL:CATalog?

ENABLED,PRIMARYES ENABLED,STANDBY,CANNOT ENABLE OUT OF SYNC,CANNOT ENABLE RELAY CANNOT CLOSE WITH VOLTAGE,TRYING TO CLOSE RELAYS,POWER SAVE MODE STATE,POWER SAVE MODE TIMEOUT,MODIFIERS HARMONIC,MODIFIERS INTERHARMONIC,MODIFIERS DEVIATION,MODIFIERS ANALOG INPUT,MODIFIERS DIGITAL INPUT,MODIFIERS NEUTRAL,MODIFIERS DELTA,MODIFIERS OUTPUT IMPEDANCE,MODIFIERS SYNC MODE FAST,MODIFIERS HIGH IMPEDANCE,OUTPUT RELAY CONTROL MODE,OUTPUT RELAY CONTROL,OUTPUT RELAY STATUS,OUTPUT CAPACITANCE STATE,OUTPUT CAPACITANCE STATE EFFECTIVE,OUTPUT CAPACITANCE VALUE

Command Syntax	OUTPut[:STATe]:AUTO
Description	This commands determines the state of the OUTPUT when the power source is turned on (powered on).
OUTPut:AUTO = ON	The output will be enabled at power on IF it was ON at the time the front panel circuit breaker of the unit was switched off. Thus, the output state will revert to the last state before power-off. This command in combination with the “[SOURce:]INITial” command allows the unattended resumption of a test station after a power failure. Note: This condition is potentially hazardous and should be used with caution.
OUTPut:AUTO = OFF	The output will always come up in the OFF state.
Parameters	< 0 OFF 1 ON >
Parameter Format	
Example	OUTP:AUTO ON
Query Format	OUTPut[:STATe]:AUTO?
Returned Data Format	
Query Example	OUTP:AUTO? 1
Command Syntax	OUTPut:STANdby
Description	In standby mode, the primary power stages are enabled. For voltage/current source mode, it allows a faster enable of the output stage. For load modes, it allows measuring voltage input sense, closing relays, and synchronizing to input voltage before enabling the load.
Parameters	None
Example	OUTP:STAN 1
Query Format	OUTPut:STANby?
Returned Data Format	<nr1>
Query Example	OUTP:STAN? 1

Command Syntax	OUTPut[:STATe]:AUTO
Description	This command determines the state of the OUTPUT when the power source is turned on (powered on).
OUTPut:AUTO = ON	The output will be enabled at power on IF it was ON at the time the front panel circuit breaker of the unit was switched off. Thus, the output state will revert to the last state before power-off. This command in combination with the “[SOURce:]INITial” command allows the unattended resumption of a test station after a power failure. Note: This condition is potentially hazardous and should be used with caution.
OUTPut:AUTO = OFF	The output will always come up in the OFF state.
Parameters	< 0 OFF 1 ON >
Parameter Format	
Example	OUTP:AUTO ON
Query Format	OUTPut[:STATe]:AUTO?
Returned Data Format	
Query Example	OUTP:AUTO? 1
Command Syntax	OUTPut:STANdby
Description	In standby mode, the primary power stages are enabled. For voltage/current source mode, it allows a faster enable of the output stage. For load modes, it allows measuring voltage input sense, closing relays, and synchronizing to input voltage before enabling the load.
Parameters	None
Example	OUTP:STAN 1
Query Format	OUTPut:STANby?
Returned Data Format	<nr1>
Query Example	OUTP:STAN? 1

Command Syntax Description	OUTPut:CAPacitors:CONTRol# < 0 1 > Sets the capacitance of the selected phase or all phases if phase reference is omitted. • In single all phases are connected in parallel, so the capacitance is multiplied by three. • With units in parallel, the capacitance is multiplied also by the number of units in parallel. • For high impedance operation if the rise/fall time is not a problem it is recommended to use more capacitance to reduce the rise rate of the voltage
Parameters	< 0 1 >
Parameter Format	
Example	OUTP:CAP:CONT2 1
Query Format	OUTPut:CAPacitors:CONTRol#?
Returned Data Format	
Query Example	OUTP:CAP:CONT1? 0
Query Format Description	OUTPut:CAPacitors:STATe#? Returns the state of the Capacitor selection of the selected phase inverter module.
Returned Data Format	
Query Example	OUTP:CAP:STAT1? 1
Query Format Description	OUTPut:CAPacitors:VALue#? Returns the output capacitance value of the selected phase inverter module in microFarads.
Returned Data Format	<nr2>
Query Example	OUTP:CAP:VAL? 4.40
Query Format Description	OUTPut:CAPacitors:CONTRol:CATalog? Returns the supported Capacitor settings of the unit.
Returned Data Format	
Query Example	OUTPut:CAPacitors:CONTRol:CATalog? 0,Minimum,1,Maximum

Command Syntax	OUTPut:DISABLEPHase
Description	This command sets the disable phase angle. This is the phase angle on phase A at which the power source output will be disabled. Available range is 0 ~ 360. Also allows a negative number that indicates a RANDOM phase angle. Refer also to the OUTPut:ZEROpogram command.
Parameters	0.0 ~ 360.0 or negative number
Parameter Format	<nr2>
Example	OUTPDISABLEPH 90.0 OUTPDISABLEPH -1
Query Format	OUTPut:DISABLEPHase?
Returned Data Format	<nr2>
Query Example	OUTP:DISABLEPH? 90.000
Query Syntax	OUTPut:DISABLEPHase:MINimum OUTPut:DISABLEPHase:MAXimum OUTPut:DISABLEPHase:DEFault
Description	These query commands return minimum, maximum and default Output Disable Phase values respectively. Available range is -0.01 (Random) through 360.0.
Returned Data Format	<nr2>
Query Example	OUTP:DISABLEPH:MIN? -0.010 OUTP:DISABLEPH:MAX? 360.000 OUTP:DISABLEPH:DEF? 0.000
Query Syntax	OUTPut:RELAY:STATe#?
Description	This command returns the output relay state as either ON (1) or OFF (0). A phase selection 1, 2 or 3 may be added.
Example	OUTP:RELAY:STAT? 1 OUTP:RELAY:STAT2? 0

Command Syntax Description	OUTPut:RELAY:CONTRol# With Output Relay configured in Manual mode and the output enabled in standby mode, this command closes or opens the output relay. Refer to section 3.9.5, “Load Relay Control In Load Mode” on page 36 for more details.
Parameters	0.0 ~ 360.0 or negative number
Parameter Format	<nr2>
Example	OUTPDISABLEPH 90.0 OUTPDISABLEPH -1
Query Format	OUTPut:RELAY:CONTRol#?
Returned Data Format	<nr1>
Query Example	OUTP:RELAY:CONT2? 1
Command Syntax Description	OUTPut:RELAY:CONTRol:MODEx This command selects between two available modes: AUTO or MANUAL. In AUTO mode, the output relay control is disabled, and the system controls it automatically. In MANUAL mode, the user can control the output relay as needed. Refer to section 3.9.5, “Load Relay Control In Load Mode” on page 36 for more details.
Parameters	0 1
Parameter Format	<nr1>
Example	OUTP:RELAY:CONT:MODE 1
Query Format	OUTPut:RELAY:CONTRol:MODE#?
Returned Data Format	<nr1>
Query Example	OUTP:RELAY:CONT:MODE2? 0
Query Syntax Description	OUTPut:RELAY:CONTRol:MODE:CATalog#? This command returns the available Relay control mode set values. A phase selection 1, 2 or 3 may be added.
Example	OUTP:RELAY:CONT:MODE:CAT? 0,Auto,1,Manual
Query Syntax Description	OUTPut:STATe:ENABLING? This query command checks to see if the output is pending activation. If the output operation is pending, it returns 1; otherwise, 0
Example	OUTPut:STATe:ENABLING? 1

Command Syntax	OUTPut:POWERSAVE:STATe
Description	Equivalent to the legacy command OUTPut:FAST
Parameters	< 0 OFF 1 ON >
Parameter Format	<nr1>
Example	OUTP:ZERO 1
Query Format	OUTPut:POWERSAVE:STATe?
Returned Data Format	<nr1>
Query Example	OUTP:POWERSAVE:STAT? 1
Command Syntax	OUTPut:POWERSAVE:TiMe
Description	This command sets the time in minutes to activate the Power Saving Mode. Settable range is 1 through 43200 minutes.(720 hours / 30 days).
Parameters	< 0 1 ON >
Parameter Format	<nr1>
Example	OUTP:ZERO 1
Query Format	OUTPut:POWERSAVE:TiMe?
Returned Data Format	<nr1>
Query Example	OUTP:POWERSAVE:TIME? 60
Command Syntax	OUTPut:STATe:AUTO:FORCE
Description	This command allows you to ignore the state of OUTPut[:STATe]:AUTO. If true, it allows OUTPut:AUTO = ON
Parameters	< 0 1 >
Parameter Format	<nr1>
Example	OUTP:STAT:AUTO:FORCE 1
Query Format	OUTPut:STATe:AUTO:FORCE?
Returned Data Format	<nr1>
Query Example	OUTPut:STATe:AUTO:FORCE? 1

Command Syntax	OUTPut:ZEROprogram
Description	This command sets the programmed output voltage to zero before opening the output relay when the OUTP OFF 0 command is sent. This feature is disabled by default but can be enabled by sending OUTP:ZERO ON 1. In this mode, the output of the power source goes to a low impedance state for 100 msec before disconnecting the load (output relay open) unless RAMP and DELAY are changed. Refer also to the OUTPut:DISABLEPHase command.
Parameters	< 0 OFF 1 ON >
Parameter Format	
Example	OUTP:ZERO 1
Query Format	OUTPut:ZEROprogram?
Returned Data Format	
Query Example	OUTP:ZERO? 1
Command Syntax	OUTPut:ZEROprogram:RAMP <nr1>
Description	This command sets the voltage ramp down to zero time before opening the output relay when the OUTP OFF 0 command is sent. See Figure for reference. Default value is 0 msec. <i>This command is intended for use with XFMR units but configurable for both couplings. XFMR and direct parameters are independent. For direct coupling delay is 100ms and ramp 0ms by default but can be changed to any value. The ramp allows the voltage to reduce slowly, useful for reducing the magnetization of the transformer so at the next turn on, there is no excessive peak current due to remaining magnetization.</i>
Parameters	Time in msec.
Parameter Format	<nr1>
Example	OUTP:ZERO:RAMP? 50
Query Format	OUTPut:ZEROprogram:RAMP?
Returned Data Format	<nr1>
Query Example	OUTP:ZERO:RAMP? 50
Command Syntax	OUTPut:ZEROprogram:DWELL <nr1>
Description	This command sets the voltage dwell time before opening the output relay when the OUTP OFF 0 command is sent. See Figure for reference. Default value is 100 msec.
Parameters	Time in msec.
Parameter Format	<nr1>
Example	OUTP:ZERO:DWELL? 20
Query Format	OUTPut:ZEROprogram:DWELL?
Returned Data Format	<nr1>
Query Example	OUTP:ZERO:DWELL? 20

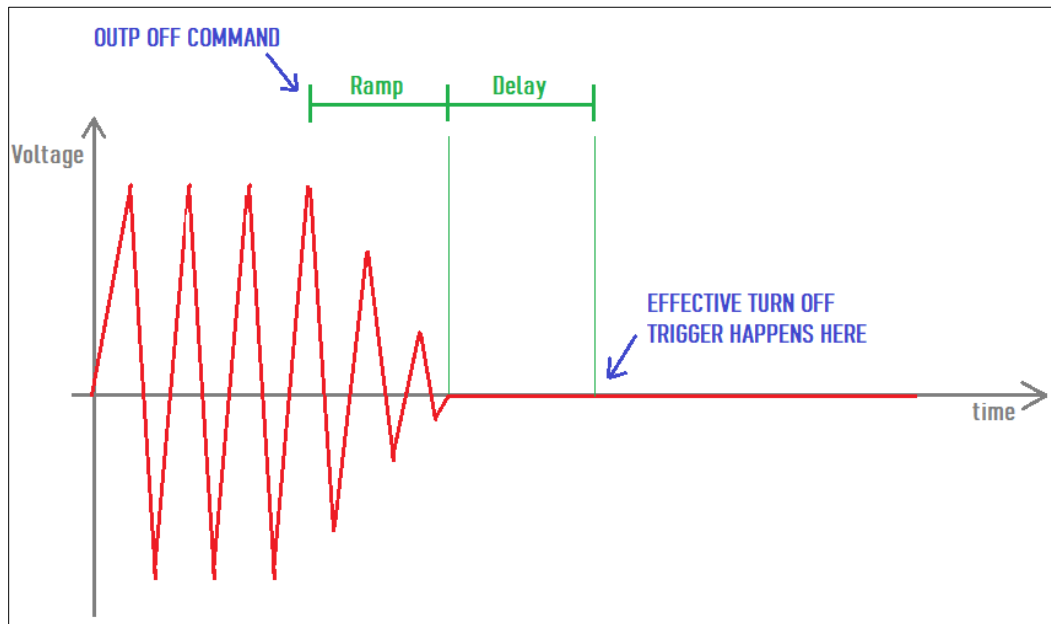


Figure 8-1: OUTP:ZERO Command Ramp and Dwell settings

8.7 Program Commands

Program commands allow management and programming of stored program segments for steady state and Transients. These commands are grouped by the following subsystems.

- Program Control Commands
- Execution Commands
- Transient Segment Commands
- Memory Management Commands

The Program commands are similar to those found on the Pacific Power UPC controllers used for other PPS AC power source models.

8.7.1 Program Control Commands

The following commands allow recall of stored programs and transient segments. Programs are selected and recalled using their memory location reference ranging from 1 through 99. Program location zero (0) is reserved for the Manual Mode setup. Optionally, a memory source may be specified. If none is provided, INTERNAL memory is used as a default.

Command Syntax	PROG ram:NAME [<nr1>,<cr>] [<cr>,<cr>] <cr>
Description	This command selects program <nr1> for execution deletion or copying.
Parameters	Option: PROGRAM, NUMBER [<cr>] or [<cr>,<nr1>] - 0 through 99 Option: MEMORY [<cr>] – Available are: INTERNAL RAM USB Parameter list define string <cr>,<cr>,<cr>,<cr>,<cr>
Parameter Format	<nr1> [<cr>]
Example	PROG:NAME 4, USB
Query Format	PROG ram:NAME?
Description	The query format of this command returns the value of last program selected. Returned value range is 0 through 99.
Returned Data Format	<nr1>
Query Example	PROG:NAME? 4

Command Syntax	
Description	This command programs all values stored in the selected program number. Both steady-state and transient segment parameter names and values may be sent. Program parameters are defined in the following sections. NOTE: Only commas may separate the values, NO Carriage Returns or Line Feeds may separate the values within a single command message.
Parameters	Option: PROGRAM, NUMBER [,<cr>} or [,<n timer>] Option: MEMORY [,<cr>} – Available are: INTERNAL RAM USB Parameter list define string <cr>,<cr>,....,<cr> Note 1: All the tags must be uppercase. Note 2:The order on the transient/step tags must be sequential.
Steady State list Tags	FORM,<n>, COUPLing,<s>, XFMRRATIO,<n.nn>, FREQuency,<n>, VOLTage,<n>, see Convention #13. VOLTage1,<n>, VOLTage2,<n>, VOLTage3,<n>, CURRent:LIMit,<n>, CURRent:PROTect:LEVel,<n> CURRent:PROTect:TOUT,<n> PHASe2,<n>, PHASe3,<n>, WAVEFORM,<n>, see Convention #13. WAVEFORM1,<n>, WAVEFORM2,<n>, WAVEFORM3,<n>, EVENTS,<n>, AUTORMS,<n> NSEGS, <n>
Optional Transient SEGment list Tags	SEGment,<n>, Multiple segments per Program Message may be sent, see Convention 17. FSEG,<n>, VSEG,<n>, AC Voltage, see Convention #13. VSEG1,<n>, VSEG2,<n>, VSEG3,<n>, VSEGDC, <n> DC Voltage, see Convention #13. VSEGDC1, <n> VSEGDC2, <n> VSEGDC3, <n> PSEG1, <n> Cmd available for FW 3.6.x or higher only PSEG2, <n> PSEG3, <n> WFSEG,<n> see Convention #13. WFSEG1,<n>, WFSEG2,<n>, WFSEG3,<n>, TSEG,<n>, LAST Sent only if this is the LAST segment.

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Segment Example Program Strings:

TRANSIENT EXECUTION

RUN

STOP

STEP

RESTART

STATE

STOPPED

PROGRESS

0%

REPEAT TIMES COUNTER

0

CONFIGURATION

SETTINGS

RUN FROM SEGMENT #

1

+

-

RUN TO SEGMENT #

2

+

-

REPEAT TIMES

⌂

Infinite

+

-

✓ APPLY

✗ CANCEL

TRANSIENT TABLE

MODE

STEP

SEGMENT

EDIT MODE

CYCLE BASED

TIME BASED

?

#	TIME [ms]	FREQ [Hz]	V _{AC} [V _{RMS}] A/B/C	V _{DC} [V] A/B/C	Waveform [#] A/B/C	Phase [Deg] A/B/C	
> 1	100.0	60.00	0.00	0.00	1	0.00/120.00/240.00	+ ✕
> 2	100.0	60.00	0.00	0.00	1	0.00/120.00/240.00	+ ✕

✓ APPLY

✗ CANCEL

+

ADD ROW

-

DELETE ROW

🗑️

CLEAR

PROGram:DEFine

FORM,3,COUPL,DIRECT,VOLT:MODE,2,CONFIG,0,RANG,0,FREQ,60.000,VOLT1,0.000,VOLT2,0.000,VOLT3,0.000,VOLT:ALC:S
 TAT,1,CURR:OV,0,CURR:LIM1,130.000,CURR:LIM2,130.000,CURR:LIM3,130.000,IPROT:STAT,0,CURR:PROT:LEV,130.000,IPE
 AK:LIM,360.000,PHAS1,0.000,PHAS2,120.000,PHAS3,240.000,WAVEFORM1,1,WAVEFORM2,1,WAVEFORM3,1,VOLT:DC1,0.
 000,VOLT:DC2,0.000,VOLT:DC3,0.000,POW:LIM1,17.2500,POW:LIM2,17.2500,POW:LIM3,17.2500,KVA:LIM1,17.2500,KVA:
 LIM2,17.2500,KVA:LIM3,17.2500,PPROT:STAT,0,POW:PROT:LEV,17.2500,KVA:PROT:LEV,17.2500,PROT:TDELAY,5,FREQ:SLE
 W,5.000,VOLT:SLEW,10.000,VOLT:DC:SLEW,10.000,UPDATEPH,0.000,RAMP,0.0002,VPEAK:MARG,100.000,EVENTS,0,AUTO
 RMS,1,SEG,1,FSEG,60.00,VSEG1,0.00,VSEG2,0.00,VSEG3,0.00,VDCSEG1,0.00,VDCSEG2,0.00,VDCSEG3,0.00,PSEG2,120.00,P
 SEG3,240.00,WFSEG1,1,WFSEG2,1,WFSEG3,1,TSEG,0.1000,SEG,2,FSEG,60.00,VSEG1,0.00,VSEG2,0.00,VSEG3,0.00,VDCSEG
 1,0.00,VDCSEG2,0.00,VDCSEG3,0.00,PSEG2,120.00,PSEG3,240.00,WFSEG1,1,WFSEG2,1,WFSEG3,1,TSEG,0.1000,LAST (Note
 I removed NSEGS,2 PSEG1,0.00)

PROGram:DEFine:ALL?

FORM,3,COUPL,DIRECT,VOLT:MODE,2,CONFIG,0,RANG,0,FREQ,60.000,VOLT1,0.000,VOLT2,0.000,VOLT3,0.000,VOLT:ALC:S
 TAT,1,CURR:OV,0,CURR:LIM1,130.000,CURR:LIM2,130.000,CURR:LIM3,130.000,IPROT:STAT,0,CURR:PROT:LEV,130.000,IPE
 AK:LIM,360.000,PHAS1,0.000,PHAS2,120.000,PHAS3,240.000,WAVEFORM1,1,WAVEFORM2,1,WAVEFORM3,1,VOLT:DC1,0.
 000,VOLT:DC2,0.000,VOLT:DC3,0.000,POW:LIM1,17.2500,POW:LIM2,17.2500,POW:LIM3,17.2500,KVA:LIM1,17.2500,KVA:
 LIM2,17.2500,KVA:LIM3,17.2500,PPROT:STAT,0,POW:PROT:LEV,17.2500,KVA:PROT:LEV,17.2500,PROT:TDELAY,5,FREQ:SLE
 W,5.000,VOLT:SLEW,10.000,VOLT:DC:SLEW,10.000,UPDATEPH,0.000,RAMP,0.0002,VPEAK:MARG,100.000,EVENTS,0,AUTO
 RMS,1,NSEGS,2,SEG,1,FSEG,60.00,VSEG1,0.00,VSEG2,0.00,VSEG3,0.00,VDCSEG1,0.00,VDCSEG2,0.00,VDCSEG3,0.00,PSEG1,
 0.00,PSEG2,120.00,PSEG3,240.00,WFSEG1,1,WFSEG2,1,WFSEG3,1,TSEG,0.1000,SEG,2,FSEG,60.00,VSEG1,0.00,VSEG2,0.00,
 VSEG3,0.00,VDCSEG1,0.00,VDCSEG2,0.00,VDCSEG3,0.00,PSEG1,0.00,PSEG2,120.00,PSEG3,240.00,WFSEG1,1,WFSEG2,1,W
 FSEG3,1,TSEG,0.1000,LAST

Step Example Program Strings:

TRANSIENT EXECUTION

RUN

STOP

STEP

RESTART

STATE

STOPPED

PROGRESS

0%

REPEAT TIMES COUNTER

0

CONFIGURATION

SETTINGS

RUN FROM STEP #

1

+

-

RUN TO STEP #

1

+

-

REPEAT TIMES

↺

Infinite

+

-

✓ APPLY

✗ CANCEL

TRANSIENT TABLE

MODE

STEP

SEGMENT

EDIT MODE

CYCLE BASED

TIME BASED

?

#	RAMP [ms]	DWELL [ms]	FREQ [Hz]	V _{AC} [V _{RMS}] A/B/C	V _{DC} [V] A/B/C	Waveform [#] A/B/C	Phase [Deg] A/B/C	
> 1	100.0	100.0	60.00	0.00	0.00	1	0.00/120.00/240.00	+ ✕

✓ APPLY

✗ CANCEL

+ ADD ROW

- DELETE ROW

🗑️ CLEAR

PROGram:DEFine

```
FORM,3,COUPL,DIRECT,VOLT:MODE,2,CONFIG,0,RANG,0,FREQ,60.000,VOLT1,0.000,VOLT2,0.000,VOLT3,0.000,VOLT:ALC:STAT,1,CURR:OV,0,CURR:LIM1,130.000,CURR:LIM2,130.000,CURR:LIM3,130.000,IPROT:STAT,0,CURR:PROT:LEV,130.000,IPEAK:LIM,360.000,PHAS1,0.000,PHAS2,120.000,PHAS3,240.000,WAVEFORM1,1,WAVEFORM2,1,WAVEFORM3,1,VOLT:DC1,0.000,VOLT:DC2,0.000,VOLT:DC3,0.000,POW:LIM1,17.2500,POW:LIM2,17.2500,POW:LIM3,17.2500,KVA:LIM1,17.2500,KVA:LIM2,17.2500,KVA:LIM3,17.2500,PPROT:STAT,0,POW:PROT:LEV,17.2500,KVA:PROT:LEV,17.2500,PROT:TDELAY,5,FREQ:SLEW,5.000,VOLT:SLEW,10.000,VOLT:DC:SLEW,10.000,UPDATEPH,0.000,RAMP,0.0002,VPEAK:MARG,100.000,EVENTS,0,AUTORMS,1,STEP,1,FSTEP,60.00,VSTEP1,0.00,VSTEP2,0.00,VSTEP3,0.00,VDCSTEP1,0.00,VDCSTEP2,0.00,VDCSTEP3,0.00,PSTEP2,120.00,PSTEP3,240.00,WFSTEP1,1,WFSTEP2,1,WFSTEP3,1,RTSTEP,0.1000,DTSTEP,0.1000,LAST
```

Note: NSTEPS,1, PSTEP1,0.00 not included in program command.

PROGram:DEFine:ALL?

```
FORM,3,COUPL,DIRECT,VOLT:MODE,2,CONFIG,0,RANG,0,FREQ,60.000,VOLT1,0.000,VOLT2,0.000,VOLT3,0.000,VOLT:ALC:STAT,1,CURR:OV,0,CURR:LIM1,130.000,CURR:LIM2,130.000,CURR:LIM3,130.000,IPROT:STAT,0,CURR:PROT:LEV,130.000,IPEAK:LIM,360.000,PHAS1,0.000,PHAS2,120.000,PHAS3,240.000,WAVEFORM1,1,WAVEFORM2,1,WAVEFORM3,1,VOLT:DC1,0.000,VOLT:DC2,0.000,VOLT:DC3,0.000,POW:LIM1,17.2500,POW:LIM2,17.2500,POW:LIM3,17.2500,KVA:LIM1,17.2500,KVA:LIM2,17.2500,KVA:LIM3,17.2500,PPROT:STAT,0,POW:PROT:LEV,17.2500,KVA:PROT:LEV,17.2500,PROT:TDELAY,5,FREQ:SLEW,5.000,VOLT:SLEW,10.000,VOLT:DC:SLEW,10.000,UPDATEPH,0.000,RAMP,0.0002,VPEAK:MARG,100.000,EVENTS,0,AUTORMS,1,NSTEPS,1,STEP,1,FSTEP,60.00,VSTEP1,0.00,VSTEP2,0.00,VSTEP3,0.00,VDCSTEP1,0.00,VDCSTEP2,0.00,VDCSTEP3,0.00,PSTEP1,0.00,PSTEP2,120.00,PSTEP3,240.00,WFSTEP1,1,WFSTEP2,1,WFSTEP3,1,RTSTEP,0.1000,DTSTEP,0.1000,LAST
```

8.7.1.1 Steady State Output Parameter List Table

The following table details the available parameters for the steady state program definitions.

Parameter	Description
FORM,<n>	sets Output Power Form of selected program n = <1>Single Φ , <2>Split Φ , or <3>Three Φ
COUPLing,<s>	sets Output coupling of selected program s = <DIRECT> <0> or <XFMR> <1>
XFMRRatio,<n.nn>	sets Output XFMR ratio (n.nn:1) of selected program n.nn = <0.0100> to <5.1111>
FREQuency,<n>	sets Output Frequency of selected program n = <:SOUR:FREQ:LIM:MIN> to <:SOUR:FREQ:LIM:MAX> Hz
VOLTage,<n>	sets Output VOLTAGE Φ A,B,C of selected program n = <0> to <300 x XFMRRatio> Volts
VOLTage1,<n>	sets Output VOLTAGE Φ A of selected program n = <0> to <300 x XFMRRatio> Volts
VOLTage2,<n>	sets Output VOLTAGE Φ B of selected program n = <0> to <300 x XFMRRatio> Volts
VOLTage3,<n>	sets Output VOLTAGE Φ C of selected program n = <0> to <300 x XFMRRatio> Volts
CURRent:LIMit,<n>	sets Output Current Limit of selected program n = <0> to <AMPS meter range> Amps
CURRent:PROTect:LEVel,<n>	sets Output Current level that triggers Current Protect mode n = <0> to <AMPS meter range> Amps
CURRent:PROTect:TOUT,<n>	sets time that the Output Current must exceed the Current Protect level before Current Protect disables the power source output. n = <1> to <65535>, 1 = 100mSec.
PHASe2,<n>	sets Output Phase Angle B of selected program n = <0> to <359> degrees
PHASe3,<n>	sets Output Phase Angle C of selected program n = <0> to <359> degrees
WAVEFORM,<n>	sets Output Waveform Φ A, Φ B, Φ C of selected program n = <1> to <16>
WAVEFORM1,<n>	sets Output Waveform Φ A of selected program n = <1> to <16>
WAVEFORM2,<n>	sets Output Waveform Φ B of selected program n = <1> to <16>
WAVEFORM3,<n>	sets Output Waveform Φ C of selected program n = <1> to <16>
EVENTS,<n>	sets number of times to repeat the transient portion of the selected program when the Transient is executed n = 0-65535. A value of 0 specifies continuous operation
AUTORMS,<n>	program Transient Waveform Auto RMS mode (4.5.2) n = 0, use program steady-state waveform RMS factor n = 1, calculate RMS factor based on transient waveform
NSEGS,<n>	Command: Specifies the number of Transient segments (all parameters) to return in a subsequent :PROG:DEFine? query. If NSEGS is not specified, 1 segment is returned by :PROG:DEFine? EXAMPLE: :PROG:DEF SEG,3,NSEGS,4;PROG:DEF? will return 4 transient segments, starting with Segment 3. NOTE: The value will revert back to 1 after each query.

Parameter	Description
	Query: The NSEGS parameter of a :PROG:DEF? query returns total number of Transient segments defined in the selected program

8.7.1.2 Transient Segment Output Parameter List Table

The following table details the available parameters for the transient segment program definitions.

Parameters	Description
SEGment,<n>	Transient segment n of the selected program to be edited. Also the starting segment when querying multiple segments (see NSEGS) n = <1> to <100>
FSEG,<n>	sets objective Frequency of selected segment n = <:SOUR:FREQ:LIM:MIN> to <:SOUR:FREQ:LIM:MAX> Hz
VSEG,<n>	sets objective voltage ΦA , ΦB , ΦC of selected segment n = <0> to <300 x XFMRATIO> Volts
VSEG1,<n>	sets objective voltage ΦA of selected segment n = <0> to <300 x XFMRATIO> Volts
VSEG2,<n>	sets objective voltage ΦB of selected segment n = <0> to <300 x XFMRATIO> Volts
VSEG3,<n>	sets objective voltage ΦC of selected segment n = <0> to <300 x XFMRATIO> Volts
WFSEG,<n>	sets Waveform ΦA , ΦB , ΦC of selected segment n = <1> to <16>
WFSEG1,<n>	sets Waveform ΦA of selected segment n = <1> to <16>
WFSEG2,<n>	sets Waveform ΦB of selected segment n = <1> to <16>
WFSEG3,<n>	sets Waveform ΦC of selected segment n = <1> to <16>
TSEG,<n>	sets execution time (to reach objective Voltage and Frequency) of selected segment n = <0> or <0.0002> to <300> seconds. Setting n to a negative value such as -5 selects cycle-based transient operation, i.e., each segment time is equal to the period of 5 cycles (1 cycle = 1/FREQ secs)
LAST	sets selected segment to be the last segment of selected transient

Command Syntax	PROG:EXECuted:DEFine# <cr>
Description	This command programs all values stored in the selected program number. Both steady-state and transient segment parameter names and values may be sent. Program parameters are defined in the following sections. The phase selection (#) allows saving in FORM2 and FORM3 as phases can be programmed for individual settings. NOTE: Only commas may separate the values, NO Carriage Returns or Line Feeds may separate the values within a single command message.
Parameters	Refer to PROG:SElected:DEFine command
Parameter Format	<cr>,<cr>,...,<cr>,<cr>
Example	
Query Format	PROG:EXECuted:DEFine#?
Returned Data Format	<cr>,<cr>,...,<cr>,<cr> The response separates each output transient with a semicolon (;)
Query Example	PROG:EXEC:DEF? -> parameter list grouped by

Transient Format Example:

```

<TRANSIENT>
  <OUTPUT_A>
    <EVENTS>0</EVENTS>
    <AUTORMS>1</AUTORMS>
    <STEP NUMBER="1">
      <FSTEP>60.00</FSTEP>
      <ACSTEP>10.00</ACSTEP>
      <DCSTEP>0.00</DCSTEP>
      <PSTEP>0.00</PSTEP>
      <WFSTEP>1</WFSTEP>
      <RTSTEP>0.1000</RTSTEP>
      <DTSTEP>2.0000</DTSTEP>
    </STEP>
    <STEP NUMBER="2">
      <FSTEP>60.00</FSTEP>
      <ACSTEP>15.00</ACSTEP>
      <DCSTEP>0.00</DCSTEP>
      <PSTEP>0.00</PSTEP>
      <WFSTEP>1</WFSTEP>
      <RTSTEP>0.1000</RTSTEP>
      <DTSTEP>2.0000</DTSTEP>
    </STEP>
  </OUTPUT_A>
  <OUTPUT_B>
    ---
    ---
  </OUTPUT_B>
  <OUTPUT_C>
    ---
    ---
  </OUTPUT_C>
</TRANSIENT>

```

Query Format	PROGRAM[:SElected]:DEFine:ALL?
Description	This query returns the parameter list for the selected program number or name.
Parameters	Option: PROGRAM, NUMBER [,<cr>} or [,<nr1>] Option: MEMORY [,<cr>}– Available are: INTERNAL RAM USB Parameter list define string <cr>,<cr>,...,<cr>
Query Example	PROG:DEF:ALL? -> parameter list
Query Format	PROGRAM:EXECuted:DEFine:ALL?
Description	This query returns the parameter list for the executing program number or name.
Parameters	Option: PROGRAM, NUMBER [,<cr>} or [,<nr1>] Option: MEMORY [,<cr>} Parameter list define string <cr>,<cr>,...,<cr>
Query Example	PROG:EXEC:DEF:ALL? 3 -> parameter list
Command Syntax	PROGRAM[:SElected]:INfOrmation <cr> [,<nr1>] [,<cr>]
Description	This command assigns program information data to the selected program.
Parameters	Information string <cr> Option: PROGRAM NUMBER [,<nr1>] Option: MEMORY [,<cr>}– Available are: INTERNAL RAM USB
Parameter Format	<cr> [,<nr1>] [,<cr>]
Example	PROG:INFO 3, INTERNAL, SAMPLE TEST
Query Format	PROGRAM[:SElected]:INfOrmation? [<nr1>] [,<cr>]
Returned Data Format	<cr>
Query Example	PROG:INFO? 2, USB -> Program info string
Command Syntax	PROGRAM:EXECuted:INfOrmation <cr> [,<nr1>] [,<cr>]
Description	This command assigns program information data to the executing program.
Parameters	Information string <cr> Option: PROGRAM NUMBER [,<nr1>] Option: MEMORY [,<cr>}– Available are: INTERNAL RAM USB
Parameter Format	<cr> [,<nr1>] [,<cr>]
Example	PROG:EXEC:INFO 3, INTERNAL, SAMPLE TEST
Query Format	PROGRAM:EXECuted:INfOrmation? [,<nr1>] [,<cr>]
Returned Data Format	<cr>
Query Example	PROG:EXEC:INFO? 2, USB -> Program info string

Command Syntax	PROGram[:SElected]:ALIAS <cr> [,<nr1>] [,<cr>]
Description	This command assigns a user provided alias string name to the selected program. Program number and memory type are optional parameters.
Parameters	Alias String <cr> Option: PROGRAM NUMBER [,<nr1>] Option: MEMORY [,<cr>]– Available are: INTERNAL RAM USB
Parameter Format	<cr> [,<nr1>] [,<cr>]
Example	PROG:ALIAS TEST1
Query Format	PROGram[:SElected]:ALIAS? [,<nr1>] [,<cr>]
Returned Data Format	<cr>
Query Example	PROG:ALIAS? TEST1
Command Syntax	PROGram:EXECuted:ALIAS <cr> [,<nr1>] [,<cr>]
Description	This command assigns a user provided alias string name to the executing program. Program number and memory type are optional parameters.
Parameters	Alias String <cr> Option: PROGRAM NUMBER [,<nr1>] Option: MEMORY [,<cr>]– Available are: INTERNAL RAM USB
Parameter Format	<cr> [,<nr1>] [,<cr>]
Example	PROG:EXEC:ALIAS TEST2
Query Format	PROGram:EXECuted:ALIAS? [,<nr1>] [,<cr>]
Returned Data Format	<cr>
Query Example	PROG:EXEC:ALIAS? TEST2
Query Format	PROGram[:SElected]:SST? [,<nr1>] [,<cr>]
Description	This command returns the Steady State Table settings of the selected program only. The transient table data is not returned.
Parameters	Option: PROGRAM NUMBER [,<nr1>] Option: MEMORY [,<cr>]– Available are: INTERNAL RAM USB
Returned Data Format	<cr>
Query Example	PROG:SST? 2, USB -> steady state table program data
Query Format	PROGram:EXECuted:SST? [,<nr1>] [,<cr>]
Description	This command returns the Steady State Table settings of the executing program only. The transient table data is not returned.
Parameters	Option: PROGRAM NUMBER [,<nr1>] Option: MEMORY [,<cr>]– Available are: INTERNAL RAM USB
Returned Data Format	<cr>
Query Example	PROG:EXEC:SST? -> steady state table program data

Query Format	
Description	PROG:TT? [<nr1>][,<nr1>] [,<cr>] This command returns the Transient Table settings of the program number specified. The format in which the data is returned can be specified with the first parameter. If no program number is passed as a parameter, the selected program data is returned. See PROG:NAME for the selected program. The steady state table data is not returned. If no memory type is specified, the transient table stored in the selected memory type is returned. See PROG:MEMORY for the selected memory type.
Parameters	Option: STYLE [,<nr1>] 0 = Human readable Style A (default if omitted) 1 = Human readable Style B 2 = Binary Data Format. Can be more useful to search for differences between programs. Option: PROGRAM NUMBER [,<nr1>] Option: MEMORY [,<cr>]– Available are: INTERNAL RAM USB <cr>
Returned Data Format	
Query Example	<pre> PROG:TT? 1,2 -> transient table program data Formats for transient table shown below are: Style A: 3,1,1,100.0,100.0,60.000,0.000,1.000 2.000 3.000,1,0.0 120.0 240.0S tyle B: 3,1,1,100.0,100.0,60.000,0.000,0.000,0.000,0.000,1.000,1.000,2.000,3. 000,1,1,1,0.0,120.0,240.0 Binary: 000070420000000000000000000000000000803F00000040000040400 000F0420000704301010100F401000000007042000000000000000000 0000000000803F00000040000040400000F0420000704301010100F40 10000 </pre>
Query Format	
Description	PROG[:SElected]:TT? [<nr1>] [,<cr>] This command returns the Transient Table settings of the selected program only. The steady state table data is not returned.
Parameters	Option: STYLE [,<nr1>] 0 = Human readable Style A (default if omitted) 1 = Human readable Style B 2 = Binary Data Format. Can be more useful to search for differences between programs. See PROG:TT? Command for formats Option: PROGRAM NUMBER [,<nr1>] Option: MEMORY [,<cr>]– Available are: INTERNAL RAM USB <cr>
Returned Data Format	
Query Example	<pre> PROG:TT? 1 -> transient table program data </pre>

Query Format	PROG:EXECuted:TT? [,<nr1>] [,<cr>]
Description	This command returns the Transient Table settings of the executing program only. The steady state table data is not returned.
Parameters	Option: STYLE [,<nr1> 0 = Human readable Style A (default if omitted) 1 = Human readable Style B 2 = Binary Data Format. Can be more useful to search for differences between programs. See PROG:TT? Command for formats Option: PROGRAM NUMBER [,<nr1> Option: MEMORY [,<cr>]– Available are: INTERNAL RAM USB <cr>
Returned Data Format	PROG:EXEC:TT? 2
Query Example	-> transient table program data
Query Format	PROG:[SE]lected:CHECK? [,<nr1>] [,<cr>]
Description	This command performs a check on the selected program steady state and transient tables looking for the following conditions: • Hardware Limit violations • User Limit violations • Saturation limits. If no violations are present, this command returns OK and the program can be executed without generating any errors. If the selected program cannot be run due to one or more issues with its content, one or more errors detailing the issues will be returned. For example, if the upper voltage user limit is set to 100V and the program contains a setting of 300V, a “Cannot load program, Run PROGRAM:CHECK?” error will be generated when attempting to execute this program. When sending the PROGRAM:CHECK? Query, the response will be “VOLT1 AC voltage set point cannot change due to user limit”.
Parameters	Option: PROGRAM NUMBER [,<nr1> Option: MEMORY [,<cr>]– Available are: INTERNAL RAM USB <cr>
Returned Data Format	PROG:CHECK?
Query Example	VOLT1 AC voltage set point cannot change due to user limit
Query Format	PROG:EXECuted:CHECK? [,<nr1>] [,<cr>]
Description	This command serves the same purpose as the PROG:CHECK? Command but applies to a program that is executing.
Parameters	Option: PROGRAM NUMBER [,<nr1> Option: MEMORY [,<cr>]– Available are: INTERNAL RAM USB <cr>
Returned Data Format	PROG:EXEC:CHECK?
Query Example	VOLT1 AC voltage set point cannot change due to user limit

Command Syntax	PROGram[:SElected]:DELeTe
Description	This command deletes the selected program. Attempting to DELeTe an EXECuting Program will result in an Error.
Parameters	Program number
Parameter Format	<nr1>
Example	PROG:DEL 9
Query Format	PROGram[:SElected]:CHANges? <nr1>, <cr>
Description	This command compares the program that is executing with another program stored in the memory type and location passed as parameters. The results of the comparison is returned as a decimal number ranging from 0 to 15 representing a four bit binary value. This result can be decoded as shown below.
Parameters	Option: PROGRAM NUMBER [, <nr1>] Option: MEMORY [, <cr>]– Available are: INTERNAL RAM USB
Returned Data Format	<nr>1
Decoding	Bit 0: If set to 1, there are differences in the steady state table (SST) Bit 1: If set to 1, there are differences in the transient table (TT) Bit 2: If set to 1, there are differences in the ALIAS of the program Bit 3: If set to 1, there are differences in INfOrmation of the program
Query Example	PROG:CHAN? 16
Example	If the query returns zero (0), the program executing is identical to the stored program referenced. If the command returns three (3), the program executing has differences with the referenced program in both the steady state table and the transient table.
Command Syntax	PROGram[:SElected]:COPY <nr1> [, <cr>]
Description	This command copies the selected program as previously specified by the PROG:NAME <nr1> command to destination program number. NOTE: The destination Program specified cannot be currently executing.
Parameters	DESTINATION PROGRAM NUMBER <nr1> Option: MEMORY [, <cr>]– Available are: INTERNAL RAM USB
Parameter Format	<nr1>, [, <cr>]
Example	PROG:COPY 2, USB
Command Syntax	PROGram:EXECuted:COPY <nr1> [, <cr>]
Description	This command copies the executed program to destination program number.
Parameters	DESTINATION PROGRAM NUMBER <nr1> Option: MEMORY [, <cr>]– Available are: INTERNAL RAM USB
Parameter Format	<nr1>, [, <cr>]
Example	PROG:EXEC:COPY 2, USB

8.7.2 Execution Commands

The following commands may be used to control stored program executions.

Command Syntax	PROGram[:SElected]:EXECute [<nr1> [,<cr>]
Description	This command executes the selected program (default) or the program number passed as the first parameter.
Parameters	Option: PROGRAM NUMBER [,<nr1>] Option: MEMORY [,<cr>]– Available are: INTERNAL RAM USB
Parameter Format	[<nr1> [,<cr>]
Example	PROG:EXEC 2
Query Format	PROGram[:SElected]:EXECute ?
Description	The query format returns the number of the program that is in effect.
Parameter Format	<nr1>
Example	PROG:EXEC? 23
Command Syntax	PROGram:EXECute:TRANS [<nr1> [,<cr>]
Description	This command executes the selected program's (default) transient table or the program number passed as the first parameter.
Parameters	Option: PROGRAM NUMBER [,<nr1>] Option: MEMORY [,<cr>]– Available are: INTERNAL RAM USB
Parameter Format	[<nr1> [,<cr>]
Example	PROG:EXEC:TRANS 2
Command Syntax	PROGram:EXECute:TRANS:RESET
Description	This command serves the same purpose as the "PROGram:TRANSient STOP" command. See next. This command resets the active transient execution. This command is included to support UPC compatibility mode although it is not documented in the UPC manual. Not recommended for new programs.
Parameters	None
Parameter Format	n/a
Example	PROG:EXEC:TRANS:RESET

8.7.3 Transient Segments Commands

The following commands may be used to control stored transient program executions.

Command Syntax	PROG:TRANSient
Description	This command controls transient execution
Parameters	RUN STOP PAUSE STEP REStart
Parameter Format	<cr>
Example	PROG:TRAN RUN
Query Format	PROG:TRANSient?
Description	Query format returns the transient execution state as either RUN, STOP, PAUS, STEP or REST
Returned Data Format	<cr>
Query Example	PROG:TRAN? RUN
Command Syntax	PROG:TRANSient:AUTORMS <BOOLEAN>
Description	If enabled, the value of any waveform used in a transient segment is normalized in order to match the RMS set point. If disabled, the waveform is reproduced without any normalization. This function is useful for waveform substitution at the steady state level. Note: This function is related to the AUTORMS function in the steady state segment.
Parameters	[0 OFF 1 ON]
Parameter Format	
Example	PROG:TRAN:AUTORMS 1
Query Format	PROG:TRANSient:AUTORMS?
Returned Data Format	
Query Example	PROG:TRAN:AUTORMS? 1
Command Syntax	PROG:TRANSient:CR <BOOLEAN>
Description	This command enables or disables the Cycle Reset mode during transient execution. When on, Cycle Reset will resync each transient run in repeat mode to the start phase angle.
Parameters	[0 OFF 1 ON]
Parameter Format	
Example	PROG:TRAN:CR 1
Query Format	PROG:TRANSient:CR?
Returned Data Format	<nr1>
Query Example	PROG:TRAN:CR? 0

Command Syntax Description	PROG:TRANSient:HOLD <ON OFF> This commands turns the Transient HOLD mode on or off. If ON, the power source holds the last segment values at steady state after the transient ends. If OFF, the output of the power source returns to the steady state settings in effect before the transient segment ran.
Parameters	[0 OFF 1 ON]
Parameter Format	<cr>
Example	PROG:TRAN:HOLD ON
Query Format	PROG:TRANSient:HOLD?
Returned Data Format	
Query Example	PROG:TRAN:MODE? 1
Command Syntax Description	PROG:TRANSient:MODE This commands selected between legacy UPC controller mode SEGMENT transient mode or STEP mode. Segment mode is backward compatible with PPS UPC controllers and use a steady state table and a transient table for each segment. A total of 99 segments can be programmed. STEP mode uses the conventional SCPI LIST system of a list of transient steps executed sequentially.
Parameters	[0 SEGMENT 1 STEP]
Parameter Format	<cr>
Example	PROG:TRAN:MODE STEP
Query Format	PROG:TRANSient:MODE?
Returned Data Format	<nr1>
Query Example	PROG:TRAN:MODE? 1
Query Format Description	PROG:TRANSient:PROGress? This command returns the progress status of a running transient. The response data content depends on the selected transient mode, SEGMENT or STEP. (Refer to the "PROG:TRANSient:MODE" command) The following information is returned in the order shown below. Values are separated by a "/" character:
Return Data Format	A. Progress as a percent of the total between 0 to 100. B. Current element progress. A percent between 0 and 100 of the elements executing. C. Active step or segment in execution. D. Active step or segment time. In multiples of 0.2 ms. E. Total time. In multiples of 0.2 ms. F. Total number of steps or segments.
Returned Data Format	<nr1> / <nr1> / <nr1> / <nr1> / <nr1> / <nr1>
Query Example	PROG:TRAN:PROG? 57/31/3/1554/20000/4
<i>Continues next page</i>	

TRANSIENT TABLE						
TRANSIENT MODE						
		STEP		SEGMENT		
	#	TIME (ms)	FREQ (Hz)	V _{AC} [V _{RMS}] A/B/C	V _{DC} [V] A/B/C	Phase [deg B/C
>	1	1000.0	60.00	0.00	0.00	120.00/240.0
>	2	1000.0	60.00	0.00	0.00	120.00/240.0
>	3	1000.0	60.00	0.00	0.00	120.00/240.0
>	4	1000.0	60.00	0.00	0.00	120.00/240.0

Example Return data for transient table shown above in STEP mode would be

57/31/3/1554/20000/4

- A. Progress = 57% of total time or $0.57 * 4000 \text{ ms} = 2280 \text{ ms}$
- B. Current element progress = 31% or $0.31 * 1000 \text{ ms} = 310 \text{ ms}$
- C. Active step = 3
- D. Active step time = $1554 * 0.2 \text{ ms} = 310.8 \text{ ms}$
- E. Total time = $20000 * 0.2 \text{ ms} = 4000 \text{ ms}$
- F. Total number of steps = 4.

Relationship between data fields

$A = (((\text{Summing of the element times between 1 and C-1}) / 0.2 + D) / E) * 100$

For the example $A = ((1000+1000)/0.2+1554)/20000 = 57\%$

$B = (D / (\text{Time of the element C} / 0.2)) * 100$

For the example $B = (1554/(1000/0.2))*100 = 31\%$

Query Format
Description

PROG:TRANSient:EIE?

This query command returns the active Element In Execution. An element is either a STEP when in transient STEP mode or a SEGMENT when in transient SEGMENT mode.

Note: the data returned on this query is the same as the "C" data returned by the "PROG:TRANSient:PROGress?" command.

Returned Data Format
Query Example

```
<nr1>
PROG:TRAN:EIE?
3
```

Query Format
Description

PROG:TRANSient:ETE?

This query command returns the active Element To Execute. An element is either a STEP when in transient STEP mode or a SEGMENT when in transient SEGMENT mode.

The ETE query is useful when a transient execution has been PAUSED by the "PROG:TRANSient PAUSE" command. For example, if the execution is paused in the middle of an element (step or segment) execution for element "n", the ETE value will be "n". If it is paused at the end of element "n", the ETE value will be "n+1".

Returned Data Format
Query Example

```
<nr1>
PROG:TRAN:ETE?
4
```

Command Syntax
Description

PROG:TRANsient:MODE

This commands selected between legacy UPC controller mode SEGMENT transient mode or STEP mode. Segment mode is backward compatible with PPS UPC controllers and use a steady state table and a transient table for each segment. A total of 99 segments can be programmed. STEP mode uses the conventional SCPI LIST system of a list of transient steps executed sequentially.

Parameters
Parameter Format
Example
Query Format
Returned Data Format
Query Example

< 0 | SEGMENT | 1 | STEP >
<cr>
PROG:TRAN:MODE STEP
PROG:TRANsient:MODE?
<cr>
PROG:TRAN:MODE?
1

Command Syntax
Description

PROG:TRANsient:CSC

This command turns the CSC Mode during transient execution on (1) or off (0). This allows load regulation adjustment during transient execution. However, keep in mind that CSC adjustments are based on RMS voltage measurement, which take several cycles to run so turning on CSC on fast changing voltage transients is not recommended as the CSC may interfere with the programmed transient voltages.

Note 1: In UPC compatibility mode, the CSC is always off during transient execution regardless of this setting to match the UPC controller operation.

Parameters
Parameter Format
Example
Query Format
Returned Data Format
Query Example

< 0 | OFF | 1 | ON >
<cr>
PROG:TRAN:CSC ON
PROG:TRANsient:CSC?
<cr>
PROG:TRAN:CSC?
1

Command Syntax
Description

PROG:TRANsient:FROM

This command sets the first transient step number at which step mode execution is to begin. The step specified must exist or an error message will be generated.

Parameters
Parameter Format
Example
Query Format
Returned Data Format
Query Example

STEP number from 1 ~ 99
<nr1>
PROG:TRAN:FROM 5
PROG:TRANsient:FROM?
<nr1>
PROG:TRAN:FROM?
5

Command Syntax	PROG:TRANSient:TO
Description	This command sets the transient step number at which step mode execution is to end. The step specified must exist or an error message will be generated.
Parameters	STEP number from 1 ~ 99
Parameter Format	<nr1>
Example	PROG:TRAN:TO 25
Query Format	PROG:TRANSient:TO?
Returned Data Format	<nr1>
Query Example	PROG:TRAN:TO? 25
Command Syntax	PROG:TRANSient:EVENTs <nr1>
Description	This command sets the number of repetitions for executing the selected transient. A zero value is equivalent to infinite execution until aborted by "PROG:TRAN STOP" command.
Parameters	Repetition, range is 0 ~ 99999
Parameter Format	<nr1>
Example	PROG:TRAN:EVEN 5
Query Format	PROG:TRANSient:EVENTs?
Returned Data Format	<nr1>
Query Example	PROG:TRAN:EVEN? 5
Command Syntax	PROG:TRANSient:GOTO <nr1>
Description	This command forces transient execution to move to the element argument passed (STEP in STEP mode or SEGMENT in segment mode).
Parameters	ELEMENT
Parameter Format	<nr1>
Example	PROG:TRAN:GOTO 3

8.7.4 Memory Management Commands

The Program memory subsystem commands allow management of Program memory contents.

Command Syntax	PROGram:MEMory <cr>
Description	This command selects the specific program memory type for storing and retrieving programs. Default is INTERNAL memory. Alternatives are RAM and USB devices. The memory type can also be specified as an optional parameter with several PROGram commands where indicated in this manual.
Parameters	Memory types: INTERNAL RAM USB. For a complete list of available memory types, use the "PROGram:MEMory:CATalog?" Command.
Parameter Format	<cr>
Example	PROG:MEM USB
Query Format	PROGram:MEMory?
Returned Data Format	<cr>
Query Example	PROG:MEM? USB
Query Format	PROGram:MEMory:CATalog?
Description	This query command returns a comma separated list of available memory types that can be selected for storage of steady state and transient table information.
Returned Data Format	INTERNAL, RAM, SD1, SD2, SD3, USB
Memory Types	INTERNAL = Internal Flash Memory. (Default selection) RAM = Internal RAM. Content will be lost when power source is turned off. USB[X][Y] = USB memory stick devices. X = port number, Y = partition number SD[Y] = SC Card, Y = partition number X = symbolizes different memory sticks connected to various available USB ports. Y = symbolizes different logical partitions on a USB memory stick or SD card. INTERNAL and RAM are always available. INTERNAL is default selection. Use the "PROGram:MEMory <cr>" command to select active memory selection.
Query Example	PROG:MEM:CAT? INTERNAL,RAM,USBA1

Query Format Description	PROGram:EXECuted:MEMory? This command selects the specific program memory type for storing and retrieving programs. Default is INTERNAL memory. Alternatives are RAM and USB devices. The memory type can also be specified as an optional parameter with several PROGram commands where indicated in this manual.
Parameters	Memory types: INTERNAL RAM USB
Parameter Format	<cr>
Example	PROG:EXEC:MEM USB
Query Format	PROGram:EXECuted:MEMory?
Returned Data Format	<cr>
Query Example	PROG:EXEC:MEM? USB
Command Syntax Description	PROGram:POWOn <nr1> Returns the number of the stored program that will be recalled at power on.
Parameters	Program number
Parameter Format	<nr1>
Example	PROG:POWO 1
Query Format	PROGram:POWOn?
Returned Data Format	<nr1>
Query Example	PROG:POWO? 1
Command Syntax Description	PROGram:DELeTe:ALL <cr> This command deletes all programs, waveforms and setup values, performs device RESET, loads Program #1 with *RST default values, executes MANUAL MODE with *RST values. Waveforms (1-16) are re-loaded from internal Flash memory. Attempting to DELeTe an EXECuting Program will result in an error message.
Parameters	Optional: Memory type: INTERNAL RAM USB
Parameter Format	<cr>
Example	PROG:DEL:ALL USB
Query Format Description	PROGram:CATalog? <cr> This query returns a comma separated list of <nr1> values representing stored programs (e.g. 1,2,7...). If the MANUAL MODE program setup exists, the list will include 0. If no programs are stored at all, this query returns a 1
Parameters	Optional: Memory type: INTERNAL RAM USB
Parameter Format	<cr>
Returned Data Format	<nr1>,<nr1>,...,<nr1>,<nr1>
Query Example	PROG:CAT? 0,1,2,9,12 PROG:CAT? INTERNAL 0

Query Format	PROG:CR? <cr>
Description	This query command calculates and returns the checksum value of the selected program. This CRC may be used to verify the program data integrity is intact. This command is provided for UPC compatibility mode and not recommended for new programs.
Parameters	Optional: Memory type: INTERNAL RAM USB
Parameter Format	<cr>
Returned Data Format	<nr1>
Query Example	PROG:CR? RAM 08ad55
Query Format	PROG:BROW?
Description	This command returns the list of available programs stored in the memory selected or passed as a parameter.
Parameters	Optional: Memory type: INTERNAL RAM USB
Parameter Format	<cr>
Returned Data Format	<nr1>, <nr1>, ..., <nr1>
Query Example	PROG:BROW? 1,8,9,23
Query Format	PROG:WFBANK?
Description	This query command returns the waveform bank number. It is provided for UPC compatibility mode and not recommended for new programs. It always returns a minus one (-1) response.
Returned Data Format	-1
Query Example	PROG:WFBANK? -1
Query Format	PROG:WFCRC?
Description	This query command calculates and returns the checksum value of all waveforms. The CRC may be used to verify the waveform data integrity is intact. This command is provided for UPC compatibility mode and not recommended for new programs.
Returned Data Format	<nr1>
Query Example	PROG:WFCRC? -31893,18622,25404,-20201,15032,-2662,-28577,-5178,-3736,-23017,-19989,-25093,-2813,3096,-32131,4403

8.8 Source Commands

Source commands control the settings of the power source. This includes all operating modes, voltages, frequency, current and power limits and phase angles as well as transient operation. Since the SOURCE subsystem is the primary system, the SOURce portion of these commands is optional. The following status commands are supported broken down by SOURCE sub groups.

8.8.1 Source Configuration Programming Commands

Command Syntax	[SOURce:]CONFIG
Description	Selects alternative loop compensation mode for improved transient response. The effect of this command depends on the selected output mode as follows: AC Mode: Changes the AC loop compensation DC Mode: Changes the DC loop compensation AC+DC Mode: Changes both the AC and DC loop compensations Note: The alternative compensation configuration setting is saved separately saved for DC and AC (only and +DC). When changed to off while in DC mode, it will be saved as off for DC only. Also if you are in AC only (or AC+DC) and you change it to 1, it is saved separately.
Parameters	< 0 1 > (0 = Normal loop, 1 = Faster Loop)
Parameter Format	
Example	SOUR:CONFIG 1
Query Format	[SOURce:]CONFIG?
Returned Data Format	
Query Example	CONFIG? 0
Command Syntax	[SOURce:]CONFIG:AC
Description	Selects alternative AC loop compensation mode for improved AC transient response. The effect of this command depends on the selected output mode as follows: AC Mode: Changes the AC loop compensation DC Mode: No effect AC+DC Mode: Changes the AC loop compensations
Parameters	< 0 1 > (0 = Normal loop, 1 = Faster Loop)
Parameter Format	
Example	SOUR:CONFIG:AC 1
Query Format	[SOURce:]CONFIG:AC?
Returned Data Format	
Query Example	CONFIG:AC? 0

Command Syntax	[SOURce:]CONFIG:DC
Description	Selects alternative DC loop compensation mode for improved DC transient response. The effect of this command depends on the selected output mode as follows: AC Mode: No effect DC Mode: Changes the DC loop compensation AC+DC Mode: No effect
Parameters	< 0 1 > (0 = Normal loop, 1 = Faster Loop)
Parameter Format	
Example	SOUR:CONFIG:DC 1
Query Format	[SOURce:]CONFIG:DC?
Returned Data Format	
Query Example	CONFIG:DC? 0
Command Syntax	[SOURce:]CONFIG:HFreq
Description	This command enables high-frequency output current protection extension mode. In this mode, the protection for high frequency content at the output of the power source is held off for up to 2 seconds to allow short time events to ride through without tripping the normal protection mode.
Parameters	< 0 OFF 1 ON > (0 = Off, 1 = On)
Parameter Format	
Example	SOUR:CONFIG:HF 1
Query Format	[SOURce:]CONFIG:HFreq?
Returned Data Format	
Query Example	CONFIG:HF? 1

Command Syntax	[SOURce:]COUPLing <cr>
Description	Selects the output coupling mode. On AGX Series®, this command only accepts DIRECT as a setting unless the optional output transformer is connected and configured. The output voltage ratio of the transformer can be queried using the “SYSTem:XFMRRatio?” command. The output voltage range is 300Vac x Ratio full scale Line to Neutral. If no transformer option is installed and configured, selecting XMFR coupling will generate a 2019 Error code. Do not select XMFR coupling if the SYSTem:XFMRRatio? query returns a 0.0000 value.
Parameters	< DIRECT 0 XMFR 1 > 0 = DIRECT 1 = XMFR
Parameter Format	<cr>
Example	COUPL DIRECT
Query Format	[SOURce:]COUPLing?
Returned Data Format	<cr>
Query Example	COUPL? 0

Command Syntax	[SOURce:]INITial <n>
Description	Sets source output settings initialization mode. This command in combination with the "OUTPut[:STATe]:AUTO" command allows the unattended resumption of a test station after a power failure. Note: This condition is potentially hazardous and should be used with caution.
[SOURce:]INITial? = ON	Set points of the unit at power on will be the last set after power off. The set points affected by this command are: - Frequency - Voltage AC1 - Voltage AC2 - Voltage AC3 - Voltage DC1 - Voltage DC2 - Voltage DC3 - Form (THREE , SPLIT or SINGLE) - Range (High or Low) - Compatibility Mode (UPC or NORMAL)
[SOURce:]INITial? = OFF	Set points of the unit at power on will have a default value of: - Frequency = 60Hz - Voltage AC1 = 0V - Voltage AC2 = 0V - Voltage AC3 = 0V - Voltage DC1 = 0V - Voltage DC2 = 0V - Voltage DC3 = 0V - Form = THREE - Range = HIGH - Compatibility = NORMAL
Parameters	< 0 OFF 1 ON >
Parameter Format	
Example	:INIT ON
Query Format	[SOURce:]INITial?
Returned Data Format	
Query Example	INIT? 0
Command Syntax	[SOURce:]FORM <nr1>
Description	Set phase mode or FORM. Allowable arguments are 1, 2 or 3.
Parameters	< 1 2 3 >
Parameter Format	<nr1>
Example	FORM 3
Query Format	[SOURce:]FORM?
Returned Data Format	<nr1>
Query Example	FORM? 3

Command Syntax	[SOURce:]RANGe
Description	Selects high or low voltage range. Although the AGX Series® has only a single voltage range, this commands allows simulation of a dual range AC voltage source which is more familiar to some users. Despite this virtual low range capability, no actual physical range change takes places so the output is never interrupted. Note: When switching from HIGH to LOW range, the output voltage may be reduced to the highest available voltage on the low range.
Parameters	< 0 LOW 1 HIGH >
Parameter Format	
Example	RANG HIGH
Query Format	[SOURce:]RANGe?
Returned Data Format	
Query Example	RANG? 1
Command Syntax	[SOURce:]RAMP#
Description	Sets voltage slew rate for selected phase number or for all phases if no phase number is specified.
Parameters	Slew rate
Parameter Format	<nr2>
Example	SOUR:RAMP3 10.5
Query Format	[SOURce:]RAMP#?
Description	Returns voltage slew rate setting for specified phase (1, 2 or 3) or for phase 1 (A) if no phase number is specified.
Returned Data Format	
Query Example	SOUR:RAMP3? 10.5000
Command Syntax	[SOURce:]SERIES
Description	Changes output configuration to series connection on AGXS units when set to ON. Requires the SPMS (Series parallel Mode Stich) hardware option. Returns to parallel output connection mode when OFF.
Parameters	< 0 OFF 1 ON >
Parameter Format	<nr1>
Example	SERIES ON
Query Format	[SOURce:]SERIES?
Description	Returns Series Mode setting on AGXS models.
Returned Data Format	
Query Example	SOUR:SERIES? 1

Command Syntax	[SOURce:]UPDATEPHase
Description	Set the phase angle at which programmed voltage changes on phase A will take place. This applies to output on and off phase angle placement as well. Available range is from 0° through 360.0° inclusive. Values higher than 360.0° will be truncated to 360.0000° automatically.
Parameters	< 0.0000 - 360.0000 >
Parameter Format	<nr2>
Example	UPDATEPH 90.00
Query Format	[SOURce:]UPDATEPHase?
Returned Data Format	<nr2>
Query Example	SOURce:UPDATEPH? 90.0000

8.8.2 Voltage Programming Commands

Note that most of the voltage programming commands are phase specific so in three or split phase mode, each phase voltage can be individually programmed. This is done by appending 1, 2 or 3 for the “#” symbol shown in the syntax below. If the “#” value is omitted, all available phase (1, 2 or 3 in single, split or three phase mode respectively) will be set to the same amplitude. This allows the same program code to be used for any phase mode as long as the phase amplitudes need to be balanced.

The following command sets each phase to a different amplitude when in three phase mode.

SOUR:VOLT:AC1 15;;SOUR:VOLT:AC2 30;;SOURCE:VOLT:AC3 45

This command sets all phases to the same amplitude, regardless of phase mode:

SOUR:VOLT:AC 100

The query format for these phase specific commands will return the value for the phase number appended to the command. If the phase number reference is omitted, the setting for phase 1 (A) is returned.

Command Syntax	[SOURce:]VOLTage:MODE
Description	Results voltage mode as 0 for AC, 1 for DC or 2 for ACDC. Note: In UPC compatibility mode, only AC mode is available
Parameters	< 0 AC 1 DC 2 ACDC >
Parameter Format	<nr1>
Example	VOLT:MODE DC
Query Format	[SOURce:]VOLTage:MODE?
Returned Data Format	<nr1>
Query Example	VOLT:MODE? 1
Command Syntax	[SOURce:]VOLTage:CSC[:STATE#] [SOURce:]CSC:STATE#
Description	Turns the Continuous Source Calibration (CSC) mode on or off.
Parameters	<0 OFF 1 ON>
Parameter Format	
Example	VOLT:CSC ON
Query Format	[SOURce:]VOLTage:CSC[:STATE]? [SOURce:]CSC:STATE#
Returned Data Format	<nr1>
Query Example	VOLT:CSC? 1

Command Syntax	[SOURce:]VOLTage[:AC]#
Description	Sets AC voltage for phase #. If # is omitted, sets all available phases to value specified.
Parameters	Range 0.0000 - 300.0000
Parameter Format	<nr2>
Example	VOLT:AC1 100.00
Query Format	[SOURce:]VOLTage[:AC]#?
Description	Returns voltage setting for specified phase. If phase is omitted, returns voltage setting for phase A.
Returned Data Format	<nr2>
Query Example	VOLT:AC1? 100.0000
Command Syntax	[SOURce:]VOLTage[:AC]#:SLEW
Description	Sets AC voltage slew rate for phase # in Volts per msec. If # is omitted, sets phase A slew rate to value specified.
Parameters	Range 0.01 – 300.0
Parameter Format	<nr2> and <nr3>
Example	VOLT:AC1:SLEW 300.00
Query Format	[SOURce:]VOLTage[:AC]#:SLEW?
Description	Returns voltage slew rate setting for specified phase. If phase is omitted, returns voltage setting for phase A.
Returned Data Format	<nr2>
Query Example	VOLT:AC1:SLEW? 300.0000
Command Syntax	[SOURce:]VOLTage[:AC]:LIMit:MINimum
Description	Sets low user limit for AC voltage programming. User limits must fall within actual hardware limits of the power source. Also, MIN limit must be less than MAX limit.
Parameters	0.000 – 350.000
Parameter Format	<nr2>
Example	VOLT:LIM:MIN 20.0
Query Format	[SOURce:]VOLTage[:AC]#:LIMit:MINimum?
Returned Data Format	<nr2>
Query Example	VOLT:LIM:MIN? 20.0000

Command Syntax	[SOURce:]VOLTage[:AC]:LIMit:MAXimum
Description	Sets high user limit for AC voltage programming. User limits must fall within actual hardware limits of the power source. Also, MAX limit must be greater than MIN limit.
Parameters	0.000 – 350.000
Parameter Format	<nr2>
Example	VOLT:LIM:MAX 240.0
Query Format	[SOURce:]VOLTage[:AC]#:LIMit:MAXimum?
Returned Data Format	<nr2>
Query Example	VOLT:LIM:MAX? 240.0000
Query Format	[SOURce:]VOLTage[:AC]#:LIMit:RANGe?
Description	Returns available AC voltage range low and high limits.
Returned Data Format	<nr2>,<nr2>
Query Example	VOLT:AC1:LIM:RANG? 0.0000,350.0000
Query Format	[SOURce:]VOLTage[:AC]#:LIMIT:SATuration:RANGe?
Description	Returns the upper and lower limit sine wave RMS voltage at which saturation of the output inverter will occur. Saturation limits are determined in the maximum peak voltage capability of the AC+DC components at the output of the power source. For the AGX Series®, these limits are -500 and +500V. The VOLT:AC1:LIM:SAT:RANG? returns the min and max. RMS of a sine wave that may be programmed based on the programmed DC component. Maximum allowable values are: Maximum positive peak voltage: $V_{peak\_max} = V_{AC\_peak\_max} + V_{DC}$ Minimum negative peak voltage: $V_{peak\_min} = V_{AC\_peak\_min} + V_{DC}$ For a sinusoidal AC waveform, these limits are: $V_{rms\_sat} = (500 - V_{dc}) / 1.4142$ $V_{rms\_sat} = (-500 + V_{dc}) / 1.4142$
Examples	$V_{DC} = 0$ $500 = 1.414 * 350 + 0$ (V_AC_rms_sat = 500) $V_{DC} = 100$ $500 = 1.414 * 283 + 100$ (V_AC_rms_sat = 283) $V_{DC} = 500$ $500 = 1.414 * 0 + 500$ (V_AC_rms_sat = 0)
Returned Data Format	<nr2>
Query Example	VOLT:AC3:LIM:SAT:RANG? 150.5204

Query Format	[SOURce:]VOLTage[:AC]#:LIMIT:SATuration:MAXimum?
Description	Returns maximum sine wave RMS voltage at which saturation of the output inverter will occur. See [SOURce:]VOLTage[:AC]#:LIMIT:SATuration:RANGe? for details.
Returned Data Format	<nr2>
Query Example	VOLT:AC3:LIM:SAT:MAX? 350.000
Query Format	[SOURce:]VOLTage[:AC]#:LIMIT:SATuration:MINimum?
Description	Returns minimum sine wave RMS voltage at which saturation of the output inverter will occur. See [SOURce:]VOLTage[:AC]#:LIMIT:SATuration:RANGe? for details.
Returned Data Format	<nr2>
Query Example	VOLT:AC3:LIM:SAT:MIN? 0.000
Command Syntax	[SOURce:]VOLTage[:AC]:INITial
Description	This command is equivalent to the “[SOURce:]INITial <n>” command but applies only to the AC1, AC2 and AC3 parameters. Set points of the unit at power on will be the last set after power off. The set points affected by this command are: - Voltage AC1 - Voltage AC2 - Voltage AC3
VOLT:INIT? = ON	Set points of the unit at power on will have a default value of: - Voltage AC1 = 0V - Voltage AC2 = 0V - Voltage AC3 = 0V
VOLT:INIT? = OFF	Set points of the unit at power on will have a default value of: - Voltage AC1 = 0V - Voltage AC2 = 0V - Voltage AC3 = 0V
Parameters	< 0 OFF 1 ON >
Parameter Format	
Example	VOLT:AC:INIT OFF
Query Format	[SOURce:]VOLTage[:AC]:INITial?
Returned Data Format	
Query Example	VOLT:AC:INIT? 0

Command Syntax	[SOURce:]VOLTage:DC#
Description	Sets DC voltage for phase #. If # is omitted, sets all available phases to value specified. Note: Source must be in DC or AC+DC mode and UPC compatibility mode must be disabled.
Parameters	Range 0.0000 - 425.0000
Parameter Format	<nr2>
Example	VOLT:DC1 375.0
Query Format	[SOURce:]VOLTage:DC#?
Returned Data Format	<nr2>
Query Example	VOLT:DC1? 375.0000
Command Syntax	[SOURce:]VOLTage:DC#:SLEW
Description	Sets DC voltage slew rate for phase #. If # is omitted, sets all available phases to value specified. Note: Source must be in DC or AC+DC mode and UPC compatibility mode must be disabled.
Parameters	Range 0.01- 850.00
Parameter Format	<nr2> and <nr3>
Example	VOLT:DC1:SLEW 850.00
Query Format	[SOURce:]VOLTage:DC#:SLEW?
Returned Data Format	<nr2>
Query Example	VOLT:DC1:SLEW? 850.0000
Command Syntax	[SOURce:]VOLTage:DC#:LIMit:MINimum
Description	Sets low user limit for DC voltage programming for phase #. If # is omitted, sets all available phases to value specified. User limits must fall within actual hardware limits of the power source. Also, MIN limit must be less than MAX limit.
Parameters	-500.0 – 500.0
Parameter Format	<nr2>
Example	VOLT:LIM:DC1:MIN 20.0
Query Format	[SOURce:]VOLTage:DC#:LIMit:MINimum?
Returned Data Format	<nr2>
Query Example	VOLT:DC1:LIM:MIN? -500.000

Command Syntax	[SOURce:]VOLTage:DC#:LIMit:MAXimum
Description	Sets upper user limit for DC voltage programming for phase #. If # is omitted, sets all available phases to value specified. User limits must fall within actual hardware limits of the power source. Also, MIN limit must be less than MAX limit.
Parameters	-500.0 – 500.0
Parameter Format	<nr2>
Example	VOLT:LIM:DC1:MAX 270.0
Query Format	[SOURce:]VOLTage:DC#:LIMit:MAXimum?
Returned Data Format	<nr2>
Query Example	VOLT:DC1:LIM:MAX? -500.000
Query Format	[SOURce:]VOLTage:DC#:LIMit:RANGe?
Description	This query returns both upper and lower user limits for DC voltage programming.
Returned Data Format	<nr2>,<nr2>
Query Example	VOLT:DC1:LIM:RANG? -500.0000,500.0000
Query Format	[SOURce:]VOLTage:DC#:LIMit:SATuration:RANGe?
Description	Returns maximum DC voltage at which saturation of the output inverter will occur. Saturation limits are determined in the maximum peak voltage capability of the AC+DC components at the output of the power source. For the AGX Series®, these limits are -425 and +425V. The VOLT:DC1:SAT? returns the max. DC level that may be programmed based on the programmed AC wave shape and RMS level.
	Maximum allowable values are: Maximum positive peak voltage: $V_{DC} = V_{peak\_max} - V_{AC\_peak\_max}$ Minimum negative peak voltage: $V_{DC} = V_{peak\_min} + V_{AC\_peak\_min}$
Examples	$V_{AC} = 350V_{rms}$ sine wave $V_{DC} = 500 - 1.414 * 300$ (V_DC_sat = 0) $V_{AC} = 120V_{rms}$ sine wave $V_{DC} = 500 - 1.414 * 120$ (V_DC_sat = 330) $V_{AC} = 0V_{rms}$ $V_{DC} = 500 - 0$ (V_DC_sat = 500)
Returned Data Format	<nr2>
Query Example	VOLT:DC1:LIM:SAT:RANG? -225, + 225

Query Format	[SOURce:]VOLTage:DC#:LIMit:SATuration:MAXimum?
Description	Returns maximum sine wave RMS voltage at which saturation of the output inverter will occur. See [SOURce:]VOLTage:DC#:LIMIT:SATuration:RANGE? for details.
Returned Data Format	<nr2>
Query Example	VOLT:DC3:LIM:SAT:MAX? 254.946
Query Format	[SOURce:]VOLTage:DC#:LIMit:SATuration:MINimum?
Description	Returns minimum sine wave RMS voltage at which saturation of the output inverter will occur. See [SOURce:]VOLTage:DC#:LIMIT:SATuration:RANGE? for details.
Returned Data Format	<nr2>
Query Example	VOLT:DC3:LIM:SAT:MIN? -254.946
Command Syntax	[SOURce:]VOLTage:EXTend
Description	This command grants access to a higher voltage range extension mode. When enabled, AC voltage settings up to 365V L-N are supported.
Parameters	[0 1] 0 = Off, 350Vac max. 1 = 365Vac max
Parameter Format	<bool>
Example	VOLT:EXT 1
Query Format	[SOURce:]VOLTage:EXTend?
Returned Data Format	<nr1>
Query Example	VOLT:EXT? 1

8.8.3 Frequency Programming Commands

Command Syntax	[SOURce:]FREQuency
Description	Sets output frequency for all phases in Source mode or expected input frequency in Load mode. Not valid when the Source or Load is in DC mode. Sending a FREQ command while in DC mode will result in an error. The query form will return 0.000 when in DC mode.
Parameters	15.00 – 1200.0
Parameter Format	<nr2>
Example	FREQ 400.0
Query Format	[SOURce:]FREQuency?
Returned Data Format	<nr2>
Query Example	FREQ? 400.0000
Command Syntax	[SOURce:]FREQuency:EXTend
Description	Enables extended output higher frequency mode (1200Hz ~ 3000Hz) for all phases in Source mode or expected input frequency in Load mode. Note that maximum voltage and power levels are reduced for extended frequency operation.
Parameters	[0 OFF 1 ON]
Parameter Format	<nr2>
Example	FREQ:EXT 1
Query Format	[SOURce:]FREQuency:EXTend?
Returned Data Format	
Query Example	FREQ:EXT? 1
Command Syntax	[SOURce:]FREQuency:LOWrange
Description	Enables extended output lower frequency mode (1Hz ~ 15Hz) for all phases. Note that maximum voltage and power levels are reduced for extended frequency operation.
Parameters	[0 OFF 1 ON]
Parameter Format	<nr2>
Example	FREQ:LOW 1
Query Format	[SOURce:]FREQuency:LOWrange?
Returned Data Format	
Query Example	FREQ:LOW? 1

Command Syntax Description	[SOURce:]FREQuency:LIMit:MINimum Sets the lower user limit for frequency programming. Not that the lower limit set value must be less than the upper limit set value or an error will be generated and no change to the set value will take place. The lower limit set value must fall within the source specified frequency range capability.
Parameters	1.00 – 1200.0
Parameter Format	<nr2>
Example	FREQ:LIM:MIN 47.0
Query Format	[SOURce:]FREQuency:LIMit:MINimum?
Returned Data Format	<nr2>
Query Example	FREQ:LIM:MIN? 47.0000
Command Syntax Description	[SOURce:]FREQuency:LIMit:MAXimum Sets the upper user limit for frequency programming. Note that the upper limit set value must be greater than the lower limit set value or an error will be generated and no change to the set value will take place. The upper limit set value must fall within the source specified frequency range capability.
Parameters	15.00 – 3000.0
Parameter Format	<nr2>
Example	FREQ:LIM:MAX 63.0
Query Format	[SOURce:]FREQuency:LIMit:MAXimum?
Returned Data Format	<nr2>
Query Example	FREQ:LIM:MAX? 63.0000
Query Format Description	[SOURce:]FREQuency:LIMit:RANGE? This command returns the lower and upper frequency user limit set value.s
Returned Data Format	<nr2>, <nr2>
Query Example	FREQ:LIM:RANG? 53.0000,63.0000
Command Syntax Description	[SOURce:]FREQuency:SLEW Sets the frequency slew rate in Hz/msec. This command is not valid when in DC mode.
Parameters	0.01 – 1200.00
Parameter Format	<nr2>
Example	FREQ:SLEW 100.0
Query Format	[SOURce:]FREQuency:SLEW?
Returned Data Format	<nr2>
Query Example	FREQ:SLEW? 100.0000

Query Format	[SOURce:]FREQuency:SPAN?
Description	This command is provided to support backward compatibility with Pacific Power UPC controllers. Refer also to the “ SYSTem:COMPatible ” command. For AGX Series®, this query always returns 1200.0000
Returned Data Format	<nr2>
Query Example	FREQ:SPAN? 1200.0000

8.8.4 Current Programming Commands

Command Syntax	[SOURce:]CURRent:EXTended < 0 1>
Description	This command enables <1> or disables <0> the extended current range feature. Default state after power on will be off <0> Note: This feature requires firmware revision 5.6.10 or higher.
Parameters	0 OFF 1 ON
Parameter Format	<nr1>
Example	CURR:EXT 1
Query Format	[SOURce:]CURRent:EXTended?
Returned Data Format	<nr1>
Query Example	CURR:EXT? 1
Command Syntax	[SOURce:]CURRent:LIMit#
Description	This command sets the programmable current level for the selected phase #. If # is omitted, sets all phases to current level specified. The value set cannot exceed the maximum current capability of the power source as returned by the “ [SOURce:]CURRent:LIMit#:MAX? ” command. If the load current exceeds the current limit set point, the source will go into constant current mode to maintain the load current at the set limit level.
Parameters	0.00 – MAX
Parameter Format	<nr2>
Example	CURR:LIM 20.5
Query Format	[SOURce:]CURRent:LIMit#?
Returned Data Format	<nr2>
Query Example	CURR:LIM? 41.667,41.667,41.667

Query Format	[SOURce:]CURRent:LIMit#:MAX?
Description	This command returns the maximum available programmable current limit setting. Note that the returned value is a function of the “ SYSTem:COMPAtible ” setting
UPC	If UPC mode is enabled, this command always returns 2000.0000 to emulate the UPC controllers
DISABLED	With UPC mode disabled, this command returns the max. available current output per phase. This value is a function of the AGX model and the number of units that are connected in parallel.
Returned Data Format	<nr2>
Query Example	CURR:LIM:MAX? 41.6667
Query Format	[SOURce:]CURRent:LIMit#:DEFault?
Description	This command returns the default current limit setting at power up for the referenced phase.
Returned Data Format	<nr2>
Query Example	CURR:LIM1:DEF? 41.67
Query Format	[SOURce:]CURRent:LIMit#:MAXimum?
Description	This command returns the maximum current limit setting available for the referenced phase.
Returned Data Format	<nr2>
Query Example	CURR:LIM:MAX1? 41.67
Query Format	[SOURce:]CURRent:LIMit#:MINimum?
Description	This command returns the minimum current limit setting available for the referenced phase.
Returned Data Format	<nr2>
Query Example	CURR:LIM:MIN1? 0.000

Command Syntax	[SOURce:]CURRent:LIMit:AUTO
Description	This commands enables or disables the Auto Current Limit function. This function automatically adjusts the programmed current limit level as a function of programmed voltage along the constant power curve of the voltage range. For example: On a 3150AGX model in three phase mode, if VOLT = 0 and CURR:LIM = 41.67 and voltage is changed to V = 300, the CURR:LIM will change to: 5000 VA / 300 Vac = 16.0. If CURR:LIM:AUTO = OFF then the CURR:LIM setting will remain at 41.67A and the power source will power limit at 5000VA instead if the load draws more than 16Aac.
Parameters	< 0 OFF 1 ON >
Parameter Format	
Example	CURR:LIM:AUTO ON
Query Format	[SOURce:]CURRent:LIMit:AUTO?
Returned Data Format	
Query Example	CURR:LIM:AUTO? 1
Command Syntax	[SOURce:]CURRent:Overload
Description	This command turns the overload current mode on or off
Parameters	[0 OFF 1 ON]
Parameter Format	
Example	SOUR:CURR:OV ON
Query Format	[SOURce:]CURRent:Overload?
Returned Data Format	
Query Example	CURR:OV? 1

8.8.5 Phase Programming Commands

Command Syntax	[SOURce:]PHASe#
Description	This command programs the phase angle for the selected phase. A phase reference (#) must be specified. Also used to set the expected input phase angle of the connected EUT AC Source when unit is in Load mode. Note that unless external sync mode is used, the A phase (# = 1) cannot be programmed is fixed at 0 degrees.
Parameters	0.0 – 359.9
Parameter Format	<nr2>
Example	PHAS2 122.5
Query Format	[SOURce:]PHASe#?
Returned Data Format	<nr2>
Query Example	PHAS2? 122.5

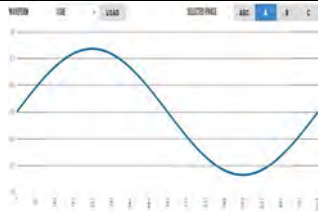
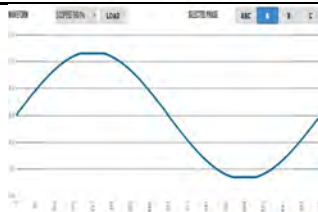
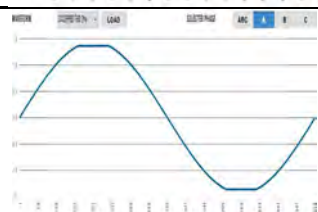
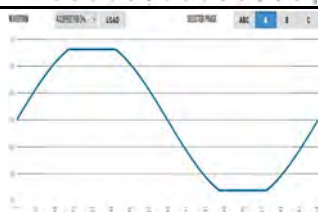
Command Syntax	[SOURce:]PHASe#:SLEW
Description	This command sets slew rate for the phase angle for the selected phase. A phase reference (#) must be specified. Note that unless external sync mode is used, the A phase (# = 1) slew rate cannot be programmed is fixed at 0 degrees.
Parameters	0.01 – 359.91
Parameter Format	<nr2>
Example	PHAS3:SLEW 10.25
Query Format	[SOURce:]PHASe#:SLEW?
Returned Data Format	<nr2>
Query Example	PHAS3:SLEW? 10.2500
Command Syntax	[SOURce:]PHASe:ROTation
Description	This command sets default phase rotation at power on. Available settings are POSITIVE (1) or NEGATIVE (0). This setting effectively swaps phases B and C and may be used to set the required phase rotation for AC motors.
Parameters	[0 NEGative 1 POSitive] 0 = NEGATIVE 1 = POSITIVE
Parameter Format	
Example	PHAS:ROT POS
Query Format	[SOURce:]PHASe:ROTation?
Returned Data Format	
Query Example	PHAS:ROT? 1
Command Syntax	[SOURce:]PHASe:SPLIT
Description	This command sets the split phase mirroring mode. This mode allows non-symmetrical AC arbitrary waveforms to be used when in split phase mode. Default state is on.
Parameters	[0 OFF 1 ON] 0 = OFF 1 = ON
Parameter Format	
Example	PHAS:SPLIT ON
Query Format	[SOURce:]PHASe:SPLIT?
Returned Data Format	
Query Example	PHAS:SPLIT? 1

Command Syntax	[SOURCE:]UPDATEPHase <nr2>
Description	This command sets the start phase angles at which any voltage or frequency setting change will take place. It also determines the start phase angle for phase A for the start of a transient execution.
Parameters	0.0 to 359.9
Parameter Format	<nr2>
Example	UPDATEPH 90.0
Query Format	[SOURCE:]UPDATEPHase?
Returned Data Format	<nr2>
Query Example	UPDATEPH? 90.0

8.8.6 Waveform Programming Commands

Waveform Storage

The AGX Series® offers full arbitrary waveform programming capability in addition to the standard waveforms that are provided. A total of 16 waveform registers are available. The default content of these registers is shown in the table below. Also shown are the waveform number names and the waveform description each waveform.

Name	Description	Image	Notes
0	AUTOGENERATED		This waveform is generated using the WAVEFORM:AUTOGENERATED SCPI commands
1	SINE		Standard sine wave. No harmonic content. This is also the default selected waveform at power on unless a power-on setup is recalled.
2	CLIPPED THD 1%		Clipped sine with 1% total harmonic voltage distortion due to flat topping of sinewave peaks.
3	CLIPPED THD 2%		Clipped sine with 2% total harmonic voltage distortion due to flat topping of sinewave peaks.
4	CLIPPED THD 5%		Clipped sine with 5% total harmonic voltage distortion due to flat topping of sinewave peaks.
5	CLIPPED THD 10%		Clipped sine with 10% total harmonic voltage distortion due to flat topping of sinewave peaks.

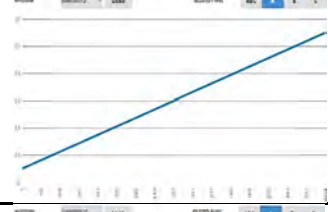
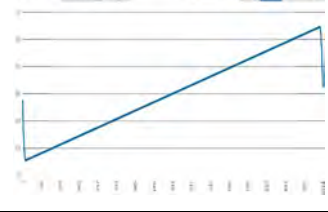
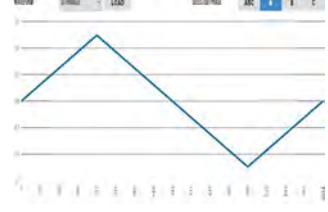
Name	Description	Image	Notes
6	SQUARE LF		Square wave. Consists of fundamental and all odd harmonics. The LF (low frequency) version is recommended for use below 100Hz.
7	SQUARE HF		Square wave. Consists of fundamental and all odd harmonics. The HF (high frequency) version is recommended for use above 100Hz.
8	SAWTOOTH LF		Saw tooth. Consist of fundamental and both odd and even harmonics. Note: Not recommended for conventional power applications. LF use < 100Hz.
9	SAWTOOTH HF		Saw tooth. Consist of fundamental and both odd and even harmonics. Note: Non-linear! Not recommended for conventional power applications. HF use > 100Hz.
10	TRIANGLE		Triangle. Similar to saw tooth but at same fundamental as a sine wave. Contains fundamental and odd harmonics with amplitudes that roll off as the inverse square of the harmonic number. (1/3, 1/9, 1/25 etc).
11~200	USER DEFINED	Number, ALIAS	User defined waveforms

Table 8-2: Available AGX Series® Waveforms

Commands

Command Syntax Description	[SOURce:]WAVEFORM#:AUTOgenerated Select the auto waveform generation mode and sets waveform <0> to the selected waveform type. Available types are Rectified Crest Factor waveform <0> and Harmonic waveform <1>. # = phase 1, 2, 3 or all phases if omitted. 0 = Rectified CF 1 = Harmonic
Parameters	<nr1>
Parameter Format	SOURce:WAVEFORM:AUTOgenerated 1
Example	[SOURce:]WAVEFORM#:AUTOgenerated?
Query Format	<nr1>, <nr1>
Returned Data Format	SOURce:WAVEFORM:AUTOgenerated?
Query Example	0,0,0
Query Format Description	[SOURce:]WAVEFORM#:AUTOgenerated:ALIAs? Returns the names (Aliases) of the available auto generated waveforms.
Returned Data Format	0 , Rectified CF 1 , Harmonic
Query Example	SOURce:WAVEFORM:AUTOgenerated:ALIAs? Rectified CF 5.00,Rectified CF 5.00,Rectified CF 5.00
Query Format Description	[SOURce:]WAVEFORM#:AUTOgenerated:CATalog? Returns available parameters for the WAVEFORM: AUTO command. # = phase 1, 2, 3 or all phases if omitted.
Returned Data Format	0,Rectified CF,1,Harmonic,0,Rectified CF,1,Harmonic
Query Example	SOURce:WAVEFORM:AUTOgenerated:CATalog? 0,Rectified CF,1,Harmonic,0,Rectified CF,1,Harmonic
Command Syntax Description	[SOURce:]WAVEFORM#:AUTOgenerated:ARGuments Sets the argument values for the auto generated crest factor waveform. Available waveshapes are rectified waveform or harmonic waveform. # = phase 1, 2, 3 or all phases if omitted.
Parameters	For rectified Crest Factor waveshape: <0> = Crest factor <1> = Form: 0 = auto, 1 = one peak, 2 = two peaks For Harmonic waveshape: <order#1, amplitude#1, phase#1, order#2, amplitude#2, phase#2, ...> up to 50 th order harmonic.
Parameter Format	<nr2>,<nr1> (for each available phase.)
Example	SOURce:WAVEFORM2:AUTOgenerated:ARGuments 4.3432,1
Query Format	[SOURce:]WAVEFORM#:AUTOgenerated:ARGuments?
Returned Data Format	Depends of waveshape type, CF or Harmonics
Query Example	SOURce:WAVEFORM:AUTOgenerated:ARGuments? 3.000000,2,3.000000,2,3.000000,2

Command Syntax	[SOURce:]WAVEFORM#:AUTOgenerated:HARmonics:CSC
Description	Sets the CSC mode values for the auto generated waveform. # = phase 1, 2, 3 or all phases if omitted. CSC mode is either off (0) or on (1). (CSC = C ontinuous S elf C alibration mode for amplitude.)
Parameters	<0> = Off <1> = On
Parameter Format	
Example	
Query Format	[SOURce:]WAVEFORM#:AUTOgenerated:HARmonics:CSC?
Returned Data Format	,, for 3 phase mode, , for split phase, for single phase mode
Query Example	SOURce:WAVEFORM:AUTOgenerated:HARmonic:CSC? 1,1,1
Query Format	[SOURce:]WAVEFORM#:AUTOgenerated:HARmonic:CSC:ARGuments?
Description	Returns the list of arguments
Returned Data Format	<nr1>
Query Example	SOURce:WAVEFORM:AUTOgenerated:HARmonic:CSC:ARGuments? ,-

Command Syntax	[SOURce:]WAVEFORM:AUTORMS <BOOLEAN>
Description	If enabled, the value of the waveform is normalized in order to match the RMS set point. If disabled, the waveform is reproduced without any normalization. This function is useful for waveform substitution at the steady state level. Note: This function is related to the AUTORMS function in the transient segment but it is not the same. Note: UPC has AUTORMS always enabled for steady state. It is not an option in UPC Mode.
Parameters	0 1 ON OFF
Parameter Format	
Example	WAVEFORM:AUTORMS OFF
Query Format	[SOURce:]WAVEFORM:AUTORMS?
Returned Data Format	
Query Example	SOURce:WAVEFORM:AUTORMS? 0
Query Format	[SOURce:]WAVEFORM:CATalog?
Description	This command returns the list of available waveforms by name. Names can only be numbers. For more descriptive names, see the ."[SOURce:]WAVEFORM:CATalog:ALIAS?" command instead.
Returned Data Format	<cr>
Query Example	WAVEFORM:CAT? 1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16

Query Format Description	[SOURCE:]WAVEFORM:CATalog:ALIAS? This command returns the list of available waveforms by description. For each waveform, both the name (number) and description are returned in a comma separated list.
Returned Data Format Query Example	<cr> WAVEFORM:CAT:ALIAS? Sine,Clipped THD 1%,Clipped THD 2%,Clipped THD 5%,Clipped THD 10%,Square Fast,Square Slow,Sawtooth Fast,Sawtooth Slow,Triangle,Clip 5% THD,Clip 6% THD,Clip 7% THD,Clip 8% THD,Clip 9% THD,Clip 10% THD
Command Syntax Description	[SOURCE:]WAVEFORM:COPY This command copies the waveform file specified as a PATH parameter to the waveform number specified. The path name is a delimited string.
Parameters Parameter Format Example	<PATH>,<NUMBER> <cr>,<nr1> WAVEFORM:COPY "internal/waveforms/1.csv",25
Command Syntax Description	[SOURCE:]WAVEFORM:DEFine This command sends a string of 1024 data points that constitute a single period of an arbitrary waveform. The data is sent as a comma separated list of <nr2> values. The waveform name to which to apply the new data values is the first parameter in the list and can be from 1 through 16. Note: Data values are scaled based on an RMS value of 1 so for a sine wave, the max data value is 1.414 and the min data value is -1.414
Parameters Parameter Format Example	1024 data values separated by commas <nr1>,<nr2>,<nr2>,...,<nr2> WAVEFORM:DEF 16,0.0000,0.0068,0.0135,0.0203,...,-0.0203,-0.0135,-0.0068
Query Format Returned Data Format Query Example	[SOURCE:]WAVEFORM:DEFine? <nr1> <nr2>,<nr2>,...,<nr2> SOURCE:WAVEFORM:DEF? 16 0.0000,0.0068,0.0135,0.0203, ..., -0.0203,-0.0135,-0.0068
Command Syntax Description	[SOURCE:]WAVEFORM:DELeTe <nr1> This command deletes a user defined waveform from any location higher than 1.
Parameters Parameter Format Example	Waveform number <nr1> WAVEFORM:DEL 16

Query Format	[SOURce:]WAVEFORM:EXIST? <nr1>
Description	This command returns a 1 if the waveform location referenced contains waveform data or a 0 if the waveform location is empty (No waveform exists).
Returned Data Format	<nr1>
Query Example	WAVEFORM:EXIST? 34 0
Command Syntax	[SOURce:]WAVEFORM#:LOAD
Description	This command loads the currently selected waveform to the actual output register of the controller causing it output the waveform on the selected phase #.
Parameters	1, 2, 3
Parameter Format	<nr1>
Example	WAVEFORM1:LOAD
Query Format	[SOURce:]WAVEFORM#:LOAD? <nr1>
Returned Data Format	<nr1>, <cr>
Query Example	SOURce:WAVEFORM1:LOAD? 1 1, Sine
Command Syntax	[SOURce:]WAVEFORM:RESTORE
Description	This command restores the first 16 waveforms registers by replacing waveform 1 to 16 with the factory defaults. See section 8.7.6. Note: This command is useful if waveforms 2 through 15 were overwritten with user-defined waveforms.
Parameters	None
Parameter Format	n/a
Example	WAVEFORM:RESTORE
Query Format	None

Command Syntax	[SOURce:]WAVEFORM#:SElect
Description	This command selects a waveform by alias (name) or number. When using the WAVEFORM:x commands, the ALIAS NUMBER is not passed as it uses the selected one. This is to avoid passing the waveform number to every command
Parameters	<ALIAS NUMBER, OPT: ALIAS NUMBER , OPT: ALIAS NUMBER > The first parameter is required. Additional optional waveforms or numbers may be added when operating the source in 2 or 3 phase mode. The waveform selection sequence by phase is A, B, C.
Parameter Format	<cr> or <nr1>
Example	WAVEFORM:SEL SINE WAVEFORM:SEL 1,2,3 WAVEFORM:SEL 5
Query Format	[SOURce:]WAVEFORM#:SElect?
Returned Data Format	<cr> or <nr1>
Query Example	WAVEFORM:SEL? 1,1,1 (FORM 3) WAVEFORM:SEL? 1,1 (FORM 2) WAVEFORM:SEL? 1 (FORM 1)
Command Syntax	[SOURce:]WAVEFORM:SINEwave
Description	This command modifies the #1 Sinewave harmonic content to reduce voltage distortion at lower frequencies (< 100Hz). It does so by disabling the 3 rd Harmonic component that is normally included to improve voltage distortion at high frequencies. Turning this OFF (0) is recommended for Harmonics and Flicker system applications at 50 and 60 Hz. For Avionics and Defense applications at 400Hz or higher, this mode should re-enabled (1). Not that this setting is saved in non-volatile memory and is retained between power on/off cycles of the power source.
Parameters	
Parameter Format	n/a
Example	SOUR:WAVEFORM:SINE 0
Query Format	SOURce:WAVEFORM:SINEwave?
Query Example	SOUR:WAVEFORM:SINE? 0

Command Syntax Description	[SOURce:]WAVEFORM:SMOOTHen <NUMBER> This command Sets the smoothing filter size that is applied to the waveform, in sample counts. A value of 1 makes the filter have no effect (Disabled) and the maximum value is 101. Only odd numbers are considered. The type of filter used is a moving-average-filter, or MAF. The smoothing filter is used to reduce slew rates of waveform edges. This is useful in certain applications to make the waveform reproduction more consistent and reduce potential distortion due to the sampling rate of the controller, especially when reproducing waveforms at high frequency.
Parameters	NUMBER
Parameter Format	<nr1>
Example	WAVEFORM:SMOOTH 33
Query Format	[SOURce:]WAVEFORM:SMOOTHen?
Returned Data Format	<nr1>
Query Example	WAVEFORM:SMOOTH? 33
Command Syntax Description	[SOURce:]WAVEFORM#:NAME Set waveform for selected phase to the waveform name passed as a parameter. If no waveform name parameter is specified, the query format returns the name of the selected waveform. See WAVEFORM#[:NAME] command.
Parameters	1 – 16
Parameter Format	<nr1>
Example	WAVEFORM1 4
Query Format	[SOURce:]WAVEFORM#:NAME?
Returned Data Format	<nr1>
Query Example	SOUR:WAVEFORM1? 4
Command Syntax Description	[SOURce:]WAVEFORM#:ALIAS Analogous to the WAVEFORM#[:NAME] command but in place of the waveform name, the waveform description is passed as a quoted string.
Parameters	Waveform description as quoted string.
Parameter Format	<cr>
Example	WAVEFORM1:NAME:ALIAS "Triangle"
Query Format	[SOURce:]WAVEFORM#:ALIAS?
Description	Analogous to the WAVEFORM#[:NAME]? query command but in place of the waveform name, the alias is returned as a string.
Returned Data Format	<cr>
Query Example	WAVEFORM1:ALIAS? Triangle

Command Syntax	[SOURce:]WAVEFORM#:LOAD
Description	Sets the waveform name (1 – 16) to be loaded for the selected phase # for the next SWITCH command. If # is omitted, sets all available phases to waveform name specified. Note: The waveform LOAD command loads the selected phase's waveform registers with the waveform data for the specified waveform name but does not cause it to appear at the output until the WAVEFORM:SWITCH command is received.
Parameters	1 – 16
Parameter Format	<nr1>
Example	WAVEFORM2:LOAD 12
Query Format	[SOURce:]WAVEFORM#:LOAD?
Returned Data Format	<nr1> or <nr1>,<nr1>,<nr1>
Query Example	WAVEFORM:LOAD? 1,12,1
Command Syntax	[SOURce:]WAVEFORM#:SWITCH
Description	When sent for the selected phase, the output waveform is switched over to the new waveform name that was last set with the WAVEFORM#:LOAD command. . If # is omitted, sets all available phases' waveforms are switched.
Parameters	None other than phase selected in command string
Parameter Format	n/a
Example	WAVEFORM1:SWITCH

8.8.7 Voltage Protection Programming Commands

Note: For all protection commands, # = Phase 1, 2 or 3 select or omit for all phases.

Command Syntax	[SOURce:]PROTect:PEAK:VOLTage#:STATe
Description	This command enables or disables the peak voltage protection.
Parameters	< 0 OFF 1 } ON >
Parameter Format	
Example	PROT:PEAK:VOLT1:STAT 1
Query Format	[SOURce:]PROTect:PEAK:VOLTage#:STATe?
Returned Data Format	<nr1>
Query Example	PROT:PEAK:VOLT1:STAT? 1

Command Syntax	[SOURCE:]PROTECT:PEAK:VOLTage#:MODE <MARGin LEVel BOTH>
Description	This command sets the voltage peak mode.
Parameters	<MARGin 0 LEVel 1 BOTH 2 > Encoding: MARGin 0 Relative level LEVel 1 Absolute level BOTH 2 Both
Parameter Format	<cr> <nr1>
Example	PROT:PEAK:VOLT1:MODE BOTH
Query Format	[SOURCE:]PROTECT:PEAK:VOLTage#:MODE?
Returned Data Format	<nr2>
Query Example	PROT:PEAK:VOLT1:MODE? 2
Command Syntax	[SOURCE:]PROTECT:PEAK:VOLTage#:MARGin <VOLTAGE MARGIN>
Description	This command sets the maximum voltage peak margin. If the output voltage peak exceeds the programmed peak margin by more than this amount, an error is tripped.
Parameters	<VOLTAGE MARGIN>
Parameter Format	<nr2>
Example	PROT:PEAK:VOLT:MARG 120.0
Query Format	[SOURCE:]PROTECT:PEAK:VOLTage#:MARGin?
Returned Data Format	<nr2>
Query Example	PROT:PEAK:VOLT1:MARG? 120.000
Query Syntax	[SOURCE:]PROTECT:PEAK:VOLTage:MARGin:MINimum?
Description	This command returns the minimum voltage peak margin setting. # = Phase 1, 2 or 3 select or none.
Query Example	PROT:PEAK:VOLT:MARG1:MIN? 0.000
Query Syntax	[SOURCE:]PROTECT:PEAK:VOLTage:MARGin:MAXimum?
Description	This command returns the maximum voltage peak margin setting
Query Example	PROT:PEAK:VOLT:MARG:MAX? 500.000
Query Syntax	[SOURCE:]PROTECT:PEAK:VOLTage:MARGin:DEFault?
Description	This command returns the default voltage peak margin setting
Query Example	PROT:PEAK:VOLT:MARG:DEF? 100.000

Command Syntax	[SOURce:]PROTect:PEAK:VOLTage#:LEVel <VOLTAGE LEVEL>
Description	This command sets the maximum voltage peak level. If the output voltage peak exceeds the programmed peak level by more than this amount, an error is tripped.
Parameters	<VOLTAGE LEVEL>
Parameter Format	<nr2>
Example	PROT:PEAK:VOLT1:LEV 120.0
Query Format	[SOURce:]PROTect:PEAK:VOLTage#:LEVel?
Returned Data Format	<nr2>
Query Example	PROT:PEAK:VOLT:LEV? 500.000
Query Syntax	[SOURce:]PROTect:PEAK:VOLTage:LEVel:MINimum?
Description	This command returns the minimum voltage peak level setting.
Query Example	PROT:PEAK:VOLT:LEV1:MIN? 0.000
Query Syntax	[SOURce:]PROTect:PEAK:VOLTage:LEVel:MAXimum?
Description	This command returns the maximum voltage peak level setting
Query Example	PROT:PEAK:VOLT:LEV:MAX? 500.000
Query Syntax	[SOURce:]PROTect:PEAK:VOLTage:LEVel:DEFault?
Description	This command returns the default voltage peak level setting
Query Example	PROT:PEAK:VOLT:LEV:DEF? 500.000
Query Syntax	[SOURce:]PROTect:PEAK:VOLTage:TRIPped?
Description	This command returns 1 if the voltage peak protection has been tripped or 0 if no trip occurred.
Query Example	PROT:PEAK:VOLT1:TRIP? 0.000
Command Syntax	[SOURce:]PROTect:PEAK:VOLTage:TRIPped:CLEar
Description	This command clears the peak voltage protection trip status. Once cleared, the power source output can be re-enabled.
Parameters	<VOLTAGE LEVEL>
Parameter Format	<nr2>
Example	PROT:PEAK:VOLT1:TRIP:CLE

Command Syntax	[SOURce:]PROTect:RMS:OV#:LEVel <VOLTAGE LEVEL>
Description	This command sets the over-voltage level. If the output voltage exceeds the programmed level, an error is tripped.
Parameters	<VOLTAGE LEVEL>
Parameter Format	<nr2>
Example	PROT:RMS:OV1:LEV 120.0
Query Format	[SOURce:]PROTect:RMS:OV#:LEVel?
Returned Data Format	<nr2>
Query Example	PROT:RMS:OV:LEV? 500.000
Command Syntax	[SOURce:]PROTect:RMS:OV#:STATe
Description	This command enables or disables the over-voltage level protection.
Parameters	< 1 } 0 >
Parameter Format	
Example	PROT:RMS:OV1:LEV 120.0
Query Format	[SOURce:]PROTect:RMS:OV#:VOLTage#:STATe?
Returned Data Format	<nr2>
Query Example	PROT:RMS:OV:STAT? 500.000
Command Syntax	[SOURce:]PROTect:RMS:UV#:LEVel <VOLTAGE LEVEL>
Description	This command sets the under-voltage level. If the output voltage drops below the programmed level, an error is tripped.
Parameters	<VOLTAGE LEVEL>
Parameter Format	<nr2>
Example	PROT:RMS:UV1:LEV 120.0
Query Format	[SOURce:]PROTect:RMS:UV#:LEVel?
Returned Data Format	<nr2>
Query Example	PROT:RMS:UV:LEV? 500.000
Command Syntax	[SOURce:]PROTect:RMS:UV#:STATe
Description	This command enables or disables the under-voltage level protection.
Parameters	< 1 } 0 >
Parameter Format	
Example	PROT:RMS:UV1:LEV 120.0
Query Format	[SOURce:]PROTect:RMS:UV#:VOLTage#:STATe?
Returned Data Format	<nr2>
Query Example	PROT:RMS:UV:STAT? 1

8.8.8 Current Protection Programming Commands

Note: For all protection commands, # = Phase 1, 2 or 3 select or omit for all phases.

Command Syntax	[SOURCE:]PROTECT[:RMS]:CURRENT[#:STATE] <ON OFF>
Description	This command enables or disables the rms current protection. If the protection is tripped the power source output is disabled.
Parameters	< ON 1 OFF 0 >
Parameter Format	<nr1> <cr>
Example	PROTECT:CURRENt1 ON
Query Format	[SOURCE:]PROTECT[:RMS]:CURRENT#[:STATE]?
Returned Data Format	<nr2>
Query Example	PROTECT:CURRENt? 1
Command Syntax	[SOURCE:]PROTECT[:RMS]:CURRENT#:LEVEL <LEVEL>
Description	This command sets the rms current protection level.
Parameters	< LEVEL >
Parameter Format	<nr2>
Example	PROT:CURRENt:LEVEl 40.0
Query Format	[SOURCE:]PROTECT[:RMS]:CURRENT#:LEVEL?
Returned Data Format	<nr2>
Query Example	PROT:CURRENt:LEV? 40.000
Query Syntax	[SOURCE:]PROTECT[:RMS]:CURRENT:LEVEL:MINimum?
Description	This command returns the minimum rms current protection level setting.
Query Example	PROT:CURRENt:LEV:MIN? 0.000
Query Syntax	[SOURCE:]PROTECT[:RMS]:CURRENT:LEVEL:MAXimum?
Description	This command returns the maximum rms current protection level setting.
Query Example	PROT:CURRENt:LEV:MAX? 41.667
Query Syntax	[SOURCE:]PROTECT[:RMS]:CURRENT:LEVEL:DEFault?
Description	This command returns the default rms current protection level setting. This value will be a function of the power source model.
Query Example	PROT:CURRENt:LEV:DEF? 41.667

Command Syntax	[SOURCE:]PROTECT[:RMS]:CURRENT#:TDELAY <DELAY>
Description	This command sets the rms current protection trip delay in 100 msec increments, i.e. as setting of 5 means 500 msec.
Parameters	< DELAY >
Parameter Format	<nr1>
Example	PROTECT:CURR:TDELAY 5
Query Format	[SOURCE:]PROTECT[:RMS]:CURRENT#:TDELAY?
Returned Data Format	<nr1>
Query Example	PROT:CURR:LEV? 5
Query Syntax	[SOURCE:]PROTECT[:RMS]:CURRENT:TDELAY:MINimum?
Description	This command returns the minimum rms current protection trip delay setting.
Query Example	PROT:CURR:TDELAY:MIN? 0
Query Syntax	[SOURCE:]PROTECT[:RMS]:CURRENT:TDELAY:MAXimum?
Description	This command returns the maximum rms current protection trip delay setting.
Query Example	PROT:CURR:TDELAY:MAX? 3000
Query Syntax	[SOURCE:]PROTECT[:RMS]:CURRENT:TDELAY:DEFault?
Description	This command returns the default rms current protection trip delay setting.
Query Example	[SOURCE:]PROTECT[:RMS]:CURRENT:TDELAY:DEFault? 41.667
Query Syntax	[SOURCE:]PROTECT[:RMS]:CURRENT:TRIPped?
Description	This command returns rms current protection trip status. Returns 1 if tripped or 0 if not.
Query Example	PROT:CURR:TRIP? 41.667
Command Syntax	[SOURCE:]PROTECT[:RMS]:CURRENT:TRIPped:CLEar
Description	This command clears the rms current protection trip status. Once cleared, the power source output can be enabled.
Parameters	None
Parameter Format	n/a
Example	PROT:CURR:TRIP:CLE

Command Syntax Description	[SOURCE:]PEAK:CURRent:LIMit <nr2> This command set the user programmable peak current protection limit. (Not available in models with -413 Option C).
Parameters	Peak current
Parameter Format	<nr2>
Example	PEAK:CURR:LIM 80.0
Query Format	[SOURCE:]PEAK:CURRent:LIMit?
Returned Data Format	<nr2>
Query Example	PEAK:CURR? 80.0000
Query Syntax Description	[SOURCE:]PEAK:CURRent:LIMit:MAXIMUM? This query command returns the maximum allowable setting for the user programmable peak current protection limit. (Not available in models with -413 Option C).
Returned Data Format	<nr2>
Query Example	PEAK:CURR:LIM:MAX? 104.0000
Query Syntax Description	[SOURCE:]PEAK:CURRent:LIMit:MINIMUM? This query command returns the minimum allowable setting for the user programmable peak current protection limit. (Not available in models with -413 Option C).
Returned Data Format	<nr2>
Query Example	PEAK:CURR:LIM:MIN? 0.0000
Query Syntax Description	[SOURCE:]PEAK:CURRent:LIMit:DEFault? This query command returns the default setting for the user programmable peak current protection limit. (Not available in models with -413 Option C).
Returned Data Format	<nr2>
Query Example	PEAK:CURR:LIM:DEF? 104.0000
Command Syntax Description	[SOURCE:]PROTect:PEAK:CURRent#[:STATe] <ON OFF> This command enables or disables the peak current protection function.
Parameters	< ON 1 OFF 0 >
Parameter Format	<cr>
Example	PROT:PEAK:CURR1 ON
Query Format	[SOURCE:]PROTect:PEAK:CURRent#[:STATe]?
Returned Data Format	
Query Example	PROT:PEAK:CURR1? 1

Command Syntax	[SOURCE:]PROTect:PEAK:CURRent#:LEVel <LEVEL>
Description	This command sets the peak current protection level.
Parameters	< LEVEL >
Parameter Format	<nr2>
Example	PROT:PEAK:CURR1:LEV 95.0
Query Format	[SOURCE:]PROTect:PEAK:CURRent#:LEVel?
Returned Data Format	
Query Example	PROT:PEAK:CURR1:LEV? 95.0000
Query Syntax	[SOURCE:]PROTect:PEAK:CURRent:LEVel:MAXIMUM?
Description	This query command returns the maximum allowable setting for the peak current protection level.
Returned Data Format	<nr2>
Query Example	PROT:PEAK:CURR:LEV:MAX? 104.0000
Query Syntax	[SOURCE:]PROTect:PEAK:CURRent:LEVel:MINIMUM?
Description	This query command returns the minimum allowable setting for the peak current protection level.
Returned Data Format	<nr2>
Query Example	PROT:PEAK:CURR:LEV:MIN? 104.0000
Query Syntax	[SOURCE:]PROTect:PEAK:CURRent:LEVel:DEFault?
Description	This query command returns the default setting for the peak current protection level.
Returned Data Format	<nr2>
Query Example	PROT:PEAK:CURR:LEV:DEF? 104.0000
Query Syntax	[SOURCE:]PROTect:PEAK:CURRent:TRIPped?
Description	This query command returns tripped state of the peak current protection level function. Return 1 if tripped, 0 if not.
Returned Data Format	
Query Example	PROT:PEAK:CURR:TRIP? 1

Command Syntax	[SOURCE:]PROTect:PEAK:CURRent:TRIPped:CLEar
Description	This command clears the peak current protection tripped status.
Parameters	None
Parameter Format	n/a
Example	PROT:PEAK:CURR:TRIP:CLE

8.8.9 Voltage Sense Protection Commands

The **SENSe:FAULT** is a fault based on the difference between the RMS voltage measurement and the RMS voltage setpoint programmed.

If the **ABS(VOLTAGE_SETPOINT_RMS – VOLTAGE_MEASUREMENT_RMS) > MAX(SENSe:FAULT:LEVel:PERCentage * VOLTAGE_SETPOINT_RMS, SENSe:FAULT:LEVel:MIN)** the fault trips and turns the output of the unit off.

The trip time is programmed with **PROT:TDELAY X** where X is in 100 milliseconds unit, so 1 means 100ms, 2 means 200ms, and so on. It can be queried with **PROT:TDELAY?**

As this is a RMS protection it will take at least 100ms to trip, it is not faster than that.

- **SENSe:FAULT:LEVel:MIN** establishes the minimum difference it will compare in RMS voltage terms.
- **SENSe:FAULT:LEVel:PERCentage** establishes the difference in terms of a percentage of the programmed RMS setpoint.

The maximum is used to compare, this gives the possibility to program in percentage terms absolute terms, or both.

For example, at 108Vrms programmed, the **ABS(VOLTAGE_SETPOINT_RMS – VOLTAGE_MEASUREMENT_RMS)** should exceed 108Vrms to trip.

For faster voltage protection use **peak voltage protection** which is based on instantaneous values instead of RMS.

Command Syntax	SENSe:FAULT:LEVel:MIN <nr2>
Description	This command sets the minimum sense voltage at which a voltage sense fault will trip the output. The protection trips if the following condition is fulfilled during a time equal to the protection trip time: $ABS(VOLTAGE\_SETPOINT\_RMS - VOLTAGE\_MEASUREMENT\_RMS) > MAX(SENSe:FAULT:LEVel:PERCentage * VOLTAGE\_SETPOINT\_RMS, SENSe:FAULT:LEVel:MIN)$ By default SENSe:FAULT:LEVel:PERCentage is 10% and SENSe:FAULT:LEVel:MIN is 25 volts.
Parameters	<VOLTAGE LEVEL>
Parameter Format	<nr2>
Example	SENS:FAULT:LEV:MIN 120.0
Query Format	SENSe:FAULT:LEVel:MIN?
Returned Data Format	<nr2>
Query Example	SENS:FAULT:LEV:MIN? 25.000

Command Syntax
Description
SENSe:FAULT:LEVel:PERCentage <nr2>

This command sets the sense voltage delta between programmed and actual senses voltage in percent of voltage range at which a voltage sense fault will trip the output. The protection trips if the following condition is fulfilled during a time equal to the protection trip time:

$$ABS(VOLTAGE\_SETPOINT\_RMS - VOLTAGE\_MEASUREMENT\_RMS) > MAX(SENSe:FAULT:LEVel:PERCentage * VOLTAGE\_SETPOINT\_RMS, SENSe:FAULT:LEVel:MIN)$$

By default SENSe:FAULT:LEVel:PERCentage is 10% and SENSe:FAULT:LEVel:MIN is 25 volts.

Parameters
Parameter Format
Example
Query Format
Returned Data Format
Query Example

<VOLTAGE LEVEL>

<nr2>

SENS:FAULT:LEV:PERC 10.0

SENSe:FAULT:LEVel:PERC?

<nr2>

SENS:FAULT:LEV:PERC?

10.000

Command Syntax
Description
**SENSe:FAULT:STATe **

This command enables or disables the send fault error. Default is on (1). It can be disabled by setting the state to off (0).

Parameters
Parameter Format
Example
Query Format
Returned Data Format
Query Example

< 0 | 1 >

SENS:FAULT:STAT 1

SENSe:FAULT:STATe?

SENS:FAULT:STAT?

1

Command Syntax	SENSe:PATH
Description	This command selects the source for metering and CSC mode as either internal (0) or external (1).
Parameters	< 0 1 >
Parameter Format	
Example	SENS:PATH 1
Query Format	SENSe:PATH?
Returned Data Format	
Query Example	SENS:PATH? 1

8.8.10 Power Protection Programming Commands

Command Syntax	[SOURce:]POWer#:LIMit#
Description	This command sets the programmable true power limit level in kW for phase #. If # is omitted, all available phases are set to the value specified. The max available power for a phase can be obtained using the [SOURce:]POWer:LIMit#:MAX? query command.
Parameters	Limit value in kW
Parameter Format	<nr2>
Example	POW1:LIM 2.5
Query Format	[SOURce:]POWer#:LIMit#?
Returned Data Format	<nr2>
Query Example	POW:LIM1? 2.5000
Query Format	[SOURce:]POWer:LIMit#:MAX?
Description	Returns maximum available true power capability for the specified phase # in kW. If # is omitted, returns maximum available power level for all phases. Typically, this value will be the same for all phases.
Returned Data Format	<nr2>
Query Example	POW:LIM1:MAX? 5.0000
Command Syntax	[SOURce:]KVA:LIMit#
Description	This command sets the programmable apparent power limit level in kVA for phase #. If # is omitted, all available phases are set to the value specified. The max available apparent power for a phase can be obtained using the [SOURce:]KVA:LIMit#:MAX? query command.
Parameters	Limit value in kVA
Parameter Format	<nr2>
Example	KVA:LIM 2.5
Query Format	[SOURce:]KVA:LIMit#?
Returned Data Format	<nr2>
Query Example	POW:LIM1? 2.5000

Query Format	[SOURCE:]KVA:LIMit#:MAX?
Description	Returns maximum available apparent power capability for the specified phase # in kVA. If # is omitted, returns maximum available apparent power levels for all phases. Typically, this value will be the same for all phases.
Returned Data Format	<nr2>
Query Example	KVA:LIM1:MAX? 5.0000
Query Format	[SOURCE:]MODE#?
Description	Returns protection mode for the selected phase # (# = 1, 2, or 3). If # is omitted, returns protection mode for all phases in comma separated format. Note: When the phase suffix is 1, 2 or 3 the possible return categories are from 0 to 4. With suffix is omitted, this command will return MIXED(5) if modes for each phase are not the same. For example, if in split phase mode phase A (suffix 1) is in VOLTAGE mode but phase B (suffix 2) is in CURRENT mode, the query SOUR:MODE? you will return MIXED: SOUR:MODE1? = VOLTAGE and SOUR:MODE2? = CURRENT -> SOUR:MODE? = MIXED If both or phases are set to the same mode, the actual mode will be returned: SOUR:MODE1? = VOLTAGE and SOUR:MODE2? = VOLTAGE -> SOUR:MODE? = VOLTAGE
Returned Data Format	<cr> Available protection modes: 0 = NONE 1 = VOLTAGE 2 = CURRENT 3 = POWER 4 = KVA 5 = MIXED
Query Example	SOUR:MODE? VOLTAGE, VOLTAGE, VOLTAGE
Command Syntax	[SOURCE:]PROTeCt[:RMS]:POWeR#[:STAtE] <ON OFF>
Description	This command turns the true power protection on or off.
Parameters	< 0 OFF 1 ON >
Parameter Format	 <cr>
Example	PROT:POW ON
Query Format	[SOURCE:]PROTeCt[:RMS]:POWeR#[:STAtE]?
Returned Data Format	
Query Example	PROT:POW? 1

Command Syntax	[SOURCE:]PROTECT[:RMS]:POWER#:LEVEL <LEVEL>
Description	This command sets the true power protection trip level. Setting is in KW.
Parameters	< LEVEL >
Parameter Format	<nr2>
Example	PROT:POW:LEV 5
Query Format	[SOURCE:]PROTECT[:RMS]:POWER#:LEVEL?
Returned Data Format	
Query Example	PROT:POW:LEV? 5.000
Query Syntax	[SOURCE:]PROTECT[:RMS]:POWER:LEVEL:MINimum?
Description	This command returns the minimum true power protection level setting.
Query Example	PROT:POW:LEV:MIN? 0.000
Query Syntax	[SOURCE:]PROTECT[:RMS]:POWER:LEVEL:MAXimum?
Description	This command returns the maximum true power protection level setting.
Query Example	PROT:POW:LEV:MAX? 41.667
Query Syntax	[SOURCE:]PROTECT[:RMS]:POWER:LEVEL:DEFAULT?
Description	This command returns the default true power protection level setting. This value will be a function of the power source model.
Query Example	PROT:POW:LEV:DEF? 41.667
Command Syntax	[SOURCE:]PROTECT[:RMS]:POWER#:TDELAY <DELAY>
Description	This command sets the true power protection trip delay time. Setting is in multiples of 100 msec so 5 equals 500 msec.
Parameters	< LEVEL >
Parameter Format	<nr2>
Example	PROT:POW:LEV 5
Query Format	[SOURCE:]PROTECT[:RMS]:POWER#:TDELAY?
Returned Data Format	
Query Example	PROT:POW:TDELAY? 5.000
Query Syntax	[SOURCE:]PROTECT[:RMS]:POWER:TDELAY:MINimum?
Description	This command returns the minimum true power protection trip delay time setting.
Query Example	PROT:POW: TDELAY:MIN? 0

Query Syntax	[SOURCE:]PROTECT[:RMS]:POWER:TDELAY:MAXimum?
Description	This command returns the maximum true power protection trip delay time setting.
Query Example	PROT:POW: TDELAY:MAX? 3000
Query Syntax	[SOURCE:]PROTECT[:RMS]:POWER:TDELAY:DEFault?
Description	This command returns the default true power protection trip delay time setting.
Query Example	PROT:POW:TDELAY:DEF? 5
Query Syntax	[SOURCE:]PROTECT[:RMS]:POWER#:TRIPped?
Description	This command returns the true power protection trip status. Returns 1 if tripped or 0 if not.
Query Example	PROT:POW:TRIP? 41.667
Command Syntax	[SOURCE:]PROTECT[:RMS]:POWER#:TRIPped:CLEar
Description	This command clears the true power protection trip status. Once cleared, the power source output can be enabled.
Parameters	None
Parameter Format	n/a
Example	PROT:POW:TRIP:CLE
Command Syntax	[SOURCE:]PROTECT[:RMS]:KVA#[:STATE] <ON OFF>
Description	This command turns the apparent power protection on or off.
Parameters	< 0 OFF 1 ON >
Parameter Format	 <cr>
Example	PROT:POW ON
Query Format	[SOURCE:]PROTECT[:RMS]:KVA#[:STATE]?
Returned Data Format	
Query Example	PROT:KVA? 1
Command Syntax	[SOURCE:]PROTECT[:RMS]:KVA#:LEVEl <LEVEL>
Description	This command sets the apparent power protection trip level. Setting is in KW.
Parameters	< LEVEL >
Parameter Format	<nr2>
Example	PROT:POW:LEV 5
Query Format	[SOURCE:]PROTECT[:RMS]:KVA#:LEVEl?
Returned Data Format	
Query Example	PROT:KVA:LEV? 5.000

Query Syntax	[SOURCE:]PROTECT[:RMS]:KVA:LEVEL:MINimum?
Description	This command returns the minimum apparent power protection level setting.
Query Example	PROT:KVA:LEV:MIN? 0.000
Query Syntax	[SOURCE:]PROTECT[:RMS]:KVA:LEVEL:MAXimum?
Description	This command returns the maximum apparent power protection level setting.
Query Example	PROT:KVA:LEV:MAX? 41.667
Query Syntax	[SOURCE:]PROTECT[:RMS]:KVA:LEVEL:DEFAULT?
Description	This command returns the default apparent power protection level setting. This value will be a function of the power source model.
Query Example	PROT:KVA:LEV:DEF? 41.667
Command Syntax	[SOURCE:]PROTECT[:RMS]:KVA#:TDELAY <DELAY>
Description	This command sets the apparent power protection trip delay time. Setting is in multiples of 100 msec so 5 equals 500 msec.
Parameters	< LEVEL >
Parameter Format	<nr2>
Example	PROT:KVA:LEV 5
Query Format	[SOURCE:]PROTECT[:RMS]:KVA#:TDELAY?
Returned Data Format	
Query Example	PROT:KVA:TDELAY? 5.000
Query Syntax	[SOURCE:]PROTECT[:RMS]:KVA:TDELAY:MINimum?
Description	This command returns the minimum apparent power protection trip delay time setting.
Query Example	PROT:KVA: TDELAY:MIN? 0
Query Syntax	[SOURCE:]PROTECT[:RMS]:KVA:TDELAY:MAXimum?
Description	This command returns the maximum apparent power protection trip delay time setting.
Query Example	PROT:KVA: TDELAY:MAX? 3000
Query Syntax	[SOURCE:]PROTECT[:RMS]:KVA:TDELAY:DEFAULT?
Description	This command returns the default apparent power protection trip delay time setting.
Query Example	PROT:KVA:TDELAY:DEF? 5

Query Syntax	[SOURCE:]PROTect[:RMS]:KVA#:TRIPped?
Description	This command returns the apparent power protection trip status. Returns 1 if tripped or 0 if not.
Query Example	PROT:KVA:TRIP? 41.667

Command Syntax	[SOURCE:]PROTECT[:RMS]:KVA#:TRIPped:CLEar
Description	This command clears the apparent power protection trip status. Once cleared, the power source output can be enabled.
Parameters	None
Parameter Format	n/a
Example	PROT:KVA:TRIP:CLE

8.8.11 Frequency Protection Programming Commands

Command Syntax	[SOURCE:]PROTECT:RMS:UF#:LEVel <FREQ LEVEL>
Description	This command sets the under-frequency level. If the output frequency drops below the programmed level, an error is tripped.
Parameters	<VOLTAGE LEVEL>
Parameter Format	<nr2>
Example	PROT:RMS:UF1:LEV 45.0
Query Format	[SOURCE:]PROTECT:RMS:UF#:LEVel?
Returned Data Format	<nr2>
Query Example	PROT:RMSUV:LEV? 45.000

Command Syntax	[SOURCE:]PROTECT:RMS:UF#:STATe
Description	This command sets the under frequency protection state. If on, an error is tripped when the frequency drops below the set protection level.
Parameters	< 0 1 >
Parameter Format	
Example	PROT:RMS:UV1:STAT 1
Query Format	[SOURCE:]PROTECT:RMS:UF#:STATe?
Returned Data Format	<nr1>
Query Example	PROT:RMS:UV1:STAT? 1

8.8.12 Impedance Programming Commands

These commands control the output impedance of the power source. The programmable output impedance is defined by a resistive component (R) and and inductive component (L).

Note: To enable the programmable impedance function, the output of the power source must be turned **OFF** first. Trying to enable this function while the output is ON will result in an error message.

Command Syntax	[SOURce:]IMPEdance[:R]
Description	This command sets the R value for the output impedance. Available programming range depends on the mode (Real-time or RMS).
Parameters	<R>
Parameter Format	<nr2>
Example	IMPED 0.2
Query Format	[SOURce:]IMPEdance[:R]?
Returned Data Format	<nr2>
Query Example	IMPED:R? 0.200
Query Syntax	[SOURce:]IMPEdance[:R][:LIMit]:MAXimum?
Description	This command return the maximum allowable setting value for the R component of the output impedance.
Parameters	None
Parameter Format	N/A
Query Example	IMPED:R:MAX? 1.000
Query Syntax	[SOURce:]IMPEdance[:R][:LIMit]:MINimum?
Description	This command return the minimum allowable setting value for the R component of the output impedance.
Parameters	None
Parameter Format	N/A
Query Example	IMPED:R:MIN? -1.000
Command Syntax	[SOURce:]IMPEdance:L
Description	This command sets the L value for the output impedance. Available programming range is -0.00000000 ~ 0.00005000 (Henry).
Parameters	<L>
Parameter Format	<nr2>
Example	IMPED:L 0.00002
Query Format	[SOURce:]IMPEdance:L?
Returned Data Format	<nr2>
Query Example	IMPED:L? 0.00002
Query Syntax	[SOURce:]IMPEdance:L[:LIMit]:MAXimum?
Description	This command return the maximum allowable setting value for the L component of the output impedance.
Parameters	None
Parameter Format	N/A
Query Example	IMPED:L:MAX? 0.00005000

Query Syntax	[SOURce:]IMPEdance:L[:LIMit]:MINimum?
Description	This command return the minimum allowable setting value for the L component of the output impedance.
Parameters	None
Parameter Format	N/A
Query Example	IMPED:L:MIN? 0.00000000
Command Syntax	[SOURce:]IMPEdance:MODE
Description	This command sets the programmable impedance mode to either Real-Time mode (0) or RMS Mode (1). See page 180 for a description of both impedance modes. 0 Real mode. 1 RMS mode. Note: To change programmable impedance modes, the output of the power source must be turned OFF first. Trying to change modes while the output is ON will result in an error message.
Parameters	< 0 1 >
Parameter Format	
Example	IMPED:MODE 1
Query Format	[SOURce:]IMPEdance:MODE?
Returned Data Format	
Query Example	IMPED:MODE? 1
Command Syntax	[SOURce:]IMPEdance:STATe
Description	This command sets the programmable impedance state to either Off (0) or On (1). Note: To enable the programmable impedance function, the output of the power source must be turned OFF first. Trying to enable this function while the output is ON will result in an error message.
Parameters	< 0 1 >
Parameter Format	
Example	IMPED:STAT 1
Query Format	[SOURce:]IMPEdance:STATe?
Returned Data Format	
Query Example	IMPED:STAT? 1

8.8.13 STEP Transient Commands

The command in this section control STEP transients. Some of these commands have the option to specify NORMAL or SATurate.

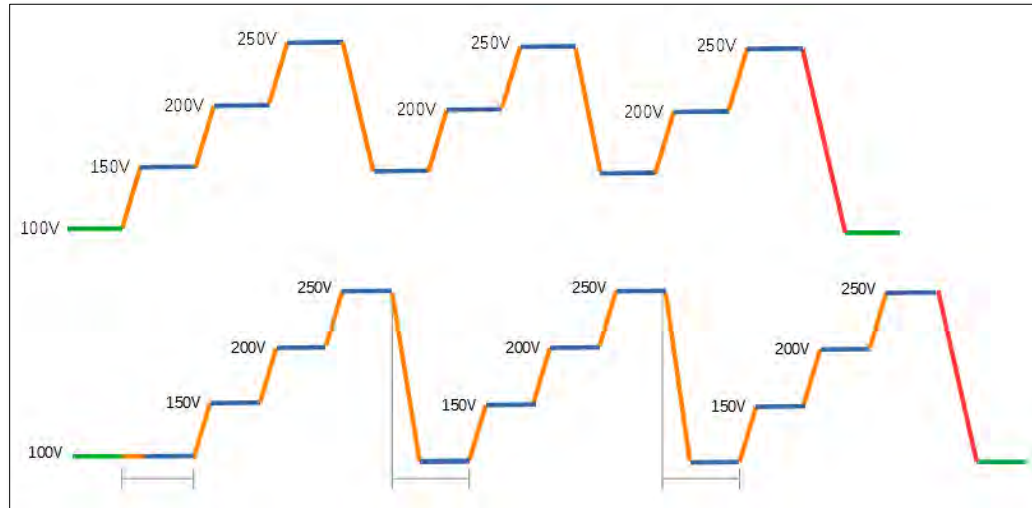
SATurate mode: If a dwell time setting is out of limits, the dwell time will saturate to the limit min/max and it will not trip an error.

NORmal mode: If a dwell time setting is out of limits, an error will be generated and the dwell time setting will not be modified.

Command Syntax	[SOURCE:]STEP:MODE < INIDEL 0 FINDEL 1 INIFIN 2 >
Description	This command sets the programming mode for a STEP Transient. 0 INIDEL Allows programming the step by initial and delta values 1 FINDEL Allows programming the step by final and delta values 2 INIFIN Allows programming the step by initial and final values
Parameters	< INIDEL 0 FINDEL 1 INIFIN 2 >
Parameter Format	<cr> or <nr1>
Example	STEP:MODE 1
Query Format	[SOURCE:]STEP:MODE?
Returned Data Format	<nr1>
Query Example	STEP:MODE? 1
Query Syntax	[SOURCE:]STEP:MODE:CATalog?
Description	This command returns the available mode settings for a STEP Transient. 0 INIDEL Allows programming the step by initial and delta values 1 FINDEL Allows programming the step by final and delta values 2 INIFIN Allows programming the step by initial and final values
Returned Data Format	<nr1>
Query Example	STEP:MODE:CAT? 0,Initial and delta,1,Final and delta,2,Initial and final
Command Syntax	[SOURCE:]STEP:INITialvalue <OFF 0 ON 1>
Description	This command determines if an initial value step is inserted at the beginning of each repeat of a step transient. 0 ON Allows programming the step by initial and delta values 1 OFF Allows programming the step by final and delta values
Parameters	< OFF 0 ON 1 >
Parameter Format	<cr> or <nr1>
Example	STEP:INIT ON
Query Format	[SOURCE:]STEP:INITialvalue?
Returned Data Format	
Query Example	STEP:INIT? 1

The impact of inserting the initial value (ON) or not (OFF) is illustrated in the figure below.

- The top sequence shows a STEP transient repeated 3 times with STEP:INIT set ot OFF. The output will not return to the initial output setting between repetitions.
- The bottom sequence is the same STEP transient with STEP:INIT set to ON. Each repeat will start from the initial set value so each repititon produces the same output levels.



Command Syntax
Description

Parameters

Parameter Format

Example

Query Format

Returned Data Format

Query Example

[SOURCE:]STEP:DWELL <time>, <opt>

This command sets the dwell time of the step in seconds

Minimum time set value allowed is 0.0002 sec. (0.2 msec)

Time in seconds, Option: < NORMAL | SATurate >

Default is NORMAL if optional second parameter is omitted.

<nr2>, <cr>

STEP:MODE:DWELL 10, SAT

[SOURCE:]STEP:MODE?

<nr2>

STEP:MODE:DWELL?

10.0000, SAT

Query Syntax
Description

Returned Data Format

Query Example

[SOURCE:]STEP:DWELL:MINimum?

This command returns lowest permissible set value for the STEP dwell time setting.

<nr2>

STEP:DWELL:MIN?

Query return values for MINimum, MAXimum and DEFault are dependent on MODE and interdependent parameter value settings

Query Syntax
Description

Returned Data Format

Query Example

[SOURCE:]STEP:DWELL:MAXimum?

This command returns highest permissible set value for the STEP dwell time setting.

<nr2>

STEP:DWELL:MAX?

Query return values for MINimum, MAXimum and DEFault are dependent on MODE and interdependent parameter value settings

Query Syntax	[SOURCE:]STEP:DWELL:DEFault?
Description	This command returns default set value for the STEP dwell time setting.
Returned Data Format	<nr2>
Query Example	STEP:DWELL:DEF? 0.0998
Command Syntax	[SOURCE:]STEP:RAMP <time>, <opt>
Description	This command sets the ramp time of the step in seconds Minimum time set value allowed is 0.0002 sec. (0.2 msec)
Parameters	Time in seconds, Option: < NORmal SATurate > Default is NORmal if optional second parameter is omitted.
Parameter Format	<nr2>, <cr>
Example	STEP:MODE:RAMP 5, SAT
Query Format	[SOURCE:]STEP:RAMP?
Returned Data Format	<nr2>
Query Example	STEP:RAMP? 5.0000, SAT
Query Syntax	[SOURCE:]STEP:RAMP:MINimum?
Description	This command returns lowest permissible set value for the STEP ramp time setting.
Returned Data Format	<nr2>
Query Example	STEP:RAMP:MIN? Query return values for MINimum, MAXimum and DEFault are dependent on MODE and interdependent parameter value settings
Query Syntax	[SOURCE:]STEP:RAMP:MAXimum?
Description	This command returns highest permissible set value for the STEP ramp time setting.
Returned Data Format	<nr2>
Query Example	STEP:RAMP:MAX? Query return values for MINimum, MAXimum and DEFault are dependent on MODE and interdependent parameter value settings
Query Syntax	[SOURCE:]STEP:RAMP:DEFault?
Description	This command returns default set value for the STEP ramp time setting.
Returned Data Format	<nr2>
Query Example	STEP:RAMP:DEF? Query return values for MINimum, MAXimum and DEFault are dependent on MODE and interdependent parameter value settings

Command Syntax	[SOURCE:]STEP:LENGth <time>, <opt>
Description	This command sets the ramp time of the step in seconds Minimum time set value allowed is 0.0002 sec. (0.2 msec)
Parameters	Time in seconds, Option: < NORmal SATurate > Default is NORmal if optional second parameter is omitted.
Parameter Format	<nr2>, <cr>
Example	STEP:MODE:LENG 5, SAT
Query Format	[SOURCE:]STEP:LENGth?
Returned Data Format	<nr2>
Query Example	STEP:LENG? 5.0000, SAT
Query Syntax	[SOURCE:]STEP:LENGth:MINimum?
Description	This command returns lowest permissible set value for the STEP length time setting.
Returned Data Format	<nr2>
Query Example	STEP:LENG:MIN? Query return values for MINimum, MAXimum and DEFault are dependent on MODE and interdependent parameter value settings
Query Syntax	[SOURCE:]STEP:LENGth:MAXimum?
Description	This command returns highest permissible set value for the STEP length time setting.
Returned Data Format	<nr2>
Query Example	STEP:LENG:MAX? Query return values for MINimum, MAXimum and DEFault are dependent on MODE and interdependent parameter value settings
Query Syntax	[SOURCE:]STEP:LENGth:DEFault?
Description	This command returns default set value for the STEP length time setting.
Returned Data Format	<nr2>
Query Example	STEP:LENG:DEF? Query return values for MINimum, MAXimum and DEFault are dependent on MODE and interdependent parameter value settings
Command Syntax	[SOURCE:]STEP:REPeat <no, opt>
Description	This command sets the number of repeat times for the ramp of the step
Parameters	No of repeats, Option: < NORmal SATurate > Default is NORmal if optional second parameter is omitted.
Parameter Format	<nr1>, <cr>
Example	STEP:MODE:REP 100
Query Format	[SOURCE:]STEP:REP?
Returned Data Format	<nr2>
Query Example	STEP:REP? 100, NOR

Query Syntax	[SOURCE:]STEP:REPeat:MINimum?
Description	This command returns lowest permissible set value for the STEP length time setting.
Returned Data Format	<nr1>
Query Example	STEP:REP:MIN? 0
Query Syntax	[SOURCE:]STEP:REPeat:MAXimum?
Description	This command returns highest permissible set value for the STEP length time setting.
Returned Data Format	<nr1>
Query Example	STEP:REP:MAX? 65535
Query Syntax	[SOURCE:]STEP:REPeat:DEFault?
Description	This command returns default set value for the STEP length time setting.
Returned Data Format	<nr2>
Query Example	STEP:REP:DEF? 1
Command Syntax	[SOURCE:]STEP:COUNT <no, opt>
Description	This command sets the number of steps count.
Parameters	No of step count, Option: < NORMal SATurate > Default is NORMal if optional second parameter is omitted.
Parameter Format	<nr1>, <cr>
Example	STEP:MODE:REP 12
Query Format	[SOURCE:]STEP:COUNT?
Returned Data Format	<nr2>
Query Example	STEP:REP? 12, NOR
Query Syntax	[SOURCE:]STEP:COUNT:MINimum?
Description	This command returns lowest permissible set value for the STEP count setting.
Returned Data Format	<nr1>
Query Example	STEP:COUNT:MIN? 1
Query Syntax	[SOURCE:]STEP:COUNT:MAXimum?
Description	This command returns highest permissible set value for the STEP count setting.
Returned Data Format	<nr1>
Query Example	STEP:COUNT:MAX? 200

Query Syntax	[SOURce:]STEP:COUNT:DEFault?
Description	This command returns default set value for the STEP count setting.
Returned Data Format	<nr2>
Query Example	STEP:COUNT:DEF? 10
Command Syntax	[SOURce:]STEP:HOLD < 0 OFF 1 ON >
Description	This command determines what happens to the source output after the step transient finishes. If ON, the last step value will be set as the steady state output when the step execution ends. If OFF, the output will revert to the original steady state setting in effect before the step transient execution.
Parameters	< 0 OFF 1 ON >
Parameter Format	<cr>
Example	STEP:HOLD ON
Query Format	[SOURce:]STEP:HOLD?
Returned Data Format	
Query Example	STEP:HOLD? 1
Command Syntax	[SOURce:]STEP:VOLTage[:AC][:INITial]# < nr2 >, <cr> [SOURce:]STEP:VOLTage[:AC][:INITial]#
Description	Voltage phase A, OPT: Voltage phase B, OPT: Voltage phase C, OPT This command sets the initial STEP voltage for selected phase # or for all phases if phase reference is omitted. Note: If you get the following error, check the STEP:MODE setting as the parameter you are trying to program is the depending one. Execution error: Not allowed command with the current configuration. Either set one of the othe STEP parameters or change the MODE. Note: If you get this error, check the min or max range for this parameter. Parameter above maximum unit scope.
Parameters	Voltage , < NORmal SATurate > Default is NORmal if optional second parameter is omitted.
Parameter Format	<nr2>, <cr>
Example	STEP:VOLT1 230.00, SAT
Query Format	[SOURce:]STEP:VOLTage[:AC][:INITial]#?
Returned Data Format	<nr2> <nr2>,<nr2>,<nr2>
Query Example	STEP:VOLT1? 230.0000

Query Syntax	[SOURCE:]STEP:VOLTage[:AC][:INITial]#:MINimum?
Description	This command returns the minimum permissible set value for the initial STEP voltage for selected phase # or for all phases if phase reference is omitted
Returned Data Format	<nr2>
Query Example	STEP:VOLT1:MIN? Query return values for MINimum, MAXimum and DEFAULT are dependent on MODE and interdependent parameter value settings
Query Syntax	[SOURCE:]STEP:VOLTage[:AC][:INITial]#:MAXimum?
Description	This command returns the maximum permissible set value for the initial STEP voltage for selected phase # or for all phases if phase reference is omitted
Returned Data Format	<nr2>
Query Example	STEP:VOLT1:MAX? Query return values for MINimum, MAXimum and DEFAULT are dependent on MODE and interdependent parameter value settings
Query Syntax	[SOURCE:]STEP:VOLTage[:AC][:INITial]#:DEFAULT?
Description	This command returns the default set value for the initial STEP voltage for selected phase # or for all phases if phase reference is omitted
Returned Data Format	<nr2>
Query Example	STEP:VOLT1:DEF? Query return values for MINimum, MAXimum and DEFAULT are dependent on MODE and interdependent parameter value settings
Command Syntax	[SOURCE:]STEP:VOLTage[:AC]:FINal# < nr2 >, <cr> [SOURCE:]STEP:VOLTage[:AC]:FINal#
Description	Voltage phase A, OPT: Voltage phase B, OPT: Voltage phase C, OPT This command sets the final STEP voltage for selected phase # or for all phases if phase reference is omitted.
Parameters	Voltage , < NORMAL SATurate > Default is NORMAL if optional second parameter is omitted.
Parameter Format	<nr2>, <cr>
Example	STEP:VOLT:FIN 180.00, SAT
Query Format	[SOURCE:]STEP:VOLTage[:AC]:FINal#?
Returned Data Format	<nr2> <nr2>,<nr2>,<nr2>
Query Example	STEP:VOLT:FIN? 180.000,180.000,180.000

Query Syntax	[SOURCE:]STEP:VOLTage[:AC]:FINal#:MINimum?
Description	This command returns the minimum permissible set value for the final STEP voltage for selected phase # or for all phases if phase reference is omitted
Returned Data Format	<nr2>
Query Example	STEP:VOLT:FIN1:MIN? Query return values for MINimum, MAXimum and DEFault are dependent on MODE and interdependent parameter value settings
Query Syntax	[SOURCE:]STEP:VOLTage[:AC]:FINal#:MAXimum?
Description	This command returns the maximum permissible set value for the final STEP voltage for selected phase # or for all phases if phase reference is omitted
Returned Data Format	<nr2>
Query Example	STEP:VOLT:FIN1:MAX? Query return values for MINimum, MAXimum and DEFault are dependent on MODE and interdependent parameter value settings
Query Syntax	[SOURCE:]STEP:VOLTage[:AC]:FINal#:DEFault?
Description	This command returns the default set value for the final STEP voltage for selected phase # or for all phases if phase reference is omitted
Returned Data Format	<nr2>
Query Example	STEP:VOLT:FIN1:DEF? Query return values for MINimum, MAXimum and DEFault are dependent on MODE and interdependent parameter value settings
Command Syntax	[SOURCE:]STEP:VOLTage[:AC]:DELTA# < nr2 >, <cr> [SOURCE:]STEP:VOLTage[:AC]:DELTA#
Description	Voltage phase A, OPT: Voltage phase B, OPT: Voltage phase C, OPT This command sets the delta STEP voltage for selected phase # or for all phases if phase reference is omitted.
Parameters	Voltage , < NORmal SATurate > Default is NORmal if optional second parameter is omitted.
Parameter Format	<nr2>, <cr>
Example	STEP:VOLT:DELT1 10.00, SAT
Query Format	[SOURCE:]STEP:VOLTage[:AC]:DELTA#?
Returned Data Format	<nr2> <nr2>,<nr2>,<nr2>
Query Example	STEP:VOLT:DELT? 10.000,10.000,10.000

Query Syntax	[SOURCE:]STEP:VOLTage[:AC]:DELTA#:MINimum?
Description	This command returns the minimum permissible set value for the delta STEP voltage for selected phase # or for all phases if phase reference is omitted
Returned Data Format	<nr2>
Query Example	STEP:VOLT:DELT1:MIN? Query return values for MINimum, MAXimum and DEFAULT are dependent on MODE and interdependent parameter value settings
Query Syntax	[SOURCE:]STEP:VOLTage[:AC]:DELTA#:MAXimum?
Description	This command returns the maximum permissible set value for the delta STEP voltage for selected phase # or for all phases if phase reference is omitted
Returned Data Format	<nr2>
Query Example	STEP:VOLT:DELT1:MAX? Query return values for MINimum, MAXimum and DEFAULT are dependent on MODE and interdependent parameter value settings
Query Syntax	[SOURCE:]STEP:VOLTage[:AC]:DELTA#:DEFAULT?
Description	This command returns the default set value for the delta STEP voltage for selected phase # or for all phases if phase reference is omitted
Returned Data Format	<nr2>
Query Example	STEP:VOLT:DELT1:DEF? Query return values for MINimum, MAXimum and DEFAULT are dependent on MODE and interdependent parameter value settings
Command Syntax	[SOURCE:]STEP:VOLTage:DC[:INITial]# < nr2 >, <cr> [SOURCE:]STEP:VOLTage:DC[:INITial]#
Description	Voltage phase A, OPT: Voltage phase B, OPT: Voltage phase C, OPT This command sets the initial STEP DC voltage for selected phase # or for all phases if phase reference is omitted.
Parameters	Voltage , < NORMAL SATurate > Default is NORMAL if optional second parameter is omitted.
Parameter Format	<nr2>, <cr>
Example	STEP:VOLT:DC1 230.00, SAT
Query Format	[SOURCE:]STEP:VOLTage:DC[:INITial]#?
Returned Data Format	<nr2> <nr2>,<nr2>,<nr2>
Query Example	STEP:VOLT:DC? 0.000,0.000,0.000

Query Syntax	[SOURCE:]STEP:VOLTage:DC[:INITial]#:MINimum?
Description	This command returns the minimum permissible set value for the initial STEP DC voltage for selected phase # or for all phases if phase reference is omitted
Returned Data Format	<nr2>
Query Example	STEP:VOLT:DC1:MIN? Query return values for MINimum, MAXimum and DEFault are dependent on MODE and interdependent parameter value settings
Query Syntax	[SOURCE:]STEP:VOLTage:DC[:INITial]#:MAXimum?
Description	This command returns the maximum permissible set value for the initial STEP DC voltage for selected phase # or for all phases if phase reference is omitted
Returned Data Format	<nr2>
Query Example	STEP:VOLT:DC1:MAX? Query return values for MINimum, MAXimum and DEFault are dependent on MODE and interdependent parameter value settings
Query Syntax	[SOURCE:]STEP:VOLTage:DC[:INITial]#:DEFault?
Description	This command returns the default set value for the initial STEP DC voltage for selected phase # or for all phases if phase reference is omitted
Returned Data Format	<nr2>
Query Example	STEP:VOLT:DC1:DEF? Query return values for MINimum, MAXimum and DEFault are dependent on MODE and interdependent parameter value settings
Command Syntax	[SOURCE:]STEP:VOLTage:DC:FINal# < nr2 >, <cr> [SOURCE:]STEP:VOLTage:DC:FINal#
Description	Voltage phase A, OPT: Voltage phase B, OPT: Voltage phase C, OPT This command sets the final STEP DC voltage for selected phase # or for all phases if phase reference is omitted.
Parameters	Voltage , < NORmal SATurate > Default is NORmal if optional second parameter is omitted.
Parameter Format	<nr2>, <cr>
Example	STEP:VOLT:DC:FIN 187.00, SAT
Query Format	[SOURCE:]STEP:VOLTage:DC:FINal#?
Returned Data Format	<nr2> <nr2>,<nr2>,<nr2>
Query Example	STEP:VOLT:DC:FIN? 187.000,187.000,187.000

Query Syntax	[SOURCE:]STEP:VOLTage:DC:FINal#:MINimum?
Description	This command returns the minimum permissible set value for the final STEP DC voltage for selected phase # or for all phases if phase reference is omitted
Returned Data Format	<nr2>
Query Example	STEP:VOLT:DC:FIN1:MIN? Query return values for MINimum, MAXimum and DEFault are dependent on MODE and interdependent parameter value settings
Query Syntax	[SOURCE:]STEP:VOLTage:DC:FINal#:MAXimum?
Description	This command returns the maximum permissible set value for the final STEP DC voltage for selected phase # or for all phases if phase reference is omitted
Returned Data Format	<nr2>
Query Example	STEP:VOLT:DC:FIN1:MAX? Query return values for MINimum, MAXimum and DEFault are dependent on MODE and interdependent parameter value settings
Query Syntax	[SOURCE:]STEP:VOLTage:DC:FINal#:DEFault?
Description	This command returns the default set value for the final STEP DC voltage for selected phase # or for all phases if phase reference is omitted
Returned Data Format	<nr2>
Query Example	STEP:VOLT:DC:FIN1:DEF? Query return values for MINimum, MAXimum and DEFault are dependent on MODE and interdependent parameter value settings
Command Syntax	[SOURCE:]STEP:VOLTage:DC:DELTA# < nr2 >, <cr> [SOURCE:]STEP:VOLTage:DC:DELTA#
Description	Voltage phase A, OPT: Voltage phase B, OPT: Voltage phase C, OPT This command sets the delta STEP DC voltage for selected phase # or for all phases if phase reference is omitted.
Parameters	Voltage , < NORMAL SATurate > Default is NORMAL if optional second parameter is omitted.
Parameter Format	<nr2>, <cr>
Example	STEP:VOLT:DC:DEL1 10.00, SAT
Query Format	[SOURCE:]STEP:VOLTage:DC:DELTA#?
Returned Data Format	<nr2> <nr2>,<nr2>,<nr2>
Query Example	STEP:VOLT:DC:DEL? 10.0000

Query Syntax	[SOURCE:]STEP:VOLTage:DC:DELTA#:MINimum?
Description	This command returns the minimum permissible set value for the delta STEP DC voltage for selected phase # or for all phases if phase reference is omitted
Returned Data Format	<nr2>
Query Example	STEP:VOLT:DC:DELT1:MIN? Query return values for MINimum, MAXimum and DEFault are dependent on MODE and interdependent parameter value settings
Query Syntax	[SOURCE:]STEP:VOLTage:DC:DELTA#:MAXimum?
Description	This command returns the maximum permissible set value for the delta STEP DC voltage for selected phase # or for all phases if phase reference is omitted
Returned Data Format	<nr2>
Query Example	STEP:VOLT:DC:DELT1:MAX? Query return values for MINimum, MAXimum and DEFault are dependent on MODE and interdependent parameter value settings
Query Syntax	[SOURCE:]STEP:VOLTage:DC:DELTA#:DEFault?
Description	This command returns the default set value for the delta STEP DC voltage for selected phase # or for all phases if phase reference is omitted
Returned Data Format	<nr2>
Query Example	STEP:VOLT:DC:DELT1:DEF? Query return values for MINimum, MAXimum and DEFault are dependent on MODE and interdependent parameter value settings
Command Syntax	[SOURCE:]STEP:FREQuency[:INITial] <nr2 >, <cr>
Description	This command sets the initial STEP frequency.
Parameters	Frequency, < NORMAL SATurate > Default is NORMAL if optional second parameter is omitted.
Parameter Format	<nr2>, <cr>
Example	STEP:FREQ 50.0, SAT
Query Format	[SOURCE:]STEP:FREQuency[:INITial]?
Returned Data Format	<nr2>
Query Example	STEP:FREQ? 50.0000
Query Syntax	[SOURCE:]STEP:FREQuency[:INITial]:MINimum?
Description	This command returns the minimum permissible set value for the initial STEP frequency.
Returned Data Format	<nr2>
Query Example	STEP:FREQ:MIN? Query return values for MINimum, MAXimum and DEFault are dependent on MODE and interdependent parameter value settings

Query Syntax	[SOURCE:]STEP:FREQuency[:INITial]:MAXimum?
Description	This command returns the maximum permissible set value for the initial STEP frequency.
Returned Data Format	<nr2>
Query Example	STEP:FREQ:MAX? Query return values for MINimum, MAXimum and DEFAULT are dependent on MODE and interdependent parameter value settings
Query Syntax	[SOURCE:]STEP:FREQuency[:INITial]:DEFAULT?
Description	This command returns the default set value for the initial STEP frequency.
Returned Data Format	<nr2>
Query Example	STEP:FREQ:DEF? Query return values for MINimum, MAXimum and DEFAULT are dependent on MODE and interdependent parameter value settings
Command Syntax	[SOURCE:]STEP:FREQuency:FINal <nr2 >, <cr>
Description	This command sets the final STEP frequency.
Parameters	Frequency, < NORMAL SATurate > Default is NORMAL if optional second parameter is omitted.
Parameter Format	<nr2>, <cr>
Example	STEP:FREQ:FIN 55.0, SAT
Query Format	[SOURCE:]STEP:FREQuency:FINal?
Returned Data Format	<nr2>
Query Example	STEP:FREQ:FIN? 55.0000
Query Syntax	[SOURCE:]STEP:FREQuency:FINal:MINimum?
Description	This command returns the minimum permissible set value for the final STEP frequency.
Returned Data Format	<nr2>
Query Example	STEP:FREQ:FIN:MIN? 15.0000
Query Syntax	[SOURCE:]STEP:FREQuency:FINal:MAXimum?
Description	This command returns the maximum permissible set value for the final STEP frequency.
Returned Data Format	<nr2>
Query Example	STEP:FREQ:FIN:MAX? 1200.0000

Query Syntax	[SOURCE:]STEP:FREQuency:FINal:DEFault?
Description	This command returns the default set value for the final STEP frequency.
Returned Data Format	<nr2>
Query Example	STEP:FREQ:FIN:DEF? 60.0000
Command Syntax	[SOURCE:]STEP:FREQuency:DELTA <nr2 >, <cr>
Description	This command sets the delta frequency.
Parameters	Frequency, < NORMal SATurate > Default is NORMal if optional second parameter is omitted.
Parameter Format	<nr2>, <cr>
Example	STEP:FREQ:DELT 5.0, SAT
Query Format	[SOURCE:]STEP:FREQuency:DELTA?
Returned Data Format	<nr2>
Query Example	STEP:FREQ:DELT? 5.0000
Query Syntax	[SOURCE:]STEP:FREQuency:DELTA:MINimum?
Description	This command returns the minimum permissible set value for the delta STEP frequency.
Returned Data Format	<nr2>
Query Example	STEP:FREQ:DELT:MIN? Query return values for MINimum, MAXimum and DEFault are dependent on MODE and interdependent parameter value settings
Query Syntax	[SOURCE:]STEP:FREQuency:DELTA:MAXimum?
Description	This command returns the maximum permissible set value for the delta STEP frequency.
Returned Data Format	<nr2>
Query Example	STEP:FREQ:DELT:MAX? Query return values for MINimum, MAXimum and DEFault are dependent on MODE and interdependent parameter value settings
Query Syntax	[SOURCE:]STEP:FREQuency:DELTA:DEFault?
Description	This command returns the default set value for the delta STEP frequency.
Returned Data Format	<nr2>
Query Example	STEP:FREQ:DELT:DEF? Query return values for MINimum, MAXimum and DEFault are dependent on MODE and interdependent parameter value settings

Command Syntax	[SOURce:]STEP:WAVEFORM# <nr1 >
Description	This command sets the selected waveform using the waveform number.
Parameters	Waveform number
Parameter Format	<nr1>, <cr>
Example	STEP:WAVEFORM 1
Query Format	[SOURce:]STEP:WAVEFORM#?
Returned Data Format	<nr1>
Query Example	STEP:WAVEFORM#? 1.0000
Query Syntax	[SOURce:]STEP:WAVEFORM#:MINimum?
Description	This command returns the minimum permissible set value for the STEP waveform.
Returned Data Format	<nr1>
Query Example	STEP:WAVEFORM#:MIN? 1
Query Syntax	[SOURce:]STEP:WAVEFORM#:MAXimum?
Description	This command returns the maximum permissible set value for the STEP waveform.
Returned Data Format	<nr1>
Query Example	STEP:WAVEFORM#:MAX? 200
Query Syntax	[SOURce:]STEP:WAVEFORM:DEFault?
Description	This command returns the default set value for the STEP waveform.
Returned Data Format	<nr1>
Query Example	STEP:WAVEFORM:DEF? 1
Command Syntax	[SOURce:]STEP:PHASe[:INITial]# < nr2 >, <cr>
Description	This command sets the initial STEP phase angle for selected phase # number. Only phase 1 (B) and 2 (C) are allowed.
Parameters	Phase No., < NORmal SATurate > Default is NORmal if optional second parameter is omitted.
Parameter Format	<nr1>, <cr>
Example	STEP:PHAS1 245.0
Query Format	[SOURce:]STEP:PHASe[:INITial]#?
Returned Data Format	<nr1>, <cr>
Query Example	STEP:PHAS1? 245.0000

Query Syntax	[SOURCE:]STEP:PHASE[:INITIAL]#:MINIMUM?
Description	This command returns the minimum permissible set value of the initial STEP phase angle for selected phase #
Returned Data Format	<nr1>
Query Example	STEP:PHAS1:MIN? Query return values for MINimum, MAXimum and DEFAULT are dependent on MODE and interdependent parameter value settings
Query Syntax	[SOURCE:]STEP:PHASE[:INITIAL]#:MAXIMUM?
Description	This command returns the maximum permissible set value of the initial STEP phase angle for selected phase #
Returned Data Format	<nr1>
Query Example	STEP:PHAS1:MAX? Query return values for MINimum, MAXimum and DEFAULT are dependent on MODE and interdependent parameter value settings
Query Syntax	[SOURCE:]STEP:PHASE[:INITIAL]#:DEF?
Description	This command returns the default set value of the initial STEP phase angle for selected phase #
Returned Data Format	<nr1>
Query Example	Query return values for MINimum, MAXimum and DEFAULT are dependent on MODE and interdependent parameter value settings
Command Syntax	[SOURCE:]STEP:PHASE:FINAL# < nr2 >, <cr>
Description	This command sets the final STEP phase angle for selected phase # number. Only phase 1 (B) and 2 (C) are allowed.
Parameters	Phase No., < NORMAL SATurate > Default is NORMAL if optional second parameter is omitted.
Parameter Format	<nr2>, <cr>
Example	STEP:PHAS:FIN1 240.0
Query Format	[SOURCE:]STEP:PHASE:FINAL#?
Returned Data Format	<nr2>
Query Example	STEP:PHAS:FIN1? 240.0000
Query Syntax	[SOURCE:]STEP:PHASE:FINAL#:MINIMUM?
Description	This command returns the minimum permissible set value of the final STEP phase angle for selected phase #
Returned Data Format	<nr1>
Query Example	STEP:PHAS:FIN1:MIN? Query return values for MINimum, MAXimum and DEFAULT are dependent on MODE and interdependent parameter value settings

Query Syntax	[SOURCE:]STEP:PHASE:FINal#:MAXimum?
Description	This command returns the maximum permissible set value of the final STEP phase angle for selected phase #
Returned Data Format	<nr1>
Query Example	STEP:PHAS:FIN1:MAX? Query return values for MINimum, MAXimum and DEFault are dependent on MODE and interdependent parameter value settings
Query Syntax	[SOURCE:]STEP:PHASE:FINal#:DEF?
Description	This command returns the default set value of the final STEP phase angle for selected phase #
Returned Data Format	<nr1>
Query Example	STEP:PHAS:FIN1:DEF? Query return values for MINimum, MAXimum and DEFault are dependent on MODE and interdependent parameter value settings
Command Syntax	[SOURCE:]STEP:PHASE:DELTA# < nr2 >, <cr>
Description	This command sets the delta STEP phase angle for selected phase # number. Only phase 1 (B) and 2 (C) are allowed.
Parameters	Phase No., < NORmal SATurate > Default is NORmal if optional second parameter is omitted.
Parameter Format	<nr1>, <cr>
Example	STEP:PHAS:DELT1 240.0
Query Format	[SOURCE:]STEP:PHASE:DELTA#?
Returned Data Format	<nr1>, <cr>
Query Example	STEP:PHAS:DELT1? 240.0000
Query Syntax	[SOURCE:]STEP:PHASE:DELTA#:MINimum?
Description	This command returns the minimum permissible set value of the delta STEP phase angle for selected phase #
Returned Data Format	<nr1>
Query Example	STEP:PHAS:DELT1:MIN? Query return values for MINimum, MAXimum and DEFault are dependent on MODE and interdependent parameter value settings
Query Syntax	[SOURCE:]STEP:PHASE:DELTA#:MAXimum?
Description	This command returns the maximum permissible set value of the delta STEP phase angle for selected phase #
Returned Data Format	<nr1>
Query Example	STEP:PHAS:DELT1:MAX? Query return values for MINimum, MAXimum and DEFault are dependent on MODE and interdependent parameter value settings

Query Syntax	[SOURCE:]STEP:PHASE:DELTA#:DEF?
Description	This command returns the default set value of the delta STEP phase angle for selected phase #
Returned Data Format	<nr1>
Query Example	Query return values for MINimum, MAXimum and DEFault are dependent on MODE and interdependent parameter value settings
Command Syntax	[SOURCE:]STEP <cr> >>> <i>Alias for PROGRAM:TRANSient command.</i> <<<
Description	This command controls step transient execution
Parameters	< RUN STOP PAUSE STEP REStart >
Parameter Format	<cr>
Example	STEP RUN
Query Format	[SOURCE:]STEP?
Description	Query format returns the step transient execution state as either RUN, STOP, PAUS, STEP or REST
Returned Data Format	<nr1> Return values represent running state as follows: 0 Stopped 1 Running 2 Paused 3 Stepping 4 Waiting for trigger
Query Example	STEP? 1
Command Syntax	[SOURCE:]STEP:LOAD
Description	This command converts the step transient definition to the power source's regular transient segment format and loads it in the controller real-time memory for execution.
Parameters	None
Parameter Format	n/a
Example	STEP RUN
Query Format	[SOURCE:]STEP:LOAD?
Description	Query format returns a 1 if the step transient load operation was successful, otherwise returns 0.
Returned Data Format	<nr1> Return values represent: 0 Load Failed 1 Load completed
Query Example	STEP? 1

Query Syntax	[SOURCE:]STEP:PROGress?
Description	>>> <i>Alias for PROGRAM:TRANSient:PROGress command.</i> <<<
Parameters	None
Parameter Format	n/a
Description	Query returns the step transient execution state as either RUN, STOP, PAUS, STEP or REST
Returned Data Format	<cr> The response is a comma-separated value string representing: PROGRESS, CURRENT SEGMENT PROGRESS, CURRENT SEGMENT, CURRENT SEGMENT TIME, TOTAL TIME, TOTAL SEGMENTS, REPEAT TIME COUNTER
Query Example	STEP:PROG? 1, 45, 2, 1.2300, 2.0000, 4, 5
Query Syntax	[SOURCE:]STEP:CHECK?
Description	This query command returns the result of a check on the programmed step parameters to determine if they are ok to run.
Parameters	None
Parameter Format	n/a
Description	Query returns result of STEP parameters integrity check
Returned Data Format	<cr> The response is either OK or if not, a string containing the error.
Query Example	STEP:PROG? OK
Query Syntax	[SOURCE:]STEP:ALL?
Description	This query command returns a comma-separated values string of the entire step parameters, settings, and limits. Each set value is preceded by a tag identifying the parameter. This same data structure is used for front panel display and by the web server. The advantage is that this command returns all step related information using just one query command.
Parameters	None
Parameter Format	n/a
Description	Returns complete STEP setup as a comma separated value string.
Returned Data Format	<cr>
Query Example	STEP:ALL? form,3,loaded,0,status,0,progress,0,current element progress,0,current element,0,current element time,0,total time,0,total elements,0,repeat times,0,hold,1,init,1,mode,0,mode max,2,mode min,0,dwell,0,dwell max,10000,dwell min,0,ramp,0,ramp max,10000,ramp min,0,length,0,length max,10000,length min,0,repeat,1,repeat max,65535,repeat min,0,count,10,count max,200,count min,1,count min reason,0,count max reason,0,waveform all,1,waveform all exist,1,waveform a,1,waveform a exist,1,waveform b,1,waveform b exist,1,waveform c,1,waveform c exist,1,waveform max,200,waveform min,1,initial frequency,0.0000,initial frequency min,0.0000,initial frequency max,0.0000,initial frequency min reason,4,initial frequency max reason,4,initial voltage ac all,0.0000,initial voltage ac all max,0.0000,initial voltage ac all min,0.0000,initial voltage ac all max reason,4,initial voltage ac all min reason,4,initial voltage ac a,0.0000,initial voltage ac a max,0.0000,initial voltage ac a min,0.0000,initial voltage ac a max reason,4,initial voltage ac a min reason,4,initial voltage ac b,0.0000,initial voltage ac b max,0.0000,initial voltage ac b min,0.0000,initial voltage ac b max reason,4,initial voltage ac b min reason,4,initial voltage ac c,0.0000,initial voltage ac c max,0.0000,initial voltage ac c min,0.0000,initial voltage ac c max reason,4,initial voltage ac c min reason,4,initial voltage dc all,0.0000,initial voltage dc all max,425.0000,initial voltage dc all min,-425.0000,initial voltage dc all max reason,0,initial voltage dc all min reason,0,initial voltage dc a,0.0000,initial voltage dc a max,425.0000,initial voltage dc a min,-425.0000,initial voltage dc a max reason,0,initial voltage dc a min reason,0,initial voltage dc b,0.0000,initial

voltage dc b max,425.0000,initial voltage dc b min,-425.0000,initial voltage dc b max reason,0,initial voltage dc b min reason,0,initial voltage dc c,0.0000,initial voltage dc c max,425.0000,initial voltage dc c min,-425.0000,initial voltage dc c max reason,0,initial phase b,120.0000,initial phase c,240.0000,initial phase max,99999.0000,initial phase min,-99999.0000,final frequency,0.0000,final frequency min,0.0000,final frequency max,0.0000,final frequency min reason,4,final frequency max reason,4,final voltage ac all,0.0000,final voltage ac all max,0.0000,final voltage ac all min,0.0000,final voltage ac all max reason,4,final voltage ac all min reason,4,final voltage ac a,0.0000,final voltage ac a max,0.0000,final voltage ac a min,0.0000,final voltage ac a max reason,4,final voltage ac a min reason,4,final voltage ac b,0.0000,final voltage ac b max,0.0000,final voltage ac b min,0.0000,final voltage ac b max reason,4,final voltage ac b min reason,4,final voltage ac c,0.0000,final voltage ac c max,0.0000,final voltage ac c min,0.0000,final voltage ac c max reason,4,final voltage ac c min reason,4,final voltage dc all,0.0000,final voltage dc all max,425.0000,final voltage dc all min,-425.0000,final voltage dc all max reason,0,final voltage dc all min reason,0,final voltage dc a,0.0000,final voltage dc a max,425.0000,final voltage dc a min,-425.0000,final voltage dc a max reason,0,final voltage dc a min reason,0,final voltage dc b,0.0000,final voltage dc b max,425.0000,final voltage dc b min,-425.0000,final voltage dc b max reason,0,final voltage dc b min reason,0,final voltage dc c,0.0000,final voltage dc c max,425.0000,final voltage dc c min,-425.0000,final voltage dc c max reason,0,final voltage dc c min reason,0,final phase b,120.0000,final phase c,240.0000,final phase max,99999.0000,final phase min,-99999.0000,delta frequency,0.0000,delta frequency min,0.0000,delta frequency max,0.0000,delta frequency min reason,4,delta frequency max reason,4,delta voltage ac all,0.0000,delta voltage ac all max,0.0000,delta voltage ac all min,0.0000,delta voltage ac all max reason,4,delta voltage ac all min reason,4,delta voltage ac a,0.0000,delta voltage ac a max,0.0000,delta voltage ac a min,0.0000,delta voltage ac a max reason,4,delta voltage ac a min reason,4,delta voltage ac b,0.0000,delta voltage ac b max,0.0000,delta voltage ac b min,0.0000,delta voltage ac b max reason,4,delta voltage ac b min reason,4,delta voltage ac c,0.0000,delta voltage ac c max,0.0000,delta voltage ac c min,0.0000,delta voltage ac c max reason,4,delta voltage ac c min reason,4,delta voltage dc all,0.0000,delta voltage dc all max,42.5000,delta voltage dc all min,-42.5000,delta voltage dc all max reason,0,delta voltage dc all min reason,0,delta voltage dc a,0.0000,delta voltage dc a max,42.5000,delta voltage dc a min,-42.5000,delta voltage dc a max reason,0,delta voltage dc a min reason,0,delta voltage dc b,0.0000,delta voltage dc b max,42.5000,delta voltage dc b min,-42.5000,delta voltage dc b max reason,0,delta voltage dc b min reason,0,delta voltage dc c,0.0000,delta voltage dc c max,42.5000,delta voltage dc c min,-42.5000,delta voltage dc c max reason,0,delta voltage dc c min reason,0,delta phase b,0.0000,delta phase c,0.0000,delta phase max,99999.0000,delta phase min,-99999.0000

8.8.14 PULSE Transient Commands

The command in this section control PULSE transients. Some of these commands have the option to specify NORMal or SATurate.

SATurate mode: If a dwell time setting is out of limits, the dwell time will saturate to the limit min/max and it will not trip an error.

NORMal mode: If a dwell time setting is out of limits, an error will be generated and the dwell time setting will not be modified.

Command Syntax	[SOURCE:]PULSE:COUNT <nr1>, <opt>
Description	This command sets the pulse count or the number of pulses to execute. Minimum time set value allowed is 1.
Parameters	Count, Option: < NORMal SATurate > Default is NORMal if optional second parameter is omitted.
Parameter Format	<nr1>, <cr>
Example	PULSE:COUNT 5
Query Format	[SOURCE:]PULSE:COUNT?
Returned Data Format	<nr1>
Query Example	PULSE:COUNT? 5.0000

Query Syntax	[SOURce:]PULSe:COUNT:MINimum?
Description	This command returns the minimum permissible set value for the PULSE count.
Returned Data Format	<nr1>
Query Example	PULS:COUNT:MIN? 0
Query Syntax	[SOURce:]PULSe:COUNT:MAXimum?
Description	This command returns the maximum permissible set value for the PULSE count.
Returned Data Format	<nr1>
Query Example	PULS:COUNT:MAX? 65535
Query Syntax	[SOURce:]PULSe:COUNT:DEFault?
Description	This command returns the default set value for the PULSE count.
Returned Data Format	<nr1>
Query Example	PULS:COUNT:DEF? 1
Command Syntax	[SOURce:]PULSe:DCYCl e <nr1>, <opt>
Description	This command sets the pulse duty cycle in percent. Minimum set value allowed is 1, max is 99.
Parameters	Duty Cycle %, Option: < NORMal SATurate > Default is NORMal if optional second parameter is omitted.
Parameter Format	<nr1>, <cr>
Example	PULS:DCYC 50
Query Format	[SOURce:]PULSe:DCYCl e?
Returned Data Format	<nr1>
Query Example	PULS:DCYC? 50.0000
Query Syntax	[SOURce:]PULSe:DCYCl e:MINimum?
Description	This command returns the minimum permissible set value for the PULSE duty cycle.
Returned Data Format	<nr2>
Query Example	PULS:DCYC:MIN? 0.0000
Query Syntax	[SOURce:]PULSe:DCYCl e:MAXimum?
Description	This command returns the maximum permissible set value for the PULSE duty cycle.
Returned Data Format	<nr2>
Query Example	PULS:DCYC:MAX? 100.0000

Query Syntax	[SOURCE:]PULSe:DCYClE:DEFault?
Description	This command returns the default set value for the PULSE duty cycle.
Returned Data Format	<nr2>
Query Example	PULS:DCYC:DEF? 50.0000
Command Syntax	[SOURCE:]PULSe:PERiod <nr2>, <opt>
Description	This command sets the pulse period in seconds.
Parameters	Period, Option: < NORmal SATurate > Default is NORmal if optional second parameter is omitted.
Parameter Format	<nr2>, <cr>
Example	PULS:PER 12.8
Query Format	[SOURCE:]PULSe:PERiod?
Returned Data Format	<nr2>
Query Example	PULS:PER? 12.8000
Query Syntax	[SOURCE:]PULSe:PERiod:MINimum?
Description	This command returns the minimum permissible set value for the PULSE period setting.
Returned Data Format	<nr2>
Query Example	PULS:PER:MIN? Query return values for MINimum, MAXimum and DEFault are dependent on MODE and interdependent parameter value settings
Query Syntax	[SOURCE:]PULSe:PERiod:MAXimum?
Description	This command returns the maximum permissible set value for the PULSE period.
Returned Data Format	<nr2>
Query Example	PULS:PER:MAX? Query return values for MINimum, MAXimum and DEFault are dependent on MODE and interdependent parameter value settings
Query Syntax	[SOURCE:]PULSe:PERiod:DEFault?
Description	This command returns the default set value for the PULSE period.
Returned Data Format	<nr2>
Query Example	PULS:PER:DEF? Query return values for MINimum, MAXimum and DEFault are dependent on MODE and interdependent parameter value settings

Command Syntax	[SOURCE:]PULSe:WIDTh <nr2>, <opt>
Description	This command sets the pulse width in seconds.
Parameters	Width, Option: < NORmal SATurate > Default is NORmal if optional second parameter is omitted.
Parameter Format	<nr2>, <cr>
Example	PULS:WIDT 25.6
Query Format	[SOURCE:]PULSe:WIDTh?
Returned Data Format	<nr2>
Query Example	PULS:WIDT? 25.6000
Query Syntax	[SOURCE:]PULSe:WIDTh:MINimum?
Description	This command returns the minimum permissible set value for the PULSE width.
Returned Data Format	<nr2>
Query Example	PULS:WIDT:MIN? Query return values for MINimum, MAXimum and DEFault are dependent on MODE and interdependent parameter value settings
Query Syntax	[SOURCE:]PULSe:WIDTh:MAXimum?
Description	This command the returns maximum permissible set value for the PULSE width.
Returned Data Format	<nr2>
Query Example	PULS:WIDT:MAX? Query return values for MINimum, MAXimum and DEFault are dependent on MODE and interdependent parameter value settings
Query Syntax	[SOURCE:]PULSe:WIDTh:DEFault?
Description	This command returns the default set value for the PULSE width.
Returned Data Format	<nr2>
Query Example	PULS:WIDT:DEF? Query return values for MINimum, MAXimum and DEFault are dependent on MODE and interdependent parameter value settings
Command Syntax	[SOURCE:]PULSe:MODE <nr2>, <opt>
Description	This command sets the pulse width in seconds.
Parameters	< 0 PW 1 PD 2 WD > Encoding: 0 PW program pulse by period and width 1 PD program pulse by period and duty cycle 2 WD program pulse by width and duty cycle
Parameter Format	<nr1> or <cr>
Example	PULS:MODE WD
Query Format	[SOURCE:]PULSe:MODE?
Returned Data Format	<nr1>
Query Example	PULS:MODE? 2

Query Syntax	[SOURCE:]PULSe:MODE:CATalog?
Description	This command returns the available programming modes: "0,Period and width,1,Period and duty cycle,2,Width and duty cycle".
Parameters	None
Returned Data Format	<cr>
Query Example	PULS:MODE:CAT? 0,Period and width,1,Period and duty cycle,2,Width and duty cycle

Command Syntax	[SOURCE:]PULSe:RAMP <nr2>, <opt>
Description	This command sets the pulse ramp time in seconds.
Parameters	Ramp time, Option: < NORmal SATurate > Default is NORmal if optional second parameter is omitted.
Parameter Format	<nr2>, <cr>
Example	PULS:RAMP 0.2
Query Format	[SOURCE:]PULSe:RAMP?
Returned Data Format	<nr2>
Query Example	PULS:RAMP? 0.2

Query Syntax	[SOURCE:]PULSe:RAMP:MINimum?
Description	This command returns the minimum permissible set value for the PULSE ramp time.
Returned Data Format	<nr2>
Query Example	PULS:RAMP:MIN? Query return values for MINimum, MAXimum and DEFault are dependent on MODE and interdependent parameter value settings

Query Syntax	[SOURCE:]PULSe:RAMP:MAXimum?
Description	This command returns the maximum permissible set value for the PULSE ramp time.
Returned Data Format	<nr2>
Query Example	PULS:RAMP:MAX? Query return values for MINimum, MAXimum and DEFault are dependent on MODE and interdependent parameter value settings

Query Syntax	[SOURCE:]PULSe:RAMP:DEFault?
Description	This command returns the default setting for the PULSE ramp time.
Returned Data Format	<nr2>
Query Example	PULS:RAMP:DEF? Query return values for MINimum, MAXimum and DEFault are dependent on MODE and interdependent parameter value settings

Command Syntax	[SOURce:]PULSe:VOLTage[:AC]# < nr2 >, <cr> [SOURce:]PULSe:VOLTage[:AC] #
Description	Voltage phase A, OPT: Voltage phase B, OPT: Voltage phase C, OPT This command sets the PULSE voltage for selected phase # or for all phases if phase reference is omitted.
Parameters	Voltage , < NORmal SATurate > Default is NORmal if optional second parameter is omitted.
Parameter Format	<nr2>, <cr>
Example	PULS:VOLT1 230.00, SAT
Query Format	[SOURce:]PULSe:VOLTage[:AC]#?
Returned Data Format	<nr2>
Query Example	PULS:VOLT1? 230.0000
Query Syntax	[SOURce:]PULSe:VOLTage[:AC]#:MINimum?
Description	This command returns the minimum permissible set value for the PULSE voltage for selected phase # or for all phases if phase reference is omitted
Returned Data Format	<nr2>
Query Example	PULS:VOLT1:MIN? 0.0000
Query Syntax	[SOURce:]PULSe:VOLTage[:AC]#:MAXimum?
Description	This command returns the maximum permissible set value for the PULSE voltage for selected phase # or for all phases if phase reference is omitted
Returned Data Format	<nr2>
Query Example	PULS:VOLT:MAX? 350.0000
Query Syntax	[SOURce:]PULSe:VOLTage[:AC]#:DEFault?
Description	This command returns the default set value for the PULSE voltage for selected phase # or for all phases if phase reference is omitted
Returned Data Format	<nr2>
Query Example	PULS:VOLT:DEF? 0.000,0.000,0.000 PULS:VOLT1:DEF? 0.000

Command Syntax	[SOURce:]PULSe:VOLTage:DC# < nr2 >, <cr> [SOURce:]PULSe:VOLTage:DC#
Description	Voltage phase A, OPT: Voltage phase B, OPT: Voltage phase C, OPT This command sets the PULSE DC voltage for selected phase # or for all phases if phase reference is omitted.
Parameters	Voltage , < NORmal SATurate > Default is NORmal if optional second parameter is omitted.
Parameter Format	<nr2>, <cr>
Example	PULS:VOLT:DC1 270.00
Query Format	[SOURce:]PULSe:VOLTage:DC#?
Returned Data Format	<nr2>
Query Example	PULS:VOLT:DC1? 270.0000
Query Syntax	[SOURce:]PULSe:VOLTage:DC#:MINimum?
Description	This command returns the minimum permissible set value for the initial PULSE DC voltage for selected phase # or for all phases if phase reference is omitted
Returned Data Format	<nr2>
Query Example	PULS:VOLT:DC1:MIN? -500.0000
Query Syntax	[SOURce:]PULSe:VOLTage:DC#:MAXimum?
Description	This command returns the maximum permissible set value for the initial PULSE DC voltage for selected phase # or for all phases if phase reference is omitted
Returned Data Format	<nr2>
Query Example	PULS:VOLT:DC1:MAX? 500.0000
Query Syntax	[SOURce:]PULSe:VOLTage:DC#:DEFault?
Description	This command returns the default set value for the initial PULSE voltage for selected phase # or for all phases if phase reference is omitted
Returned Data Format	<nr2>
Query Example	PULS:VOLT:DC1:DEF? 0.000,0.000,0.000

Command Syntax	[SOURce:]PULSe:FREQuency < nr2 >, <cr>
Description	This command sets the PULSE frequency.
Parameters	Voltage , < NORmal SATurate > Default is NORmal if optional second parameter is omitted.
Parameter Format	<nr2>, <cr>
Example	PULS:FREQ 50.00
Query Format	[SOURce:]PULSe:FREQuency?
Returned Data Format	<nr2>
Query Example	PULS:FREQ? 60.0000
Query Syntax	[SOURce:]PULSe:FREQuency:MINimum?
Description	This command returns the minimum permissible set value for the PULSE frequency.
Returned Data Format	<nr2>
Query Example	PULS:FREQ:MIN? 15.0000
Query Syntax	[SOURce:]PULSe:FREQuency:MAXimum?
Description	This command returns the maximum permissible set value for the PULSE frequency.
Returned Data Format	<nr2>
Query Example	PULS:FREQ:MIN? 1200.0000
Query Syntax	[SOURce:]PULSe:FREQuency:DEFault?
Description	This command returns the default set value for the initial PULSE frequency.
Returned Data Format	<nr2>
Query Example	PULS:FREQ:DEF? 60.0000
Command Syntax	[SOURce:]PULSe:WAVEFORM# <nr1 >
Description	This command sets the selected waveform using the waveform number.
Parameters	Waveform number
Parameter Format	<nr1>, <cr>
Example	PULS:WAVEFORM 1
Query Format	[SOURce:]PULSe:WAVEFORM#?
Returned Data Format	<nr1>
Query Example	PULS:WAVEFORM#? 1.0000

Query Syntax	[SOURCE:]PULSe:WAVEFORM#:MINimum?
Description	This command returns the minimum permissible set value for the PULSE waveform.
Returned Data Format	<nr1>
Query Example	PULS:WAVEFORM#:MIN? 1
Query Syntax	[SOURCE:]PULSe:WAVEFORM#:MAXimum?
Description	This command returns the maximum permissible set value for the PULSE waveform.
Returned Data Format	<nr1>
Query Example	PULS:WAVEFORM#:MAX? 200
Query Syntax	[SOURCE:]PULSe:WAVEFORM:DEfault?
Description	This command returns the default set value for the PULSE waveform.
Returned Data Format	<nr1>
Query Example	PULS:WAVEFORM:DEF? 1
Command Syntax	[SOURCE:]PULSe:PHASe# < nr2 >, <cr>
Description	This command sets the initial PULSE phase angle for selected phase # number. Only phase 2 (B) and 3 (C) are allowed.
Parameters	Phase No., < NORMal SATurate > Default is NORMal if optional second parameter is omitted.
Parameter Format	<nr1>, <cr>
Example	PULS:PHAS1 245.0
Query Format	[SOURCE:]PULSe:PHASe#?
Returned Data Format	<nr1>, <cr>
Query Example	PULS:PHAS1? 245.0000
Query Syntax	[SOURCE:]PULSe:PHASe#:MINimum?
Description	This command returns the minimum permissible set value of the initial PULSE phase angle for selected phase #
Returned Data Format	<nr1>
Query Example	PULS:PHAS1:MIN? 0.0000
Query Syntax	[SOURCE:]PULSe:PHASe#:MAXimum?
Description	This command returns the maximum permissible set value of the initial PULSE phase angle for selected phase #
Returned Data Format	<nr1>
Query Example	PULS:PHAS1:MAX? 360.000

Query Syntax	[SOURCE:]PULSe:PHASe#:DEF?
Description	This command returns the default set value of the initial PULSE phase angle for selected phase #
Returned Data Format	<nr1>
Query Example	PULS:PHAS2:DEF? 120.0000 PULS:PHAS3:DEF? 240.0000
Command Syntax	[SOURCE:]PULSe <cr> >>> <i>Alias for PROGram:TRANsient command.</i> <<<
Description	This command controls pulse transient execution
Parameters	< RUN STOP PAUSe STEP REStart >
Parameter Format	<cr>
Example	PULS RUN
Query Format	[SOURCE:]PULSe?
Description	Query format returns the pulse transient execution state as either RUN, STOP, PAUS, STEP or REST
Returned Data Format	<nr1> Return values respresent running state as follows: 0 Stopped 1 Running 2 Paused 3 Stepping 4 Waiting for trigger
Query Example	PULS? 1
Command Syntax	[SOURCE:]PULSe:LOAD
Description	This command converts the pulse transient definition to the power source's regular transient segment format and loads it in the controller real-time memory for execution.
Parameters	None
Parameter Format	n/a
Example	STEP RUN
Query Format	[SOURCE:]PULSe:LOAD?
Description	Query format returns a 1 if the pulse transient load operation was successful, otherwise returns 0.
Returned Data Format	<nr1> Return values respresent: 0 Load Failed 1 Load completed
Query Example	STEP? 1

Query Syntax	[SOURCE:]PULSe:PROGress?
Description	>>> <i>Alias for PROGRAM:TRANSient:PROGress command.</i> <<< This query command returns the status of the step being executed.
Parameters	None
Parameter Format	n/a
Description	Query returns the step transient execution state as either RUN, STOP, PAUS, STEP or REST
Returned Data Format	<cr> The response is a comma-separated value string representing: PROGRESS, CURRENT SEGMENT PROGRESS, CURRENT SEGMENT, CURRENT SEGMENT TIME, TOTAL TIME, TOTAL SEGMENTS, REPEAT TIME COUNTER
Query Example	PULS:PROG? 1, 45, 2, 1.2300, 2.0000, 4, 5
Query Syntax	[SOURCE:]PULSe:CHECK?
Description	This query command returns the result of a check on the programmed pulse parameters to determine if they are ok to run.
Parameters	None
Parameter Format	n/a
Description	Query returns result of PULSE parameters integrity check
Returned Data Format	<cr> The response is either OK or if not, a string containing the error.
Query Example	PULS:PROG? OK
Query Syntax	[SOURCE:]PULSe:ALL?
Description	This query command returns a comma-separated values string of the entire pulse parameters, settings, and limits. Each set value is preceded by a tag identifying the parameter. This same data structure is used for front panel display and by the web server. The advantage is that this commands returns all pulse related information using just one query command.
Parameters	None
Parameter Format	n/a
Description	Returns complete PULSE setup as a comma separated value string.
Returned Data Format	<cr>
Query Example	PULS:ALL? form,3,loaded,0,status,0,progress,0,current element progress,0,current element,0,current element time,0,total time,0,total elements,0,repeat times,0,count,1,count max,65535,count min,0,dcycle,50.0000,dcycle max,100.0000,dcycle max,0.0000,period,0,period max,50000,period min,0,width,0,width max,50000,width min,0,ramp,0,ramp max,0,ramp min,0,mode,0,mode max,2,mode min,0,frequency,60.000,frequency min,15.000,frequency max,1200.000,frequency min reason,1,frequency max reason,2,waveform all,1,waveform all exist,1,waveform a,1,waveform a exist,1,waveform b,1,waveform b exist,1,waveform c,1,waveform c exist,1,waveform max,200,waveform min,1,voltage ac all,0.000,voltage ac all max,300.000,voltage ac all min,0.000,voltage ac all max reason,2,voltage ac all min reason,0,voltage ac a,0.000,voltage ac a max,300.000,voltage ac a

min,0.000,voltage ac a max reason,2,voltage ac a min reason,0,voltage ac
b,0.000,voltage ac b max,300.000,voltage ac b min,0.000,voltage ac b max
reason,2,voltage ac b min reason,0,voltage ac c,0.000,voltage ac c
max,300.000,voltage ac c min,0.000,voltage ac c max reason,2,voltage ac c
min reason,0,voltage dc all,0.000,voltage dc all max,425.000,voltage dc all
min,-425.000,voltage dc all max reason,0,voltage dc all min reason,0,voltage
dc a,0.000,voltage dc a max,425.000,voltage dc a min,-425.000,voltage dc a
max reason,0,voltage dc a min reason,0,voltage dc b,0.000,voltage dc b
max,425.000,voltage dc b min,-425.000,voltage dc b max reason,0,voltage dc
b min reason,0,voltage dc c,0.000,voltage dc c max,425.000,voltage dc c min,-
425.000,voltage dc c max reason,0,voltage dc c min reason,0,phase
b,120.000,phase c,240.000,phase max,360.000,phase min,0.000

8.8.15 IEC413 Option Interharmonics Commands

The following SCPI commands apply only to AGX models with the -413 Option installed. The presence of this option can be checked using the *IDN? Query to check for the letter “C” in the AXF Model number. Examples: 3150AGX-4AGC”. See section 4.16 on page 65 for more details.

Command Syntax	[SOURce:]INTHarmonic:FREQuency
Description	Sets the frequency of the interharmonic voltage component for all phases. The query format returns the active setting
Parameters	Frequency
Parameter Format	<nr2>
Example	INTH:FREQ 470
Query Format	[SOURce:]INTHarmonic:FREQuency?
Description	Query format returns the interharmonic frequency setting.
Returned Data Format	<nr2>
Query Example	INTH:FREQ? 470.0000
Command Syntax	[SOURce:]INTHarmonic:FREQuency:DEFault
Description	Sets the default frequency of the inter harmonic voltage component for all phases. The factory default setting is 1800 Hz.
Parameters	Frequency
Parameter Format	<nr2>
Example	INTH:FREQ:DEF 90
Query Format	[SOURce:]INTHarmonic:FREQuency:DEFault?
Description	Query format returns the interharmonic frequency setting.
Returned Data Format	<nr2>
Query Example	INTH:FREQ:DEF? 90.0000
Query Format	[SOURce:]INTHarmonic:FREQuency:MAXimum?
Description	Returns the maximum value for the interharmonic frequency setting which is 10,000 Hz..
Returned Data Format	<nr2>
Query Example	INTH:FREQ:MAX? 10000.0000
Query Format	[SOURce:]INTHarmonic:FREQuency:MINimum?
Description	Returns the minimum value for the interharmonic frequency setting which is 15 Hz..
Returned Data Format	<nr2>
Query Example	INTH:FREQ:MIN? 15.0000

Command Syntax	[SOURCE:]INTHarmonic:VOLTage[:AC#]
Description	Sets the inter harmonic voltage amplitude for the selected phase (1 = A, 2 = B, 3 = C) or for all three phases if the phase selection is omitted in Vac RMS
Parameters	Voltage
Parameter Format	<nr2>
Example	INTH:VOLT:AC1 12.00
Query Format	[SOURCE:]INTHarmonic:VOLTage[:AC#]?
Description	Query format returns the interharmonic amplitude setting.
Returned Data Format	<nr2>
Query Example	INTH:VOLT? 12.0000, 0.0000, 0.0000
Command Syntax	[SOURCE:]INTHarmonic:VOLTage:AC#:DEfault
Description	Sets the default amplitude of the interharmonic voltage component for all phases. The factory default setting is 0.000 Vrms.
Parameters	Frequency
Parameter Format	<nr2>
Example	INTH:VOLT:AC:DEF 5
Query Format	[SOURCE:]INTHarmonic:VOLTage:AC#:DEfault?
Description	Query format returns the interharmonic default amplitude setting.
Returned Data Format	<nr2>
Query Example	INTH:VOLT:AC:DEF? 5.0000, 5.0000, 5.0000
Query Format	[SOURCE:]INTHarmonic:VOLTage:AC#:MAXimum?
Description	Returns the maximum value for the interharmonic amplitude setting which is 300.0000 Vac RMS.
Returned Data Format	<nr2>
Query Example	INTH:VOLT:AC:MAX? 300.0000
Query Format	[SOURCE:]INTHarmonic:VOLTage:AC#:MINimum?
Description	Returns the minimum value for the interharmonic amplitude setting which is 0.0000 Vac RMS.
Returned Data Format	<nr2>
Query Example	INTH:VOLT:AC:MIN? 0.0000

Command Syntax Description	[SOURCE:]INTHarmonic:PHASe# This command sets the interharmonic voltage phase angle with respect to the phase A interharmonic fundamental for the selected phase (2 = B, 3 = C) or for both phases if the phase selection is omitted in degrees.
Parameters	Phase
Parameter Format	<nr2>
Example	INTH:PHAS2 45.00
Query Format Description	[SOURCE:]INTHarmonic:PHASe? Query format returns the interharmonic voltage phase angle with respect to the phase A setting.
Returned Data Format	<nr2>
Query Example	INTH:PHAS2? 45.0000
Command Syntax Description	[SOURCE:]INTHarmonic:PHASe#:DEFault The default interharmonic voltage phase angle for each phase or all phases can be selected using the following command: Factory default is 0.000° for phase A, 120.000° for phase B and 240.000° for phase C.
Parameters	Frequency
Parameter Format	<nr2>
Example	INTH:PHAS2:DEF 90
Query Format Description	[SOURCE:]INTHarmonic:PHASe#:DEFault? Query format returns the interharmonic default voltage phase angle setting.
Returned Data Format	<nr2>
Query Example	INTH:PHAS:DEF? 0.0000, 120.0000, 240.0000
Query Format Description	[SOURCE:]INTHarmonic:PHASe#:MAXimum? Returns the upper interharmonic voltage phase angle setting range for each phase or all phases. The Maximum set values in 360.000°.
Returned Data Format	<nr2>
Query Example	INTH:PHAS:MAX? 360.0000
Query Format Description	[SOURCE:]INTHarmonic:PHASe#:MINimum? Returns the lower interharmonic voltage phase angle setting range for each phase or all phases. Minimum set value is 0.000°.
Returned Data Format	<nr2>
Query Example	INTH:PHAS:MIN? 0.0000

Command Syntax	[SOURCE:]INTHarmonic:STATe
Description	This command enables (1) or disables Inter Harmonics mode. When off, no interharmonics are generated. This command can only be sent while the OUTPUT is OFF. If the OUTPUT is ON, an error is generated and no change of state occurs. ("Unable to execute this action with output enabled").
Parameters	< 0 OFF 1 ON >
Parameter Format	
Example	INTH:STAT ON
Query Format	[SOURCE:]INTHarmonic:STATe?
Description	Query format returns the interharmonic state setting.
Returned Data Format	
Query Example	INTH:STAT? 1

8.9 Current Source Commands (AGX)

For Active Load or Current Source mode, the following current programming commands apply:

8.9.1 Current Programming Commands

Command Syntax	[SOURce:]CURRent[:AC]# <nr2>
Description	Sets AC current for phase #. If # is omitted, sets all available phases to value specified.
Parameters	Model specific
Parameter Format	<nr2>
Example	CURR:AC1 100.00
Query Format	[SOURce:]CURRent[:AC]#?
Description	Returns current setting for specified phase. If phase is omitted, returns voltage setting for all phases.
Returned Data Format	<nr2>
Query Example	CURR:AC1? 100.0000
Command Syntax	[SOURce:]CURRent[:AC]#:SLEW <nr2>
Description	This command set the programmed current slew rate for the selected phase or all phases if # is omitted.
Parameter	Current
Parameter Format	<nr2>
Example	CURR:AC:SLEW 10.0
Query Format	[SOURce:]CURRent[:AC]#:SLEW?
Returned Data Format	<nr2>
Query Example	CURR? 10.000,10.000,10.000
Query Command	[SOURce:]CURRent[:AC]:SLEW:MINimum?
Returned Data Format	<nr2>
Query Example	CURR:SLEW:MIN#? 0.010
Query Command	[SOURce:]CURRent[:AC]:SLEW:MAXimum?
Returned Data Format	<nr2>
Query Example	CURR:SLEW:MAX? 1500.000
Query Command	[SOURce:]CURRent[:AC]:SLEW:DEFault?
Returned Data Format	<nr2>
Query Example	CURR:SLEW:DEF? 10.000

Query Command	[SOURce:]CURRent[:AC]#:MINimum?
Returned Data Format	<nr2>
Query Example	CURR:MIN#? 0.0000
Query Command	[SOURce:]CURRent[:AC]#:MAXimum?
Returned Data Format	<nr2>
Query Example	CURR:MAX? 130.0000, 130.000, 130.000
Query Command	[SOURce:]CURRent[:AC]#:DEFault?
Returned Data Format	<nr2>
Query Example	CURR:DEF? 1.0000, 1.000, 1.000
Command Syntax Description	[SOURce:]CURRent:DC# <nr2> Sets DC current for phase #. If # is omitted, sets all available phases to value specified.
Parameters	Model specific
Parameter Format	<nr2>
Example	CURR:DC1 100.00
Query Format	[SOURce:]CURRent:DC#?
Description	Returns current setting for specified phase. If phase is omitted, returns current setting for all phases.
Returned Data Format	<nr2>
Query Example	CURR:DC1? 100.0000
Command Syntax Description	[SOURce:]CURRent:DC:SLEW <nr2> Sets DC current for all available phases to value specified in Amps per milisecond.
Parameters	Model specific
Parameter Format	<nr2>
Example	CURR:DC:SLEW 10.00
Query Format	[SOURce:]CURRent:DC:SLEW?
Description	Returns current setting for all available phases
Returned Data Format	<nr2>
Query Example	CURR:DC:SLEW? 10.0000
Query Command	[SOURce:]CURRent:DC:SLEW:MINimum?
Returned Data Format	<nr2>
Query Example	CURR:DC:SLEW:MIN#? 0.0000

Query Command	[SOURce:]CURRent:DC:SLEW:MAXimum?
Returned Data Format	<nr2>
Query Example	CURR:DC:SLEW:MAX? 100000.0000
Query Command	[SOURce:]CURRent:DC:SLEW:DEFault?
Returned Data Format	<nr2>
Query Example	CURR:DC:SLEW:DEF? 10.000
Query Command	[SOURce:]CURRent:DC#:MINimum?
Returned Data Format	<nr2>
Query Example	CURR:DC:MIN#? 0.0000
Query Command	[SOURce:]CURRent:DC#:MAXimum?
Returned Data Format	<nr2>
Query Example	CURR:DC:MAX? 90.0000, 90.000, 900.000
Query Command	[SOURce:]CURRent:DC#:DEFault?
Returned Data Format	<nr2>
Query Example	CURR:DC:DEF? 1.0000, 1.000, 1.000

8.9.2 Current Slew Rate Programming Commands

The current slew rate settings determine how fast current level changes will take place. When set to the minimum value, the Current source will slew as fast as the hardware supports.

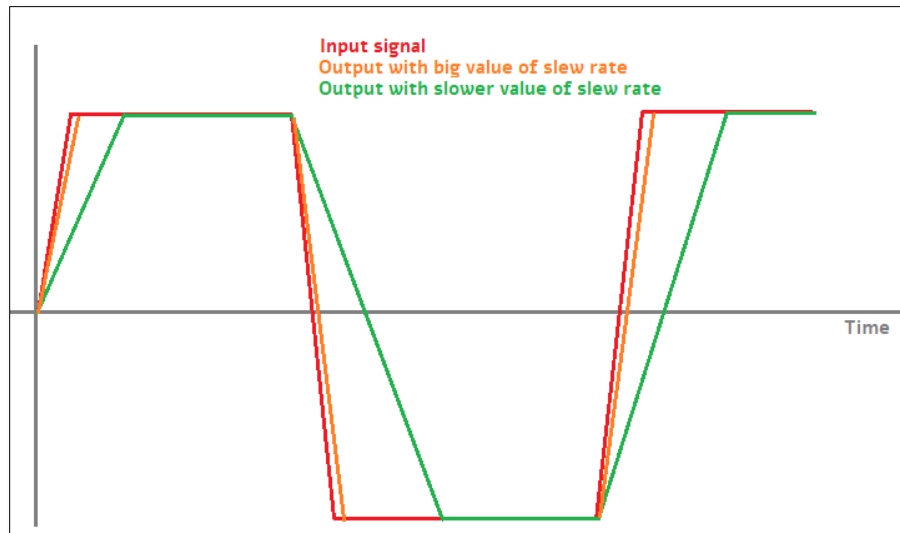
Command Syntax	[SOURce:]CURRent[:AC]:SLEW <nr2>
Description	Sets AC current for all available phases to value specified in Amps per milisecond.
Parameters	Model specific
Parameter Format	<nr2>
Example	CURR:AC:SLEW 10.00
Query Format	[SOURce:]CURRent[:AC]:SLEW?
Description	Returns current setting for all available phases
Returned Data Format	<nr2>
Query Example	CURR:AC:SLEW? 10.0000
Query Command	[SOURce:]CURRent[:AC]:SLEW:MINimum?
Returned Data Format	<nr2>
Query Example	CURR:SLEW:MIN#? 0.0000
Query Command	[SOURce:]CURRent[:AC]:SLEW:MAXimum?
Returned Data Format	<nr2>
Query Example	CURR:SLEW:MAX? 100000.0000
Query Command	[SOURce:]CURRent[:AC]:SLEW:DEFault?
Returned Data Format	<nr2>
Query Example	CURR:SLEW:DEF? 10.000
Command Syntax	[SOURce:]CURRent:DC:SLEW <nr2>
Description	Sets DC current for all available phases to value specified in Amps per milisecond.
Parameters	Model specific
Parameter Format	<nr2>
Example	CURR:DC:SLEW 10.00
Query Format	[SOURce:]CURRent:DC:SLEW?
Description	Returns current setting for all available phases
Returned Data Format	<nr2>
Query Example	CURR:DC:SLEW? 10.0000

Query Command	[SOURce:]CURRent:DC:SLEW:MINimum?
Returned Data Format	<nr2>
Query Example	CURR:DC:SLEW:MIN#? 0.0000
Query Command	[SOURce:]CURRent:DC:SLEW:MAXimum?
Returned Data Format	<nr2>
Query Example	CURR:DC:SLEW:MAX? 100000.0000
Query Command	[SOURce:]CURRent:DC:SLEW:DEFault?
Returned Data Format	<nr2>
Query Example	CURR:DC:SLEW:DEF? 10.000

8.9.3 Real Time Current Slew Rate Programming Commands

These current slew rate settings are intended for use with analog input AC or DC voltage programming when in Current Source or Active Load mode of operation. In analog programming mode, the output is the amplified input with the rise time limited by this programmable slew rate setting or by the power stage response time. (100us approx.). Do not confuse these commands with the programable current slew rates for voltage settings, see **[SOURce:]CURRent[:AC]#:SLEW** in section 8.8.1, page 411.

By default, this setting is at the maximum, so the output current would be the most similar to the input plus the response of the output stage. See the picture below where this slew rate is used to limit the rise time of the output regardless of input.



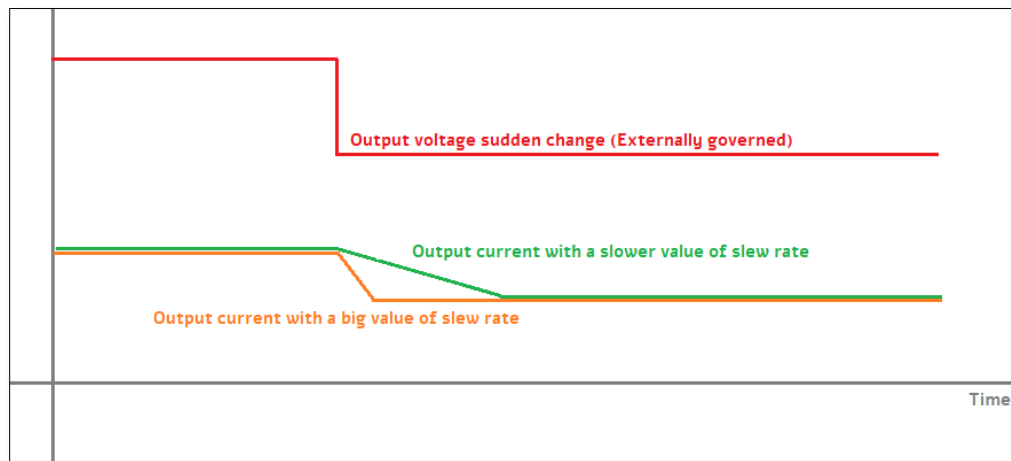
Note that for all active loads this slew is not only useful for analog programming. It is actually more useful to limit the rise time of the output current when the voltage change are externally controlled.

If the sensed input voltage suddenly changes, the unit will generate a fast change in the current to keep the setpoint. This fast change in the current may be undesirable and the way to limit it would be with this slew command. See image below.

For example, for resistance mode, the current is $I = V/R$.

The R, which is the setpoint is kept constant, but a sudden voltage change can cause a sudden current change. The setpoint could be in resistance, power etc., depending on the mode.

The slew rate is at the maximum by default, so it does not limit to more than the response time of the power stage.



Command Syntax	[SOURce:]SLEW:CURRent <nr2>
Description	Sets the maximum real-time current slew rate value associated with analog programming mode.
Parameters	Current slew rate
Parameter Format	<nr2>
Example	SLEW:CURRE 10.00
Query Format	[SOURce:]SLEW:CURRent?
Description	Returns current slew rate setting for all phases.
Returned Data Format	<nr2>
Query Example	SLEW:CURRE? 10.0000
Query Syntax	[SOURce:]SLEW:CURRent:MINimum?
Description	Returns the minimum real-time current slew rate setting associated with analog programming mode.
Returned Data Format	<nr2>
Query Example	SLEW:CURRE:MIN? 0.010

Query Syntax	[SOURce:]SLEW:CURRent:MAXimum?
Description	Returns the maximum real-time current slew rate setting associated with analog programming mode.
Returned Data Format	<nr2>
Query Example	SLEW:CURR:MAX? 0.010
Query Syntax	[SOURce:]SLEW:CURRent:DEFault?
Description	Returns the default real-time current slew rate setting associated with analog programming mode.
Returned Data Format	<nr2>
Query Example	SLEW:CURR:DEF? 0.010

8.9.4 Current Transient Programming

Transient programming while in Current Source mode is similar to the Voltage Source mode transient commands except instead of setting Voltage values, current values are set instead.

So instead of using the Voltage command

[SOURce:]STEP:VOLTage[:AC][:INITial]# < nr2 >, <cr>

Use the equivalent Current keyword:

[SOURce:]STEP:CURRent[:AC][:INITial]# < nr2 >, <cr>

Refer to section 8.7.12, “STEP Transient Commands” and section 8.7.13” PULSE Transient Commands” for equivalent command syntax information.

8.9.5 Voltage Protection Programming Commands

Command Syntax	[SOURce:]PROTect:PEAK:VOLTage#[:STATe] < 0 OFF 1 ON >
Description	This command sets the maximum voltage peak margin. If the output voltage peak exceeds the programmed peak level by more than this amount, an error is tripped.
Parameters	< 0 OFF 1 ON >
Parameter Format	<cr> <nr1>
Example	PROT:PEAK:VOLT:STAT 1
Query Format	[SOURce:]PROTect:PEAK:VOLTage:STAT?
Returned Data Format	<nr1>
Query Example	PROT:PEAK:VOLT:STAT? 1

Command Syntax	[SOURce:]PROTect:PEAK:VOLTage#:MODE < 0 MARGin 1 LEVel 2 BOTH >									
Description	This command sets the maximum voltage peak margin. If the output voltage peak exceeds the programmed peak level by more than this amount, an error is tripped.									
Parameters	<MARGin 0 LEVel 1 BOTH 2 > Encoding: <table><tr><td>MARGin</td><td>0</td><td>Relative level</td></tr><tr><td>LEVel</td><td>1</td><td>Absolute level</td></tr><tr><td>BOTH</td><td>2</td><td>Margin and level</td></tr></table>	MARGin	0	Relative level	LEVel	1	Absolute level	BOTH	2	Margin and level
MARGin	0	Relative level								
LEVel	1	Absolute level								
BOTH	2	Margin and level								
Parameter Format	<cr> <nr1>									
Example	PROT:PEAK:VOLT:MODE BOTH									
Query Format	[SOURce:]PROTect:PEAK:VOLTage#:MODE?									
Returned Data Format	<nr1>									
Query Example	PROT:PEAK:VOLT1:MODE? 2									
Command Query Syntax	[SOURce:]PROTect:PEAK:VOLTage#:MODE:CATalog?									
Description	This command returns the available parameter options for the PROT:PEAK:VOLT#:MODE command.									
Example	PROT:PEAK:VOLT:MODE BOTH									
Returned Data Format	0, Margin, 1, Level, 2, Margin and level									
Command Syntax	[SOURce:]PROTect:PEAK:VOLTage#:MARGin <nr2>									
Description	This command sets the maximum voltage peak margin. If the output voltage peak exceeds the programmed peak margin by more than this amount, an error is tripped.									
Parameter Format	<nr2>									
Example	PROT:PEAK:VOLT:MARG 120.0									
Query Format	[SOURce:]PROTect:PEAK:VOLTage#:MARGin?									
Returned Data Format	<nr2>									
Query Example	PROT:PEAK:VOLT2:MARG? 120.000									
Query Syntax	[SOURce:]PROTect:PEAK:VOLTage#:MARGin:MINimum?									
Description	This command returns the minimum voltage peak margin setting.									
Query Example	PROT:PEAK:VOLT1:MARG:MIN? 0.000									
Query Syntax	[SOURce:]PROTect:PEAK:VOLTage#:MARGin:MAXimum?									
Description	This command returns the maximum voltage peak margin setting									
Query Example	PROT:PEAK:VOLT:MARG:MAX? 500.000									

Query Syntax	[SOURCE:]PROTECT:PEAK:VOLTage#:MARGin:DEFault?
Description	This command returns the default voltage peak margin setting
Query Example	PROT:PEAK:VOLT:MARG:DEF? 100.000
Command Syntax	[SOURCE:]PROTECT:PEAK:VOLTage#:LEVel <VOLTAGE LEVEL>
Description	This command sets the maximum voltage peak level. If the output voltage peak exceeds the programmed peak level by more than this amount, an error is tripped.
Parameters	<VOLTAGE LEVEL>
Parameter Format	<nr2>
Example	PROT:PEAK:VOLT:LEV 120.0
Query Format	[SOURCE:]PROTECT:PEAK:VOLTage#:LEVel?
Returned Data Format	<nr2>
Query Example	PROT:PEAK:VOLT:LEV? 500.000
Query Syntax	[SOURCE:]PROTECT:PEAK:VOLTage#:LEVel:MINimum?
Description	This command returns the minimum voltage peak level setting.
Query Example	PROT:PEAK:VOLT3:LEV:MIN? 0.000
Query Syntax	[SOURCE:]PROTECT:PEAK:VOLTage#:LEVel:MAXimum?
Description	This command returns the maximum voltage peak level setting
Query Example	PROT:PEAK:VOLT:LEV2:MAX? 500.000
Query Syntax	[SOURCE:]PROTECT:PEAK:VOLTage#:LEVel:DEFault?
Description	This command returns the default voltage peak level setting
Query Example	PROT:PEAK:VOLT:LEV1:DEF? 500.000
Query Syntax	[SOURCE:]PROTECT:PEAK:VOLTage#:TRIPped?
Description	This command returns 1 if the voltage peak protection has been tripped or 0 if no trip occurred.
Query Example	PROT:PEAK:VOLT:TRIP? 1
Command Syntax	[SOURCE:]PROTECT:PEAK:VOLTage#:TRIPped:CLEar
Description	This command clears the peak voltage protection trip status. Once cleared, the power source output can be re-enabled.
Parameters	<VOLTAGE LEVEL>
Parameter Format	<nr2>
Example	PROT:PEAK:VOLT3:TRIP:CLE

8.9.6 Peak Current Protection Programming Commands

Command Syntax	[SOURce:]PROTect:PEAK:CURRent#[:STATe] <0 OFF 1 ON >
Description	This command enables or disables the peak current protection. If the protection is tripped the power source output is disabled.
Parameters	<0 OFF 1 ON >
Parameter Format	<nr1> <cr>
Example	PROTect:CURRent ON
Query Format	[SOURce:]PROTect:PEAK:CURRent#[:STATe]?
Returned Data Format	<nr1>
Query Example	PROT:PEAK:CURR1? 1
Command Syntax	[SOURce:]PROTect:PEAK:CURRent#:MODE <0 MARGin 1 LEVel 2 BOTH >
Description	This command sets the maximum voltage peak margin. If the output voltage peak exceeds the programmed peak level by more than this amount, an error is tripped.
Parameters	<MARGin 0 LEVel 1 BOTH 2 > Encoding: MARGin 0 Relative level LEVel 1 Absolute level BOTH 2 Margin and Level
Parameter Format	<cr> <nr1>
Example	PROT:PEAK:CURR:MODE BOTH
Query Format	[SOURce:]PROTect:PEAK:CURRent#:MODE?
Returned Data Format	<nr1>
Query Example	PROT:PEAK:CURR1:MODE? 2
Command Query Syntax	[SOURce:]PROTect:PEAK:CURRent#:MODE:CATalog?
Description	This command returns the available parameters options for the PROT:PEAK:CURR#:MODE command.
Example	PROT:PEAK:CURR:MODE BOTH
Returned Data Format	0, Margin, 1, Level, 2, Margin and level
Command Syntax	[SOURce:]PROTect:PEAK:CURRent#:MARGin <nr2>
Description	This command sets the peak current protection margin.
Parameters	< DELAY >
Parameter Format	<nr1>
Example	PROT:PEAK:CURR:MARG 20
Query Format	[SOURce:]PROTect:PEAK:CURRent#:MARGin?
Returned Data Format	<nr1>
Query Example	PROT:PEAK:CURR:MARG? 20

Query Syntax	[SOURCE:]PROTECT:PEAK:CURRENt#:MARGIN:MINimum?
Description	This command returns the peak current protection margin setting.
Query Example	PROT:PEAK:CURR:MARGINI:MIN? 0
Query Syntax	[SOURCE:]PROTECT:PEAK:CURRENt#:MARGIN:MAXimum?
Description	This command returns the peak current protection margin setting.
Query Example	PROT:PEAK:CURR:MARG:MAX? 3000
Query Syntax	[SOURCE:]PROTECT:PEAK:CURRENt#:MARGIN:DEFAULT?
Description	This command returns the default peak current protection margin setting.
Query Example	PROT:PEAK:CURR2:MARG:DEF? 10
Command Syntax	[SOURCE:]PROTECT:PEAK:CURRENt#:LEVEl <nr2>
Description	This command sets the peak current protection level.
Parameters	< LEVEL >
Parameter Format	<nr2>
Example	PROT:CURR:LEVEl 40.0
Query Format	[SOURCE:]PROTECT:PEAK:CURRENt#:LEVEl?
Returned Data Format	<nr2>
Query Example	PROT:PEAK:CURR:LEV? 40.000
Query Syntax	[SOURCE:]PROTECT:PEAK:CURRENt#:LEVEl:MINimum?
Description	This command returns the minimum peak current protection level setting.
Query Example	PROT:PEAK:CURR:LEV:MIN? 0.000
Query Syntax	[SOURCE:]PROTECT:PEAK:CURRENt#:LEVEl:MAXimum?
Description	This command returns the maximum peak current protection level setting.
Query Example	PROT:PEAK:CURR:LEV:MAX? 40.000
Query Syntax	[SOURCE:]PROTECT:PEAK:CURRENt#:LEVEl:DEFAULT?
Description	This command returns the default peak current protection level setting. This value will be a function of the power source model.
Query Example	PROT:PEAK:CURR:LEV:DEF? 10.000

Query Syntax	[SOURCE:]PROTECT:PEAK:CURRENt#:TRIPped?
Description	This command returns peak current protection trip status. Returns 1 if tripped or 0 if not.
Query Example	PROT:PEAK:CURR:TRIP? 1
Command Syntax	[SOURCE:]PROTECT:PEAK:CURRENt#:TRIPped:CLEAr
Description	This command clears the rms current protection trip status. Once cleared, the power source peak can be enabled.
Parameters	None
Parameter Format	n/a
Example	PROT:PEAK:CURR:TRIP:CLE

8.9.7 Peak Power Protection Programming Commands

Command Syntax	[SOURCE:]PROTECT:PEAK:POWEr#[:STATe] <0 OFF 1 ON >
Description	This command enables or disables the peak power protection. If the protection is tripped the power source output is disabled.
Parameters	< 0 OFF 1 ON >
Parameter Format	<nr1> <cr>
Example	PROTECT:CURRENt ON
Query Format	[SOURCE:]PROTECT:PEAK:POWEr#[:STATe]?
Returned Data Format	<nr1>
Query Example	PROT:PEAK:POW? 1
Command Syntax	[SOURCE:]PROTECT:PEAK:POWEr#:LEVEl <nr2>
Description	This command sets the peak power protection level. (in KW)
Parameters	< LEVEL >
Parameter Format	<nr2>
Example	PROT:POW:LEVEl 4.4
Query Format	[SOURCE:]PROTECT:PEAK:POWEr#:LEVEl?
Returned Data Format	<nr2>
Query Example	PROT:POW:POW:LEV? 4.4000
Query Syntax	[SOURCE:]PROTECT:PEAK:POWEr#:LEVEl:MINimum?
Description	This command returns the minimum peak power protection level setting.
Query Example	PROT:PEAK:POW:LEV:MIN? 0.000

Query Syntax	[SOURCE:]PROTect:PEAK:POWer#:LEVel:MAXimum?
Description	This command returns the maximum peak power protection level setting.
Query Example	PROT:PEAK:POW:LEV:MAX? 40.000
Query Syntax	[SOURCE:]PROTect:PEAK:POWer#:LEVel:DEFault?
Description	This command returns the default peak power protection level setting. This value will be a function of the power source model.
Query Example	PROT:PEAK:POW:LEV:DEF? 10.000
Query Syntax	[SOURCE:]PROTect:PEAK:POWer#:TRIPped?
Description	This command returns peak power protection trip status. Returns 1 if tripped or 0 if not.
Query Example	PROT:PEAK:POW:TRIP? 1
Command Syntax	[SOURCE:]PROTect:PEAK:POWer#:TRIPped:CLEar
Description	This command clears the rms power protection trip status. Once cleared, the power source peak can be enabled.
Parameters	None
Parameter Format	n/a
Example	PROT:PEAK:POW:TRIP:CLE

8.9.8 User Limit Commands

User limit commands allow programmable ranges to be limited to a narrower range than full spec in order to avoid accidental damage to an EUT. In Current Source Mode, the following Current setting user limits commands apply in lieu of the Voltage setting limit commands that apply to Voltage Source Mode. All other User Limit commands in Section 8.7, "Voltage Source Commands" apply to all modes and are not repeated here.

Note: Do not confuse these commands with the **[SOURCE:]CURRENT:LIMit#** commands used to set the RMS Current limit user limits applicable to the Voltage Source mode of operation as listed in section 8.7.4, "Current Programming Commands".

Command Syntax	[SOURce:]CURRent[:AC]:USER:LIMit:MINimum
Description	Sets low user limit for AC voltage programming. User limits must fall within actual hardware limits of the power source. Also, MIN limit must be less than MAX limit.
Parameters	0.000 – 130.000
Parameter Format	<nr2>
Example	CURR:USER:LIM:MIN 20.0
Query Format	[SOURce:]CURRent[:AC]:USER:LIMit:MINimum?
Returned Data Format	<nr2>
Query Example	CURR:USER:LIM:MIN? 20.0000

Command Syntax	[SOURce:]CURRent[:AC]:USER:LIMit:MAXimum
Description	Sets high user limit for AC current programming. User limits must fall within actual hardware limits of the power source. Also, MAX limit must be greater than MIN limit.
Parameters	0.000 – 130.000
Parameter Format	<nr2>
Example	CURR:USER:LIM:MAX 50.0
Query Format	[SOURce:]CURRent[:AC]:USER:LIMit:MAXimum?
Returned Data Format	<nr2>
Query Example	CURR:USER:LIM:MAX? 50.0000

Command Syntax	[SOURce:]CURRent:DC:USER:LIMit:MINimum
Description	Sets low user limit for DC voltage programming. User limits must fall within actual hardware limits of the power source. Also, MIN limit must be less than MAX limit.
Parameters	0.000 – 75.000
Parameter Format	<nr2>
Example	CURR:DC:USER:LIM:MIN 20.0
Query Format	[SOURce:]CURRent:DC:USER:LIMit:MINimum?
Returned Data Format	<nr2>
Query Example	CURR:DC:USER:LIM:MIN? 20.0000

Command Syntax	[SOURce:]CURRent:DC:USER:LIMit:MAXimum
Description	Sets high user limit for DC current programming. User limits must fall within actual hardware limits of the power source. Also, MAX limit must be greater than MIN limit.
Parameters	0.000 – 75.000
Parameter Format	<nr2>
Example	CURR:DC:USER:LIM:MAX 50.0
Query Format	[SOURce:]CURRent:DC:USER:LIMit:MAXimum?
Returned Data Format	<nr2>
Query Example	CURR:DC:USER:LIM:MAX? 50.0000

8.9.9 Voltage and Frequency RMS Protection Commands

These under and over Voltage and Frequency RMS protections are available in all modes but most useful in active load modes where the voltage and frequency is determined by the UUT connected. The trip times apply to these protections as well and for all RMS protections types.

8.9.9.1 Under Voltage Protection

Command Syntax	[SOURCE:]PROTECT[:RMS]:UV#[:STATE] <0 OFF 1 ON >
Description	This command enables or disables the RMS under voltage protection. If the protection is tripped the power source output is disabled.
Parameters	< 0 OFF 1 ON >
Parameter Format	<nr1> <cr>
Example	PROT:UV1 ON
Query Format	[SOURCE:]PROTECT[:RMS]:UV#[:STATE]?
Returned Data Format	<nr1>
Query Example	PROT:UV1? 1
Command Syntax	[SOURCE:]PROTECT[:RMS]:UV#:LEVel <nr2>
Description	This command sets the RMS under voltage protection level.
Parameters	< LEVEL >
Parameter Format	<nr2>
Example	PROT:UV:LEV 50.0
Query Format	[SOURCE:]PROTECT[:RMS]:UV#:LEVel?
Returned Data Format	<nr2>
Query Example	PROT:UV:LEV? 50.0000
Query Syntax	[SOURCE:]PROTECT[:RMS]:UV#:LEVel:MINimum?
Description	This command returns the minimum RMS under voltage protection level setting.
Query Example	PROT:UV:LEV:MIN? 0.000
Query Syntax	[SOURCE:]PROTECT[:RMS]:UV#:LEVel:MAXimum?
Description	This command returns the maximum RMS under voltage protection level setting.
Query Example	PROT:UV:LEV:MAX? 440.000
Query Syntax	[SOURCE:]PROTECT[:RMS]:UV#:LEVel:DEFault?
Description	This command returns the default RMS under voltage protection level setting. This value will be a function of the power source model.
Query Example	PROT:UV:LEV:DEF? 10.000

Command Syntax	[SOURCE:]PROTECT[:RMS]:UV#:TDELAY <nr2>
Description	This command sets the RMS under voltage protection trip delay time.
Parameters	< LEVEL >
Parameter Format	<nr2>
Example	PROT:UV:TDELAY 50.0
Query Format	[SOURCE:]PROTECT[:RMS]:UV#:TDELAY?
Returned Data Format	<nr2>
Query Example	PROT:UV:TDELAY? 2.0000
Query Syntax	[SOURCE:]PROTECT[:RMS]:UV#:TDELAY:MINimum?
Description	This command returns the minimum RMS under voltage protection trip delay time..
Query Example	PROT:UV:TDELAY:MIN? 0.1000
Query Syntax	[SOURCE:]PROTECT[:RMS]:UV#: TDELAY:MAXimum?
Description	This command returns the maximum RMS under voltage protection trip delay time.
Query Example	PROT:UV:TDELAY:MAX? 10.000
Query Syntax	[SOURCE:]PROTECT[:RMS]:UV#: TDELAY:DEFault?
Description	This command returns the default RMS under voltage protection trip delay time.
Query Example	PROT:UV:TDELAY:DEF? 0.1000
Query Syntax	[SOURCE:]PROTECT[:RMS]:UV#:TRIPped?
Description	This command returns RMS the under voltage protection trip status. Returns 1 if tripped or 0 if not.
Query Example	PROT:UV:TRIP? 1
Command Syntax	[SOURCE:]PROTECT[:RMS]:UV#:TRIPped:CLEar
Description	This command clears the RMS under voltage protection trip status. Once cleared, the power source peak can be enabled.
Parameters	None
Parameter Format	n/a
Example	PROT:UV:TRIP:CLE

8.9.9.2 Over Voltage Protection

Command Syntax	[SOURCE:]PROTect[:RMS]:OV#[:STATe] <0 OFF 1 ON >
Description	This command enables or disables the RMS over voltage protection. If the protection is tripped the power source output is disabled.
Parameters	< 0 OFF 1 ON >
Parameter Format	<nr1> <cr>
Example	PROT:OV1 ON
Query Format	[SOURCE:]PROTect[:RMS]:OV#[:STATe]?
Returned Data Format	<nr1>
Query Example	PROT:OV1? 1

Command Syntax	[SOURCE:]PROTect[:RMS]:OV#:LEVel <nr2>
Description	This command sets the RMS over voltage protection level.
Parameters	< LEVEL >
Parameter Format	<nr2>
Example	PROT:OV:LEV 50.0
Query Format	[SOURCE:]PROTect[:RMS]:OV#:LEVel?
Returned Data Format	<nr2>
Query Example	PROT:OV:LEV? 50.0000

Query Syntax	[SOURCE:]PROTect[:RMS]:OV#:LEVel:MINimum?
Description	This command returns the minimum RMS over voltage protection level setting.
Query Example	PROT:OV:LEV:MIN? 0.000

Query Syntax	[SOURCE:]PROTect[:RMS]:OV#:LEVel:MAXimum?
Description	This command returns the maximum RMS over voltage protection level setting.
Query Example	PROT:OV:LEV:MAX? 440.000

Query Syntax	[SOURCE:]PROTect[:RMS]:OV#:LEVel:DEFault?
Description	This command returns the default RMS over voltage protection level setting. This value will be a function of the power source model.
Query Example	PROT:OV:LEV:DEF? 10.000

Command Syntax	[SOURce:]PROTect[:RMS]:OV#:TDELAY <nr2>
Description	This command sets the RMS over voltage protection trip delay time.
Parameters	< LEVEL >
Parameter Format	<nr2>
Example	PROT:OV:TDELAY 50.0
Query Format	[SOURce:]PROTect[:RMS]:OV#:TDELAY?
Returned Data Format	<nr2>
Query Example	PROT:OV:TDELAY? 2.0000
Query Syntax	[SOURce:]PROTect[:RMS]:OV#:TDELAY:MINimum?
Description	This command returns the minimum RMS over voltage protection trip delay time..
Query Example	PROT:OV:TDELAY:MIN? 0.1000
Query Syntax	[SOURce:]PROTect[:RMS]:OV#: TDELAY:MAXimum?
Description	This command returns the maximum RMS over voltage protection trip delay time.
Query Example	PROT:OV:TDELAY:MAX? 10.000
Query Syntax	[SOURce:]PROTect[:RMS]:OV#: TDELAY:DEFault?
Description	This command returns the default RMS over voltage protection trip delay time.
Query Example	PROT:OV:TDELAY:DEF? 0.1000
Query Syntax	[SOURce:]PROTect[:RMS]:OV#:TRIPped?
Description	This command returns the RMS over voltage protection trip status. Returns 1 if tripped or 0 if not.
Query Example	PROT:OV:TRIP? 1
Command Syntax	[SOURce:]PROTect[:RMS]:OV#:TRIPped:CLEar
Description	This command clears the RMS over voltage protection trip status. Once cleared, the power source peak can be enabled.
Parameters	None
Parameter Format	n/a
Example	PROT:OV:TRIP:CLE

8.9.9.3 Under Frequency Protection

Command Syntax	[SOURCE:]PROTect[:RMS]:UF#[:STATe] <0 OFF 1 ON >
Description	This command enables or disables the RMS under frequency protection. If the protection is tripped the power source output is disabled.
Parameters	< 0 OFF 1 ON >
Parameter Format	<nr1> <cr>
Example	PROT:UF ON
Query Format	[SOURCE:]PROTect[:RMS]:UF #[:STATe]?
Returned Data Format	<nr1>
Query Example	PROT:UF? 1
Command Syntax	[SOURCE:]PROTect[:RMS]:UF#:LEVel <nr2>
Description	This command sets the RMS under frequency protection level.
Parameters	< LEVEL >
Parameter Format	<nr2>
Example	PROT:UF:LEV 45.0
Query Format	[SOURCE:]PROTect[:RMS]:UF#:LEVel?
Returned Data Format	<nr2>
Query Example	PROT:UF:LEV? 45.0000
Query Syntax	[SOURCE:]PROTect[:RMS]:UF#:LEVel:MINimum?
Description	This command returns the minimum RMS under frequency protection level setting.
Query Example	PROT:UF:LEV:MIN? 0.000
Query Syntax	[SOURCE:]PROTect[:RMS]:UF#:LEVel:MAXimum?
Description	This command returns the maximum RMS under frequency protection level setting.
Query Example	PROT:UF:LEV:MAX? 1000.0000
Query Syntax	[SOURCE:]PROTect[:RMS]:UF#:LEVel:DEFault?
Description	This command returns the default RMS under frequency protection level setting. This value will be a function of the power source model.
Query Example	PROT:UF:LEV:DEF? 10.000

Command Syntax	[SOURCE:]PROTECT[:RMS]:UF#:TDELAY <nr2>
Description	This command sets the RMS under frequency protection trip delay time.
Parameters	< LEVEL >
Parameter Format	<nr2>
Example	PROT:UF:TDELAY 50.0
Query Format	[SOURCE:]PROTECT[:RMS]:UF#:TDELAY?
Returned Data Format	<nr2>
Query Example	PROT:UF:TDELAY? 2.0000
Query Syntax	[SOURCE:]PROTECT[:RMS]:UF#:TDELAY:MINimum?
Description	This command returns the minimum RMS under frequency protection trip delay time..
Query Example	PROT:UF:TDELAY:MIN? 0.1000
Query Syntax	[SOURCE:]PROTECT[:RMS]:UF#: TDELAY:MAXimum?
Description	This command returns the maximum RMS under frequency protection trip delay time.
Query Example	PROT:UF:TDELAY:MAX? 10.000
Query Syntax	[SOURCE:]PROTECT[:RMS]:UF#: TDELAY:DEFault?
Description	This command returns the default RMS under frequency protection trip delay time.
Query Example	PROT:UF:TDELAY:DEF? 0.1000
Query Syntax	[SOURCE:]PROTECT[:RMS]:UF#:TRIPped?
Description	This command returns the RMS under frequency protection trip status. Returns 1 if tripped or 0 if not.
Query Example	PROT:UF:TRIP? 1
Command Syntax	[SOURCE:]PROTECT[:RMS]:UF#:TRIPped:CLEar
Description	This command clears the RMS under frequency protection trip status. Once cleared, the power source peak can be enabled.
Parameters	None
Parameter Format	n/a
Example	PROT:UF:TRIP:CLE

8.9.9.4 Over Frequency Protection

Command Syntax	[SOURCE:]PROTect[:RMS]:OF#[:STATe] <0 OFF 1 ON >
Description	This command enables or disables the RMS over frequency protection. If the protection is tripped the power source output is disabled.
Parameters	< 0 OFF 1 ON >
Parameter Format	<nr1> <cr>
Example	PROT:OF ON
Query Format	[SOURCE:]PROTect[:RMS]:OF #[:STATe]?
Returned Data Format	<nr1>
Query Example	PROT:OF? 1
Command Syntax	[SOURCE:]PROTect[:RMS]:OF#:LEVel <nr2>
Description	This command sets the RMS over frequency protection level.
Parameters	< LEVEL >
Parameter Format	<nr2>
Example	PROT:OF:LEV 45.0
Query Format	[SOURCE:]PROTect[:RMS]:OF#:LEVel?
Returned Data Format	<nr2>
Query Example	PROT:OF:LEV? 45.0000
Query Syntax	[SOURCE:]PROTect[:RMS]:OF#:LEVel:MINimum?
Description	This command returns the minimum RMS over frequency protection level setting.
Query Example	PROT:OF:LEV:MIN? 0.000
Query Syntax	[SOURCE:]PROTect[:RMS]:OF#:LEVel:MAXimum?
Description	This command returns the maximum RMS over frequency protection level setting.
Query Example	PROT:OF:LEV:MAX? 1000.0000
Query Syntax	[SOURCE:]PROTect[:RMS]:OF#:LEVel:DEFault?
Description	This command returns the default RMS over frequency protection level setting. This value will be a function of the power source model.
Query Example	PROT:OF:LEV:DEF? 10.000

Command Syntax	[SOURCE:]PROTECT[:RMS]:OF#:TDELAY <nr2>
Description	This command sets the RMS over frequency protection trip delay time.
Parameters	< LEVEL >
Parameter Format	<nr2>
Example	PROT:OF:TDELAY 50.0
Query Format	[SOURCE:]PROTECT[:RMS]:OF#:TDELAY?
Returned Data Format	<nr2>
Query Example	PROT:OF:TDELAY? 2.0000
Query Syntax	[SOURCE:]PROTECT[:RMS]:OF#:TDELAY:MINimum?
Description	This command returns the minimum RMS over frequency protection trip delay time..
Query Example	PROT:OF:TDELAY:MIN? 0.1000
Query Syntax	[SOURCE:]PROTECT[:RMS]:OF#: TDELAY:MAXimum?
Description	This command returns the maximum RMS over frequency protection trip delay time.
Query Example	PROT:OF:TDELAY:MAX? 10.000
Query Syntax	[SOURCE:]PROTECT[:RMS]:OF#: TDELAY:DEFault?
Description	This command returns the default RMS over frequency protection trip delay time.
Query Example	PROT:OF:TDELAY:DEF? 0.1000
Query Syntax	[SOURCE:]PROTECT[:RMS]:OF#:TRIPped?
Description	This command returns the RMS over frequency protection trip status. Returns 1 if tripped or 0 if not.
Query Example	PROT:OF:TRIP? 1
Command Syntax	[SOURCE:]PROTECT[:RMS]:OF#:TRIPped:CLEar
Description	This command clears the RMS over frequency protection trip status. Once cleared, the power source peak can be enabled.
Parameters	None
Parameter Format	n/a
Example	PROT:OF:TRIP:CLE

8.10 Active Load Commands

8.10.1 Load Mode Commands

The Active load commands listed in this section are only supported on the AGX or RGS Series if configured with the Load Option (Option L) and the Operating mode is set to Active Load. They are also supported on the RLS Series. See the SYSTEM:OPMMode command for mode selection.

Available Load modes are:

- Constant Current Mode (0)
- Constant Resistance Mode (1)
- Constant Power Mode (2)

Command Syntax	LOAD:TYPE [0 1 2]
Description	Sets the load operating mode
Parameters	0 Constant Current 1 Constant Resistance 2 Constant Power
Parameter Format	<nr1>
Example	LOAD:TYPE 0
Query Format	LOAD:TYPE?
Returned Data Format	<nr1>
Query Example	LOAD:TYPE? 2
Query Format	LOAD:TYPE:CATalog?
Description	Returns the available operating mode settings.
Returned Data Format	<csv>
Return Value	0,Constant Current,1,Constant Resistance,2,Constant Power
Query Example	LOAD:TYPE:CAT? 0,Constant current,1,Constant resistance,2,Constant power

8.10.2 Load Sync Commands

The electronic load uses a single loop Phase-Locked Loop (PLL) sync mode when working as an AC load. This PLL allows it to sync on all frequency ranges with a very precise phase. The PLL takes up to a few seconds to sync or detect that it is un-synced. When it detects that it is un-synced, the current is internally driven to zero.

Command Syntax	LOAD:SYNC[:STATe]# <0 OFF 1 ON>
Description	Sets the load sync mode
Parameters	0 OFF 1 ON
Parameter Format	<nr1> or <cr>
Example	LOAD:SYNC 1
Query Format	LOAD:SYNC[:STATe]#?
Returned Data Format	<nr1>
Query Example	LOAD:SYNC? 1

8.10.3 Expected Input Frequency Command

Command Syntax	[SOURce:]FREQuency
Description	Sets output frequency for all phases in Source mode or expected input frequency in Load mode. Not valid when the Source or Load is in DC mode. Sending a FREQ command while in DC mode will result in an error. The query form will return 0.000 when in DC mode.
Parameters	15.00 – 1200.0
Parameter Format	<nr2>
Example	FREQ 400.0
Query Format	[SOURce:]FREQuency?
Returned Data Format	<nr2>
Query Example	FREQ? 400.0000

8.10.4 Load Waveform Commands

Command Syntax	LOAD:WAVEform:RECTifier[:STATe]# <0 OFF 1 ON>
Description	Enables or Disables the Load Rectifier Emulation Waveform for the selected phase # or all phases if omitted.
Parameters	0 OFF 1 ON
Parameter Format	<nr1> or <cr>
Example	LOAD:WAVE:RECT ON
Query Format	LOAD:WAVEform:RECTifier[:STATe]#?
Returned Data Format	<nr1>
Query Example	LOAD:WAVE:RECT? 1
Command Syntax	LOAD:WAVEform:RECTifier:CF# <nr2>
Description	Sets the Crest Factor of the current waveform for the selected phase # or all phases if omitted.
Parameters	Crest factor
Parameter Format	<nr2>
Example	LOAD:WAVE:RECT:CF1 3.00
Query Format	LOAD:WAVEform:RECTifier:CF#?
Returned Data Format	<nr2>
Query Example	LOAD:WAVE:RECT:CF1? 3.0000

Query Syntax	LOAD:WAVEform:RECTifier:CF#:MINimum?
Description	Returns the minimum settable Crest Factor value for the current waveform for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>
Query Example	LOAD:WAVE:RECT:CF1:MIN? 1.0000
Query Syntax	LOAD:WAVEform:RECTifier:CF#:MAXimum?
Description	Returns the maximum settable Crest Factor value for the current waveform for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>
Query Example	LOAD:WAVE:RECT:CF1:MAX? 10.0000
Query Syntax	LOAD:WAVEform:RECTifier:CF#:DEFault?
Description	Returns the default Crest Factor value for the current waveform for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>
Query Example	LOAD:WAVE:RECT:CF1:DEF? 1.0000

8.10.5 Load Source Frequency Commands

Command Syntax	[SOURce:]FREQuency# <nr2>
Description	Sets the expected in frequency form the connected EUT AC Source for the selected phase # or all phases if omitted.
Parameters	Frequency Input
Parameter Format	<nr2>
Example	FREQ1 50.000
Query Format	[SOURce:]FREQuency#?
Returned Data Format	<nr2>
Query Example	FREQ#? 50.0000
Query Syntax	[SOURce:]FREQuency#:MINimum?
Description	Returns the minimum settable Frequency value for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>
Query Example	FREQ:MIN1? 15.0000
Query Syntax	[SOURce:]FREQuency#:MAXimum?
Description	Returns the maximum settable Frequency value for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>
Query Example	FREQ:MAX1? 1200.0000

Query Syntax	[SOURce:]FREQuency#:DEFault?
Description	Returns the default Frequency value for the current waveform for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>
Query Example	FREQ:DEF3? 60.0000

8.10.6 Load Voltage Input Protection Commands

Command Syntax	[SOURce:]PROTect:PEAK:VOLTage#:LEVel <nr2>
Description	This command sets the maximum voltage peak level. If the output voltage peak exceeds the programmed peak level by more than this amount, an error is tripped.
Parameters	Voltage setting
Parameter Format	<nr2>
Example	PROT:PEAK:VOLT:LEV 120.0
Query Format	[SOURce:]PROTect:PEAK:VOLTage#:LEVel?
Returned Data Format	<nr2>
Query Example	PROT:PEAK:VOLT:LEV? 120.0000
Query Syntax	[SOURce:]PROTect:PEAK:VOLTage#:LEVel:MINimum?
Description	This command returns the minimum voltage peak level setting.
Query Example	PROT:PEAK:VOLT3:LEV:MIN? 0.0000
Query Syntax	[SOURce:]PROTect:PEAK:VOLTage#:LEVel:MAXimum?
Description	This command returns the maximum voltage peak level setting.
Query Example	PROT:PEAK:VOLT:LEV2:MAX? 700.0000

Query Syntax	[SOURce:]PROTect:PEAK:VOLTage#:LEVel:DEFault?
Description	This command returns the default voltage peak level setting
Query Example	PROT:PEAK:VOLT:LEV1:DEF? 335.0000

8.10.7 Load Phase Commands

Command Syntax	[SOURce:]PHASe# <nr2>
Description	Sets the expected in phase angle of the connected EUT AC Source.
Parameters	Phase angle
Parameter Format	<nr2>
Example	PHAS2 120.000
Query Format	[SOURce:]PHASe#?
Returned Data Format	<nr2>
Query Example	PHAS2? 120.0000

Query Syntax	[SOURce:]PHASe #:MINimum?
Description	Returns the minimum settable phase angle value for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>
Query Example	PHAS:MIN? -1000.000

Query Syntax	[SOURce:]PHASe#:MAXimum?
Description	Returns the maximum settable phase angle value for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>
Query Example	PHAS:MAX1? 1000.000

Query Syntax	[SOURce:]PHASe#:DEFault?
Description	Returns the default Phase angle for the selected phase #. Defaults are 0 for Phase1, 120 for Phase2 and 240 for Phase3.
Returned Data Format	<nr2>
Query Example	PHAS:DEF2? 120.000

8.10.8 Load Power & KVA Limit Commands

Command Syntax	[SOURce:]POWer:LIMit# <nr2>
Description	Sets the maximum allowable Real Power in kW to accept from the connected EUT AC Source on the selected phase #.
Parameters	True Power Limit
Parameter Format	<nr2>
Example	POW:LIM1 15.000
Query Format	[SOURce:]POWer:LIMit#?
Returned Data Format	<nr2>
Query Example	POW:LIM? 7.0000

Query Syntax	[SOURce:]POWer:LIMit#:MINimum?
Description	Returns the minimum settable Real Power in kW for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>
Query Example	POW:LIM:MIN? 0.0000

Query Syntax	[SOURce:]POWer:LIMit#:MAXimum??
Description	Returns the maximum settable Real Power in kW for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>
Query Example	POW:LIM:MAX? 21.00

Query Syntax	[SOURce:]POWer:LIMit#:DEFault??
Description	Returns the default Real Power limit setting in kW for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>
Query Example	POW:LIM:DEF? 21.00

Command Syntax	[SOURce:]KVA:LIMit# <nr2>
Description	Sets the maximum allowable Apparent Power in kVA to accept from the connected EUT AC Source on the selected phase #.
Parameters	Apparent Power Limit
Parameter Format	<nr2>
Example	POW:LIM1 5.000
Query Format	[SOURce:]KVA:LIMit#?
Returned Data Format	<nr2>
Query Example	KVA:LIM1? 5.0000
Query Syntax	[SOURce:]KVA:LIMit#:MINimum?
Description	Returns the minimum settable Apparent Power in kVA for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>
Query Example	KVA:LIM1:MIN? 0.0000
Query Syntax	[SOURce:]KVA:LIMit#:MAXimum?
Description	Returns the maximum settable Apparent Power in kVA for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>
Query Example	KVA:LIM1:MAX? 7.0000
Query Syntax	[SOURce:]KVA:LIMit#:DEFault?
Description	Returns the default Apparent Power limit setting in kVA for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>
Query Example	KVA:LIM1:DEF? 7.0000

8.10.9 Load CC Mode Commands

Command Syntax	[SOURce:]CURRent[:AC]# <nr2>
Description	Sets the AC rms current setting for the selected phase # or all phases if omitted. A negative value represents regenerative current flow.
Parameters	Current RMS
Parameter Format	<nr2>
Example	CURR:AC1 41.700
Query Format	[SOURce:]CURRent#?
Returned Data Format	<nr2>
Query Example	CURR1? 41.7000
Query Syntax	[SOURce:]CURRent[:AC]#:MINimum?
Description	Returns the minimum settable AC rms current setting value for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>
Query Example	CURR:MIN? -41.7000,-41.7000,-41.7000
Query Syntax	[SOURce:]CURRent[:AC]#:MAXimum?
Description	Returns the maximum settable AC rms current setting value for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>
Query Example	CURR:MAX? 41.7000, 41.7000, 41.7000
Query Syntax	[SOURce:]CURRent[:AC]#:DEFault?
Description	Returns the default settable AC rms current setting value for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>
Query Example	CURR:DEF? 0.000,0.000,0.000
Command Syntax	[SOURce:]CURRent:DC# <nr2>
Description	Sets the DC current setting for the selected phase # or all phases if omitted.
Parameters	Current DC
Parameter Format	<nr2>
Example	CURR:DC1 21.000
Query Format	[SOURce:]CURRent:DC#?
Returned Data Format	<nr2>
Query Example	CURR:DC1? 21.0000

Query Syntax	[SOURce:]CURRent:DC#:MINimum?
Description	Returns the minimum settable DC current setting value for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>
Query Example	CURR:MIN? -21.000,-21.000,-21.000
Query Syntax	[SOURce:]CURRent:DC#:MAXimum?
Description	Returns the maximum settable DC current setting value for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>
Query Example	CURR:DC:MAX? 21.000,21.000,21.000
Query Syntax	[SOURce:]CURRent:DC#:DEFault?
Description	Returns the default settable DC current setting value for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>
Query Example	CURR:DC:DEF? 0.000,0.000,0.000

8.10.10 Load CR Mode Commands

In this mode the setpoint are resistance/conductance. The units generate the current based on the voltage measurement and the setpoint. There are four types for this mode:

Resistance RMS

Setpoint are resistive in Ohms, infinite option is available. The output current waveform is the arbitrary or the rectifier one. The output current is computed as:

$$I_{out} = V_{ac}/S_{ac} * \text{waveform}(t) + V_{dc}/S_{dc}$$

Where:

V_{ac} is the measured voltage AC

V_{dc} is the measured voltage DC

Waveform(t) is the normalized arbitrary or rectifier waveform.

S_{ac} is the AC setpoint

S_{dc} is the DC setpoint

Conductance RMS

Analog to resistive RMS but the setpoints are in conductance units or siemens. This mode can be useful because a zero setting generates zero load current whereas a zero in Ohms would be an infinite current. In the equation above the setpoints multiples instead of divide.

Instant Resistance

The difference with the RMS mode is that it uses the instantaneous voltage instead of the RMS.

For AC, the arbitrary waveform control the instant resistance.

Instant Conductance

Analog to instant resistance but the setpoints are in conductance units or siemens.

Other features:

- All the types have the sync control.
- As with constant current load the sync enabled is useful to sync the generation with the output voltage.
- The peak current limit limits the peak current in real time by clipping the waveform.
- The max current slew limits the slew rate of the current in real time.
- Rectifier waveform is available for the RMS modes.

Note: This Load mode of operation does **not** support the following functions:

- Interharmonics & Harmonics

Query Syntax	LOAD:CR:TYPE#:CATalog?
Description	This command returns the available Constant Resistance Load type selections as a comma separated value list. 0 Resistance RMS 1 Conductance RMS 2 Instant Resistance 3 Instant Conductance
Returned Data Format	<csv>
Query Example	LOAD:CR:TYPE:CAT? 0,Resistance RMS,1,Conductance RMS,2,Instant Resistance,3,Instant Conductance
Command Syntax	LOAD:CR:TYPE# <nr1>
Description	Sets the CR Load type setting for the selected phase # or all phases if omitted. 0 1 2 3
Parameters	<nr1>, <cr>
Parameter Format	LOAD:CR:TYPE 2
Example	LOAD:CR:TYPE#?
Query Format	<nr1>
Returned Data Format	LOAD:CR:TYPE?
Query Example	2
Query Syntax	LOAD:CR:MODE#:CATalog?
Description	This command returns the available Constant Resistance Load mode selections as a comma separated value list. <csv>
Returned Data Format	LOAD:CR:MOD:CAT?
Query Example	0,AC,1,DC,2,AC&DC,3,AC=DC
Command Syntax	LOAD:CR:MODE# <nr1>
Description	Sets the CR Load coupling mode setting for the selected phase # or all phases if omitted. Parameters available depend of CR mode: In CR RESISTANCE & CONDUCTANCE RMS modes, available settings are: 0 for AC, 1 for DC, 2 for AC&DC or 3 for AC=DC In CR RESISTANCE & CONDUCTANCE instantaneous mode, available settings are: 1 = DC CONSTANT, 2 = AC&DC MODULATED 0 1 2 3
Parameters	<nr1>, <cr>
Parameter Format	LOAD:CR:MOD 2
Example	LOAD:CR:MODE#?
Query Format	<nr1>
Returned Data Format	LOAD:CR:MOD?
Query Example	1,3,2

Command Syntax	LOAD:CR:RESistance# <nr2>
Description	Sets the CR Load mode resistance setting in Ohms for the selected phase # or all phases if omitted.
Parameters	CR mode
Parameter Format	<nr2>
Example	LOAD:CR:RES 1.258
Query Format	LOAD:CR:RESistance#?
Returned Data Format	<nr2>
Query Example	LOAD:CR:RES? 1.2580
Query Syntax	LOAD:CR:RESistance#:MINimum?
Description	Returns the minimum settable Resistance setting value for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>
Query Example	LOAD:CR:RES1:MIN? -100000.0000
Query Syntax	LOAD:CR:RESistance#:MAXimum?
Description	Returns the maximum settable Resistance setting value for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>
Query Example	LOAD:CR:RES1:MAX? 100000.0000
Query Syntax	LOAD:CR:RESistance#:DEFault?
Description	Returns the default Resistance setting value for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>
Query Example	LOAD:CR:RES1:DEF? 10.0000
Command Syntax	LOAD:CR:RESistance:AC# <nr2>
Description	Sets the CR Load mode AC only resistance setting in Ohms for the selected phase # or all phases if omitted.
Parameters	Setting
Parameter Format	<nr2>
Example	LOAD:CR:RES:AC1 2.258
Query Format	LOAD:CR:RESistance:AC#?
Returned Data Format	<nr2>
Query Example	LOAD:CR:RES:AC1? 2.2580

Query Syntax Description	LOAD:CR:RESistance:AC#:MINimum? Returns the minimum settable AC Resistance setting value for the selected phase # or all phases if omitted.
Returned Data Format Query Example	<nr2> LOAD:CR:RES:AC1:MIN? -100000.0000
Query Syntax Description	LOAD:CR:RESistance:AC#:MAXimum? Returns the maximum settable AC Resistance setting value for the selected phase # or all phases if omitted.
Returned Data Format Query Example	<nr2> LOAD:CR:RES:AC1:MAX? 100000.0000
Query Syntax Description	LOAD:CR:RESistance:AC#:DEFault? Returns the default AC Resistance setting value for the selected phase # or all phases if omitted.
Returned Data Format Query Example	<nr2> LOAD:CR:RES:AC1:DEF? 10.0000
Command Syntax Description	LOAD:CR:RESistance:AC#:USER:LIMit:MINimum <nr2> Sets the lower user limit for CR Load mode AC only resistance setting in Ohms for the selected phase # or all phases if omitted.
Parameters Parameter Format Example Query Format Returned Data Format Query Example	Setting <nr2> LOAD:CR:RES:AC1:USER:LIM:MIN 0.100 LOAD:CR:RESistance:AC#:USER:LIMit:MINimum? <nr2> LOAD:CR:RES:AC1:USER:LIM:MIN? 0.1000
Command Syntax Description	LOAD:CR:RESistance:AC#:USER:LIMit:MAXimum <nr2> Sets the upper user limit for CR Load mode AC only resistance setting in Ohms for the selected phase # or all phases if omitted.
Parameters Parameter Format Example Query Format Returned Data Format Query Example	Setting <nr2> LOAD:CR:RES:AC1:USER:LIM:MAX 10000.00 LOAD:CR:RESistance:AC#:USER:LIMit:MAXimum? <nr2> LOAD:CR:RES:AC1:USER:LIM:MAX? 10000.0000

Query Syntax	LOAD:CR:RESistance:AC#:USER:LIMit:RANGe?
Description	Returns the available setting range for the AC Resistance user limit setting for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>, <nr2>
Query Example	LOAD:CR:RES:AC3:USER:LIM:RANG? 0.1000, 10000.0000
Query Syntax	LOAD:CR:RESistance:AC#:RANGe:MINimum?
Description	Returns the minimum settable AC Resistance Range setting value for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>
Query Example	LOAD:CR:RES:AC1:RANG:MIN? 0.1000
Query Syntax	LOAD:CR:RESistance:AC#:RANGe:MAXimum?
Description	Returns the maximum settable AC Resistance Range setting value for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>
Query Example	LOAD:CR:RES:AC1:RANG:MAX? 10000.0000
Query Syntax	LOAD:CR:RESistance:AC#:RANGe?
Description	Returns the Min and Max AC Resistance Range setting values for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>, <nr2>
Query Example	LOAD:CR:RES:AC#:RANG? 0.1000, 10.0000
Command Syntax	LOAD:CR:RESistance:AC#:SLEW <nr2>
Description	Sets the CR Load mode AC Resistance setting slew rate in Ohms per second for the selected phase # or all phases if omitted.
Parameters	Setting
Parameter Format	<nr2>
Example	LOAD:CR:RES:AC2:SLEW 100.00
Query Format	LOAD:CR:RESistance:AC#:SLEW?
Returned Data Format	<nr2>
Query Example	LOAD:CR:RES:AC2:SLEW? 100.0000
Query Syntax	LOAD:CR:RESistance:AC#:SLEW:MINimum?
Description	Returns the minimum settable AC Resistance slew rate setting value for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>
Query Example	LOAD:CR:RES:AC1:SLEW:MIN? 0.001

Query Syntax	LOAD:CR:RESistance:AC#:SLEW:MAXimum?
Description	Returns the maximum settable AC Resistance slew rate setting value for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>
Query Example	LOAD:CR:RES:AC1:SLEW:MAX? 1000.000
Query Syntax	LOAD:CR:RESistance:AC#:SLEW:DEFault?
Description	Returns the default AC Resistance slew rate setting value for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>
Query Example	LOAD:CR:RES:AC1:DEF? 10.000
Command Syntax	LOAD:CR:RESistance:DC# <nr2>
Description	Sets the CR Load mode DC only resistance setting in Ohms for the selected phase # or all phases if omitted.
Parameters	Setting
Parameter Format	<nr2>
Example	LOAD:CR:RES:DC1 2.258
Query Format	LOAD:CR:RESistance:DC#?
Returned Data Format	<nr2>
Query Example	LOAD:CR:RES:DC1? 2.2580
Query Syntax	LOAD:CR:RESistance:DC#:MINimum?
Description	Returns the minimum settable DC Resistance setting value for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>
Query Example	LOAD:CR:RES:DC1:MIN? -100000.0000
Query Syntax	LOAD:CR:RESistance:DC#:MAXimum?
Description	Returns the maximum settable DC Resistance setting value for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>
Query Example	LOAD:CR:RES:AC1:DC:MAX? 10000.0000
Query Syntax	LOAD:CR:RESistance:DC#:DEFault?
Description	Returns the default DC Resistance setting value for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>
Query Example	LOAD:CR:RES:DC1:DEF? 10.0000

Command Syntax	LOAD:CR:RESistance:DC#:USER:LIMit:MINimum <nr2>
Description	Sets the lower user limit for CR Load mode AC only resistance setting in Ohms for the selected phase # or all phases if omitted.
Parameters	Setting
Parameter Format	<nr2>
Example	LOAD:CR:RES:DC1:USER:LIM:MIN 0.100
Query Format	LOAD:CR:RESistance:DC#:USER:LIMit:MINimum?
Returned Data Format	<nr2>
Query Example	LOAD:CR:RES:DC1:USER:LIM:MIN? 0.1000
Command Syntax	LOAD:CR:RESistance:DC#:USER:LIMit:MAXimum <nr2>
Description	Sets the upper user limit for CR Load mode DC only resistance setting in Ohms for the selected phase # or all phases if omitted.
Parameters	Setting
Parameter Format	<nr2>
Example	LOAD:CR:RES:DC1:USER:LIM:MAX 10000.00
Query Format	LOAD:CR:RESistance:DC#:USER:LIMit:MAXimum?
Returned Data Format	<nr2>
Query Example	LOAD:CR:RES:DC1:USER:LIM:MAX? 10000.0000
Query Syntax	LOAD:CR:RESistance:DC#:USER:LIMit:RANGe?
Description	Returns the available setting range for the DC Resistance user limit setting for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>, <nr2>
Query Example	LOAD:CR:RES:DC3:USER:LIM:RANG? 0.1000, 10000.0000
Query Syntax	LOAD:CR:RESistance:DC#:RANGe:MINimum?
Description	Returns the minimum settable DC Resistance Range setting value for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>
Query Example	LOAD:CR:RES:DC1:RANG:MIN? 0.1000
Query Syntax	LOAD:CR:RESistance:DC#:RANGe:MAXimum?
Description	Returns the maximum settable DC Resistance Range setting value for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>
Query Example	LOAD:CR:RES:DC1:RANG:MAX? 10000.0000

Query Syntax	LOAD:CR:RESistance:DC#:RANGe?
Description	Returns the Min and Max DC Resistance Range setting values for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>, <nr2>
Query Example	LOAD:CR:RES:DC#:RANG? 0.1000, 10.0000
Command Syntax	LOAD:CR:RESistance:DC#:SLEW <nr2>
Description	Sets the CR Load mode DC Resistance setting slew rate in Ohms per second for the selected phase # or all phases if omitted.
Parameters	Setting
Parameter Format	<nr2>
Example	LOAD:CR:RES:DC2:SLEW 100.00
Query Format	LOAD:CR:RESistance:DC#:SLEW?
Returned Data Format	<nr2>
Query Example	LOAD:CR:RES:DC2:SLEW? 100.0000
Query Syntax	LOAD:CR:RESistance:DC#:SLEW:MINimum?
Description	Returns the minimum settable DC Resistance slew rate setting value for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>
Query Example	LOAD:CR:RES:DC1:SLEW:MIN? 0.001
Query Syntax	LOAD:CR:RESistance:DC#:SLEW:MAXimum?
Description	Returns the maximum settable DC Resistance slew rate setting value for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>
Query Example	LOAD:CR:RES:DC1:SLEW:LMAX? 1000.000
Query Syntax	LOAD:CR:RESistance:DC#:SLEW:DEFault?
Description	Returns the default DC Resistance slew rate setting value for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>
Query Example	LOAD:CR:RES:DC1:SLEW:DEF? 10.000

Command Syntax	LOAD:CR:CONductance# <nr2>
Description	Sets the CR Load mode conductance setting in Siemes for the selected phase # or all phases if omitted.
Parameters	Setting
Parameter Format	<nr2>
Example	LOAD:CR:CON3 0.001
Query Format	LOAD:CR:CONductance#?
Returned Data Format	<nr2>
Query Example	LOAD:CR:CON3? 0.0001
Query Syntax	LOAD:CR:CONductance#:MINimum?
Description	Returns the minimum settable conductance setting value for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>
Query Example	LOAD:CR:CON1:MIN? -0.1382
Query Syntax	LOAD:CR:CONductance#:MAXimum?
Description	Returns the maximum settable conductance setting value for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>
Query Example	LOAD:CR:CON1:MAX? 0.1382
Query Syntax	LOAD:CR:CONductance#:DEFault?
Description	Returns the default conductance setting value for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>
Query Example	LOAD:CR:CON1:DEF? 0.0000
Command Syntax	LOAD:CR:CONductance:AC# <nr2>
Description	Sets the CR Load mode AC only conductance setting in Siemens for the selected phase # or all phases if omitted.
Parameters	Setting
Parameter Format	<nr2>
Example	LOAD:CR:CON:AC1 2.258
Query Format	LOAD:CR:CONductance:AC#?
Returned Data Format	<nr2>
Query Example	LOAD:CR:CON:AC1? 2.2580

Query Syntax	LOAD:CR:CONductance:AC#:MINimum?
Description	Returns the minimum settable AC conductance setting value for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>
Query Example	LOAD:CR:CON:AC1:MIN? -0.2362
Query Syntax	LOAD:CR:CONductance:AC#:MAXimum?
Description	Returns the maximum settable AC conductance setting value for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>
Query Example	LOAD:CR:CON:AC1:MAX? 0.2362
Query Syntax	LOAD:CR:CONductance:AC#:DEFault?
Description	Returns the default AC conductance setting value for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>
Query Example	LOAD:CR:CON:AC1:DEF? 0.0000
Command Syntax	LOAD:CR:CONductance:AC#:USER:LIMit:MINimum <nr2>
Description	Sets the lower user limit for CR Load mode AC only conductance setting in Ohms for the selected phase # or all phases if omitted.
Parameters	Setting
Parameter Format	<nr2>
Example	LOAD:CR:CON:AC1:USER:LIM:MIN 0.100
Query Format	LOAD:CR:CONductance:AC#:USER:LIMit:MINimum?
Returned Data Format	<nr2>
Query Example	LOAD:CR:CON:AC1:USER:LIM:MIN? 0.1000
Command Syntax	LOAD:CR:CONductance:AC#:USER:LIMit:MAXimum <nr2>
Description	Sets the upper user limit for CR Load mode AC only conductance setting in Ohms for the selected phase # or all phases if omitted.
Parameters	Setting
Parameter Format	<nr2>
Example	LOAD:CR:CON:AC1:USER:LIM:MAX 10000.00
Query Format	LOAD:CR:CONductance:AC#:USER:LIMit:MAXimum?
Returned Data Format	<nr2>
Query Example	LOAD:CR:CON:AC1:USER:LIM:MAX? 10000.0000

Query Syntax	LOAD:CR:CONductance:AC#:USER:LIMit:RANGe?
Description	Returns the available setting range for the AC conductance user limit setting for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>, <nr2>
Query Example	LOAD:CR:CON:AC3:USER:LIM:RANG? 0.1000, 10000.0000
Query Syntax	LOAD:CR:CONductance:AC#:RANGe:MINimum?
Description	Returns the minimum settable AC conductance Range setting value for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>
Query Example	LOAD:CR:CON:AC1:RANG:MIN? 0.1000
Query Syntax	LOAD:CR:CONductance:AC#:RANGe:MAXimum?
Description	Returns the maximum settable AC conductance Range setting value for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>
Query Example	LOAD:CR:CON:AC1:RANG:MAX? 10000.0000
Query Syntax	LOAD:CR:CONductance:AC#:RANGe?
Description	Returns the Min and Max AC conductance Range setting values for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>, <nr2>
Query Example	LOAD:CR:CON:AC#:RANG? 0.1000, 10.0000
Command Syntax	LOAD:CR:CONductance:AC#:SLEW <nr2>
Description	Sets the CR Load mode AC conductance setting slew rate in Siemens per second for the selected phase # or all phases if omitted.
Parameters	Setting
Parameter Format	<nr2>
Example	LOAD:CR:CON:AC2:SLEW 100.00
Query Format	LOAD:CR:CONductance:AC#:SLEW?
Returned Data Format	<nr2>
Query Example	LOAD:CR:CON:AC2:SLEW? 100.0000
Query Syntax	LOAD:CR:CONductance:AC#:SLEW:MINimum?
Description	Returns the minimum settable AC conductance slew rate setting value for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>
Query Example	LOAD:CR:CON:AC1:SLEW:MIN? -0.2362

Query Syntax	LOAD:CR:CONductance:AC#:SLEW:MAXimum?
Description	Returns the maximum settable AC conductance slew rate setting value for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>
Query Example	LOAD:CR:CON:AC1:SLEW:MAX? 0.2362
Query Syntax	LOAD:CR:CONductance:AC#:SLEW:DEFault?
Description	Returns the default AC conductance slew rate setting value for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>
Query Example	LOAD:CR:CON:AC1:SLEW:DEF? 10.000
Command Syntax	LOAD:CR:CONductance:DC# <nr2>
Description	Sets the CR Load mode DC only conductance setting in Siemens for the selected phase # or all phases if omitted.
Parameters	Setting
Parameter Format	<nr2>
Example	LOAD:CR:CON:DC1 0.200
Query Format	LOAD:CR:CONductance:DC#?
Returned Data Format	<nr2>
Query Example	LOAD:CR:CON:DC1? 0.2000
Query Syntax	LOAD:CR:CONductance:DC#:MINimum?
Description	Returns the minimum settable DC conductance setting value for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>
Query Example	LOAD:CR:CON:DC1:MIN? -0.3333
Query Syntax	LOAD:CR:CONductance:DC#:MAXimum?
Description	Returns the maximum settable DC conductance setting value for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>
Query Example	LOAD:CR:CON:DC1:MAX? 0.3333
Query Syntax	LOAD:CR:CONductance:DC#:DEFault?
Description	Returns the default DC conductance setting value for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>
Query Example	LOAD:CR:CON:DC1:DEF? 0.0000

Command Syntax	LOAD:CR:CONductance:DC#:USER:LIMit:MINimum <nr2>
Description	Sets the lower user limit for CR Load mode DC only conductance setting in Ohms for the selected phase # or all phases if omitted.
Parameters	Setting
Parameter Format	<nr2>
Example	LOAD:CR:CON:DC1:USER:LIM:MIN 0.100
Query Format	LOAD:CR:CONductance:DC#:USER:LIMit:MINimum?
Returned Data Format	<nr2>
Query Example	LOAD:CR:CON:DC1:USER:LIM:MIN? 0.1000
Command Syntax	LOAD:CR:CONductance:DC#:USER:LIMit:MAXimum <nr2>
Description	Sets the upper user limit for CR Load mode DC only conductance setting in Ohms for the selected phase # or all phases if omitted.
Parameters	Setting
Parameter Format	<nr2>
Example	LOAD:CR:CON:DC1:USER:LIM:MAX 10000.00
Query Format	LOAD:CR:CONductance:DC#:USER:LIMit:MAXimum?
Returned Data Format	<nr2>
Query Example	LOAD:CR:CON:DC1:USER:LIM:MAX? 10000.0000
Query Syntax	LOAD:CR:CONductance:DC#:USER:LIMit:RANGe?
Description	Returns the available setting range for the DC conductance user limit setting for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>, <nr2>
Query Example	LOAD:CR:CON:DC3:USER:LIM:RANG? -0.3333, 0.3333
Query Syntax	LOAD:CR:CONductance:DC#:RANGe:MINimum?
Description	Returns the minimum settable DC conductance Range setting value for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>
Query Example	LOAD:CR:CON:DC1:RANG:MIN? -0.3333
Query Syntax	LOAD:CR:CONductance:DC#:RANGe:MAXimum?
Description	Returns the maximum settable DC conductance Range setting value for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>
Query Example	LOAD:CR:CON:DC1:RANG:MAX? 0.3333

Query Syntax	LOAD:CR:CONductance:DC#:RANGe?
Description	Returns the Min and Max DC conductance Range setting values for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>, <nr2>
Query Example	LOAD:CR:CON:DC#:RANG? -0.3333,0.3333
Command Syntax	LOAD:CR:CONductance:DC#:SLEW <nr2>
Description	Sets the CR Load mode DC conductance setting slew rate in Ohms per second for the selected phase # or all phases if omitted.
Parameters	Setting
Parameter Format	<nr2>
Example	LOAD:CR:CON:DC2:SLEW 100.00
Query Format	LOAD:CR:CONductance:DC#:SLEW?
Returned Data Format	<nr2>
Query Example	LOAD:CR:CON:AC2:SLEW? 100.0000
Query Syntax	LOAD:CR:CONductance:DC#:SLEW:MINimum?
Description	Returns the minimum settable DC conductance slew rate setting value for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>
Query Example	LOAD:CR:CON:DC1:SLEW:MIN? 0.001
Query Syntax	LOAD:CR:CONductance:DC#:SLEW:MAXimum?
Description	Returns the maximum settable DC conductance slew rate setting value for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>
Query Example	LOAD:CR:CON:DC1:SLEW:MAX? 1000.000
Query Syntax	LOAD:CR:CONductance:DC#:SLEW:DEFault?
Description	Returns the default DC conductance slew rate setting value for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>
Query Example	LOAD:CR:CON:DC1:SLEW:DEF? 10.000

8.10.11 Load CP Mode Commands

These CP AC and DC commands operate as follows:

LOAD:CP:KVA commands are for:

(1) ACTIVE LOAD -> CONSTANT POWER -> APPARENT POWER RMS

- The DC setpoints produce a DC current that multiplied by the V_{rms} gives the desired KVA:DC.
- The AC setpoint produces an AC current (arbitrary or rectifier) that multiplied by the V_{rms} gives the desired KVA:AC.

So the difference is whether the load produces an AC and/or DC load condition to obtain the desired KVA.

LOAD:CP:POW commands are for:

(2) ACTIVE LOAD -> CONSTANT POWER -> ACTIVE POWER RMS

- The DC setpoints produce a DC current that multiplied by the V_{dc} gives the desired POW:DC.
- The AC setpoint produces an AC current (arbitrary or rectifier) that multiplied by the $V_{ac} \cdot \cos(\phi)$ gives the desired POW:AC.

(3) ACTIVE LOAD -> CONSTANT POWER -> INSTANT POWER

- The DC setpoints produce an instant current that multiplied by the $V(t)$ gives the desired instantaneous POW:DC.
- The AC setpoints produce an instant current that multiplied by the $V(t)$ gives the desired instantaneous arbitrary waveform of power.

Note: This Load mode of operation does **not** support the following functions:

- Interharmonics & Harmonics

Query Syntax	LOAD:CP:TYPE#:CATalog?
Description	This command returns the available Constant Power Load type selections as a comma separated value list. 0 Apparent Power 1 Active Power
Returned Data Format	<csv>
Query Example	LOAD:CP:TYPE:CAT? 0,Apparent Power RMS,1,Active Power RMS
Command Syntax	LOAD:CP:TYPE# <nr1>
Description	Sets the CP Load type for the selected phase # or all phases if omitted. 0 = Apparent Power 1 = Active Power
Parameters	0 1
Parameter Format	<nr1>
Example	LOAD:CP:TYPE 1
Query Format	LOAD:CP:TYPE#?
Returned Data Format	<nr1>
Query Example	LOAD:CP:TYPE? 1
Query Syntax	LOAD:CP:MODE#:CATalog?
Description	This command returns the available Constant Power operating mode selections as a comma separated value list. Allowable settings AC mode, DC mode or AC&DC mode.
Returned Data Format	<csv>
Query Example	LOAD:CP:MOD:CAT? 0,AC,1,DC,2,AC&DC
Command Syntax	LOAD:CP:MODE# <nr1>
Description	This command sets the available Constant Power operating mode selections. Allowable settings are 0 (AC mode), 1 (DC mode) or 2 (AC&DC mode).
Parameters	CP mode
Parameter Format	<nr1>, <cr>
Example	LOAD:CP:MOD 2
Query Format	LOAD:CP:MODE#?
Returned Data Format	<nr1>
Query Example	LOAD:CP:MOD? 1,1,1

Command Syntax	LOAD:CP:POWer:AC# <nr2>
Description	Sets the CP Load mode AC power setting in kW for the selected phase # or all phases if omitted.
Parameters	Setting
Parameter Format	<nr2>
Example	LOAD:CP:POW:AC1 10.000
Query Format	LOAD:CP:POWer:AC#?
Returned Data Format	<nr2>
Query Example	LOAD:CP:POW:AC1? 7.0000
Query Syntax	LOAD:CP:POWer:AC#:MINimum?
Description	Returns the minimum settable AC power setting value for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>
Query Example	LOAD:CP:POW:AC1:MIN? -7.0000
Query Syntax	LOAD:CP:POWer:AC#:MAXimum?
Description	Returns the maximum settable AC power setting value for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>
Query Example	LOAD:CP:POW:AC1:MAX? 17.2500
Query Syntax	LOAD:CP:POWer:AC#:DEFault?
Description	Returns the default AC power setting value for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>
Query Example	LOAD:CP:POW:AC1:DEF? 0.0000
Command Syntax	LOAD:CP:POWer:AC#:USER:LIMit:MINimum <nr2>
Description	Sets the lower user limit for CP Load mode AC power setting in kW for the selected phase # or all phases if omitted.
Parameters	Setting
Parameter Format	<nr2>
Example	LOAD:CP:POW:AC1:USER:LIM:MIN 0.100
Query Format	LOAD:CP:POWer:AC#:USER:LIMit:MINimum?
Returned Data Format	<nr2>
Query Example	LOAD:CP:POW:AC1:USER:LIM:MIN? -7.0000

Command Syntax	LOAD:CP:POWer:AC#:USER:LIMit:MAXimum <nr2>
Description	Sets the upper user limit for CP Load mode AC power setting in kW for the selected phase # or all phases if omitted.
Parameters	Setting
Parameter Format	<nr2>
Example	LOAD:CP:POW:AC1:USER:LIM:MAX 10000.00
Query Format	LOAD:CP:POWer:AC#:USER:LIMit:MAXimum?
Returned Data Format	<nr2>
Query Example	LOAD:CP:POW:AC1:USER:LIM:MAX? 7.0000
Query Syntax	LOAD:CP:POWer:AC#:USER:LIMit:RANGe?
Description	Returns the available setting range for the AC power user limit setting for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>, <nr2>
Query Example	LOAD:CP:POW:AC3:USER:LIM:RANG? 0.1000, 7.0000
Query Syntax	LOAD:CP:POWer:AC#:RANGe:MINimum?
Description	Returns the minimum settable AC power Range setting value for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>
Query Example	LOAD:CP:POW:AC1:RANG:MIN? -7.0000
Query Syntax	LOAD:CP:POWer:AC#:RANGe:MAXimum?
Description	Returns the maximum settable AC power Range setting value for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>
Query Example	LOAD:CP:POWer:AC1:RANG:MAX? 7.0000
Query Syntax	LOAD:CP:POWer:AC#:RANGe?
Description	Returns the Min and Max AC power Range setting values for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>, <nr2>
Query Example	LOAD:CP:POW:AC#:RANG? -7.0000, 7.0000

Command Syntax	LOAD:CP:POWer:AC#:SLEW <nr2>
Description	Sets the CP Load mode AC power setting slew rate in kW per second for the selected phase # or all phases if omitted.
Parameters	Setting
Parameter Format	<nr2>
Example	LOAD:CP:POW:AC2:SLEW 100.00
Query Format	LOAD:CP:POWer:AC#:SLEW?
Returned Data Format	<nr2>
Query Example	LOAD:CP:POW:AC2:SLEW? 100.0000
Query Syntax	LOAD:CP:POWer:AC#:SLEW:MINimum?
Description	Returns the minimum settable AC power slew rate setting value for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>
Query Example	LOAD:CP:POW:AC1:SLEW:MIN? 0.001
Query Syntax	LOAD:CP:POWer:AC#:SLEW:MAXimum?
Description	Returns the maximum settable AC power slew rate setting value for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>
Query Example	LOAD:CP:POW:AC1:SLEW:MAX? 1000.000
Query Syntax	LOAD:CP:POWer:AC#:SLEW:DEFault?
Description	Returns the default AC power slew rate setting value for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>
Query Example	LOAD:CP:POW:AC1:DEF? 10.0000
Command Syntax	LOAD:CP:POWer:DC# <nr2>
Description	Sets the CP Load mode DC power setting in kW for the selected phase # or all phases if omitted.
Parameters	Setting
Parameter Format	<nr2>
Example	LOAD:CP:POW:DC1 10.000
Query Format	LOAD:CP:POWer:DC#?
Returned Data Format	<nr2>
Query Example	LOAD:CP:POW:DC1? 10.0000

Query Syntax Description	LOAD:CP:POWer:DC#:MINimum? Returns the minimum settable DC power setting value for the selected phase # or all phases if omitted.
Returned Data Format Query Example	<nr2> LOAD:CP:POW:DC1:MIN? -17.2500
Query Syntax Description	LOAD:CP:POWer:DC#:MAXimum? Returns the maximum settable DC power setting value for the selected phase # or all phases if omitted.
Returned Data Format Query Example	<nr2> LOAD:CP:POW:DC1:MAX? 17.2500
Query Syntax Description	LOAD:CP:POWer:DC#:DEFault? Returns the default DC power setting value for the selected phase # or all phases if omitted.
Returned Data Format Query Example	<nr2> LOAD:CP:POW:DC1:DEF? 0.0000
Command Syntax Description	LOAD:CP:POWer:DC#:USER:LIMit:MINimum <nr2> Sets the lower user limit for CP Load mode DC power setting in kW for the selected phase # or all phases if omitted.
Parameters Parameter Format Example Query Format Returned Data Format Query Example	Setting <nr2> LOAD:CP:POW:DC1:USER:LIM:MIN 0.100 LOAD:CP:POWer:DC#:USER:LIMit:MINimum? <nr2> LOAD:CP:POW:DC1:USER:LIM:MIN? 0.1000
Command Syntax Description	LOAD:CP:POWer:DC#:USER:LIMit:MAXimum <nr2> Sets the upper user limit for CP Load mode DC power setting in kW for the selected phase # or all phases if omitted.
Parameters Parameter Format Example Query Format Returned Data Format Query Example	Setting <nr2> LOAD:CP:POW:DC1:USER:LIM:MAX 10000.00 LOAD:CP:POWer:DC#:USER:LIMit:MAXimum? <nr2> LOAD:CP:POW:DC1:USER:LIM:MAX? 7.0000

Query Syntax	LOAD:CP:Power:DC#:USER:LIMit:RANGe?
Description	Returns the available setting range for the DC power user limit setting for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>, <nr2>
Query Example	LOAD:CP:POW:DC3:USER:LIM:RANG? 0.1000, 7.0000
Query Syntax	LOAD:CP:Power:DC#:RANGe:MINimum?
Description	Returns the minimum settable DC power Range setting value for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>
Query Example	LOAD:CP:POW:DC1:RANG:MIN? 0.1000
Query Syntax	LOAD:CP:Power:DC#:RANGe:MAXimum?
Description	Returns the maximum settable DC power Range setting value for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>
Query Example	LOAD:CP:POWer:DC1:RANG:MAX? 10000.0000
Query Syntax	LOAD:CP:Power:DC#:RANGe?
Description	Returns the Min and Max DC power Range setting values for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>, <nr2>
Query Example	LOAD:CP:POW:DC#:RANG? 0.1000, 7.0000
Command Syntax	LOAD:CP:Power:DC#:SLEW <nr2>
Description	Sets the CP Load mode DC power setting slew rate in kW per second for the selected phase # or all phases if omitted.
Parameters	Setting
Parameter Format	<nr2>
Example	LOAD:CP:POW:DC2:SLEW 100.00
Query Format	LOAD:CP:Power:DC#:SLEW?
Returned Data Format	<nr2>
Query Example	LOAD:CP:POW:DC2:SLEW? 100.0000
Query Syntax	LOAD:CP:Power:DC#:SLEW:MINimum?
Description	Returns the minimum settable DC power slew rate setting value for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>
Query Example	LOAD:CP:POW:DC1:SLEW:MIN? 0.001

Query Syntax	LOAD:CP:Power:DC#:SLEW:MAXimum?
Description	Returns the maximum settable DC power slew rate setting value for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>
Query Example	LOAD:CP:POW:DC1:SLEW:MAX? 1000.000
Query Syntax	LOAD:CP:Power:DC#:SLEW:DEFault?
Description	Returns the default DC power slew rate setting value for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>
Query Example	LOAD:CP:POW:DC1:DEF? 10.000
Command Syntax	LOAD:CP:KVA:AC# <nr2>
Description	Sets the CP Load mode AC apparent power setting in kVA for the selected phase # or all phases if omitted.
Parameters	Setting
Parameter Format	<nr2>
Example	LOAD:CP:POW:AC1 10.000
Query Format	LOAD:CP:KVA:AC#?
Returned Data Format	<nr2>
Query Example	LOAD:CP:KVA:AC1? 7.0000
Query Syntax	LOAD:CP:KVA:AC#:MINimum?
Description	Returns the minimum settable AC apparent power setting value for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>
Query Example	LOAD:CP:KVA:AC1:MIN? - 7.0000
Query Syntax	LOAD:CP:KVA:AC#:MAXimum?
Description	Returns the maximum settable AC apparent power setting value for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>
Query Example	LOAD:CP:KVA:AC1:MAX? 7.0000
Query Syntax	LOAD:CP:KVA:AC#:DEFault?
Description	Returns the default AC apparent power setting value for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>
Query Example	LOAD:CP:KVA:AC1:DEF? 0.0000

Command Syntax	LOAD:CP:KVA:AC#:USER:LIMit:MINimum <nr2>
Description	Sets the lower user limit for CP Load mode AC apparent power setting in kVA for the selected phase # or all phases if omitted.
Parameters	Setting
Parameter Format	<nr2>
Example	LOAD:CP:KVA:AC1:USER:LIM:MIN 0.100
Query Format	LOAD:CP:KVA:AC#:USER:LIMit:MINimum?
Returned Data Format	<nr2>
Query Example	LOAD:CP:KVA:AC1:USER:LIM:MIN? 0.1000
Command Syntax	LOAD:CP:KVA:AC#:USER:LIMit:MAXimum <nr2>
Description	Sets the upper user limit for CP Load mode AC apparent power setting in kVA for the selected phase # or all phases if omitted.
Parameters	Setting
Parameter Format	<nr2>
Example	LOAD:CP:KVA:AC1:USER:LIM:MAX 10000.00
Query Format	LOAD:CP:KVA:AC#:USER:LIMit:MAXimum?
Returned Data Format	<nr2>
Query Example	LOAD:CP:KVA:AC1:USER:LIM:MAX? 7.0000
Query Syntax	LOAD:CP:KVA:AC#:USER:LIMit:RANGe?
Description	Returns the available setting range for the AC apparent power user limit setting for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>, <nr2>
Query Example	LOAD:CP:KVA:AC3:USER:LIM:RANG? 0.1000, 7.0000
Query Syntax	LOAD:CP:KVA:AC#:RANGe:MINimum?
Description	Returns the minimum settable AC apparent power range setting value for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>
Query Example	LOAD:CP:KVA:AC1:RANG:MIN? -7.0000
Query Syntax	LOAD:CP:KVA:AC#:RANGe:MAXimum?
Description	Returns the maximum settable AC apparent power range setting value for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>
Query Example	LOAD:CP:KVA:AC1:RANG:MAX? 7.0000

Query Syntax	LOAD:CP:KVA:AC#:RANGe?
Description	Returns the Min and Max AC apparent power range setting values for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>, <nr2>
Query Example	LOAD:CP:KVA:AC#:RANG? -7.0000,7.0000
Command Syntax	LOAD:CP:KVA:AC#:SLEW <nr2>
Description	Sets the CP Load mode AC apparent power setting slew rate in kVA per second for the selected phase # or all phases if omitted.
Parameters	Setting
Parameter Format	<nr2>
Example	LOAD:CP:KVA:AC2:SLEW 100.00
Query Format	LOAD:CP:KVA:AC#:SLEW?
Returned Data Format	<nr2>
Query Example	LOAD:CP:KVA:AC2:SLEW? 100.0000
Query Syntax	LOAD:CP:KVA:AC#:SLEW:MINimum?
Description	Returns the minimum settable AC apparent power slew rate setting value for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>
Query Example	LOAD:CP:KVA:AC1:SLEW:MIN? 0.001
Query Syntax	LOAD:CP:KVA:AC#:SLEW:MAXimum?
Description	Returns the maximum settable AC apparent power slew rate setting value for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>
Query Example	LOAD:CP:KVA:AC1:SLEW:MAX? 1000.000
Query Syntax	LOAD:CP:KVA:AC#:SLEW:DEFault?
Description	Returns the default AC apparent power slew rate setting value for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>
Query Example	LOAD:CP:KVA:AC1:DEF? 10.000

Command Syntax	LOAD:CP:KVA:DC# <nr2>
Description	Sets the CP Load mode DC apparent power setting in kVA for the selected phase # or all phases if omitted.
Parameters	Setting
Parameter Format	<nr2>
Example	LOAD:CP:POW:AC1 10.000
Query Format	LOAD:CP:KVA:DC#?
Returned Data Format	<nr2>
Query Example	LOAD:CP:KVA:DC1? 10.0000
Query Syntax	LOAD:CP:KVA:DC#:MINimum?
Description	Returns the minimum settable DC apparent power setting value for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>
Query Example	LOAD:CP:KVA:DC1:MIN? -7.0000
Query Syntax	LOAD:CP:KVA:DC#:MAXimum?
Description	Returns the maximum settable DC apparent power setting value for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>
Query Example	LOAD:CP:KVA:DC1:MAX? 7.0000
Query Syntax	LOAD:CP:KVA:DC#:DEFault?
Description	Returns the default DC apparent power setting value for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>
Query Example	LOAD:CP:KVA:DC1:DEF? 0.000
Command Syntax	LOAD:CP:KVA:DC#:USER:LIMit:MINimum <nr2>
Description	Sets the lower user limit for CP Load mode DC apparent power setting in kVA for the selected phase # or all phases if omitted.
Parameters	Setting
Parameter Format	<nr2>
Example	LOAD:CP:KVA:DC1:USER:LIM:MIN 0.100
Query Format	LOAD:CP:KVA:DC#:USER:LIMit:MINimum?
Returned Data Format	<nr2>
Query Example	LOAD:CP:KVA:DC1:USER:LIM:MIN? 0.1000

Command Syntax	LOAD:CP:KVA:DC#:USER:LIMit:MAXimum <nr2>
Description	Sets the upper user limit for CP Load mode DC apparent power setting in kVA for the selected phase # or all phases if omitted.
Parameters	Setting
Parameter Format	<nr2>
Example	LOAD:CP:KVA:DC1:USER:LIM:MAX 10000.00
Query Format	LOAD:CP:KVA:DC#:USER:LIMit:MAXimum?
Returned Data Format	<nr2>
Query Example	LOAD:CP:KVA:DC1:USER:LIM:MAX? 7.0000
Query Syntax	LOAD:CP:KVA:DC#:USER:LIMit:RANGe?
Description	Returns the available setting range for the DC apparent power user limit setting for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>, <nr2>
Query Example	LOAD:CP:KVA:DC3:USER:LIM:RANG? 0.1000, 7.0000
Query Syntax	LOAD:CP:KVA:DC#:RANGe:MINimum?
Description	Returns the minimum settable DC apparent power range setting value for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>
Query Example	LOAD:CP:KVA:DC1:RANG:MIN? -7.0000
Query Syntax	LOAD:CP:KVA:DC#:RANGe:MAXimum?
Description	Returns the maximum settable DC apparent power range setting value for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>
Query Example	LOAD:CP:KVA:DC1:RANG:MAX? 7.0000,
Query Syntax	LOAD:CP:KVA:DC#:RANGe?
Description	Returns the Min and Max DC apparent power range setting values for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>, <nr2>
Query Example	LOAD:CP:KVA:DC#:RANG? -7.0000,7.0000

Command Syntax	LOAD:CP:KVA:DC#:SLEW <nr2>
Description	Sets the CP Load mode DC apparent power setting slew rate in kVA per second for the selected phase # or all phases if omitted.
Parameters	Setting
Parameter Format	<nr2>
Example	LOAD:CP:KVA:DC2:SLEW 100.00
Query Format	LOAD:CP:KVA:DC#:SLEW?
Returned Data Format	<nr2>
Query Example	LOAD:CP:KVA:DC2:SLEW? 100.0000
Query Syntax	LOAD:CP:KVA:DC#:SLEW:MINimum?
Description	Returns the minimum settable DC apparent power slew rate setting value for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>
Query Example	LOAD:CP:KVA:DC1:SLEW:MIN? 0.001
Query Syntax	LOAD:CP:KVA:DC#:SLEW:MAXimum?
Description	Returns the maximum settable DC apparent power slew rate setting value for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>
Query Example	LOAD:CP:KVA:DC1:SLEW:MAX? 1000.0000
Query Syntax	LOAD:CP:KVA:DC#:SLEW:DEFault?
Description	Returns the default DC apparent power slew rate setting value for the selected phase # or all phases if omitted.
Returned Data Format	<nr2>
Query Example	LOAD:CP:KVA:DC1:DEF? 10.000

8.10.12 Transient Inrush Current Mode Commands

Note: The commands in this section apply only to the following operating models:

- Current source
- Active load:
 - Constant current, sync and no sync
 - Constant resistance
 - Resistance RMS
 - Conductance RMS
 - Constant power
 - Active power RMS
 - Apparent power RMS

Refer to section 3.8.4, “Inrush Current Simulation Mode” on page 34 for more information on this special transient mode.

Command Syntax	[SOURce:]INRUsh:EDIT:MODE
Description	This command allows choosing the way to build the inrush transient depending on the user's needs.
Parameters	<REQ: 0 CFRMS 1 CFPEAK 2 PEAKRMS> 0 CFRMS: Crest factor and RMS values. (Default selection). 1 CFPEAK: Crest factor and Peak values. 2 PEAKRMS: Peak and RMS values.
Parameter Format	<nr1> <cr>
Example	INRU:EDIT:MODE CFRMS
Query Format	[SOURce:]INRUsh:EDIT:MODE?
Returned Data Format	<nr1>
Query Example	INRU:EDIT:MODE? 1
Query Format	[SOURce:]INRUsh:EDIT:MODE:CATalog?
Description	This command returns the available mode settings for an inrush transient.
Returned Data Format	<nr1>,<cr>,...,<nr1>,<cr>
Return Value	0,CF & RMS: Crest factor and RMS values. (Default selection). 1,CF & PEAK: Crest factor and Peak values. 2,PEAK & RMS: Peak and RMS values.
Query Example	INRU:EDIT:MODE:CAT? 0,CF & RMS,1,CF & PEAK,2,PEAK & RMS

Command Syntax	[SOURce:]INRUsh[:PROGram]:MODE
Description	This command sets the programming mode for an inrush transient.
Parameters	<REQ: 0 INIDEL 1 FINDEL 2 INIFIN> 0 INIDEL: Allows programming the inrush by initial and delta values 1 FINDEL: Allows programming the inrush by final and delta values 2 INIFIN: Allows programming the inrush by initial and final values
Parameter Format	<cr> <nr1>
Example	INRU:PROG:MODE INIDEL
Query Format	[SOURce:]INRUsh[:PROGram]:MODE?
Returned Data Format	<nr1>
Query Example	INRU:PROG:MODE? 1
Query Format	[SOURce:]INRUsh[:PROGram]:MODE:CATalog?
Description	This command returns the available mode settings for an inrush transient.
Returned Data Format	<nr1>, <cr>, ..., <nr1>, <cr>
Return Value	0 Initial and delta: Allows programming the inrush by initial and delta values 1 Final and delta: Allows programming the inrush by final and delta values 2 Initial and final: Allows programming the inrush by initial and final values
Query Example	INRU:PROG:MODE:CAT? 0,Initial and delta,1,Final and delta,2,Initial and final
Command Syntax	[SOURce:]INRUsh:CYCLES
Description	This command sets the number of cycles that the transient will generate.
Parameters	<REQ: CYCLES NUMBER>
Parameter Format	<nr1>
Example	INRU:CYCLE
Query Format	[SOURce:]INRUsh:CYCLES?
Returned Data Format	<nr1>
Query Example	INRU:CYCLE? 5
Query Format	[SOURce:]INRUsh:CYCLES:MINimum?
Description	This command returns the lowest value allowed for cycles. Minimum value is 1.
Returned Data Format	<nr1>
Return Value	1
Query Example	INRU:CYCLE:MIN? 1

Query Format	[SOURce:]INRUsh:CYCLEs:MAXimum?
Description	This command returns the highest value allowed for cycles. Maximum value is 10.
Returned Data Format	<nr1>
Return Value	10
Query Example	INRU:CYCLE:MAX? 10

Query Format	[SOURce:]INRUsh:CYCLEs:DEFault?
Description	This value returns the value set by default. Default value is 10.
Returned Data Format	<nr1>
Return Value	10
Query Example	INRU:CYCLE:DEF? 10

Command Syntax	[SOURce:]INRUsh:REPeat
Description	This command sets the number of repeat times for the transient.
Parameters	<REQ: CYCLES NUMBER>
Parameter Format	<nr1>
Example	INRU:REP 100
Query Format	[SOURce:]INRUsh:REPeat?
Returned Data Format	<nr1>
Query Example	INRU:REP? 100

Query Format	[SOURce:]INRUsh:REPeat:MINimum?
Description	This command returns the lowest value allowed for repeats. Minimum value is 0.
Returned Data Format	<nr1>
Return Value	1
Query Example	INRU:REP:MIN? 1

Query Format	[SOURce:]INRUsh:REPeat:MAXimum?
Description	This command returns the highest value allowed for repeats. Maximum value is 65535.
Returned Data Format	<nr1>
Return Value	65535
Query Example	INRU:REP:MAX? 65535

Query Format	[SOURce:]INRUsh:REPeat:DEFault?
Description	This value returns the value set by default. Default value is 1.
Returned Data Format	<nr1>
Return Value	1
Query Example	INRU:REP:DEF? 1
Command Syntax	[SOURce:]INRUsh:FORM
Description	This command configures different waveform modes to use in an inrush transient. The possibilities are waveforms with one peak or two peaks.
Parameters	<REQ: 0 AUTO 1 ONEPEAK 2 TWOPEAK> 0 AUTO: In this mode the waveform will depend on the SOUR:FORM setting. If the unit is configured as three-phase then the inrush waveform will be two peaks, otherwise one peak. (Default selection). 1 ONEPEAK: Force waveform with one peak. 2 TWOPEAK: Force waveform with two peaks.
Parameter Format	<cr> or <nr1>
Example	INRU:FORM AUTO
Query Format	[SOURce:]INRUsh:FORM?
Returned Data Format	<nr1>
Query Example	INRU:FORM? 0
Query Format	[SOURce:]INRUsh:FORM:CATalog?
Description	This command returns the available form mode settings for an inrush transient. 0 Auto: In this mode the waveform will depend on the SOUR:FORM setting. If the unit is configured as three-phase then the inrush waveform will be two peaks, otherwise one peak. (Default selection). 1 One Peak: Force waveform with one peak. 2 Two Peak: Force waveform with two peaks.
Returned Data Format	<nr1>, <cr>, ..., <nr1>, <cr>
Return Value	0,Auto,1,One Peak,2,Two Peak
Query Example	INRU:PROG:FORM:CAT? 0,Auto,1,One Peak,2,Two Peak

Command Syntax	[SOURce:]INRUsh:HOLD
Description	This command determines what happens to the source output after the step transient finishes. If ON, the last step value will be set as the steady state output when the step execution ends. If OFF, the output will revert to the original steady state setting in effect before the step transient execution.
Parameters	<REQ: 0 OFF 1 ON>
Parameter Format	<nr1> or <cr>
Example	INRU:HOLD ON
Query Format	[SOURce:]INRUsh:HOLD ?
Returned Data Format	
Query Example	INRU:HOLD? 0.0
Command Syntax	[SOURce:]INRUsh:CF:INITial#
Description	This command sets the initial crest factor value for selected phase # or for all phases if phase reference is omitted. <u>Note 1:</u> Execution error: Not allowed command with the current configuration. If you get this error, check the INRU:PROG:MODE. <u>Note 2:</u> Parameter above minimum/maximum unit scope. If you get this error, check the min or max range for this parameter.
Parameters	<REQ: CF PHASE A, OPT: CF PHASE B, OPT: CF PHASE C>
Parameter Format	<nr2> <nr2>, <nr2>, <nr2>
Example	NRU:CF:INIT 3.1 INRU:CF:INIT 3.1,3.1,3.1
Query Format	[SOURce:]INRUsh:CF:INITial#?
Returned Data Format	<nr2> <nr2>, <nr2>, <nr2>
Query Example	INRU:CF:INIT1? 4.0
Query Format	[SOURce:]INRUsh:CF:INITial#:MINimum?
Description	This command returns the minimum permissible set value for the initial inrush CF for selected phase # or for all phases if phase reference is omitted.
Returned Data Format	<nr2> <nr2>, <nr2>, <nr2>
Return Value	1.0
Query Example	INRU:CF:INIT1:MIN? 1.0

Query Format	[SOURce:]INRUsh:CF:INITial#:MAXimum?
Description	This command returns the maximum permissible set value for the initial inrush CF for selected phase # or for all phases if phase reference is omitted.
Returned Data Format	<nr2> <nr2>, <nr2>, <nr2>
Return Value	1.0
Query Example	INRU:CF:INIT1:MAX? 10.0
Query Format	[SOURce:]INRUsh:CF:INITial#:DEFault?
Description	This command returns the default value for the initial inrush CF for selected phase # or for all phases if phase reference is omitted.
Returned Data Format	<nr2>
Return Value	1.0
Query Example	INRU:CF:INIT1:DEF? 1.0
Command Syntax	[SOURce:]INRUsh:CF:FINal#
Description	This command sets the final crest factor value for selected phase # or for all phases if phase reference is omitted. <u>Note:</u> Execution error: Not allowed command with the current configuration. If you get this error, check the INRU:PROG:MODE. <u>Note:</u> Parameter above minimum/maximum unit scope. If you get this error, check the min or max range for this parameter.
Parameters	<REQ: CF PHASE A, OPT: CF PHASE B, OPT: CF PHASE C>
Parameter Format	<nr2> <nr2>, <nr2>, <nr2>
Example	INRU:CF:FIN 8.0 INRU:CF:FIN 8.0,8.0,8.0
Query Format	[SOURce:]INRUsh:CF:FINal#?
Returned Data Format	<nr2> <nr2>, <nr2>, <nr2>
Query Example	INRU:CF:FIN1? 4.0
Query Format	[SOURce:]INRUsh:CF:FINal#:MINimum?
Description	This command returns the minimum permissible set value for the final inrush CF for selected phase # or for all phases if phase reference is omitted.
Returned Data Format	<nr2> <nr2>, <nr2>, <nr2>
Return Value	1.0
Query Example	INRU:CF:FIN1:MIN? 1.0

Query Format	[SOURCE:]INRUsh:CF:FINal#:MAXimum?
Description	This command returns the maximum permissible set value for the final inrush CF for selected phase # or for all phases if phase reference is omitted.
Returned Data Format	<nr2> <nr2>, <nr2>, <nr2>
Return Value	10.0
Query Example	INRU:CF:FIN1:MAX? 10.0
Query Format	[SOURCE:]INRUsh:CF:FINal#:DEFault?
Description	This command returns the default value for the final inrush CF for selected phase # or for all phases if phase reference is omitted.
Returned Data Format	<nr2>
Return Value	1.0
Query Example	INRU:CF:FIN1:DEF? 1.0
Command Syntax	[SOURCE:]INRUsh:CF:DELTa#
Description	This command sets the delta crest factor value for selected phase # or for all phases if phase reference is omitted.
	<u>Note:</u> Execution error: Not allowed command with the current configuration. If you get this error, check the INRU:PROG:MODE.
	<u>Note:</u> Parameter above minimum/maximum unit scope. If you get this error, check the min or max range for this parameter.
Parameters	<REQ: CF PHASE A, OPT: CF PHASE B, OPT: CF PHASE C>
Parameter Format	<nr2> <nr2>, <nr2>, <nr2>
Example	INRU:CF:DELT 8.0 INRU:CF:DELT 8.0,8.0,8.0
Query Format	[SOURCE:]INRUsh:CF:DELTa#?
Returned Data Format	<nr2> <nr2>, <nr2>, <nr2>
Query Example	INRU:CF:DELT1? 2.0
Query Format	[SOURCE:]INRUsh:CF:DELTa#:MINimum?
Description	This command returns the minimum permissible set value for the delta inrush CF for selected phase # or for all phases if phase reference is omitted.
Returned Data Format	<nr2> <nr2>, <nr2>, <nr2>
Return Value	1.0
Query Example	INRU:CF:DELT1:MIN? 1.0

Query Format	[SOURce:]INRUsh:CF:DELTa#:MAXimum?
Description	This command returns the maximum permissible set value for the delta inrush CF for selected phase # or for all phases if phase reference is omitted.
Returned Data Format	<nr2> <nr2>, <nr2>, <nr2>
Return Value	10.0
Query Example	INRU:CF:DELT1:MAX? 10.0
Query Format	[SOURce:]INRUsh:CF:DELTa #:DEFault?
Description	This command returns the default value for the delta inrush CF for selected phase # or for all phases if phase reference is omitted.
Returned Data Format	<nr2>
Return Value	0.0
Query Example	INRU:CF:DELT1:DEF? 0.0
Command Syntax	[SOURce:]INRUsh:FREQuency:INITial
Description	This command sets the initial inrush frequency. <u>Note:</u> Execution error: Not allowed command with the current configuration. If you get this error, check the INRU:PROG:MODE. <u>Note:</u> Parameter above minimum/maximum unit scope. If you get this error, check the min or max range for this parameter.
Parameters	<REQ:FREQ>
Parameter Format	<nr2>
Example	INRU:FREQ:INIT 15.0
Query Format	[SOURce:]INRUsh:FREQuency:INITial?
Returned Data Format	<nr2>
Query Example	INRU:FREQ:INIT? 60.0
Query Format	[SOURce:]INRUsh:FREQuency:INITial:MINimum?
Description	This command returns the minimum permissible set value for the initial inrush frequency.
Returned Data Format	<nr2>
Return Value	15.0
Query Example	INRU:FREQ:INIT:MIN? 15.0

Query Format	[SOURce:]INRUsh:FREQuency:INITial:MAXimum?
Description	This command returns the maximum permissible set value for the initial inrush frequency.
Returned Data Format	<nr2>
Return Value	1000.0
Query Example	INRU:FREQ:INIT:MAX? 1000.0
Query Format	[SOURce:]INRUsh:FREQuency:INITial:DEFault?
Description	This command returns the default value for the initial inrush frequency.
Returned Data Format	<nr2>
Return Value	60.0
Query Example	INRU:FREQ:INIT:DEF? 60.0
Command Syntax	[SOURce:]INRUsh:FREQuency:FINal
Description	This command sets the final inrush frequency.
	<u>Note:</u> Execution error: Not allowed command with the current configuration.
	If you get this error, check the INRU:PROG:MODE.
	<u>Note:</u> Parameter above minimum/maximum unit scope.
	If you get this error, check the min or max range for this parameter.
Parameters	<REQ: FREQ>
Parameter Format	<nr2>
Example	INRU:FREQ:FIN 200.0
Query Format	<nr2>
Returned Data Format	[SOURce:]INRUsh:FREQuency:FINal?
Query Example	INRU:FREQ:FIN? 60.0
Query Format	[SOURce:]INRUsh:FREQuency:FINal:MINimum?
Description	This command returns the minimum permissible set value for the final inrush frequency.
Returned Data Format	<nr2>
Return Value	15.0
Query Example	INRU:FREQ:FIN:MIN? 15.0

Query Format	[SOURce:]INRUsh:FREQuency:FINal:MAXimum?
Description	This command returns the maximum permissible set value for the final inrush frequency.
Returned Data Format	<nr2>
Return Value	1000.0
Query Example	INRU:FREQ:FIN:MAX? 1000.0
Query Format	[SOURce:]INRUsh:FREQuency:FINal:DEFault?
Description	This command returns the default value for the final inrush frequency.
Returned Data Format	<nr2>
Return Value	60.0
Query Example	INRU:FREQ:FIN:DEF? 60.0
Command Syntax	[SOURce:]INRUsh:FREQuency:DELTa
Description	This command sets the delta inrush frequency. <u>Note:</u> Execution error: Not allowed command with the current configuration. If you get this error, check the INRU:PROG:MODE. <u>Note:</u> Parameter above minimum/maximum unit scope. If you get this error, check the min or max range for this parameter.
Parameters	<REQ: FREQ>
Parameter Format	<nr2>
Example	INRU:FREQ:DELT 10.0
Query Format	[SOURce:]INRUsh:FREQuency:DELTa?
Returned Data Format	<nr2>
Query Example	INRU:FREQ:DELT? 60.0
Query Format	[SOURce:]INRUsh:FREQuency:DELTa:MINimum?
Description	This command returns the minimum permissible set value for the delta inrush frequency.
Returned Data Format	<nr2>
Return Value	15.0
Query Example	INRU:FREQ:DELT:MIN? 15.0

Query Format	[SOURCE:]INRUsh:FREQuency:DELTa:MAXimum?
Description	This command returns the maximum permissible set value for the delta inrush frequency.
Returned Data Format	<nr2>
Return Value	1000.0
Query Example	INRU:FREQ:DELT:MAX? 1000.0
Command Syntax	[SOURCE:]INRUsh:PHASe:INITial#
Description	This command sets the initial inrush phase angle for selected phase # or for all phases if phase reference is omitted. <u>Note:</u> Execution error: Not allowed command with the current configuration. If you get this error, check the INRU:PROG:MODE. <u>Note:</u> Parameter above minimum/maximum unit scope. If you get this error, check the min or max range for this parameter.
Parameters	<REQ: PHASE ANGLE A, OPT: PHASE ANGLE B, OPT: PHASE ANGLE C>
Parameter Format	<nr2> <nr2>, <nr2>, <nr2>
Example	NRU:PHAS:INIT1 0.0 INRU:PHAS:INIT 0.0,180.0,240.0
Query Format	[SOURCE:]INRUsh:PHASe:INITial#?
Returned Data Format	<nr2> <nr2>, <nr2>, <nr2>
Query Example	INRU:PHAS:INIT1? 0.0
Query Format	[SOURCE:]INRUsh:PHASe:INITial#:MINimum?
Description	This command returns the minimum permissible set value for the initial inrush phase angle for selected phase # or for all phases if phase reference is omitted.
Returned Data Format	<nr2> <nr2>, <nr2>, <nr2>
Return Value	-99999.0
Query Example	INRU:PHAS:INIT1:MIN? -99999.0
Query Format	[SOURCE:]INRUsh:PHASe:INITial#:MAXimum?
Description	This command returns the maximum permissible set value for the initial inrush phase angle for selected phase # or for all phases if phase reference is omitted.
Returned Data Format	<nr2> <nr2>, <nr2>, <nr2>
Return Value	99999.0
Query Example	INRU:PHAS:INIT1:MAX? 99999.0

Query Format Description	[SOURce:]INRUsh:PHASe:INITial#:DEFault? This command returns the default value for the initial inrush phase angle for selected phase # or for all phases if phase reference is omitted. <u>Note:</u> Execution error: Not allowed command with the current configuration. If you get this error, check the INRU:PROG:MODE. <u>Note:</u> Parameter above minimum/maximum unit scope. If you get this error, check the min or max range for this parameter.
Returned Data Format	<nr2>
Return Value	0.0
Query Example	INRU:PHAS:INIT1:DEF? 0.0
Command Syntax Description	[SOURce:]INRUsh:PHASe:FINal# This command sets the final inrush phase angle for selected phase # or for all phases if phase reference is omitted. <u>Note:</u> Execution error: Not allowed command with the current configuration. If you get this error, check the INRU:PROG:MODE. <u>Note:</u> Parameter above minimum/maximum unit scope. If you get this error, check the min or max range for this parameter.
Parameters	<REQ: PHASE ANGLE A, OPT: PHASE ANGLE B, OPT: PHASE ANGLE C>
Parameter Format	<nr2> <nr2>, <nr2>, <nr2>
Example	INRU:PHAS:FIN 180.0 INRU:PHAS:FIN 180.0,160.0,140.0
Query Format	[SOURce:]INRUsh:PHASe:FINal#?
Returned Data Format	<nr2> <nr2>, <nr2>, <nr2>
Query Example	INRU:PHAS:FIN1? 0.0
Query Format Description	[SOURce:]INRUsh:PHASe:FINal#:MINimum? This command returns the minimum permissible set value for the final inrush phase angle for selected phase # or for all phases if phase reference is omitted.
Returned Data Format	<nr2> <nr2>, <nr2>, <nr2>
Return Value	-99999.0
Query Example	INRU:PHAS:FIN1:MIN? -99999.0

Query Format	[SOURce:]INRUsh:PHASe:FINal#:MAXimum?
Description	This command returns the maximum permissible set value for the final inrush phase angle for selected phase # or for all phases if phase reference is omitted.
Returned Data Format	<nr2> <nr2>, <nr2>, <nr2>
Return Value	99999.0
Query Example	INRU:PHAS:FIN1:MAX? 99999.0
Query Format	[SOURce:]INRUsh:PHASe:FINal#:DEFault?
Description	This command returns the default value for the final inrush phase angle for selected phase # or for all phases if phase reference is omitted.
Returned Data Format	<nr2>
Return Value	0.0
Query Example	INRU:PHAS:FIN1:DEF? 0.0
Command Syntax	[SOURce:]INRUsh:PHASe:DELTa#
Description	This command sets the delta inrush phase angle for selected phase # or for all phases if phase reference is omitted.
	<u>Note:</u> Execution error: Not allowed command with the current configuration. If you get this error, check the INRU:PROG:MODE.
	<u>Note:</u> Parameter above minimum/maximum unit scope. If you get this error, check the min or max range for this parameter.
Parameters	<REQ: PHASE ANGLE A, OPT: PHASE ANGLE B, OPT: PHASE ANGLE C>
Parameter Format	<nr2> <nr2>, <nr2>, <nr2>
Example	INRU:PHAS:DELT1 0.0 INRU:PHAS:DELT 0.0,160.0,140.0
Query Format	[SOURce:]INRUsh:PHASe:DELT#?
Returned Data Format	<nr2> <nr2>, <nr2>, <nr2>
Query Example	INRU:PHAS:FIN1? 0.0
Query Format	[SOURce:]INRUsh:PHASe:DELTa#:MINimum?
Description	This command returns the minimum permissible set value for the delta inrush phase angle for selected phase # or for all phases if phase reference is omitted.
Returned Data Format	<nr2> <nr2>, <nr2>, <nr2>
Return Value	-99999.0
Query Example	INRU:PHAS:DELT1:MIN? -99999.0

Query Format	[SOURce:]INRUsh:PHASe:DELTA#:MAXimum?
Description	This command returns the maximum permissible set value for the delta inrush phase angle for selected phase # or for all phases if phase reference is omitted.
Returned Data Format	<nr2> <nr2>, <nr2>, <nr2>
Return Value	99999.0
Query Example	INRU:PHAS:DELT1:MAX? 99999.0
Query Format	[SOURce:]INRUsh:PHASe:DELTA#:DEFault?
Description	This command returns the default value for the delta inrush phase angle for selected phase # or for all phases if phase reference is omitted.
Returned Data Format	<nr2>
Return Value	0.0
Query Example	INRU:PHAS:DELT:DEF? 0.0
Command Syntax	[SOURce:]INRUsh:CURRent:PEAK:INITial#
Description	This command sets the initial inrush peak current value for selected phase # or for all phases if phase reference is omitted. <u>Note:</u> Execution error: Not allowed command with the current configuration. If you get this error, check the INRU:PROG:MODE. <u>Note:</u> Parameter above minimum/maximum unit scope. If you get this error, check the min or max range for this parameter.
Parameters	<REQ: CURRENT PEAK A, OPT: CURRENT PEAK B, OPT: CURRENT PEAK C>
Parameter Format	<nr2> <nr2>, <nr2>, <nr2>
Example	INRU:CURR:PEAK:INIT1 10.0 INRU:CURR:PEAK:INIT 10.0,12.0,15.0
Query Format	[SOURce:]INRUsh:CURRent:PEAK:INITial#?
Returned Data Format	<nr2> <nr2>, <nr2>, <nr2>
Query Example	INRU:CURR:PEAK:INIT1? 10.0
Query Format	[SOURce:]INRUsh:CURRent:PEAK:INITial#:MINimum?
Description	This command returns the minimum permissible set value for the initial inrush peak current for selected phase # or for all phases if phase reference is omitted.
Returned Data Format	<nr2> <nr2>, <nr2>, <nr2>
Return Value	-125.000
Query Example	INRU:CURR:PEAK:INIT1:MIN? -125.000

Query Format	[SOURce:]INRUsh:CURRent:PEAK:INITial#:MAXimum?
Description	This command returns the maximum permissible set value for the initial inrush peak current for selected phase # or for all phases if phase reference is omitted.
Returned Data Format	<nr2> <nr2>, <nr2>, <nr2>
Return Value	125.000
Query Example	INRU:CURR:PEAK:INIT1:MAX? 125.000
Query Format	[SOURce:]INRUsh:CURRent:PEAK:INITial#:DEFault?
Description	This command returns the default value for the initial inrush peak current for selected phase # or for all phases if phase reference is omitted.
Returned Data Format	<nr2>
Return Value	0.0
Query Example	INRU:CURR:PEAK:INIT1:DEF? 0.0
Command Syntax	[SOURce:]INRUsh:CURRent:PEAK:FINal#
Description	This command sets the final inrush peak current value for selected phase # or for all phases if phase reference is omitted. <u>Note:</u> Execution error: Not allowed command with the current configuration. If you get this error, check the INRU:PROG:MODE. <u>Note:</u> Parameter above minimum/maximum unit scope. If you get this error, check the min or max range for this parameter.
Parameters	<REQ: CURRENT PEAK A, OPT: CURRENT PEAK B, OPT: CURRENT PEAK C>
Parameter Format	<nr2> <nr2>, <nr2>, <nr2>
Example	INRU:CURR:PEAK:FIN1 2.0 INRU:CURR:PEAK:FIN 2.0,2.0,2.0
Query Format	[SOURce:]INRUsh:CURRent:PEAK:FINal#?
Returned Data Format	<nr2> <nr2>, <nr2>, <nr2>
Query Example	INRU:CURR:PEAK:FIN1? 2.0
Query Format	[SOURce:]INRUsh:CURRent:PEAK:FINal#:MINimum?
Description	This command returns the minimum permissible set value for the final inrush peak current for selected phase # or for all phases if phase reference is omitted
Returned Data Format	<nr2> <nr2>, <nr2>, <nr2>
Return Value	-125.000
Query Example	INRU:CURR:PEAK:FIN1:MIN? -125.000

Query Format	[SOURce:]INRUsh:CURRent:PEAK:FINal#:MAXimum?
Description	This command returns the maximum permissible set value for the final inrush peak current for selected phase # or for all phases if phase reference is omitted
Returned Data Format	<nr2> <nr2>, <nr2>, <nr2>
Return Value	125.000
Query Example	INRU:CURR:PEAK:FIN1:MAX? 125.000
Query Format	[SOURce:]INRUsh:CURRent:PEAK:FINal#:DEFault?
Description	This command returns the default value for the final inrush peak current for selected phase # or for all phases if phase reference is omitted.
Returned Data Format	<nr2>
Return Value	0.0
Query Example	INRU:CURR:PEAK:FIN1:DEF? 0.0
Command Syntax	[SOURce:]INRUsh:CURRent:PEAK:DELTa#
Description	This command sets the delta inrush peak current value for selected phase # or for all phases if phase reference is omitted. <u>Note:</u> Execution error: Not allowed command with the current configuration. If you get this error, check the INRU:PROG:MODE. <u>Note:</u> Parameter above minimum/maximum unit scope. If you get this error, check the min or max range for this parameter.
Parameters	<REQ: CURRENT PEAK A, OPT: CURRENT PEAK B, OPT: CURRENT PEAK C>
Parameter Format	<nr2> <nr2>, <nr2>, <nr2>
Example	NRU:CURR:PEAK:DELT1 0.5 INRU:CURR:PEAK:DELT 1.0,1.5,2.0
Query Format	[SOURce:]INRUsh:CURRent:PEAK:DELTa#?
Returned Data Format	<nr2> <nr2>, <nr2>, <nr2>
Query Example	INRU:CURR:PEAK:DELT1? 1.0
Query Format	[SOURce:]INRUsh:CURRent:PEAK:DELTa#:MINimum?
Description	This command returns the minimum permissible set value for the delta inrush peak current for selected phase # or for all phases if phase reference is omitted
Returned Data Format	<nr2> <nr2>, <nr2>, <nr2>
Return Value	-125.000
Query Example	INRU:CURR:PEAK:DELT1:MIN? -125.000

Query Format	[SOURce:]INRUsh:CURRent:PEAK:DELTA#:MAXimum?
Description	This command returns the maximum permissible set value for the delta inrush peak current for selected phase # or for all phases if phase reference is omitted
Returned Data Format	<nr2> <nr2>, <nr2>, <nr2>
Return Value	125.0
Query Example	INRU:CURR:PEAK:DELT1:MAX? 125.0
Query Format	[SOURce:]INRUsh:CURRent:PEAK:DELTA#:DEFault?
Description	This command returns the default value for the delta inrush peak current for selected phase # or for all phases if phase reference is omitted.
Returned Data Format	<nr2>
Return Value	0.0
Query Example	INRU:CURR:PEAK:DELT1:DEF? 0.0
Command Syntax	[SOURce:]INRUsh:CURRent[:AC][:INITial]#
Description	This command sets the initial inrush AC current value for selected phase # or for all phases if phase reference is omitted. <u>Note:</u> Execution error: Not allowed command with the current configuration. If you get this error, check the INRU:PROG:MODE. <u>Note:</u> Parameter above minimum/maximum unit scope. If you get this error, check the min or max range for this parameter.
Parameters	<REQ: AC CURRENT A, OPT: AC CURRENT B, OPT: AC CURRENT C>
Parameter Format	<nr2> <nr2>, <nr2>, <nr2>
Example	INRU:CURR:AC:INIT1 10.0 INRU:CURR:AC:INIT 10.0,12.0,15.0
Query Format	[SOURce:]INRUsh:CURRent[:AC][:INITial]#?
Returned Data Format	<nr2> <nr2>, <nr2>, <nr2>
Query Example	INRU:CURR:AC:INIT1? 10.0
Query Format	[SOURce:]INRUsh:CURRent[:AC][:INITial]#:MINimum?
Description	This command returns the minimum permissible set value for the initial inrush AC current for selected phase # or for all phases if phase reference is omitted.
Returned Data Format	<nr2> <nr2>, <nr2>, <nr2>
Return Value	-125.000
Query Example	INRU:CURR:AC:INIT1:MIN? -125.000

Query Format	[SOURce:]INRUsh:CURRent[:AC][:INITial]#:MAXimum?
Description	This command returns the maximum permissible set value for the initial inrush AC current for selected phase # or for all phases if phase reference is omitted.
Returned Data Format	<nr2> <nr2>, <nr2>, <nr2>
Return Value	125.000
Query Example	INRU:CURR:AC:INIT1:MAX? 125.000
Query Format	[SOURce:]INRUsh:CURRent[:AC][:INITial]#:DEFault?
Description	This command returns the default value for the initial inrush AC current for selected phase # or for all phases if phase reference is omitted.
Returned Data Format	<nr2>
Return Value	0.0
Query Example	INRU:CURR:AC:INIT1:DEF? 0.0
Command Syntax	[SOURce:]INRUsh:CURRent[:AC:]FINal#
Description	This command sets the final inrush AC current value for selected phase # or for all phases if phase reference is omitted.
	<u>Note:</u> Execution error: Not allowed command with the current configuration. If you get this error, check the INRU:PROG:MODE.
	<u>Note:</u> Parameter above minimum/maximum unit scope. If you get this error, check the min or max range for this parameter.
Parameters	<REQ: AC CURRENT A, OPT: AC CURRENT B, OPT: AC CURRENT C>
Parameter Format	<nr2> <nr2>, <nr2>, <nr2>
Example	INRU:CURR:AC:FIN1 2.0 INRU:CURR:AC:FIN 2.0,2.0,2.0
Query Format	[SOURce:]INRUsh:CURRent[:AC:]FINal#?
Returned Data Format	<nr2> <nr2>, <nr2>, <nr2>
Query Example	INRU:CURR:AC:FIN1? 2.0
Query Format	[SOURce:]INRUsh:CURRent[:AC:]FINal#:MINimum?
Description	This command returns the minimum permissible set value for the final inrush AC current for selected phase # or for all phases if phase reference is omitted.
Returned Data Format	<nr2> <nr2>, <nr2>, <nr2>
Return Value	-125.000
Query Example	INRU:CURR:AC:FIN1:MIN? -125.000

Query Format	[SOURCE:]INRUsh:CURRENT:[AC:]FINal#:MAXimum?
Description	This command returns the maximum permissible set value for the final inrush AC current for selected phase # or for all phases if phase reference is omitted.
Returned Data Format	<nr2> <nr2>, <nr2>, <nr2>
Return Value	125.000
Query Example	INRU:CURR:AC:FIN1:MAX? 125.000
Query Format	[SOURCE:]INRUsh:CURRENT:[AC:]FINal#:DEFault?
Description	This command returns the default value for the final inrush AC current for selected phase # or for all phases if phase reference is omitted.
Returned Data Format	<nr2>
Return Value	0.0
Query Example	INRU:CURR:AC:FIN1:DEF? 0.0
Command Syntax	[SOURCE:]INRUsh:CURRENT:[AC:]DELTA#
Description	This command sets the delta inrush AC current value for selected phase # or for all phases if phase reference is omitted. <u>Note:</u> Execution error: Not allowed command with the current configuration. If you get this error, check the INRU:PROG:MODE. <u>Note:</u> Parameter above minimum/maximum unit scope. If you get this error, check the min or max range for this parameter.
Parameters	<REQ: AC CURRENT A, OPT: AC CURRENT B, OPT: AC CURRENT C>
Parameter Format	<nr2> <nr2>, <nr2>, <nr2>
Example	INRU:CURR:AC:DELT1 0.5 INRU:CURR:AC:DELT 1.0,1.5,2.0
Query Format	[SOURCE:]INRUsh:CURRENT:[AC:]DELTA#?
Returned Data Format	<nr2> <nr2>, <nr2>, <nr2>
Query Example	INRU:CURR:AC:DELT1? 1.0
Query Format	[SOURCE:]INRUsh:CURRENT:[AC:]DELTA#:MINimum?
Description	This command returns the minimum permissible set value for the delta inrush AC current for selected phase # or for all phases if phase reference is omitted.
Returned Data Format	<nr2> <nr2>, <nr2>, <nr2>
Return Value	-125.000
Query Example	INRU:CURR:AC:DELT1:MIN? -125.000

Query Format	[SOURce:]INRUsh:CURRent:[AC:]DELta#:MAXimum?
Description	This command returns the maximum permissible set value for the delta inrush AC current for selected phase # or for all phases if phase reference is omitted.
Returned Data Format	<nr2> <nr2>, <nr2>, <nr2>
Return Value	125.000
Query Example	INRU:CURR:AC:DELT1:MAX? 125.000
Query Format	[SOURce:]INRUsh:CURRent:[AC:]DELta #:DEFault?
Description	This command returns the default value for the delta inrush AC current for selected phase # or for all phases if phase reference is omitted.
Returned Data Format	<nr2>
Return Value	0.0
Query Example	INRU:CURR:AC:DELT1:DEF? 0.0
Command Syntax	[SOURce:]INRUsh
Description	>>> <i>Alias for PROGram:TRANSient command.</i> <<<
Parameters	This command controls inrush transient execution
Parameter Format	<REQ: RUN STOP PAUSE STEP REStart>
Example	INRUSH RUN
Query Format	[SOURce:]INRUsh?
Returned Data Format	Return values represent running state as follows: 0: Stopped 1: Running 2: Paused 3: Stepping 4: Waiting for trigger
Query Example	INRU? 1
Command Syntax	[SOURce:]INRUsh:LOAD
Description	This command converts the inrush transient definition to the power source's regular transient segment format and loads it in the controller real-time memory for execution.
Parameters	None
Parameter Format	n/a
Example	INRU:LOAD
Query Format	[SOURce:]INRUsh:LOAD?
Returned Data Format	<nr1> 0: Load Failed 1: Load completed
Query Example	INRU:LOAD? 1

Query Format	[SOURce:]INRUsh:PROGress?
Description	>>> <i>Alias for PROGram:TRANSient:PROGress command.</i> <<< This query command returns the status of the inrush being executed.
Returned Data Format	None
Return Value	<cr> The response is a comma-separated value string representing: PROGRESS, CURRENT SEGMENT PROGRESS, CURRENT SEGMENT, CURRENT SEGMENT TIME, ELEMENT TO EXECUTE, TOTAL TIME, TOTAL SEGMENTS, REPEAT TIME COUNTER
Query Example	INRU:PROG? 78,72,21,242,21,8333,26,1
Query Format	[SOURce:]INRUsh:CHECK?
Description	This query command returns the result of a check on the programmed inrush parameters to determine if they are ok to run.
Returned Data Format	<cr>
Return Value	The response is either OK or if not, a string containing the error.
Query Example	INRU:CHECK? OK
Query Format	[SOURce:]INRUsh:ALL?
Description	This query command returns a comma-separated values string of the entire inrush parameters, settings, and limits. Each set value is preceded by a tag identifying the parameter. This same data structure is used for front panel display and by the web server. The advantage is that this command returns all inrush related information using just one query command.
Returned Data Format	<cr>
Return Value	
Query Example	INRU:ALL? form,3,loaded,1,status,0,hold,0,progress,0,current element progress,.....
Command Syntax	[SOURce:]INRUsh:EXPDECayfactor
Description	This exponential decay factor controls how quickly the inrush current decays. A higher factor makes it disappear faster.
Parameters	<REQ: FACTOR VALUE>
Parameter Format	<nr2>
Example	INRU:EXPDEC 5.0
Query Format	[SOURce:]INRUsh:EXPDECayfactor?
Returned Data Format	<nr2>
Query Example	INRU:EXPDEC? 5.0

Query Format	[SOURce:]INRUsh:EXPDECayfactor:MINimum?
Description	This command returns the minimum permissible set value for the exponential decay factor.
Returned Data Format	<nr2>
Return Value	0.0
Query Example	INRU:EXPDEC:MIN? 0.0
Query Format	[SOURce:]INRUsh:EXPDECayfactor:MAXimum?
Description	This command returns the maximum permissible set value for the exponential decay factor.
Returned Data Format	<nr2>
Return Value	10.0
Query Example	INRU:EXPDEC:MAX? 10.0
Query Format	[SOURce:]INRUsh:EXPDECayfactor:DEFault?
Description	This command returns the default value for the exponential decay factor.
Returned Data Format	<nr2>
Return Value	1.0
Query Example	INRU:EXPDEC:DEF? 1.0
Command Syntax	[SOURce:]INRUsh:STEADYstatetime
Description	This command allows adding a new segment at the end of the transient, with configurable time, and automatically adopts the values of the last programmed inrush segment. If the time is 0, it is disabled.
Parameters	<REQ: S. STATE TIME VALUE>
Parameter Format	<nr2>
Example	INRU:STEADY 0.5
Query Format	[SOURce:]INRUsh:STEADYstatetime?
Returned Data Format	<nr2>
Query Example	INRU:STEADY? 0.5
Query Format	[SOURce:]INRUsh:STEADYstatetime:MINimum?
Description	This command returns the minimum permissible set value for the steady state time
Returned Data Format	<nr2>
Return Value	0.0
Query Example	INRU:STEADY:MIN? 0.0

Query Format	[SOURce:]INRUsh:STEADYstatetime:MAXimum?
Description	This command returns the maximum permissible set value for the steady state time
Returned Data Format	<nr2>
Return Value	10000.0
Query Example	INRU:STEADY:MAX? 10000.0
Query Format	[SOURce:]INRUsh:STEADYstatetime:DEFault?
Description	This command returns the default value for the steady state time
Returned Data Format	<nr2>
Return Value	0.1
Query Example	INRU:STEADY:DEF? 0.1
Command Syntax	[SOURce:]INRUsh:PFC:SIMulation
Description	This command turns on the simulation of the PFC to simulate a system commonly observed in practice. It adds a new sine waveform segment to the end of the last programmed inrush segment with the previously configured parameters.
Parameters	<REQ 1 ON 0 OFF>
Parameter Format	<nr1> <cr>
Example	INRU:PFC:SIM 1
Query Format	[SOURce:]INRUsh:PFC:SIMulation?
Returned Data Format	0: PFC simulation disabled. 1: PFC simulation enabled.
Query Example	INRU:PFC:SIM? 1
Command Syntax	[SOURce:]INRUsh:PFC:RAMPtime
Description	This command allows configure the PFC simulation ramp time duration.
Parameters	<REQ: PFC RAMP TIME VALUE>
Parameter Format	<nr2>
Example	INRU:PFC:RAMP 0.1
Query Format	[SOURce:]INRUsh:PFC:RAMPtime?
Returned Data Format	<nr2>
Query Example	INRU:PFC:RAMP? 0.1
Query Format	[SOURce:]INRUsh:PFC:RAMPtime:MINimum?
Description	This command returns the minimum permissible set value for the PFC ramp time duration.
Returned Data Format	<nr2>
Return Value	0.0
Query Example	INRU:PFC:RAMP:MIN? 0.0

Query Format	[SOURce:]INRUsh:PFC:RAMPtime:MAXimum?
Description	This command returns the maximum permissible set value for the PFC ramp time duration.
Returned Data Format	<nr2>
Return Value	10000.0
Query Example	INRU:PFC:RAMP:MAX? 10000.0
Query Format	[SOURce:]INRUsh:PFC:RAMPtime:DEFault?
Description	This command returns the default value for the PFC ramp time duration.
Returned Data Format	<nr2>
Return Value	0.1
Query Example	INRU:PFC:RAMP:DEF? 0.1
Command Syntax	[SOURce:]INRUsh:PFC:TURNontime
Description	This command allows to configure a delay time before running the PFC simulation. This includes a new segment in the transient list with the last added waveform.
Parameters	<REQ: PFC TURN ON TIME VALUE>
Parameter Format	<nr2>
Example	INRU:PFC:TURN 0.1
Query Format	[SOURce:]INRUsh:PFC:TURNontime?
Returned Data Format	<nr2>
Query Example	INRU:PFC:TURN? 0.1
Query Format	[SOURce:]INRUsh:PFC:TURNontime:MINimum?
Description	This command returns the minimum permissible set value for the PFC turn on time.
Returned Data Format	<nr2>
Return Value	0.0
Query Example	INRU:PFC:TURN:MIN? 0.0
Query Format	[SOURce:]INRUsh:PFC:TURNontime:MAXimum?
Description	This command returns the maximum permissible set value for the PFC turn on time.
Returned Data Format	<nr2>
Return Value	10000.0
Query Example	INRU:PFC:TURN:MAX? 10000.0

Query Format	[SOURCE:]INRUsh:PFC:TURNontime:DEFault?
Description	This command returns the default value for the PFC turn on time.
Returned Data Format	<nr2>
Return Value	0.1
Query Example	INRU:PFC:TURN:DEF? 0.1
Command Syntax	[SOURCE:]INRUsh:PFC:CURREnt[:AC]#
Description	This command allows to configure the PFC simulation AC current value for selected phase # or for all phases if phase reference is omitted.
Parameters	<REQ: PFC AC CURRENT A, OPT: PFC AC CURRENT B, OPT: PFC AC CURRENT C >
Parameter Format	<nr2> <nr2>, <nr2>, <nr2>
Example	INRU:PFC:Curr:AC1 10.0 INRU:PFC:Curr:AC 10.0, 10.0, 10.0
Query Format	[SOURCE:]INRUsh:PFC:CURREnt[:AC]#?
Returned Data Format	<nr2>
Query Example	INRU:PFC:Curr:AC1? 10.0
Query Format	[SOURCE:]INRUsh:PFC:CURREnt[:AC]#:MINimum?
Description	This command returns the minimum permissible set value for AC current of PFC simulation.
Returned Data Format	<nr2>
Return Value	-130.0
Query Example	INRU:PFC:Curr:AC1:MIN? -130.0
Query Format	[SOURCE:]INRUsh:PFC:CURREnt[:AC]#:MAXimum?
Description	This command returns the maximum permissible set value for AC current of PFC simulation.
Returned Data Format	<nr2>
Return Value	130.0
Query Example	INRU:PFC:Curr:AC1:MAX? 130.0
Query Format	[SOURCE:]INRUsh:PFC:CURREnt[:AC]#:DEFault?
Description	This command returns the default value for AC current of PFC simulation.
Returned Data Format	<nr2>
Return Value	0.0
Query Example	INRU:PFC:Curr:AC1:DEF? 0.0

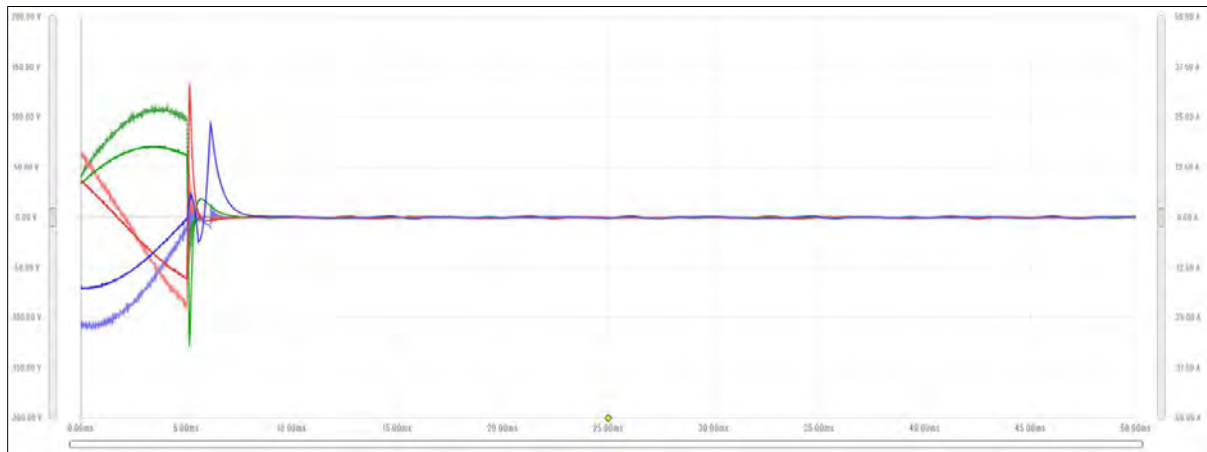
8.10.13 High Impedance Mode Commands

The AGX/RGS-L source in mode or the RLS load has a high impedance mode with a programmed voltage threshold. When the threshold is reached the unit realizes that it is in high impedance and regulates its voltage to zero. When it detects voltage again it exits this mode and starts acting as load again.

This mode allows the unit to stay enabled or to enable its output in high impedance/open circuit conditions when used as an electronic load.

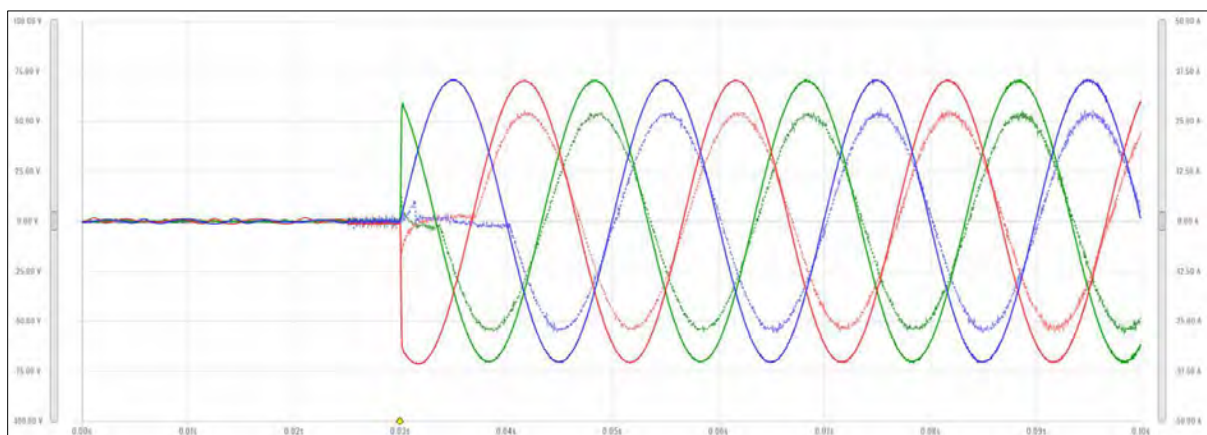
Note: This mode is not enabled by default because any voltage spike can cause the unit to enter this mode and exit it quickly. This may be confusing and not desired by the user depending on the application.

Below image shows an example of such a disconnection event. Note the peak on the voltage before the unit enters the high impedance mode.



This is an example of the connection of the load as it exists high impedance mode when it detects the AC input voltage being applied.

Note: This uses the fast sync mode – see section 8.10.2 on page 433 for reference.



The dynamic of the voltage spikes depends on DUT, capacitance, and programmed current. If the user desires to further mitigate the spikes a pre-charge resistance, additional output capacitance, and/or active voltage clamping could be used. In those cases, please contact PPS support.

High Impedance Mode SCPI commands are:

Command Syntax	[SOURCE:]HIGHIMPEDance:THREshold:LEVel# <LEVEL>
Description	Sets the level impedance threshold value.
Parameters	Threshold level
Parameter Format	<nr2>
Example	SOUR:HIGHIMPED:THRE:LEV 10.0
Query Format	[SOURCE:]HIGHIMPEDance:THREshold:LEVel#?
Returned Data Format	<nr2>
Query Example	SOUR:HIGHIMPED:THRE:LEV? 10.00,10.00,10.00
Query Format	[SOURCE:]HIGHIMPEDance:THREshold:LEVel#:MINimum? [SOURCE:]HIGHIMPEDance:THREshold:LEVel#:MAXimum? [SOURCE:]HIGHIMPEDance:THREshold:LEVel#:DEFault?
Description	Returns Upper Minimum = -9999.00, Maximum = 9999.00 or Default = 40 setting for impedance threshold levels.
Returned Data Format	<nr2>
Query Example	SOURce:HIGHIMPEDance:THREshold:LEVel:DEFault? 40.00,40.00,40.00

8.11 Status Commands

Status commands control status and event registers. These commands are aliases for some of the IEEE488.2 common commands and may be used interchangeably. Refer to section 8.14, “Status and Events Registers” for details on status and event register configurations.

The following status commands are supported.

Command	Description
STATus:OPERation[:EVENT]?	Queries the Operation Status Event Register
STATus:OPERation:CONDition?	Queries the Operation Status Condition Register
STATus:OPERation:ENABle <nr1>	Sets the Operation Status Enable Register
STATus:OPERation:ENABle?	Queries the Operation Status Enable Register
STATus:QUEStionable[:EVENT]?	Queries the Questionable Status Event Register
STATus:QUEStionable:CONDition?	Queries the Questionable Status Condition Register
STATus:QUEStionable:ENABle <nr1>	Sets the Questionable Status Enable Register
STATus:QUEStionable:ENABle?	Queries the Questionable Status Enable Register
STATus:PRESet	Presets the Status Registers

Query Format	STATus:OPERation[:EVENT]?
Description	Queries the Operation Status Event Register.
Returned Data Format	<nr1>
Query Example	STAT:OPER? 0
Query Format	STATus:OPERation:CONDition?
Description	Queries the Operation Status Condition Register.
Returned Data Format	<nr1>
Query Example	STAT:OPER:COND? 0
Command Syntax	STATus:OPERation:ENABle <nr1>
Description	Sets the content Operation Status Enable Register.
Parameters	0-32767
Parameter Format	<nr1>
Example	STAT:OPER:ENAB 255
Query Format	STATus:OPERation:ENABle?
Returned Data Format	<nr1>
Query Example	STAT:OPER:ENAB? 6144

Query Format	STATus:QUESTionable[:EVENT]?
Description	Queries the Questionable Status Event Register.
Returned Data Format	<nr1>
Query Example	STAT:QUES? 0
Query Format	STATus:QUESTionable:CONDition?
Description	Queries the Questionable Status Condition Register.
Returned Data Format	<nr1>
Query Example	STAT:QUES:COND? 0
Command Syntax	STATus:QUESTionable:ENABle
Description	Sets the content of the Questionable Status Enable Register.
Parameters	0-32767
Parameter Format	<nr1>
Example	STAT:QUES:ENAB 255
Query Format	STATus:QUESTionable:ENABle?
Returned Data Format	<nr1>
Query Example	STAT:QUES:ENAB? 255
Command Syntax	STATus:PRESet
Description	The Status Preset command presets the Status Registers. The Operational Status. Enable Register is set to 0 and the Questionable Status Enable Register is set to 0.
Parameters	None
Parameter Format	n/a
Example	STAT:PRES

8.12 System Commands

Systems commands control system level functions or return model and revision information on the connected unit. The following system commands are supported.

8.12.1 System Error Commands and Queuing

Error queue and status handling can be complicated. Any faults that occur during operation turn **OFF** the output of the unit/system and get latched in the error queue. When the user resets/clears the faults, there are two possible scenarios:

- The fault condition is no longer preset, so it gets cleared
 - (Example: OVP, can be clear and will trip again in case of another OVP)
- The fault condition is still present, and it stays after the clear action
 - (Example: OTP, temperature is still high, so the fault stays)

The Error & Events is a queue. Thus, when something happens, it gets queued up and is marked with a timestamp. All faults are pushed to the queue when they happen, to have a timing tracking register of faults.

Other relevant **events** are pushed as well, like command syntax errors, parameter errors, warnings, etc.

Note that this is not as critical as **faults**; events are pushed but **do not** turn OFF the output. In other words, it is a log register of events (including faults, errors, warnings, etc.)

Relevant Queue Handling Commands are:

***CLS** clears faults and the E&E queue.

STAT:FAULT:RESET resets faults only.

SYST:ERR:ALL:CLEAR clears the E&E queue.

SYST:ERR? return items from the E&E queue and clear the item returned.

Faults can be queried with **STAT:FAULT?** Command. A zero (0) returned means no faults, other values mean at least one fault.

After sending a **STAT:FAULT?** Query, it is recommended to send a ***STB?**

Bit 2 of ***STB?** is EEQ (0x4, 100b mask)

If this bit is **1**, something got pushed to the E&E queue.

The user can query these items with **SYST:ERR?** and/or queue fault with **STAT:FAULT?** Commands.

***CLS** resets the bit to 0, or a **SYST:ERR?** until no items in the queue are present.

Query Format
Description

SYSTem:ERror[:NEXT]?

This command returns next available error message from the error queue. If no more error messages are available, returns 0, "NO ERROR" result. Available error messages are:

Returned Data Format

ERROR	Description
-0, "No error"	No error detected
-100, "Command error"	indicates invalid command or query received
-102, "Command error: Syntax error."	Incorrect command syntax
-200, "Execution error"	indicates can't execute command with parameters received
-222, "Command error: Data out of range."	Data exceeds available parameter range
-300, "Device-specific error"	indicates UPC not properly configured
-400, "Query error"	indicates query aborted

Query Example

SYST:ERR?
-102, "Command error: Syntax error."

Query Format
Description

SYSTem:ERror:ALL?

Returns all available error messages as a of error numbers and clears the error message queue.

Returned Data Format

TOTAL_ERRORS ,ERRORS, CODE(INDEX), DESCRIPTION(INDEX),
CODE(INDEX+1), DESCRIPTION(INDEX+1),..., CODE(INDEX+N),
DESCRIPTION(INDEX+N),...

Query Example

SYST:ERR:ALL?
0,0
SYST:ERR:ALL?
2,2,-102, "Command error: Syntax error. Webpage interface.;2022/10/12 18:23:37",-102, "Command error: Syntax error. Webpage interface.+-+2022/10/12 18:23:50"

Command Syntax
Description
Parameters
Parameter Format
Example

SYSTem:ERror:ALL:CLEAR

This command clears the error message queue.

None

n/a

SYST:ERR:ALL:CLEAR

Command Syntax	SYSTem:ERROr:ALL:NOCLEAR? < Optional: Index>
Description	Returns all available error messages as a single unterminated string but does not clear the error message queue .
Returned Data Format	<nr1>,<nr1>,...<nr1> Format of response: YYYY/MM/DD,HH:MM::SS,S.NS,TOTAL_ERRORS,INDEX,ERRORS,CODE (INDEX),DESCRIPTION(INDEX),CODE(INDEX+1),DESCRIPTION(INDEX+1),...,CODE(INDEX+N),DESCRIPTION(INDEX+N),... Response Legend: YYYY/MM/DD,HH:MM::SS,S.NS is the timestamp of the latest error pushed to the queue. S is absolute seconds and NS absolute nanoseconds. TOTAL_ERRORS are the total errors in the queue. INDEX is 1 by default if not passed as optional argument. ERRORS is the total errors returned in the response. As there may be too many errors the response may return a few of them starting from the INDEX. The INDEX is useful to navigate the queue. CODE is the error code and DESCRIPTION the description.
Query Example	SYST:ERR:ALL:NOCLEAR? 2018/05/29,14:29:53,1207438.903668873,0,1,0 <u>For no errors:</u> <i>>SYSTem:ERROr:ALL:NOCLEAR?</i> <i>2024/10/12,18:17:01,122450.794695832,0,1,0</i> <u>Two errors in the queue:</u> <i>>SYSTem:ERROr:ALL:NOCLEAR?</i> <i>2024/10/12,18:17:19,122467.903705666,2,1,2,-102,"Command error: Syntax error. Webpage interface.;2022/10/12 18:17:18",-102,"Command error: Syntax error. Webpage interface.;2022/10/12 18:17:19"</i> <i>>SYSTem:ERROr:ALL:NOCLEAR? 2</i> <i>2024/10/12,18:17:19,122467.903705666,2,2,1,-102,"Command error: Syntax error. Webpage interface.;2022/10/12 18:17:19"</i>

Command Syntax	SYSTem:ERRor:POE
Description	This command sets the Power on Error reporting mode. Returns status of Power on Error setting as 1 (enabled) or 0 (disabled).
Parameters	< 0 OFF 1 ON >
Parameter Format	
Example	SYST:ERR:POE ON
Query Format	SYSTem:ERRor:POE?
Returned Data Format	
Query Example	SYST:ERR:POE? 1

8.12.2 System Information Commands

Command Syntax	SYSTem:BEEP
Description	This command generates an audible beep at the front panel of the power source.
Parameters	None
Parameter Format	n/a
Example	SYST:BEEP

Query Format	SYSTem:FW:FRONTPANEL:VERsion?
Description	Returns the firmware revision for the front panel processor.
Returned Data Format	<cr>
Query Example	SYST:FW:FRONTPANEL:VER? 2.0.0

Query Format	SYSTem:FW:FRONTPANEL:APPS:VERsion?
Description	Returns the firmware revision for the front panel application program.
Returned Data Format	<cr>
Query Example	SYST:FW:FRONTPANEL:APPS:VER? 2.0.0

Query Format	SYSTem:FW:IO:VERsion?
Description	Returns the firmware revision for the Auxiliary I/O board processor.
Returned Data Format	<cr>
Query Example	SYST:FW:IO? 1.0.4

Query Format	SYSTem:FW:POWER:VERsion?
Description	Returns the revision number of the power source's power stages.
Returned Data Format	<nr2>-<nr2>
Query Example	SYST:FW:POWER:VER? 81.0.0-77.1.0

Query Format Description	SYSTem:LANGuage:CATalog? Returns list of available languages that can be selected for front panel operation.
Returned Data Format	<cr>
Query Example	SYST:LANG? english, chinese
Query Format Description	SYSTem:LXI:FEATures? R eturns string listing supported LXI features.
Returned Data Format	<cr>
Query Example	SYST:LXI:FEAT? None
Query Format Description	SYSTem:LXI:VERSion? Returns LXI revision compliance version number.
Returned Data Format	<cr>
Query Example	SYST:LXI:VERSION? LXI Core 2011
Query Format Description	SYSTem:MODE? Returns LOCAL (0) or REMOTE (1) front panel status. Use IEEE 488.2 command commands *LLO to lock front panel and *GTL to release front panel operation.
Returned Data Format	
Query Example	SYST:MODE? 1
Query Format Description	SYSTem:SERIALNUM? Returns the serial number of the power source. Same information can be queried with the *IDN? command
Returned Data Format	<nr1>
Query Example	SYST:HWREV? 0
Command Syntax Description	SYSTem:TIME Sets the real time clock date and time. Note: Since both date and time are returned, there is no SYSTem:DATE?
Parameters	Data and time
Parameter Format	'YYYY-MM-DD:HH:MM:SS'
Example	'2022-05-21 16:21:02'
Query Format	SYSTem:TIME?
Returned Data Format	Returns real time clock date and time. Note: Since both date and time are returned, there is no SYSTem:DATE?
Query Example	SYST:TIME '2022-05-21 16:21:02'

Query Format	SYSTem:TIME:SOURce?
Description	Queries source of date and time information.
Returned Data Format	<cr>
Query Example	SYST:TIME:SOUR? NTP Note: NTP stands for “Network Time Protocol”. A protocol built on top of TCP/IP that assures accurate local timekeeping with reference to radio, atomic or other clocks located on the Internet. This protocol is capable of synchronizing distributed clocks within milliseconds over long time periods. It is defined in STD 12, RFC 1119 (RFC = Request for comment. RFCs are used by the Internet Engineering Task Force (IETF) and other standards bodies.
Query Format	SYSTem:TIME:UTC?
Description	Returns the UTC time, independent of the zone.
Returned Data Format	DD/MM/YYYY HH:MM:SS
Query Example	SYST:TIME:UTC? 29/05/2019 14:40:57
Command Syntax	SYSTem:TIME:ZONE <ZONE>
Description	Set the zone, allowed values are GMT+/-X.
Example	SYST:TIME:ZONE GMT-7
Query Format	SYSTem:TIME:ZONE?
Description	Returns the current time zone setting, normally GMT+/-X
Returned Data Format	<cr>
Query Example	SYST:TIME:ZONE? GMT-7
Query Format	SYSTem:TIME:ZONE:CATalog?
Description	Returns the available zones.
Returned Data	GMT-12,GMT-11,GMT-10,GMT-9,GMT-8,GMT-7,GMT-6,GMT-5,GMT-4,GMT-3, GMT-2,GMT-1,GMT+0,GMT+1,GMT+2,GMT+3,GMT+4,GMT+5,GMT+6,GMT+7,GMT+8,GMT+9,GMT+10,GMT+11,GMT+12,GMT+13,GMT+14
Command Syntax	SYSTem:TIME:ZONE:LEAP <0 OFF 1 ON>
Description	Enables or Disables Leap Second mode.
Parameters	1 or ON to consider leap seconds, otherwise 0 or OFF
Example	SYST:TIME:LEAP ON
Query Format	SYSTem:TIME:ZONE:LEAP?
Description	Returns 1 if it considers leap seconds, otherwise 0.
Returned Data	1 = Leap seconds considered, 0 = Leap seconds ignored

Command Syntax Description	SYSTem:TIME:SOURce < RTC NTP > Set the time source, RTC is the local real time clock of the front panel. NTP is internet time protocol. NTP requires internet connection. If NTP is used with internet connection then the RTC is updated every time the NTP synchronizes.
Parameters Example	< RTC NTP > SYST:TIME:SOUR NTP
Query Format Description Returned Data	SYSTem:TIME:SOURce:CATalog? Returns the available time source options, NTP or RTC. NTP, RTC
Query Format Description Returned Data	SYSTem:TIME:SOURce:NTP:SERVer? Returns "pool.ntp.org" This is the server that uses the unit NTP service. pool.ntp.org
Command Syntax Description Parameters Example	SYSTem:TIME:SOURce:NTP:SYNC <OPTIONAL: SERVER> Forces an NTP sync. If the argument is not passed then it uses "pool.ntp.org". Any IP/domain that runs a NTP server can be used. Alternative commons servers are "time.windows.com" or "time.nist.gov". < time server domain > SYST:TIME:SOUR:NTP:SYNC
Command Syntax Description Parameters Example	SYSTem:TIME:SOURce:NTP:REStart Restarts the NTP service none SYST:TIME:SOUR:NTP:REST
Query Format Description Returned Data Format Query Example	SYSTem:VERSion? Returns SCPI standard revision version. <nr2> SYST:VERS? 1992.0
Query Format Description Returned Data Format Query Example	SYSTem:XFMRRATIO? Returns the transformer option (T Option) voltage ratio. If no transformer option is installed and configured, this query will return a value of 0.000. See also the [SOURce:]COUPLing command. <nr2> SYSTem:XFMRRATIO? 1.3333

8.12.3 System Interface Commands

These commands allow programming front panel user interface controls and functions of the power source, including the output programming preset soft key values. The same can be accomplished by the user from the front panel. Using a program to set these values can ensure they are always set to a known value if this is important for operator use of the power source in a specific test situation.

8.12.3.1 Preset Syntax

The syntax for all these commands is very similar. Prefix is always "SYSTem:INTERFace:PRESET:" followed by the parameter. Available soft key preset parameters are:

- VOLTage[:AC]
- VOLTage:DC
- FREQuency
- PHASe
- CURRent:LIMit
- POWer:LIMit
- KVA:LIMit

To program or query a specific soft key number (1 ~ 5), append "SK#" to the command where # is a value from 1 through 5 for soft key 1 through 5. (Top soft key = 1, bottom soft key = 5).

8.12.3.2 Command parameters

Available softkey parameters are:

- MIN MIN is the preset value for the min allowable setting based on the power source model
- MAX MAX is the the preset value for the max allowable setting based on the power source model
- DEF DEF sets the preset value to factory default
- Value A <nr1> value between MIN and MAX may be specified instead.

Up to five sets of parameters can be appended to these commands to program more than one soft key for the same parameter setting with a single command string.

Example:

SYST:INTERF:PRESET:VOLT MAX, MIN, 108, 140

Programs the voltage AC soft keys as follows:

SK1 = MAX or 300, SK2 = MIN or 0, SK3 = 108, SK4 = 140.

8.12.3.3 Preset Commands Listing

The following lists shows all available soft key preset programming commands.

Voltage AC

SYSTem:INTERFace:PRESET:VOLTage[:AC] <REQ: MIN|MAX|DEF|Value, OPT: MIN|MAX|DEF|Value, OPT: MIN|MAX|DEF|Value, OPT: MIN|MAX|DEF|Value, OPT: MIN|MAX|DEF|Value>

SYSTem:INTERFace:PRESET:VOLTage[:AC]? <OPT: ALL|DEF> <OPT: ALL|DEF>

SYSTem:INTERFace:PRESET:VOLTage[:AC]:SK# <REQ: MIN|MAX|DEF|Value>

SYSTem:INTERFace:PRESET:VOLTage[:AC]:SK#?

Voltage DC

SYSTem:INTERFace:PRESET:VOLTage:DC <REQ: MIN|MAX|DEF|Value, OPT: MIN|MAX|DEF|Value, OPT: MIN|MAX|DEF|Value, OPT: MIN|MAX|DEF|Value>

SYSTem:INTERFace:PRESET:VOLTage:DC? <OPT: ALL|DEF> <OPT: ALL|DEF>

SYSTem:INTERFace:PRESET:VOLTage:DC:SK# <REQ: MIN|MAX|DEF|Value>

SYSTem:INTERFace:PRESET:VOLTage:DC:SK#?

Frequency

SYSTem:INTERFace:PRESET:FREQuency <REQ: MIN|MAX|DEF|Value, OPT: MIN|MAX|DEF|Value, OPT: MIN|MAX|DEF|Value, OPT: MIN|MAX|DEF|Value>

SYSTem:INTERFace:PRESET:FREQuency? <OPT: ALL|DEF> <OPT: ALL|DEF>

SYSTem:INTERFace:PRESET:FREQuency:SK# <REQ: MIN|MAX|DEF|Value>

SYSTem:INTERFace:PRESET:FREQuency:SK#?

Phase Angle

SYSTem:INTERFace:PRESET:PHASe <REQ: MIN|MAX|DEF|Value, OPT: MIN|MAX|DEF|Value, OPT: MIN|MAX|DEF|Value, OPT: MIN|MAX|DEF|Value>

SYSTem:INTERFace:PRESET:PHASe? <OPT: ALL|DEF> <OPT: ALL|DEF>

SYSTem:INTERFace:PRESET:PHASe:SK# <REQ: MIN|MAX|DEF|Value>

SYSTem:INTERFace:PRESET:PHASe:SK#?

Current Limit

SYSTem:INTERFace:PRESET:CURREnt:LIMit <REQ: MIN|MAX|DEF|Value, OPT: MIN|MAX|DEF|Value, OPT: MIN|MAX|DEF|Value, OPT: MIN|MAX|DEF|Value>

SYSTem:INTERFace:PRESET:CURREnt:LIMit? <OPT: ALL|DEF> <OPT: ALL|DEF>

SYSTem:INTERFace:PRESET:CURREnt:LIMit:SK# <REQ: MIN|MAX|DEF|Value>

SYSTem:INTERFace:PRESET:CURREnt:LIMit:SK#?

Power Limit

SYSTem:INTERFace:PRESET:POWer:LIMit <REQ: MIN|MAX|DEF|Value, OPT: MIN|MAX|DEF|Value, OPT: MIN|MAX|DEF|Value, OPT: MIN|MAX|DEF|Value>

SYSTem:INTERFace:PRESET:POWer:LIMit? <OPT: ALL|DEF> <OPT: ALL|DEF>

SYSTem:INTERFace:PRESET:POWer:LIMit:SK# <REQ: MIN|MAX|DEF|Value>

SYSTem:INTERFace:PRESET:POWer:LIMit:SK#?

Apparent Power Limit

SYSTem:INTERFace:PRESET:KVA:LIMit <REQ: MIN|MAX|DEF|Value, OPT: MIN|MAX|DEF|Value, OPT: MIN|MAX|DEF|Value, OPT: MIN|MAX|DEF|Value, OPT: MIN|MAX|DEF|Value>

SYSTem:INTERFace:PRESET:KVA:LIMit? <OPT: ALL|DEF> <OPT: ALL|DEF>

SYSTem:INTERFace:PRESET:KVA:LIMit:SK# <REQ: MIN|MAX|DEF|Value>

SYSTem:INTERFace:PRESET:KVA:LIMit:SK#?

Examples of programming User Preset Soft keys:

SYST:INTERF:PRESET:VOLT:AC 115.000,230.000,300.000,MAX

SYST:INTERF:PRESET:VOLT:DC MAX,200.000,0.000,-200.000,MIN

SYST:INTERF:PRESET:FREQ 50.000,60.000,400.000,800.000,1200.000

SYST:INTERF:PRESET:PHAS 0.000,90.000,120.000,180.000,240.000

SYST:INTERF:PRESET:CURR:LIM MAX,15.000,5.000

SYST:INTERF:PRESET:POW:LIM MAX,4.000,2.000,1.000

SYST:INTERF:PRESET:KVA:LIM MAX,4.000,2.000,1.000

Examples of programming a specific User Preset Soft key:

SYST:INTERF:PRESET:VOLT:AC:SK1 115

Examples of querying programming User Preset Soft key settings:

SYSTem:INTERF:PRESET:VOLT:AC? -> 115.000,230.000,300.000,MAX

SYSTem:INTERF:PRESET:VOLT:DC? -> MAX,200.000,0.000,-200.000,MIN

SYSTem:INTERF:PRESET:FREQ? -> 50.000,60.000,400.000,800.000,1200.000

SYSTem:INTERF:PRESET:PHAS? -> 0.000,90.000,120.000,180.000,240.000

SYSTem:INTERF:PRESET:CURR:LIM? -> MAX,15.000,5.000

SYSTem:INTERF:PRESET:POW:LIM? -> MAX,4.000,2.000,1.000

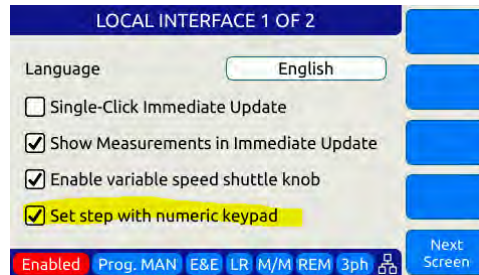
SYSTem:INTERF:PRESET:KVA:LIM? -> MAX,4.000,2.000,1.000

Example of querying programming User Preset for a specific soft key number:

SYST:INTERF:PRESET:VOLT:AC:SK1? -> 115.000

8.12.3.4 Other Front Panel Function Commands

These commands are equivalent to some of the functions available in the LOCAL INTERFACE settings.



Beeper Volume - Range is 0 through 10:

SYSTem:INTERFace:VOLume <VOLUME>

SYSTem:INTERFace:VOLume?

LCD Brightness - Range is 0 through 10:

SYSTem:INTERFace:LCD[:BRIGHTness] <BRIGHTNESS>

SYSTem:INTERFace:LCD[:BRIGHTness]?

Keypad Backlit Brightness - Range is 0 through 10:

SYSTem:INTERFace:KEYS:BRIGHTness <BRIGHTNESS>

SYSTem:INTERFace:KEYS:BRIGHTness?

Key Press Sounds:

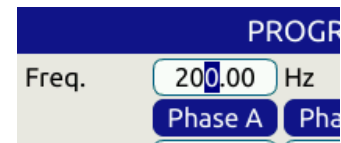
SYSTem:INTERFace:KEYS:SOUNDS <ON|OFF>

SYSTem:INTERFace:KEYS:SOUNDS?

Set Resolution Step Size with the numeric keypad

SYSTem:INTERFace:KEYS:STEPset <ON|OFF>

SYSTem:INTERFace:KEYS:STEPset?



Single Click Update Mode:

SYSTem:INTERFace:IMMEDIATEupdate:SINGLEclick <ON|OFF>

SYSTem:INTERFace:IMMEDIATEupdate:SINGLEclick?

Show Measurements in Immediate Update:

SYSTem:INTERFace:IMMEDIATEupdate:SHOWMEASurements <ON|OFF>

SYSTem:INTERFace:IMMEDIATEupdate:SHOWMEASurements?

Variable Shuttle Knob Speed - Range is 0 through 10:

SYSTem:INTERFace:KNOB:SPeed <SPEED>

SYSTem:INTERFace:KNOB:SPeed?

8.12.4 System Configuration Commands

Query Format	SYSTem:MAXKVA?
Description	Returns maximum available kVA output capability of the power source. Example for 3210AGX model = 21.0000
Returned Data Format	<nr2>
Query Example	SYST:MAXKVA? 21.000
Query Format	SYSTem:MAXCURRent?
Description	Returns maximum available RMS or DC output current capability of the power source. Example for 3210AGX model = 41.6667.
Returned Data Format	<nr2>
Query Example	SYST:MAXCURR? 41.6667
Query Format	SYSTem:MAXVOLTage?
Description	Returns maximum available RMS or DC voltage output capability of the power source. Example for 3210AGX model = 350.
Returned Data Format	<nr1>
Query Example	SYST:MAXVOLT? 300
Command Syntax	SYSTem:COMPAtible
Description	Sets Pacific Power Source UPC controller compatibility mode. This mode allows use of the power source with legacy software.
Parameters	< 0 DISABLE 1 UPC >
Parameter Format	
Example	SYST:COMP UPC
Query Format	SYSTem:COMPAtible?
Returned Data Format	
Query Example	SYST:COMP? 1
Query Format	SYSTem:HWREVision?
Description	Returns the hardware revision letter of the power source
Returned Data Format	<cr>
Query Example	SYST:HWREV? A

Command Syntax	SYSTem:LANGuage
Description	Sets Pacific Power Source UPC controller compatibility mode. This mode allows use of the power source with legacy software.
Parameters	< english Chinese > Note: Refer to SYSTem:LANGuage:CATalog? query command for list of supported languages.
Parameter Format	<cr>
Example	SYST:LANG chinese
Query Format	SYSTem:LANGuage?
Returned Data Format	
Query Example	SYST:LANG? chinese

These commands allow complete system configurations to be exported or imported.

Command Syntax	SYSTem:EXPort <OPT: CONFIGURATION, OPT: WAVEFORMS, OPT: PROGRAMS, OPT: SETPOINTS, OPT: [NAME, NAMEFILE]>
Description	Exports complete record of system configuration of the power source to a compressed file. If argument name is omitted it is stored in temporal/DATE—TIME.7z otherwise in temporal/NAMEFILE.7z. The others arguments indicate what is going to be exported, if none of them are passed all is going to be exported.
Parameters	<OPT: CONFIGURATION, OPT: WAVEFORMS, OPT: PROGRAMS, OPT: SETPOINTS, OPT: [NAME, NAMEFILE]>
Parameter Format	<cr>
Example	SYST:EXPORT SYST:EXPORT NAME,TEST SYST:EXPORT SETPOINTS,NAME,TEST2 SYST:EXPORT SETPOINTS, WAVEFORMS,NAME,TEST3

Command Syntax	SYSTem:IMPort <OPT: CONFIGURATION, OPT: WAVEFORMS, OPT: PROGRAMS, OPT: SETPOINTS, [NAME, NAMEFILE]>
Description	Imports complete system configuration records of the power source. The compressed file has to be in /temporal/NAMEFILE.7z. The other others arguments indicate what will be imported, if none of them are passed all is going to be imported.
Parameters	<OPT: CONFIGURATION, OPT: WAVEFORMS, OPT: PROGRAMS, OPT: SETPOINTS, [NAME, NAMEFILE]>
Parameter Format	<cr>
Example	SYST:IMPORT NAME,TEST

8.12.5 System Operation Mode Commands

These commands select between the available operation mode of the Power System. Note that some commands may be options and not supported on the model configuration used.

Available modes are:

- Voltage Source
- Current Source
- Active Load (Requires option L)

Command Syntax	SYSTem:OPMMode [0 1 2]
Description	Sets the operating mode of the unit
Parameters	0 Voltage Source 1 Current Source 2 Active Load
Parameter Format	<nr1>
Example	SYST:OPMO 0
Query Format	SYSTem:OPMMode?
Returned Data Format	<nr1>
Query Example	SYST:OPMO? 2
Query Format	SYSTem:OPMMode:CATalog?
Description	Returns the available operation mode settings.
Returned Data Format	<nr1>,<cr>,<nr1>,<cr>,<nr1>,<cr>
Return Value	0, Voltage Source, 1, Current Source, 2, Active Load
Query Example	SYST:OPMO:CAT? 0, Voltage Source, 1, Current Source, 2, Active Load

8.12.6 Parallel System Commands

Command Syntax	SYSTem:DISCOVERY
Description	Initiates discovery of the number of paralleled power sources
Parameters	None
Parameter Format	n/a
Example	SYST:DISCOVERY

Query Format	SYSTem:PARALLELUNITS?
Description	Returns the number of power sources found. The response will be different for a Parallel AGX system vs a Series/Parallel AGXS system. For a parallel AGX system, this command returns the total number of units, 2 or higher. For a Series or Series/Parallel system, if SOURCE:SERIES is 0/OFF, it returns the total units, same as a parallel only system. If SOURCE:SERIES is 1, it returns the total number units divided by two. SYSTem:CONNECTEDUNITS? returns the total units no matter the value of SOURCE:SERIES. This is equal to SYSTem:SERIESUNITS? * SYSTem:PARALLELUNITS?
Returned Data Format	<nr1>
Query Example	SYST:PARALLELUNITS? 1
Command Syntax Description	SYSTem:PARALLELUNITS:EXPEcted Sets the number of power sources that should be connected to the system interface bus.
Parameters	1 – 200
Parameter Format	<nr1>
Example	SYST:PARALLELUNITS:EXPE 4
Query Format	SYSTem:PARALLELUNITS:EXPEcted?
Returned Data Format	<nr1>
Query Example	SYST:PARALLELUNITS:EXPE? 4

Multi-Unit System Configuration Command Examples:

42kVA Parallel Only Standard System	42kVA Series/Parallel xxxS System
SOURCE:SERIES 0 SYSTem:SERIESUNITS? = 1 SYSTem:PARALLELUNITS? = 2 SYSTem:CONNECTEDUNITS? = 2	SOURCE:SERIES 1 SYSTem:SERIESUNITS? = 2 SYSTem:PARALLELUNITS? = 1 SYSTem:CONNECTEDUNITS? = 2
63kVA Parallel Only Standard System	63kVA Series/Parallel xxxS System
SOURCE:SERIES 0 SYSTem:SERIESUNITS? = 1 SYSTem:PARALLELUNITS? = 4 SYSTem:CONNECTEDUNITS? = 4	SOURCE:SERIES 1 SYSTem:SERIESUNITS? = 2 SYSTem:PARALLELUNITS? = 2 SYSTem:CONNECTEDUNITS? = 4

8.12.7 System Sanitization Commands

Query Format	SYSTem:SANITIZE:CODE?
Description	Returns sanitization password string.
Returned Data Format	<nr1>
Query Example	SYSTem:SANITIZE:CODE? 0659

Command Syntax	SYSTem:SANITIZE <code>
Description	Erases all user data stored in non-volatile memory settings including settings and custom waveforms if required. The code is obtained by the query command above.
Parameters	None
Parameter Format	n/a
Example	SYST:SANITIZE 0659

8.12.8 Communication LAN Commands

Command Syntax	SYSTem:COMMunicate:LAN[:ENABLE]
Description	This command turns remote control via LAN on or off. To control the power source through its LAN interface, this state has to on (1).
Parameters	< 0 OFF 1 ON >
Parameter Format	
Example	SYST:COMM:LAN ON
Query Format	SYSTem:COMMunicate:LAN[:ENABLE]?
Returned Data Format	
Query Example	SYST:COMM:LAN? 1

Command Syntax	SYSTem:COMMunicate:LAN:RESPonse
Description	This command allows the termination character for LAN communication to be defined by the user.
Parameters	0 (AUTO) 1 (\r\n) 2 (\n) 3 (\r)
Parameter Format	<nr1>
Example	SYST:COMM:LAN:REPSONSE 1
Query Format	SYSTem:COMMunicate:LAN:RESPonse?
Returned Data Format	<nr1>
Query Example	SYST:COMM:LAN:RESP? 1

Command Syntax	SYSTem:COMMunicate:LAN:RESPonse:TELNET
Description	This command allows the termination character for LAN Telnet communication to be defined by the user.
Parameters	0 (AUTO) 1 (\r\n) 2 (\n) 3 (\r)
Parameter Format	<nr1>
Example	SYST:COMM:LAN:REPSONSE:TELNET 1
Query Format	SYSTem:COMMunicate:LAN:RESPonse:TELNET?
Returned Data Format	<nr1>
Query Example	SYST:COMM:LAN:RESP:TELNET? 1

Command Syntax	SYSTem:COMMunicate:SERial:RESPonse
Description	This command allows the termination character for RS232 communication to be defined by the user.
Parameters	0 (AUTO) 1 (\r\n) 2 (\n) 3 (\r)
Parameter Format	<nr1>
Example	SYST:COMM:SERial:RESPonse 1
Query Format	SYSTem:COMMunicate:SERial:RESPonse?
Returned Data Format	<nr1>
Query Example	SYST:COMM:SER:RESP? 1
Command Syntax	SYSTem:COMMunicate:USB:VIRTualport:RESPonse
Description	This command allows the termination character for USB communication to be defined by the user.
Parameters	0 (AUTO) 1 (\r\n) 2 (\n) 3 (\r)
Parameter Format	<nr1>
Example	SYST:COMM:USB:VIRT:RESPonse 1
Query Format	SYSTem:COMMunicate:USB:VIRTualport:RESPonse?
Returned Data Format	<nr1>
Query Example	SYST:COMM:USB:VIRT:RESP? 1
Command Syntax	SYSTem:COMMunicate:LXI:RESPonse
Description	This command allows the termination character for USB communication to be defined by the user.
Parameters	0 (AUTO) 1 (\r\n) 2 (\n) 3 (\r)
Parameter Format	<nr1>
Example	SYST:COMM:LXI:RESPonse 1
Query Format	SYSTem:COMMunicate:LXI:RESPonse?
Returned Data Format	<nr1>
Query Example	SYST:COMM:LXI:RESP? 1
Query Format	SYSTem:COMMunicate:LAN:STATus?
Description	This command returns all LAN settings in a single comma delimited string of values.
Returned Data Format	<cr>, <cr>,.....,<cr>,<cr>
Query Example	SYSTem:COMMunicate:LAN:STATus? 192.168.14.22,255.255.254.0,192.168.15.254,192.168.15.208,AGX-106378937,AGX-106378889,0,1,0

Command Syntax	SYSTem:COMMunicate:LAN:DHCP[:ENABLE]
Description	This command turns DHCP mode for the LAN interface on or off. DHCP = Dynamic Host Configuration Protocol. This protocol automatically provides an IP address and other related information such as the subnet mask and default gateway. When turned off, a static IP address must be assigned by the user instead.
Parameters	< 0 OFF 1 ON >
Parameter Format	
Example	SYST:COMM:LAN:DHCP ON
Query Format	SYSTem:COMMunicate:LAN:DHCP[:ENABLE]?
Returned Data Format	
Query Example	SYST:COMM:LAN:DHCP? 1
Command Syntax	SYSTem:COMMunicate:LAN:DHCP:RENEW
Description	This command renews the lease of an IP address assigned through the DHCP protocol. This may be necessary if the power source has not been used in a while and its IP address lease has expired. If not renewed, a different IP address may be assigned.
Parameters	None
Parameter Format	n/a
Example	SYST:COMM:LAN:DHCP:RENEW
Command Syntax	SYSTem:COMMunicate:LAN:ADDress
Description	This command is used to assign a fixed IP address to the power source for LAN communication. IP Address info must be enclosed by single (') or double (") quotes.
Parameters	'ddd.ddd.ddd.ddd' (four octets ranging in value from 0 to 255 representing one 16 bit unsigned integer value each.
Parameter Format	<cr>
Example	SYST:COMM:LAN:ADD '132.18.21.105'
Query Format	SYSTem:COMMunicate:LAN:ADDress?
Returned Data Format	<cr>
Query Example	SYST:COMM:LAN:ADD? 132.18.21.105

Query Format	SYSTem:COMMunicate:LAN:MACaddress?
Description	This query returns the MAC address of the connected power source. The Media Access Control address or MAC address is also referred to as physical address as it is fix and unique to any device on the network. The MAC address for the power source is also printed on the rear panel near the LAN interface connector. It consists of 8 sets of hexadecimal 16 bit unsigned integer values.
Returned Data Format	<cr>
Query Example	SYST:COMM:LAN:MAC? 3A.3F.00.4C.DE.AA.39.8F
Query Format	SYSTem:COMMunicate:LAN:VISA?
Description	Queries the VISA resource name / address string
Returned Data Format	<cr>
Query Example	TCPIP::AGX-1003::INSTR
Command Syntax	SYSTem:COMMunicate:LAN:APPLY
Description	Applies all changes sent using the COMM:LAN commands.
Parameters	None
Parameter Format	n/a
Example	SYST:COMM:LAN:APP
Command Syntax	SYSTem:COMMunicate:LAN:MASK
Description	This command sets the IP mark value for the power source LAN interface. It is normally obtained through DHCP. If a static IP must be used, the mask has to set as well. IP Address info must be enclosed by single (') or double (") quotes.
Parameters	'ddd.ddd.ddd.ddd' (four octets ranging in value from 0 to 255 representing one 16 bit unsigned integer value each.
Parameter Format	<cr>
Example	SYST:COMM:LAN:MASK "255.255.254.0"
Query Format	SYSTem:COMMunicate:LAN:MASK?
Returned Data Format	<cr>
Query Example	SYST:COMM:LAN:MASK? 255.255.254.0

Command Syntax	SYSTem:COMMunicate:LAN:DNSaddress
Description	Sets the IP address for the DNS server
Parameters	'ddd.ddd.ddd.ddd' (four octets ranging in value from 0 to 255 representing one 16 bit unsigned integer value each. IP Address info must be enclosed by single (') or double (") quotes.
Parameter Format	<cr>
Example	SYST:COMM:LAN:DNS '132.18.21.208'
Query Format	SYSTem:COMMunicate:LAN:DNSaddress?
Returned Data Format	<cr>
Query Example	SYST:COMM:LAN:DNS? 132.18.21.208
Command Syntax	SYSTem:COMMunicate:LAN:GWAddress
Parameters	Sets the IP address for the Network Gateway. A default gateway is the node on the computer network that the network software uses when an IP address does not match any other routes in the routing table. IP Address info must be enclosed by single (') or double (") quotes.
Parameter Format	<cr>
Example	SYST:COMM:LAN:GWAD '132.18.21.254'
Query Format	SYSTem:COMMunicate:LAN:GWAddress?
Returned Data Format	<cr>
Query Example	SYST:COMM:LAN:GWAD? '132.18.21.254'
Command Syntax	SYSTem:COMMunicate:LAN:HOST:CONFigured
Description	Sets the network host address. The host address is the portion of the address used to identify hosts (any device requiring a Network Interface Card, such as a PC or networked printer) on the network. The network ID, by contrast, is the portion of the address that refers to the network itself. IP Address info must be enclosed by single (') or double (") quotes.
Parameters	'ddd.ddd.ddd.ddd' (four octets ranging in value from 0 to 255 representing one 16 bit unsigned integer value each.
Parameter Format	<cr>
Example	SYST:COMM:LAN:HOST '132.18.21.0'
Query Format	SYSTem:COMMunicate:LAN:HOST:CONFigured?
Returned Data Format	<cr>
Query Example	SYST:COMM:LAN:HOST:CONF? 132.18.21.0

Command Syntax Description	SYSTem:COMMunicate:LAN:PASSword Assign a password to enable or disable LAN communications. This feature allows the owner/operator to disable or enable remote LAN access or limit functionality over LAN. Note: There is no query format for this command so the password code cannot be queried back.
Parameters	Four digit passcode enclosed by single or double quotes.
Parameter Format	<nr1>
Example	SYST:COMM:LAN:PASS '1234'
Command Syntax Description	SYSTem:COMMunicate:LAN:PORT Sets LAN interface port address. For SCPI message communications, the standard port number is 5025.
Parameters	1024–49151, default = 5025
Parameter Format	<nr1>
Example	SYST:COMM:LAN:PORT 5025
Query Format	SYSTem:COMMunicate:LAN:PORT?
Returned Data Format	<nr1>
Query Example	SYST:COMM:LAN:PORT? 5025
Command Syntax Description	SYSTem:COMMunicate:LAN:PORT:TELNET Sets the port address for TELNET protocol
Parameters	1024–49151, default = 5024
Parameter Format	<nr1>
Example	SYST:COMM:LAN:PORT:TELNET 5024
Query Format	SYSTem:COMMunicate:LAN:PORT:TELNET?
Returned Data Format	<nr1>
Query Example	SYST:COMM:LAN:PORT:TELNET? 5024

8.12.9 Communication Serial Port Commands

Command Syntax Description	SYSTem:COMMunicate:SERial[:ENABLE] This command is used to turn the RS232 serial interface on or off. To use this interface for remote control of the power source, it must be set to ON.
Parameters	< 0 OFF 1 ON >
Parameter Format	
Example	SYST:COMM:SER ON
Query Format	SYSTem:COMMunicate:SERial[:ENABLE]?
Returned Data Format	
Query Example	SYST:COMM:SER? 1

Query Format	SYSTem:COMMunicate:SERIal:STATus?
Description	This command returns all serial port settings
Returned Data Format	Baud rate, status,data bits, stop bits, parity, flow control
Query Example	SYST:COMM:SER:STAT? 921600,0,8,1,0,0
Command Syntax	SYSTem:COMMunicate:SERIal:BAUD
Description	This command sets the baud rate for the serial port.
Parameters	< 1200 1800 2400 4800 9600 14400 19200 38400 57600 62500 115200 230400 460800 500000 576000 921600 >
Parameter Format	<nr1>
Example	SYST:COMM:SER:BAUD 115200
Query Format	SYSTem:COMMunicate:SERIal:BAUD?
Returned Data Format	<cr1>
Query Example	SYST:COMM:SER:BAUD? 115200
Command Syntax	SYSTem:COMMunicate:SERIal:PARity
Description	This command sets the parity for the serial port.
Parameters	< 0 NONE 1 OFF 2 EVEN >
Parameter Format	<nr1>
Example	SYST:COMM:SER:PAR NONE
Query Format	SYSTem:COMMunicate:SERIal:PARity?
Returned Data Format	<nr1>
Query Example	SYST:COMM:SER:PAR? 0
Command Syntax	SYSTem:COMMunicate:SERIal:BITS
Description	This command sets the number of data bits used for serial communications. Available settings are 7 or 8
Parameters	< 7 8 >
Parameter Format	<nr1>
Example	SYST:COMM:SER:BITS 8
Query Format	SYSTem:COMMunicate:SERIal:BITS?
Returned Data Format	<nr1>
Query Example	SYST:COMM:SER:BITS? 8

Command Syntax	SYSTem:COMMunicate:SERial:SBITs
Description	This command sets the number of stop bits used for serial communications. Available settings are 1 or 2.
Parameters	< 1 2 >
Parameter Format	<nr1>
Example	SYST:COMM:SER:SBIT 2
Query Format	SYSTem:COMMunicate:SERial:SBITs?
Returned Data Format	<nr1>
Query Example	SYST:COMM:SER:SBIT? 2
Command Syntax	SYSTem:COMMunicate:SERial:FLOWcontrol
Description	This command sets the method of handshaking used for serial communications. Available settings are Xon/Xoff or Hardware handshake.
Parameters	< 0 OFF 1 ON >
Parameter Format	
Example	SYST:COMM:SER:FLOW ON
Query Format	SYSTem:COMMunicate:SERial:FLOWcontrol?
Returned Data Format	<nr1>
Query Example	SYST:COMM:SER:FLOW? 1

8.12.10 Communication USB Commands

Command Syntax	SYSTem:COMMunicate:USB:VIRTualport[:ENABLE]
Description	This command enables USB device control using virtual comm driver.
Parameters	< 0 OFF 1 ON >
Parameter Format	
Example	SYST:COMM:USB:VIRT ON
Query Format	SYSTem:COMMunicate:USB:VIRTualport[:ENABLE]?
Returned Data Format	
Query Example	SYST:COMM:USB:VIRT? 1
Command Syntax	SYSTem:COMMunicate:USB:LAN[:ENABLE]
Description	Enables access to embedded webserver using virtual IP Address through USB interface.
Parameters	< 0 OFF 1 ON >
Parameter Format	
Example	SYST:COMM:USB:ETH ON
Query Format	SYSTem:COMMunicate:USB:LAN[:ENABLE]?
Returned Data Format	
Query Example	SYST:COMM:USB:LAN? 1

Command Syntax	SYSTem:COMMunicate:USB:LAN:ADDress
Description	Sets the embedded webserver virtual IP Address for USB interface.
Parameters	< 0 OFF 1 ON >
Parameter Format	
Example	SYST:COMM:USB:LAN ON
Query Format	SYSTem:COMMunicate:USB:LAN:ADD?
Returned Data Format	
Query Example	SYST:COMM:USB:LAN:ADD? 192.168.123.1
Command Syntax	SYSTem:COMMunicate:USB:LAN:APPLY
Description	Applies IP settings for Virtual USB Lan interface.
Parameters	None
Parameter Format	N/A
Example	SYST:COMM:USB:LAN:APP
Command Syntax	SYSTem:COMMunicate:USB:LAN:MASK
Description	Sets the embedded webserver virtual IP Mask Address for USB interface.
Parameters	IP Mask
Parameter Format	<cr>
Example	SYST:COMM:USB:LAN '255.255.255.0'
Query Format	SYSTem:COMMunicate:USB:LAN:MASK?
Returned Data Format	<cr>
Query Example	SYST:COMM:USB:LAN:MASK? 255.255.255.0

8.12.11 Communication GPIB Commands

Command Syntax	SYSTem:COMMunicate:GPIB:ADDress <nr1>
Description	This command sets the GPIB address.
Parameters	< 1..30 >
Parameter Format	<nr1>
Example	SYST:COMM:GPIB:ADD 5
Query Format	SYSTem:COMMunicate:GPIB:ADDress?
Returned Data Format	<nr1>
Query Example	SYST:COMM:GPIB:ADD? 5

Command Syntax	SYSTem:COMMunicate:GPIB:ENABle
Description	Enables access to embedded webserver using virtual IP Address through USB interface.
Parameters	< 0 OFF 1 ON >
Parameter Format	
Example	SYST:COMM:GPIB:ENAB 1
Query Format	SYSTem:COMMunicate:GPIB:ENABle?
Returned Data Format	
Query Example	SYST:COMM:GPIB:ENAB? 1
Command Syntax	SYSTem:COMMunicate:GPIB:BAUDrate
Description	Sets the internal serial link speed between the GPIB interface and the front panel processor. This setting is set to 921600 bps as a default and should only be changed to a lower setting if there is a problem with the GPIB interface not working reliably.
Parameters	< 1200 1800 2400 4800 9600 14400 19200 38400 57600 62500 115200 230400 460800 500000 576000 921600 >
Parameter Format	<nr1>
Example	SYST:COMM:GPIB:BAUD 921600
Query Format	SYSTem:COMMunicate:GPIB:BAUDrate?
Returned Data Format	<nr1>
Query Example	SYST:COMM:GPIB:BAUD? 921600

8.12.12 System Firmware Commands

Query Format	SYSTem:FW:POWER[:VERsion]?
Description	This command returns the firmware revision of the power converter DSP's. This information is for reference only.
Returned Data Format	<cr>-<cr>
Query Example	SYST:FW:POWER:VER? 81.0.0.RC8-77.1.0
Query Format	SYSTem:FW:FRONTPANEL:VERsion?
Description	This command returns the firmware revision of front panel controller processor. This information is for reference only.
Returned Data Format	<cr>
Query Example	SYST:FW:FRONTPANEL:VER? 2.0.0
Query Format	SYSTem:FW:FRONTPANEL:APPS:VERsion?
Description	This command returns the firmware revision of front panel controller user interface application. This information is for reference only. Note: This revision number is also returned as part of the *IDN? query response.
Returned Data Format	<cr>
Query Example	SYST:FW:FRONTPANEL:APPS:VER? 2.0.0
Query Format	SYSTem:HWREVision?
Description	This command returns the hardware revision (build) of the power source.
Returned Data Format	<nr2>
Query Example	SYST:HWREV? 0

8.12.13 System Remote Access Commands

Command Syntax	SYSTem:REMOte:ACCESS
Description	Sets remote access permission.
Parameters	<0 DISABLED 1 ENABLED>
Parameter Format	
Example	SYST:REM:ACCESS 1
Query Format	SYSTem:REMOte:ACCESS?
Returned Data Format	<cr>
Query Example	SYST:REM:ACCESS? 1
Command Syntax	SYSTem:REMOte:ACCESS:REQuest
Description	This commands results in a pop up dialog on the front panel display requesting the local user to ACCEPT. Confirms presence of a person at the location of the instrument.
Parameters	Alias name. (This argument is optional)
Parameter Format	<cr>
Example	SYSTem:REMOte:ACCESS:REQuest
Query Format	None
Command Syntax	SYSTem:REMOte:ACCESS:LOGIN
Description	This command uses a password as an argument to request access to the instrument. The password can be set on the front panel or using the SYSTem:REMOte:PASSword command
Parameters	Password
Parameter Format	<nr1>
Example	SYSTem:REMOte:ACCESS:LOGIN 1234
Query Format	None
Command Syntax	SYSTem:REMOte:ACCESS:MESSAge <cr>
Description	Allows a user specific message to be displayed at the bottom of the Access Control Browser dialog informing anyone requesting access whom to contact.
Parameters	User Message
Parameter Format	<cr>
Example	SYSTem:REMOte:ACCESS:MESS "Unit is used by John. Please contact 123456789."
Query Format	SYSTem:REMOte:ACCESS:MESSAge?
Returned Data Format	<cr>
Query Example	SYST:REM:ACCESS:MESS? "Unit is used by John. Please contact 123456789."

Command Syntax	SYSTem:REMOte:ACCESS:MONItor
Description	Enables or disables remote access monitor mode only. ON by default for backward compatibility.
Parameters	< 0 OFF 1 ON >
Parameter Format	 or <cr>
Example	SYSTem:REMOte:ACCESS:MONI ON
Query Format	SYSTem:REMOte:ACCESS:MONItor?
Returned Data Format	
Query Example	SYST:REM:ACCESS:MONI? 1
Command Syntax	SYSTem:REMOte:FTP:ENAbLe
Description	Enable/disable the FTP service.
Parameters	<0 OFF 1 ON>
Parameter Format	
Example	SYST:REM:FTP:ENA 1
Query Format	SYSTem:REMOte:FTP:ENAbLe?
Returned Data Format	
Query Example	SYST:REM:FTP:ENA? 1
Command Syntax	SYSTem:REMOte:FTP:PASSword
Description	Sets remote FTP access permission password.
Parameters	password
Parameter Format	<cr>
Example	SYST:REM:FTP:PASS temporal
Query Format	SYSTem:REMOte:FTP:PASSword?
Returned Data Format	<cr>
Query Example	SYST:REM:FTP:PASS? temporal
Command Syntax	SYSTem:REMOte:SMB:ENAbLe
Description	Enable/disable the samba service.
Parameters	<0 OFF 1 ON>
Parameter Format	
Example	SYST:REM:FTP:ENA 1
Query Format	SYSTem:REMOte:SMB:ENAbLe?
Returned Data Format	
Query Example	SYST:REM:SMB:ENA? temporal

Command Syntax	SYSTem:REMOte:SMB:PASSword
Description	Sets remote Samba services access permission password
Parameters	password
Parameter Format	<cr>
Example	SYST:REM:SMB:PASS temporal
Query Format	SYSTem:REMOte:SMB:PASSword?
Returned Data Format	<cr>
Query Example	SYST:REM:SMB:PASS? temporal

8.12.14 System Regional Setting Commands

These commands are used to set regional setting for Dates, Times and Decimal separators. They are relevant when exporting or importing CSV files for use in applications like MS Excel or MS Word.

Command: **SYSTem:REGion:DATEFormat <FORMAT>**

Sets the date display format as either **DD/MM/YYYY** (Asia) EU or **MM/DD/YYYY** (USA)

Example: SYST:REG:DATE DD/MM/YYYY

Query: **SYSTem:REGion:DATEFormat?**

Example: SYST:REG:DATE?
DD/MM/YYYY

Command: **SYSTem:REGion:DATEFormat:CATalog?**

Returns: MM/DD/YYYY,DD/MM/YYYY

Command: **SYSTem:REGion:DECImalsymbol <SEPARATOR>**

Sets the decimal separator to either a comma (Asia, EU) or a period (USA). Parameters are "." Or ",".

Example: SYST:REG:DECI ","

Query: **SYSTem:REGion:DECImalsymbol?**

Returns decimal separator setting.

Examples SYST:REG:DATE?

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8.12.15 System Import / Export Commands

These commands allow complete system configurations to be exported or imported.

Command Syntax	SYSTem:EXPort <OPT: CONFIGURATION, OPT: WAVEFORMS, OPT: PROGRAMS, OPT: SETPOINTS, OPT: [NAME, NAMEFILE]>
Description	Exports complete record of system configuration of the power source to a compressed file. If argument name is omitted it is stored in temporal/DATE—TIME.7z otherwise in temporal/NAMEFILE.7z. The others arguments indicate what is going to be exported, if none of them are passed all is going to be exported.
Parameters	<OPT: CONFIGURATION, OPT: WAVEFORMS, OPT: PROGRAMS, OPT: SETPOINTS, OPT: [NAME, NAMEFILE]>
Parameter Format	<cr>
Example	SYST:EXPORT SYST:EXPORT NAME,TEST SYST:EXPORT SETPOINTS,NAME,TEST2 SYST:EXPORT SETPOINTS, WAVEFORMS,NAME,TEST3

Command Syntax	SYSTem:IMPort <OPT: CONFIGURATION, OPT: WAVEFORMS, OPT: PROGRAMS, OPT: SETPOINTS, [NAME, NAMEFILE]>
Description	Imports complete system configuration records of the power source. The compressed file has to be in /temporal/NAMEFILE.7z. The other others arguments indicate what will be imported, if none of them are passed all is going to be imported.
Parameters	<OPT: CONFIGURATION, OPT: WAVEFORMS, OPT: PROGRAMS, OPT: SETPOINTS, [NAME, NAMEFILE]>
Parameter Format	<cr>
Example	SYST:IMPORT NAME,TEST

8.12.16 Miscellaneous System Commands

Command Syntax	SYSTem:BEEP
Description	This command generates a beep from the front panel speaker. May be used in ATE programs to get operator's attention. Make sure the beep volume is not set to 0. See SYSTem:INTERFace:VOLume cmd.
Returned Data Format	<cr>, ..., <cr>
Query Format	None
Query Format	SYSTem:MEMory:CATalog?
Description	This command returns the available memory types catalog.
Returned Data Format	<cr>, ..., <cr>
Query Example	SYST:MEM:CAT? INTERNAL, RAM
Command Syntax	SYSTem:MEMory:REMove
Description	This command unmounts system memory.
Returned Data Format	<cr>, ..., <cr>
Query Format	None

Command Syntax	SYSTem:DELeTe <PATH>
Description	This command deletes a file or folder. The path or filename can be between double quotation marks or not.
Parameters	PATH or FILE
Parameter Format	<cr>
Example	SYST:DEL internal/program/program_1.xml SYST:DEL "internal/program/program_1.xml" SYST:DEL temporal/program/program_1.xml SYST:DEL "temporal/program/program_1.xml"
Query Format	none
Query Format	SYSTem:FILE:TYPE? <MEM>
Description	This command returns the file type in numeric available memory types catalog.
Returned Data Format	<nr1>
Query Example	SYST:FILE:TYPE? RAM 0 SYST:FILE:TYPE? INTERNAL 0
Command Syntax	SYSTem:SCREENshot
Description	This command takes a screen shot of the LCD display. The LCD image is saved as a ".png" format image file to folder "internal/screenshots"
Parameters	None
Parameter Format	N/A
Example	SYST:SCREEN
Query Format	none

8.13 Auxiliary I/O System Commands

Commands specific to the auxiliary I/O functions are listed in this section.

8.13.1 System Analog & Digital IO Commands

```

SYSTem:AIO
    :INput[1 | 2 | 3 | .4][?]
        :CATalog?
        :GAIN[?]
            :DEFault?
            :MAXimum?
            :MINimum?
        : OFFSET[?]
            :DEFault?
            :MAXimum?
            :MINimum?
        :RANGe[?]
            :DEFault?
            :MAXimum?
            :MINimum?
        :UNITs?
        :VOLTage?
    :OUTput[1 | 2 | 3 | .4][?]

```

```

:CATalog?
:GAIN[?]
:DEFault?
:MAXimum?
:MINimum?
:OFFSEt[?]
:DEFault?
:MAXimum?
:MINimum?
:RANGe[?]
:DEFault?
:MAXimum?
:MINimum?
:UNITs?
:VOLTage?
SYSTem:DIO
:INput[1 | 2 | 3 | .4][?]
:FALLing[?]
:FILttersize[?]
:DEFault?
:MAXimum?
:MINimum?
:RISing[?]
:OUTput[1 | 2 | 3 | .4][?]
:CATalog?
:INVert[?]
:STATe?
:REMOte
:ENABle[?]
:INHibit[?]
:STROBE
:OUTPutstate[?]
:SOURce[?]
:TRANsient[?]

```

8.13.1.1 SYSTem:AIO:Input

Command Syntax	SYSTem:AIO:INput[n] <cr>
Description	Sets the AGX parameter to be controlled by the analog input.
Parameters	[CURR:LIM CURR:LIM1 CURR:LIM2 CURR:LIM3 FREQ KVA:LIM KVA:LIM1 KVA:LIM2 KVA:LIM3 OFF PHAS2 PHAS3 POW:LIM POW:LIM1 POW:LIM2 POW:LIM3 VOLT:AC VOLT:AC1 VOLT:AC2 VOLT:AC3 VOLT:DC VOLT:DC1 VOLT:DC2 VOLT:DC3] See the “SYSTem:AIO:INput:CATalog?” command response for a list of supported parameters.
Parameter Format	<cr>
Example	SYST:AIO:IN1 VOLTAGE
Query Format	SYSTem:AIO:INput[n]?
Returned Data Format	<cr>
Query Example	SYST:AIO:IN1? VOLTAGE

Query Format	SYSTem:AIO:INput:CATalog?
Description	Returns list of available analog inputs
Returned Data Format	<cr>
Query Example	SYST:AIO:IN:CAT? CURR:LIM,CURR:LIM1,CURR:LIM2,CURR:LIM3,FREQ,KVA:LIM,KVA:LIM1,KVA:LIM2,KVA:LIM3,OFF,PHAS2,PHAS3,POW:LIM,POW:LIM1,POW:LIM2,POW:LIM3,VOLT:AC,VOLT:AC1,VOLT:AC2,VOLT:AC3,VOLT:DC,VOLT:DC1,VOLT:DC2,VOLT:DC3
Command Syntax	SYSTem:AIO:INput[n]:GAIN <nr2>
Description	Sets the full-scale gain of the AGX parameter controlled by the analog input.
Parameters	Full scale value
Parameter Format	<nr2>
Example	SYST:AIO:IN1:GAIN 230.0
Query Format	SYSTem:AIO:INput[n]:GAIN?
Returned Data Format	<nr2>
Query Example	SYST:AIO:IN1:GAIN? 230.00
Query Format	SYSTem:AIO:INput[n]:GAIN:DEFault?
Description	Returns the default full-scale gain for the specified analog input.
Parameters	None
Returned Data Format	<nr2>
Query Example	SYST:AIO:IN1:GAIN:DEF? 300.0
Query Format	SYSTem:AIO:INput[n]:GAIN:MAXimum?
Description	Returns the maximum full-scale gain for the specified analog input.
Parameters	None
Returned Data Format	n/a
Query Example	SYST:AIO:IN1:GAIN:MAX? 100000.000000
Query Format	SYSTem:AIO:INput[n]:GAIN:MINimum?
Description	Returns the minimum full-scale gain for the specified analog input.
Parameters	None
Returned Data Format	n/a
Query Example	SYST:AIO:IN1:GAIN:MIN? -100000.000000

Command Syntax	SYSTem:AIO:INput[n]:OFFSET <nr2>
Description	Sets the offset of the AGX parameter controlled by the analog input.
Parameters	Offset
Parameter Format	<nr2>
Example	SYST:AIO:IN1:OFFSET 50.0
Query Format	SYSTem:AIO:INput[n]:OFFSET?
Returned Data Format	<nr2>
Query Example	SYST:AIO:IN1:OFFSET? 15.00
Query Format	SYSTem:AIO:INput[n]:OFFSET:DEfault?
Description	Returns the default offset for the specified analog input.
Parameters	None
Returned Data Format	n/a
Query Example	SYST:AIO:IN1:OFFSET:DEF? 15.0
Query Format	SYSTem:AIO:INput[n]:OFFSET:MAXimum?
Description	Returns the maximum offset for the specified analog input.
Parameters	None
Returned Data Format	n/a
Query Example	SYST:AIO:IN1:OFFSET:MAX? 100000.000000
Query Format	SYSTem:AIO:INput[n]:OFFSET:MINimum?
Description	Returns the minimum offset for the specified analog input.
Parameters	None
Returned Data Format	n/a
Query Example	SYST:AIO:IN1:OFFSET:MIN? -100000.000000
Command Syntax	SYSTem:AIO:INput[n]:RANGe <nr2>
Description	Sets the range of the specified analog input. Available range is 0.0 ~ 10.
Parameters	Offset
Parameter Format	<nr2>
Example	SYST:AIO:IN1:RANG 50.0
Query Format	SYSTem:AIO:INput[n]:RANGe?
Returned Data Format	<nr2>
Query Example	SYST:AIO:IN1:RANG? 10.00

Query Format	SYSTem:AIO:INput[n]:RANGe:DEFault?
Description	Returns the default range for the specified analog input.
Parameters	None
Returned Data Format	n/a
Query Example	SYST:AIO:IN1:RANG:DEF? 0.0
Query Format	SYSTem:AIO:INput[n]:RANGe:MAXimum?
Description	Returns the maximum range for the specified analog input.
Parameters	None
Returned Data Format	n/a
Query Example	SYST:AIO:IN1:RANG:MAX? 10.0
Query Format	SYSTem:AIO:INput[n]:RANGe:MINimum?
Description	Returns the minimum range for the specified analog input.
Parameters	None
Returned Data Format	n/a
Query Example	SYST:AIO:IN1:RANG:MIN? 0.0
Query Format	SYSTem:AIO:INput[n]:UNITs?
Description	Returns the assigned unit for the specified analog input port.
Parameters	None
Returned Data Format	<cr>
Query Example	SYST:AIO:IN2:UNIT? Vrms
Query Format	SYSTem:AIO:INput[n]:VOLTage?
Description	Returns the voltage value at the specified analog input port.
Parameters	None
Returned Data Format	<nr2>
Query Example	SYST:AIO:IN2:VOLT? 4.895

8.13.1.2 SYSTem:AIO:OUTput

Command Syntax	SYSTem:AIO:OUTput[n] <cr>
Description	Sets the AGX measurement that is mapped to each analog output port.
Parameters	[MEAS:CURRE1? MEAS:CURRE2? MEAS:CURRE3? MEAS:CURRE:CREST1? MEAS:CURRE:CREST2? MEAS:CURRE:CREST3? MEAS:CURRE:CREST? MEAS:CURRE:DC1? MEAS:CURRE:DC2? MEAS:CURRE:DC3? MEAS:CURRE:DC? MEAS:CURRE:PEAK1? MEAS:CURRE:PEAK2? MEAS:CURRE:PEAK3? MEAS:CURRE:PEAK? MEAS:CURRE? MEAS:FREQ? MEAS:KVA1? MEAS:KVA2? MEAS:KVA3? MEAS:KVA? MEAS:PF1? MEAS:PF2? MEAS:PF3? MEAS:PF? MEAS:POW1? MEAS:POW2? MEAS:POW3? MEAS:POW? MEAS:VLL:AC1? MEAS:VLL:AC2? MEAS:VLL:AC3? MEAS:VLL:AC? MEAS:VLL:ACDC1? MEAS:VLL:ACDC2? MEAS:VLL:ACDC3? MEAS:VLL:ACDC? MEAS:VLL:DC1? MEAS:VLL:DC2? MEAS:VLL:DC3? MEAS:VLL:DC? MEAS:VOLT:AC1? MEAS:VOLT:AC2? MEAS:VOLT:AC3? MEAS:VOLT:AC? MEAS:VOLT:ACDC1? MEAS:VOLT:ACDC2? MEAS:VOLT:ACDC3? MEAS:VOLT:ACDC? MEAS:VOLT:DC1? MEAS:VOLT:DC2? MEAS:VOLT:DC3? MEAS:VOLT:DC?] See the “SYSTem:AIO:OUTput:CATalog?” command for a list of available parameters.
Parameter Format	<cr>
Example	SYST:AIO:OUT1 VRMS
Query Format	SYSTem:AIO:OUTput[n]?
Returned Data Format	<cr>
Query Example	SYST:AIO:OUTP? VRMS
Query Format	SYSTem:AIO:OUTput:CATalog?
Description	Returns list of available analog outputs
Returned Data Format	<cr>
Query Example	SYST:AIO:OUT:CAT? MEAS:CURRE1?,MEAS:CURRE2?,MEAS:CURRE3?,MEAS:CURRE:CREST1?,MEAS:CURRE:CREST2?,MEAS:CURRE:CREST3?,MEAS:CURRE:CREST?,MEAS:CURRE:DC1?,MEAS:CURRE:DC2?,MEAS:CURRE:DC3?,MEAS:CURRE:DC?,MEAS:CURRE:PEAK1?,MEAS:CURRE:PEAK2?,MEAS:CURRE:PEAK3?,MEAS:CURRE:PEAK?,MEAS:CURRE?,MEAS:FREQ?,MEAS:KVA1?,MEAS:KVA2?,MEAS:KVA3?,MEAS:KVA?,MEAS:PF1?,MEAS:PF2?,MEAS:PF3?,MEAS:PF?,MEAS:POW1?,MEAS:POW2?,MEAS:POW3?,MEAS:POW?,MEAS:VLL:AC1?,MEAS:VLL:AC2?,MEAS:VLL:AC3?,MEAS:VLL:AC?,MEAS:VLL:ACDC1?,MEAS:VLL:ACDC2?,MEAS:VLL:ACDC3?,MEAS:VLL:ACDC?,MEAS:VLL:DC1?,MEAS:VLL:DC2?,MEAS:VLL:DC3?,MEAS:VLL:DC?,MEAS:VOLT:AC1?,MEAS:VOLT:AC2?,MEAS:VOLT:AC3?,MEAS:VOLT:AC?,MEAS:VOLT:ACDC1?,MEAS:VOLT:ACDC2?,MEAS:VOLT:ACDC3?,MEAS:VOLT:ACDC?,MEAS:VOLT:DC1?,MEAS:VOLT:DC2?,MEAS:VOLT:DC3?,MEAS:VOLT:DC?

Command Syntax	SYSTem:AIO:OUTput[n]:GAIN <nr2>
Description	Sets the full-scale gain of the AGX measurement mapped to the analog input.
Parameters	Full scale value
Parameter Format	<nr2>
Example	SYST:AIO:OUT1:GAIN 230.0
Query Format	SYSTem:AIO:OUTput[n]:GAIN?
Returned Data Format	<nr2>
Query Example	SYST:AIO:OUT1:GAIN? 425.0000
Query Format	SYSTem:AIO:OUTput[n]:GAIN:DEfault?
Description	Returns the default full-scale gain for the specified analog output port.
Parameters	None
Returned Data Format	n/a
Query Example	SYST:AIO:OUT1:GAIN:DEF? 425.0000
Query Format	SYSTem:AIO:OUTput[n]:GAIN:MAXimum?
Description	Returns the maximum gain for the specified analog output port.
Parameters	None
Returned Data Format	n/a
Query Example	SYST:AIO:OUT1:GAIN:MAX? 100000.00000
Query Format	SYSTem:AIO:OUTput[n]:GAIN:MINimum?
Description	Returns the minimum gain for the specified analog output port.
Parameters	None
Returned Data Format	n/a
Query Example	SYST:AIO:OUT1:GAIN:MIN? -100000.00000
Command Syntax	SYSTem:AIO:OUTput[n]:OFFSET <nr2>
Description	Sets the offset of the specified analog output port.
Parameters	Offset
Parameter Format	<nr2>
Example	SYST:AIO:OUT1:OFFSET 50.0
Query Format	SYSTem:AIO:OUTput[n]:OFFSET?
Returned Data Format	<nr2>
Query Example	SYST:AIO:OUT1:OFFSET? 50.00

Query Format	SYSTem:AIO:OUTput[n]:OFFSET:DEFault?
Description	Returns the default offset for the specified analog output port.
Parameters	None
Returned Data Format	n/a
Query Example	SYST:AIO:OUT1:OFFSET:DEF? 0.00000
Query Format	SYSTem:AIO:OUTput[n]:OFFSET:MAXimum?
Description	Returns the maximum gain for the specified analog output port.
Parameters	None
Returned Data Format	n/a
Query Example	SYST:AIO:OUT1:GAIN:MAX? 100000.00000
Query Format	SYSTem:AIO:OUTput[n]:OFFSET:MINimum?
Description	Returns the minimum gain for the specified analog output port.
Parameters	None
Returned Data Format	n/a
Query Example	SYST:AIO:OUT1:GAIN:MIN? -100000.00000
Command Syntax	SYSTem:AI:OUTput[n]:GAIN <nr2>
Description	Sets the full-scale gain of the specified analog output port.
Parameters	Full scale value
Parameter Format	<nr2>
Example	SYST:AIO:OUT1:GAIN 230.0
Query Format	SYSTem:AIO:OUTput[n]:GAIN?
Returned Data Format	<nr2>
Query Example	SYST:AIO:OUT1:GAIN? 230.00
Query Format	SYSTem:AIO:OUTput[n]:GAIN:DEFault?
Description	Returns the default full-scale gain for the specified analog output.
Parameters	None
Returned Data Format	<nr2>
Query Example	SYST:AIO:OUT1:GAIN:DEF? 425.00000
Query Format	SYSTem:AIO:OUTput[n]:GAIN:MAXimum?
Description	Returns the maximum full-scale gain for the specified analog output.
Parameters	None
Returned Data Format	n/a
Query Example	SYST:AIO:OUT1:GAIN:MAX? 100000.00000

Query Format	SYSTem:AIO:OUTput[n]:GAIN:MINimum?
Description	Returns the minimum full-scale gain for the specified analog output.
Parameters	None
Returned Data Format	n/a
Query Example	SYST:AIO:OUT1:GAIN:MIN? -100000.00000
Query Format	SYSTem:AIO:OUTput[n]:UNITs?
Description	Returns the assigned unit for the specified analog output port.
Parameters	None
Returned Data Format	<cr>
Query Example	SYST:AIO:OUT2:UNIT? Vrms
Query Format	SYSTem:AIO:OUTput[n]:VOLTage?
Description	Returns the voltage at the analog output port.
Parameters	None
Returned Data Format	<nr2>
Query Example	SYST:AIO:OUT2:VOLT? 7.2590

8.13.1.3 SYSTem:DIO:Input

Query Format	SYSTem:DIO:INput[n]?
Description	Queries status of Digital Input 1, 2 or 3. If I/O number is omitted, all three input values are returned. n = 1, 2 or 3.
Parameters	none
Returned Data Format	<cr>
Parameter Format	<nr1>
Query Example	SYST:DIO:IN2? 0

Command Syntax	SYSTem:DIO:INput[n]:FALLing <cr>
Description	SYSTem:DIO:INput[n]:RISing <cr> Sets the SCPI command to be executed at the rising or falling event of that digital input [n]. n = 1, 2 or 3.
Parameters	SPCI command string
Parameter Format	<cr>
Example	SYST:DIO:IN1:FALL "OUTP 0" SYST:DIO:IN1:RIS "OUTP 1" These settings will enable the output at the rising edge of the pulse and disable it at the falling edge.
Query Format	SYSTem:DIO:INput[n]:FALLing? SYSTem:DIO:INput[n]:RISing?
Returned Data Format	<cr>
Query Example	SYST:DIO:IN1:RIS? OUTP 1 SYST:DIO:IN1:FALL? -
Command Syntax	SYSTem:DIO:INput[n]:FILtersize <nr1>
Description	Defines the time in ms (milliseconds) that the digital input has to keep the state after a transition in order to generate the event. If filtersize is zero, then the event is immediately generated, otherwise the specified time will prevent short pulses from generating events. This is useful in noisy environments and also if the digital signal is controlled by a switch or a mechanical actuator.
Parameters	0 – 1000
Parameter Format	<nr1>
Example	SYST:DIO:IN1:FIL 8
Query Format	SYSTem:DIO:INput[n]:FILtersize?
Returned Data Format	<nr1>
Query Example	SYST:DIO:IN1:FIL? 8
Query Format	SYSTem:DIO:INput[n]:FILtersize:DEFault?
Description	Returns the default filter size value.
Returned Data Format	<nr1>
Query Example	SYST:DIO:IN1:FIL:DEF? 0
Query Format	SYSTem:DIO:INput[n]:FILtersize:MAXimum?
Description	Returns the maximum allowed filter size value.
Returned Data Format	<nr1>
Query Example	SYST:DIO:IN1:FIL:MAX? 1000

Query Format	SYSTem:DIO:INput[n]:FILtersize:MINimum?
Description	Returns the minimum allowed filter size value.
Returned Data Format	<nr1>
Query Example	SYST:DIO:IN1:FIL:MIN?
	1

8.13.1.4 SYSTem:DIO:OUTput

Command Syntax	SYSTem:DIO:OUTput[n] <MODE>
Description	Sets output value of digital output n. n = 1 or 2.
Parameter 1	MODE The mode determines when an output is generated. Available MODE settings are: 1, ON, 0, OFF it is used as general purpose output. [0 LOW 1 HIGH] - OUTPUT_STATE indicates output enabled(1) or disabled(0). - FORM indicates single(1) or split/three(0). - FAULT indicates fault(1) or no fault(0). - TRANSIENT indicates when a transient is running/paused/stepping(1) or stopped(0). - PROGRAM indicates when a program is in execution at steady state level(1) or manual mode(0). - REMOTE indicates remote(1) or local(0) state Defaults are: OUTPUT1: OUTPUT_STATE OUTPUT2: FORM
Parameter Format	<cr>
Example	SYST:DIO:OUT1 FAULT
Query Format	SYSTem:DIO:OUTput[n]?
Description	Returns settings for selected pin number n
Returned Data Format	<nr1>
Query Example	SYST:DIO:OUT1? OUTPUT STATE,NON-INVERTING
Query Format	SYSTem:DIO:OUTput:CATalog?
Description	Returns list of available digital outputs
Returned Data Format	<cr>
Query Example	SYST:DIO:OUT:CAT? COUPLING,FAULT,FORM,HIGH,LOW,OUTPUT STATE,PROGRAM,REMOTE,TRANSIENT

Command Syntax	SYSTem:DIO:OUTput[n]:INVert
Description	Inverts the logic polarity of the selected digital output.
Parameters	[0 NORMAL 1 INVERT]
Example	SYST:DIO:OUT1 1
Query Format	SYSTem:DIO:OUTput[n]:INVert?
Description	Returns logic inversion setting
Returned Data Format	<nr1>
Query Example	SYST:DIO:OUT1:INV?
	1

Query Format	SYSTem:DIO:OUTput[n]:STATe?
Description	Returns logic level of selected output pin.
Returned Data Format	
Query Example	SYST:DIO:OUT1:STAT?
	1

8.13.1.5 SYSTem:DIO:REMOte

Command Syntax	SYSTem:DIO:REMOte:ENABle
Description	Turns the remote enable state on or off
Parameters	< 0 OFF 1 ON >
Parameter Format	
Example	SYST:DIO:REMOte:ENABle 1
Query Format	SYSTem:DIO:REMOte:ENABle?
Returned Data Format	
Query Example	SYST:DIO:REM:ENA?
	1

Command Syntax	SYSTem:DIO:REMOte:ENABle:AUTO
Description	Enables or Disables the Remote Input function at power on. By default, on a regular AGX/ADF it is 1 for backward compatibility. When it is 1 it enables the output immediately when remote enable is set to 1 or when the unit boots. A warning will be displayed on the LCD and a beep will sound before the output enables. When it is 0 it only enables the output when it detects a 0 to 1 change in the input and disables the output with a 1 to 0. Both settings can be changed by the user. Sending a sanitize command returns this setting back to 1 and 0 respectively.
Parameters	< 0 OFF 1 ON >
Parameter Format	
Example	SYST:DIO:REMOte:ENABle:AUTO 1
Query Format	SYSTem:DIO:REMOte:ENABle:AUTO?
Returned Data Format	
Query Example	SYST:DIO:REM:ENA:AUTO?
	1

Command Syntax	SYSTem:DIO:REMOte:INHibit
Description	Turns the remote inhibit state on or off
Parameters	< 0 OFF 1 ON >
Parameter Format	
Example	SYST:DIO:REMOte:INHibit 1
Query Format	SYSTem:DIO:REMOte:INHibit?
Returned Data Format	
Query Example	SYST:DIO:REM:INH? 1

8.13.1.6 SYSTem:DIO:STROBE

Command Syntax	SYSTem:DIO:STROBE:OUTPustate
Description	Sets the function strobe mode active when the output relay changes state
Parameters	< 0 OFF 1 ON >
Parameter Format	
Example	SYST:DIO:STROBE:OUTP 1
Query Format	SYSTem:DIO:STROBE:OUTPustate?
Returned Data Format	
Query Example	SYST:DIO:STROBE:OUTP? 1

Command Syntax	SYSTem:DIO:STROBE:SOURce
Description	Sets the function strobe mode to program changes.
Parameters	< 0 OFF 1 ON >
Parameter Format	
Example	SYST:DIO:STROBE:SOUR 1
Query Format	SYSTem:DIO:STROBE:SOURce?
Returned Data Format	
Query Example	SYST:DIO:STROBE:SOUR? 1

Command Syntax	SYSTem:DIO:STROBE:TRANsient
Description	Sets the function strobe mode to generate an output at the start of a transient execution.
Parameters	< 0 OFF 1 ON >
Parameter Format	
Example	SYST:DIO:STROBE:TRAN 1
Query Format	SYSTem:DIO:STROBE:TRANsient?
Returned Data Format	
Query Example	SYST:DIO:STROBE:TRAN? 1

8.13.2 SOURce:SYNChronize Commands

```
SOURce:SYNChronize
    [:INput][?]
        :PHASEshift[?]
        :RANGE[?]
        :SOURCE[?]
        :SPeed[?]
        :STATe?

SOURce:SYNChronize
    :OUTPut[?]
```

8.13.2.1 SOURce:SYNChronize[:INput]

Command Syntax	SOURce:SYNChronize[:INput]
Description	This command enables or disables the external sync input mode.
Parameters	[0 OFF 1 ON]
Parameter Format	
Example	SOUR:SYNC 1
Query Format	SOURce:SYNChronize[:INput]?
Returned Data Format	
Query Example	SOUR:SYNC? 1

Command Syntax	SOURce:SYNChronize[:Input]:PHASEshift <nr2>
Description	Defines a fixed phase shift between phase A waveform generation and the external sync source. Used to calibrate any phase difference between the sync signal and the power source output on phase A.
Parameters	Phase shift
Parameter Format	<nr>
Example	SOUR:SYNC:PHASE 2.8
Query Format	SOURce:SYNChronize[:Input]:PHASEshift?
Returned Data Format	<nr2>
Query Example	SOUR:SYNC:PHASE? 0.5

Command Syntax	SOURce:SYNChronize[:Input]:RANGe <nr2>
Description	Allows configuration of how much the synchronization engine is able to deviate from the AGX programmed frequency. This helps to keep the waveform frequency under control, even if the external source is not present all the time. The synchronization engine is limited to frequencies of FSETPOINT +/- FRANGE.
Parameters	Range in Hz
Parameter Format	<nr2>
Example	SOUR:SYNC:RANG 5.0
Query Format	SOURce:SYNChronize[:Input]:RANGe?
Returned Data Format	<nr2>
Query Example	SOUR:SYNC:RANGe? 10.000
Command Syntax	SOURce:SYNChronize[:Input]:SOURce <cr>
Description	This command selects either the external sync TTL (1) or the internal AC line sync (0) mode. The internal AC sync signal is derived from the power sources three phase L-L voltages so a phase adjustment for Phase A output will be needed using the SOURce:SYNChronize[:Input]:PHASEshift command.
Parameters	[0 AC 1 TTL]
Parameter Format	<cr>
Example	SOUR:SYNC:SOUR TTL
Query Format	SOURce:SYNChronize[:Input]:SOURce?
Returned Data Format	<cr>
Query Example	SOUR:SYNC:SOUR? 1
Command Syntax	SOURce:SYNChronize[:Input]:SPeet <nr2>
Description	Allows accelerating the speed of the internal synchronization engine (PLL) in case the external sync source is not constant and presents periodic or continuous changes. A slower speed improves the stability of the waveform frequency, so it is recommended to keep use the smallest possible speed values.
Parameters	Speed (multiplier value)
Parameter Format	<nr1> Range is 1.000 ~ 10.000
Example	SOUR:SYNC:SP 0.50
Query Format	SOURce:SYNChronize[:Input]:SPeet?
Returned Data Format	<nr2>
Query Example	SOUR:SYNC:SP? 2.500

Query Command	SOURce:SYNChronize[:Input]:STATe?
Description	This query only command returns the status of the Phase-Locked Loop (PLL). A "0" response indicates the PLL has not locked on to the sync input yet. A 1 response indicates the PLL is locked.
Returned Data Format	
Returned Data	0 = PLL is not locked 1 = PLL is locked
Query Example	SOUR:SYNC:STAT? 1

8.13.2.2 SOURce:SYNChronize[:OUTput]

Command Syntax	SOURce:SYNChronize:OUTput
Description	This command enables the SYNC output
Query Format	SOURce:SYNChronize:OUTput?
Returned Data Format	
Returned Data	0 = SYNC output off 1 = SYNCoutput on
Query Example	SOUR:SYNC:OUT? 1

8.13.3 PROGram:TRANsient Triggers Commands

```

PROGram:TRANsient:TRIGger
    :Input[?]
        :IMMediate[?]
        :AUTOrun[?]
    :OUTput[?]
  
```

8.13.3.1 PROGram:TRANsient

The following **PROGram:TRANsient:TRIGger** commands are available.

Command Syntax	PROGram:TRANsient:TRIGger:INput
Description	When the trigger input is active, this command selects the trigger input source mode as on or off. When ON, the external trigger input is enabled.
Parameters	[0 OFF 1 ON]
Parameter Format	
Example	PROG:TRAN:TRIG:IN 1
Query Format	PROGram:TRANsient:TRIGger:INput?
Returned Data Format	
Query Example	PROG:TRAN:TRIG:IN? 1
Command Syntax	PROGram:TRANsient:TRIGger:INput:IMMediate
Description	When the trigger input is active, this command starts the transient segments immediately after the trigger input is received, without waiting for the zero crossing, as determined by the update phase setting. Refer to SOURce:UPDATEPhase
Parameters	[0 OFF 1 ON]
Parameter Format	
Example	PROG:TRAN:TRIG:IN:IMM 1
Query Format	PROGram:TRANsient:TRIGger:INput:IMMediate?
Returned Data Format	
Query Example	PROG:TRAN:TRIG:IN:IMM? 1

Command Syntax
Description

**PROG:TRANSient:TRIGger:INput:AUTOrun **

When the trigger input is active and segments are running state, each trigger event (pulse) will automatically start a new sequence, without the need of a new RUN command before each trigger. The RUN command has to be executed only once, and then each subsequent trigger input event will cause a new segment sequence to run.

Note: the trigger signal is level-sensitive; hence if it is kept high, it will continuously issue a trigger.

Parameters

[0 | OFF | 1 | ON]

Parameter Format

Example

PROG:TRAN:TRIG:IN:AUTO 1

Query Format

PROG:TRANSient:TRIGger:INput:AUTOrun?

Returned Data Format

Query Example

PROG:TRAN:TRIG:IN:AUTO?
1

Command Syntax
Description

PROG:TRANSient:TRIGger:OUTput

This command causes a trigger output pulse to be generated when a transient execution is started. Note that this output is used as a function strobe during steady state operation.

Parameters

[0 | OFF | 1 | ON]

Parameter Format

Example

PROG:TRAN:TRIG:OUT 1

Query Format

PROG:TRANSient:TRIGger:OUTput?

Returned Data Format

Query Example

PROG:TRAN:TRIG:OUT?
1

8.13.4 AUX I/O Calibration Commands

```

SYSTem:AIO
  :INPut#
    :CALibration
      :GAIN{?}
        :DEFault{?}
        :MAXimum
        :MINimum
      :OFFset{?}
        :DEFault{?}
        :MAXimum
        :MINimum
  :OUTput#
    :CALibration
      :GAIN{?}
        :DEFault{?}
        :MAXimum
        :MINimum
      :OFFset{?}
        :DEFault{?}
        :MAXimum
        :MINimum

```

8.13.4.1 SYSTem:AIO:INPut#:CALibration

Command Syntax	SYSTem:AIO:INput[n]:CALibration:GAIN <nr2>
Description	Calibrates the full scale gain of the AGX parameter controlled by the analog input.
Parameters	Reference
Parameter Format	<nr2>
Example	SYST:AIO:IN1:CAL:GAIN 100.0
Query Format	SYSTem:AIO:INput[n]:CALibration:GAIN?
	Returns calibration coefficient
Returned Data Format	<nr2>
Query Example	SYST:AIO:IN1:CAL:GAIN? 1.000
Query Command	SYSTem:AIO:INput[n]:CALibration:GAIN:DEFAult?
	Returns default calibration coefficient value
Returned Data Format	<nr2>
Query Example	SYST:AIO:IN1:CAL:GAIN:DEF? 1.000
Query Command	SYSTem:AIO:INput[n]:CALibration:GAIN:MAXimum?
	Returns upper limit of calibration coefficient value
Returned Data Format	<nr2>
Query Example	SYST:AIO:IN1:CAL:GAIN:MAX? 1.000

Query Command	SYSTem:AIO:INput[n]:CALibration:GAIN:MINimum?
	Returns lower limit of calibration coefficient value
Returned Data Format	<nr2>
Query Example	SYST:AIO:IN1:CAL:GAIN:MIN? 0.000
Command Syntax Description	SYSTem:AIO:INput[n]:CALibration:OFFset <nr2> Calibrates the full scale gain of the AGX parameter controlled by the analog input.
Parameters	Reference
Parameter Format	<nr2>
Example	SYST:AIO:IN1:CAL:OFF 0.01
Query Format	SYSTem:AIO:INput[n]:CALibration:OFFset?
	Returns calibration coefficient
Returned Data Format	<nr2>
Query Example	SYST:AIO:IN1:CAL:OFF? 0.010
Query Command	SYSTem:AIO:INput[n]:CALibration:OFFset:DEFault?
	Returns default calibration coefficient value
Returned Data Format	<nr2>
Query Example	SYST:AIO:IN1:CAL:OFF:DEF? 1.000
Query Command	SYSTem:AIO:INput[n]:CALibration:OFFset:MAXimum?
	Returns upper limit of calibration coefficient value
Returned Data Format	<nr2>
Query Example	SYST:AIO:IN1:CAL:OFF:MAX? 1.000

Query Command	SYSTem:AIO:INput[n]:CALibration:OFFset:MINimum? Returns lower limit of calibration coefficient value
Returned Data Format	<nr2>
Query Example	SYST:AIO:IN1:CAL:OFF:MIN? 1.000

8.13.4.2 SYSTem:AIO:OUTput#:CALibration

Command Syntax	SYSTem:AIO:OUTput[n]:CALibration:GAIN <nr2>
Description	Calibrates the full scale gain of the AGX parameter controlled by the analog output.
Parameters	Reference
Parameter Format	<nr2>
Example	SYST:AIO:OUT1:CAL:GAIN 100.0
Query Format	SYSTem:AIO:OUTput[n]:CALibration:GAIN? Returns calibration coefficient
Returned Data Format	<nr2>
Query Example	SYST:AIO:OUT1:CAL:GAIN? 1.000

Query Command	SYSTem:AIO:OUTput[n]:CALibration:GAIN:DEFault? Returns default calibration coefficient value
Returned Data Format	<nr2>
Query Example	SYST:AIO:OUT1:CAL:GAIN:DEF? 1.000

Query Command	SYSTem:AIO:OUTput[n]:CALibration:GAIN:MAXimum? Returns upper limit of calibration coefficient value
Returned Data Format	<nr2>
Query Example	SYST:AIO:OUT1:CAL:GAIN:MAX? 1.000

Query Command	SYSTem:AIO:OUTput[n]:CALibration:GAIN:MINimum? Returns lower limit of calibration coefficient value
Returned Data Format	<nr2>
Query Example	SYST:AIO:OUT1:CAL:GAIN:MIN? 0.000

Command Syntax	SYSTem:AIO:OUTput[n]:CALibration:OFFset <nr2>
Description	Calibrates the full scale gain of the AGX parameter controlled by the analog output.
Parameters	Reference
Parameter Format	<nr2>
Example	SYST:AIO:OUT1:CAL:OFF 0.01
Query Format	SYSTem:AIO:OUTput[n]:CALibration:OFFset?
	Returns calibration coefficient
Returned Data Format	<nr2>
Query Example	SYST:AIO:OUT1:CAL:OFF? 0.010
Query Command	SYSTem:AIO:OUTput[n]:CALibration:OFFset:DEFault?
	Returns default calibration coefficient value
Returned Data Format	<nr2>
Query Example	SYST:AIO:OUT1:CAL:OFF:DEF? 1.000
Query Command	SYSTem:AIO:OUTput[n]:CALibration:OFFset:MAXimum?
	Returns upper limit of calibration coefficient value
Returned Data Format	<nr2>
Query Example	SYST:AIO:OUT1:CAL:OFF:MAX? 1.000
Query Command	SYSTem:AIO:OUTput[n]:CALibration:OFFset:MINimum?
	Returns lower limit of calibration coefficient value
Returned Data Format	<nr2>
Query Example	SYST:AIO:OUT1:CAL:OFF:MIN? 1.000

8.14 Web Browser Test Sequence Commands

The following SCPI commands are available to control Power source embedded Test Sequence operation from an user ATE test program.

Command Syntax	TSequence:CATalog?
Description	Returns a comma-separated list of available sequences files. The query can be customized with the type of memory, OFFSET to determine start index, and LENGTH to define the number of results. <OPT: MEMORY, OPT: OFFSET, OPT: LENGTH>
Parameters	Memory types: INTERNAL RAM INTERNAL = Internal Flash Memory. (Default selection) RAM = Internal RAM. Content will be lost when power source is turned off.
Parameter Format	<cr>, <nr1>, <nr1>
Returned Data Format	<cr>
Example	TSEQ:CAT? 1,"4-11-Dips-Class2-Test.7z",2,"4-11-Dips-Class3-Test.7z",3,"4-11-Short-Interruptions-Test.7z",4,"4-11-Vars-Test.7z" TSEQ:CAT? RAM 1,"TestExample.7z" TSEQ:CAT? INTERNAL, 3, 4 3,"4-11-Short-Interruptions-Test.7z",4,"4-11-Vars-Test.7z"
Command Syntax	TSequence:SElect
Description	This command selects a sequence file by name or number.
Parameters	<REQ: FILE STRING FILE NUMBER, OPT: MEMORY> Memory types: INTERNAL RAM INTERNAL = Internal Flash Memory. (Default selection) RAM = Internal RAM. Content will be lost when power source is turned off.
Parameter Format	<cr> or <nr1>, <cr>
Example	TSEQ:SEL "TestExample.7z", RAM TSEQ:SEL 3, INTERNAL TSEQ:SEL 1
Query Format	TSequence:SElected?
Returned Data Format	<cr>
Query Example	TSEQ:SEL? "4-11-Short-Interruptions-Test"
Command Syntax	TSequence:CONTRol
Description	This command controls sequence execution
Parameters	<RUN PAUSE STOP STEP REStart PASS FAIL CLEAR> RUN: to start the execution from the last selected step PAUSE: to pause the execution, only available when the sequence state is running. STOP: to stop the execution. STEP: to execute only the selected step. REST: to restart all progress and test execution. PASS: to pass the current step in execution.

	FAIL: to fail the current step in execution and stop the sequence progress. CLEAR: to clear all logs and remove currently selected sequence from the execution panel.
Parameter Format Example	<cr> TSEQ:CON RUN TSEQ:CON PASS TSEQ:CON CLEAR
Command Syntax Description	TSEquence:STATUS? This command returns sequence execution status, where: NUMBER: <nr1>. Current step number. Example: 1 PROGRESS: <nr1>. Current step progress. <0> to <100> STATUS: <cr>. Current state of the step execution: "0-SKIPPED" "1-PASSED" "2-FAILED" "3-STOPPED" "4-RUNNING" "5-PAUSED" DESCRIPTION: <cr>. Current step description. Example: "User Input" INSTRUCTION: <cr>. Returns TRUE if there is pending user input. Note: When an instruction is pending, some commands will not be available, for example: TSEQ:STEP:GOTO or TSEQ:CON RUN
Parameters	None
Returned Data Format	<cr>
Query Example	TSEQ:STAT? NUMBER,1,PROGRESS,0,STATUS,"4-RUNNING",DESCRIPTION,"Configuration",INSTRUCTION,TRUE
Command Syntax Description	TSEquence:Input This command allows to enter the necessary parameter when the instruction status is pending (INSTRUCTION, TRUE).
Parameters	<REQ: VARIABLE STRING INPUT NUMBER, REQ: VALUE STRING> Where input number is the index obtained using TSEQ:IN?. In addition, it is possible to enter each entry with its respective variable name.
Parameter Format Example	<cr> or <nr1>, <cr> TSEQ:IN "IEC61000_4_11_UUT_SN", "00024" TSEQ:IN "IEC61000_4_11_COMPANY", "PPST" TSEQ:IN 3, "PPST"
Query Format	TSEquence:INput?
Returned Data Format	<cr>
Query Example	TSEQ:IN? 1,INPUT,"UUT Part Number",VARIABLE,"IEC61000_4_11_UUT_PN",VALUE,"1",2,INPUT,"UUT Serial Number",VARIABLE,"IEC61000_4_11_UUT_SN",VALUE,"00024",3,INPUT,"Company"

```
Name",VARIABLE,"IEC61000_4_11_COMPANY",VALUE,"",4,INPUT,"Test Operator",VARIABLE,"IEC61000_4_11_TECH",VALUE,"",5,INPUT,"UUT Mode of Operation",VARIABLE,"IEC61000_4_11_UUT_OP_MODE",VALUE,""
```

Command Syntax
Description

TSEquence:RESULT?

Returns a comma-separated list of all steps in the sequence with their respective status.

Parameters
Parameter Format
Returned Data Format
Example

None
n/a
<cr>
TSEQ:RES?
1,PASSED,2,PASSED,3,SKIPPED,4,STOPPED,5,-,6,-,7,-,8,-,9,-,10,-,11,-,12,-,13,-,14,-,15,-,16,-,17,-,18,-,19,-,20,-,21,-,22,-,23,-,24,-,25,-

Command Syntax
Description

TSEquence:STEP:GOTO

This command moves the execution cursor to the argument of the element passed.

Parameters
Parameter Format
Returned Data Format
Query Example

<REQ: STEP NUMBER>
<nr1>
n/a
TSEQ:STEP:GOTO 1
TSEQ:STEP:GOTO 3
TSEQ:STEP:GOTO 10

8.15 Series Operation Mode Commands

These commands apply to AGXS or RGSS Model master power source models only. The “S” for Series mode designation is part of the Model number returned by the *IDN? Query command. Standard units return 3150AGX whereas units configured with the Series mode option return “3150AGXS”.

Command Syntax	SOURce:SERIES < 0 OFF 1 ON >
Description	Turns Series output mode ON or OFF. This command can be changed as long as the series modes was configured with SYSTem:SERIESconnection 600. This command allows switching between high voltage/low current or low voltage/high current modes if the SPMS is present. • OFF or 0 = All AGXs in parallel • ON or 1 = AGXs in series Without the SPMS option, the user has to ensure that this command matches the wiring (parallel or series depending on customer requirement) before changing modes.
Parameters	< 0 OFF 1 ON >
Parameter Format	 or <cr>
Example	SOUR:SERIES ON
Query Format	SOURce:SERIES?
	Returns series setting mode
Returned Data Format	<nr1>
Query Example	SOUR:SERIES? 1

Command Syntax	SOURCE:SERIES:PROTection < 0 OFF 1 ON >
Description	Useful only with external SPMS switch circuit. Without, it cannot be set to 1. The default for this is ON when the series unit is configured with the SPMS switch. When ON and the inhibit input state (digital input 3) is a logical 1, it does not allow to the "SOURCE:SERIES 1" command. When OFF, it allows it, no matter the value of the digital input 3. In this case, the digital input 3 can be used for any other purpose by the user. If ON, digital input 3 cannot be used for other purposes, it's function is fixed to series inhibit.
Parameters	< 0 OFF 1 ON >
Parameter Format	 or <cr>
Example	SOUR:SERIES:PROT ON
Query Format	SOURCE:SERIES:PROT?
	Returns protection setting
Returned Data Format	<nr1>
Query Example	SOUR:SERIES:PROT? 1
Query Command	SYSTem:SERIESUNITS? This command returns 1 if SOURCE:SERIES is set to 0/OFF. It returns 2 if SOURCE:SERIES is set 1/ON. No matter the number of units. Note: This command does NOT return the number of AGX's connected in series. To determine the actual number of units, use the SYSTem:CONNECTEDUNITS? Command instead. For a Series or Series/Parallel system, if SOURCE:SERIES is 0/OFF, it returns the total units, same as a parallel only system. If SOURCE:SERIES is 1, it returns the total number units divided by two. Refer also to the SYSTem:PARALLELUNITS? Command. SYSTem:CONNECTEDUNITS? returns the total units no matter the value of SOURCE:SERIES?. This is equal to SYSTem:SERIESUNITS? * SYSTem:PARALLELUNITS?
Returned Data Format	<nr1>
Query Example	SYST:SERIESUNITS? 2

Command Syntax
Description

SYSTem:SERIESconnection <VOLTAGE, OPT: OPTIONS >

This is used to configure the AGXS system. For AGXS systems with the SPMS option, this is done at the factory. For system integrators that connect their own AGXS system, contact factory for support.

VOLTAGE should be 600 for series capable systems and 0 for non-series capable systems.

OPTIONS is a 32 bits word, for now only the first 2 bits are used:

- Bit 0 is used to indicate the SPMS option is present. 1 = indicates SPMS option, 0 = no SPMS option.
- Bit 1 is for protection blocked, when set to 1, this will force the SOURce:SERIES:PROTection command to always ON so it cannot be set to OFF.
- All other bits are reserved.

For example for an AGXS system with external SPMS circuit, set "SYSTem:SERIESconnection 600,1"

For manual output wiring changes (i.e. no SPMS hardware), set to "SYSTem:SERIESconnection 600" or "SYSTem:SERIESconnection 600,0"

The external circuits are contained in the SPMS Option and allow automatic parallel or series connection changes via SCPI command or GUI.

Parameters

<VOLTAGE, OPT: OPTIONS>

Parameter Format

 or <cr>

Example

SYST:SERIES 600,1

Query Format

SYSTem:SERIESconnection?

Returns protection setting

Returned Data Format

<nr1>

Query Example

SYST:SERIES?

600.000,0,0.0000000000,0

Multi Unit System Configuration Command Examples:

42kVA Parallel Only AGX System	42kVA Series/Parallel AGXS System
SOURCE:SERIES 0 SYSTem:SERIESUNITS? = 1 SYSTem:PARALLELUNITS? = 2 SYSTem:CONNECTEDUNITS? = 2	SOURCE:SERIES 1 SYSTem:SERIESUNITS? = 2 SYSTem:PARALLELUNITS? = 1 SYSTem:CONNECTEDUNITS? = 2
63kVA Parallel Only AGX System	63kVA Series/Parallel AGXS System
SOURCE:SERIES 0 SYSTem:SERIESUNITS? = 1 SYSTem:PARALLELUNITS? = 4 SYSTem:CONNECTEDUNITS? = 4	SOURCE:SERIES 1 SYSTem:SERIESUNITS? = 2 SYSTem:PARALLELUNITS? = 2 SYSTem:CONNECTEDUNITS? = 4

8.16 IEEE488.2 Common Commands

The following IEEE488.2 common commands (a.k.a. star commands) are supported by the AC power source. These commands are provided for compatibility with the IEEE488.2 standard. They are aliases to the relevant proprietary command and can be used interchangeably. Commands are shown in alphabetical order.

IEEE488.2 Command	Description	Group	Mandatory
*CLS	Clear Status	Status and Event	Yes
*DCL	Device Clear	Internal Operations	
*ESE <n>	Event Status Register Enable	Status and Event	Yes
*ESE?	ESE Query	Status and Event	Yes
*ESR?	Event Status Register Query	Status and Event	Yes
*GTL	Goto Local	Control	
*IDN?	Identify	System Data	Yes
*LLO	Local Lock Out	Control	Yes
*OPC	Operation Complete	Synchronization	Yes
*OPC?	OPC Status Query	Synchronization	Yes
*RST	Reset	Internal Operations	Yes
*SRE	Service Request Enable	Status and Event	Yes
*SRE?	SRE Query	Status and Event	Yes
*STB?	Status Byte Query	Status and Event	Yes
*TRG	Trigger	Synchronization	
*WAI	Wait	Synchronization	Yes

Table 8-3: Mandatory IEEE488.2 Common Commands

Command Syntax
Description

***CLS**

Clear Status. The Clear Status (CLS) command clears the status byte by emptying the error queue and clearing all the event registers including the Data Questionable Event Register, the Standard Event Status Register, the Standard Operation Status Register and any other registers that are summarized in the status byte.

Command Syntax
Description
Parameters
Parameter Format

***DCL**

Device Clear. Resets the instrument to a default state.

None

n/a

Command Syntax	*ESE<nr1>
Description	Selects the desired bits from the standard event status enable register. The variable <nr1> represents the sum of the bits that will be enabled. This register monitors I/O errors and synchronization conditions such as operation complete, request control, query error, device dependent error, status execution error, command error and power on. The selected bits are OR'd to become a summary bit (bit 5) in the byte register which can be queried. The setting by this command is not affected by *RST. However, cycling the power will reset this register to zero. Refer to section 8.14 for register bit values.
Parameters	Range 0-255
Parameter Format	<nr1>
Example	*ESE 128
Query Format	*ESE?
Returned Data Format	<nr1>
Query Example	*ESE? 193
Query Format	*ESR?
Description	Event Status Register Query. Reads the contents of the Status Event Register (ESR). After this query, the content of the ESR register is reset. Refer to section 8.14 for register bit values.
Returned Data Format	<nr1>
Query Example	*ESR? 0
Command Syntax	*GTL
Description	Goto Local. Releases lock of front panel controls.
Returned Data Format	N/A
Query Example	N/A
Query Format	*IDN?
Description	Identification Query. Returns the unit's Identity string. The IDN string response contains several fields separated by a comma. <i>Query response:</i> Manufacturer, model, serial number, firmware revision.
Returned Data Format	<cr>,<cr>,<nr1>,<nr2>
Query Example	*IDN? PPSC,3150AGX-2AG,106378889,2.0.0
Command Syntax	*LLO
Description	Local Lock out. Locks out front panel LOCAL function.
Parameters	None
Parameter Format	n/a

Command Syntax	*OPC
Description	The Operation Complete (OPC) command sets bit 0 in the Standard Event Status Register when all pending operations have finished.
Parameters	Optional: < BLOCK 0 NOBLOCK 1>
Example	*OPC
Query Format	*OPC? < BLOCK 0 NOBLOCK 1>
Description	IEEE488.2 standard command. The parameter is optional. The argument is optional, if it is not sent: • In UPC compatible mode default argument will be NONBLOCK or 1. • In normal mode default argument will be BLOCK or 0.
	*OPC? BLOCK 0
	Returns 1 when all pending overlapped operations have been completed. It can be used to cause the controller to wait for commands to complete.
	*OPC? NOBLOCK 1
	Returns 1 if all pending overlapped operations have been completed or 0 if there are pending overlapped operations. It will not cause the controller to wait for commands to complete. Pending overlapped operations can be a transient or a soft start using ramp time/slew rates.
Returned Data Format	
Query Example	*OPC? 1
Command Syntax	*SRE <nr1>
Description	Before reading a status register, bits must be enabled. This command enables bits in the service request register. The current setting is saved in non-volatile memory.
Parameters	0-255
Parameter Format	<nr1>
Example	*SRE 255
Query Format	*SRE?
Description	Reads the current state of the service request enable register. The register is cleared after reading it. Refer to section 8.14 for register bit values.
Returned Data Format	<nr1>
Query Example	*SRE? 255

Command Syntax	*RST			
Description	RESET. The *RST command (reset) has the same effect as an IEEE-488 Device Clear bus command but can be used over the RS232C, USB or LAN interface as well. This command resets the unit to its power on default state. User defined waveforms or programs are not erased but the mode is set to manual and the transient list table is cleared. (Unless there is a power-on program configured using the [SOURCE:]INITial command) <i>Note: A reset cycle of the power source can take up to 20 seconds to complete. When developing test programs, allow this time to pass before sending other commands. Adjust interface time-out settings as needed.</i>			
Parameters	None			
Parameter Format	n/a			
RESET STATE	FORM	3	VOLT:MODE	AC
	VOLT:AC	0.0000	COUPLING	DC
	VOLT:DC	0.0000	RANGE	AC
	CURR:AC	41.6667		
	CURR:DC	20.8333		
Query Format	*STB?			
Description	Status Byte Query. The *STB? query returns the contents of the status byte register (STB). After this query, the content of the STB register is reset. Refer to section 8.14 for register bit values.			
Returned Data Format	<nr1>			
Query Example	*STB? 4			
Command Syntax	*TRG			
Description	Triggers pending operation.			
Parameters	None			
Parameter Format	n/a			
Command Syntax	*WAI			
Description	Prohibits the instrument from executing any new commands until all pending overlapped commands have been completed.			
Parameters	None			
Parameter Format	n/a			

8.17 Status and Events Registers

The IEEE488.2 standard defines a standardized status and events register system. Refer to the ANSI/IEEE-488.2 1987 standard for more information. This section provides an overview of these registers and bit positions for various status and error events.

8.17.1 Status Byte Register (STB)

The status register content is returned on a *STB? query. It contains 8 bits as shown in the table below. The return value represents the 8 bits positions and can range from 0-255. A *CLS command will clear the Status Byte Register (STB) and the Event Status Register (ESR). Refer to Figure 8-3, "Status Byte Logical Model".

BIT	NAME	DEFINITION
7	SOS	:STATus:OPERation register bit summary
6	MSS/RQS	- MASTER SUMMARY summarizes all STATUS BYTE bits (except bit 6) for *STB?, or, - REQUEST SERVICE indicates this device requested service when a Serial Poll was performed.
5	ESB	STANDARD EVENT STATUS REGISTER bit summary
4	MAV	MESSAGE AVAILABLE indicates Query response data is available
3	SQS	:STATus:QUESTionable register bit summary
2	EEQ	ERROR/EVENT QUEUE indicates an SCPI Error/Event message is available
1	BUSY	indicates UPC front panel not in V/I mode
0	FAULT	indicates Power Source FAULT

Table 8-4: Status Byte Register (STB)

Note: Setting a SERVICE REQUEST ENABLE (SRE) bit true unmask the STATUS bit in the STB. Bit 6 of the SRE is not applicable as the MASTER SUMMARY bit of the STB cannot be masked. The STB, SRE, ESR and ESE registers are 8 bits each.

The status byte logical model is shown in the figure below.

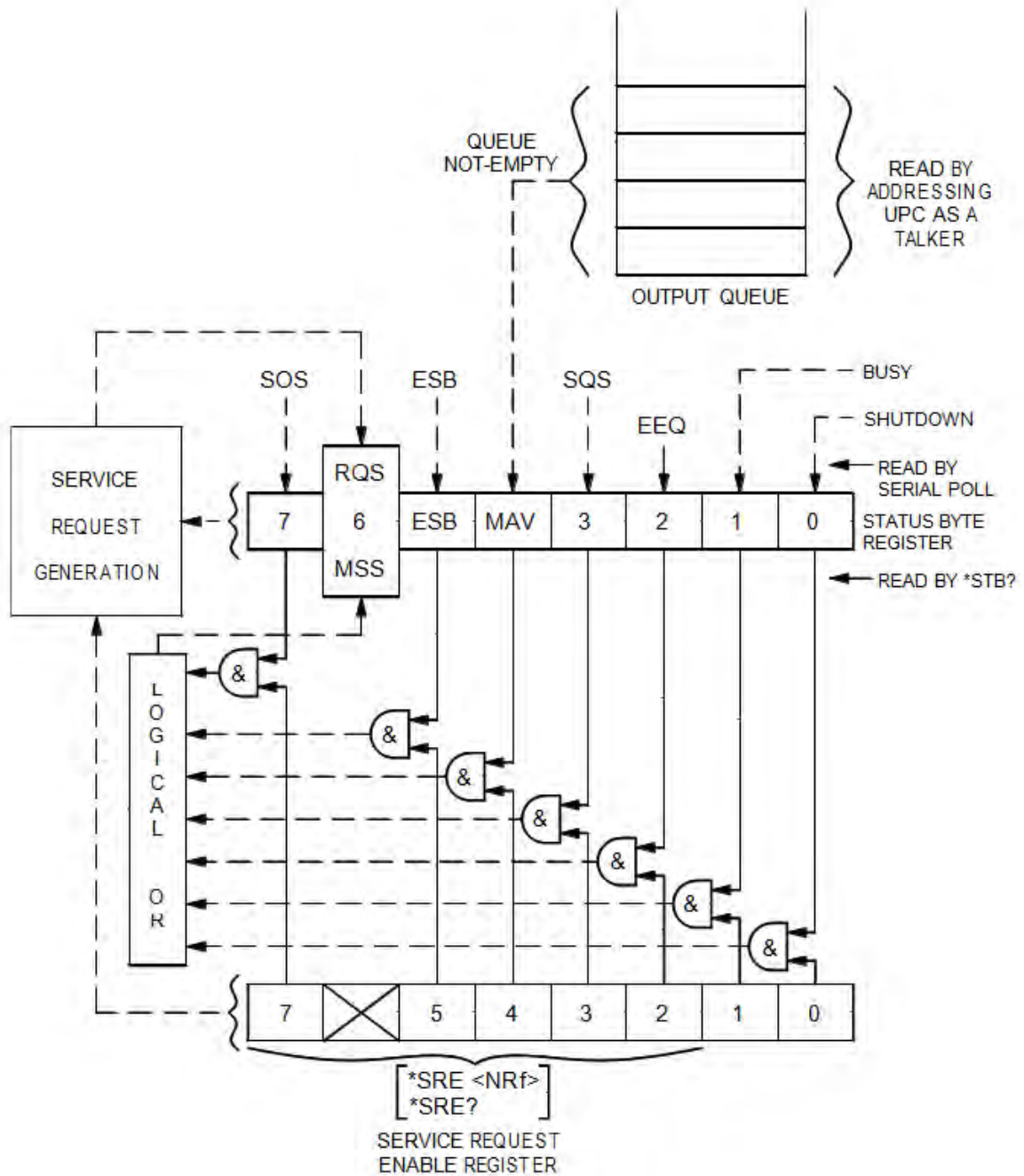


Figure 8-2: Status Byte Logical Model

8.17.2 Status Event Register (ESR)

Events reported by the STANDARD EVENT STATUS register may be queried via the *ESR? command. Reading the ESR register clears it. The EVENT STATUS summary bit in the STATUS BYTE (STB) will be set when an unmasked EVENT STATUS bit goes true.

BIT	NAME	DEFINITION
7	PON	POWER ON indicates Input power was just applied
6	URQ	USER REQUEST indicates "LOCAL" key was just pressed
5	CME	COMMAND ERROR indicates invalid command or query received
4	EXE	EXECUTION ERROR indicates can't execute command with data received
3	DDE	DEVICE DEPENDANT ERROR indicates UPC not properly configured
2	QYE	QUERY ERROR indicates cannot respond with data
1	RQC	REQUEST CONTROL - not used
0	OPC	OPERATION COMPLETE indicates previous operation complete

Table 8-5: Status Event Register (ESR)

Setting an EVENT STATUS ENABLE (ESE) bit true unmask the EVENT bit in the ESR. Also see :SYSTEM:ERROR? query for relevant information.

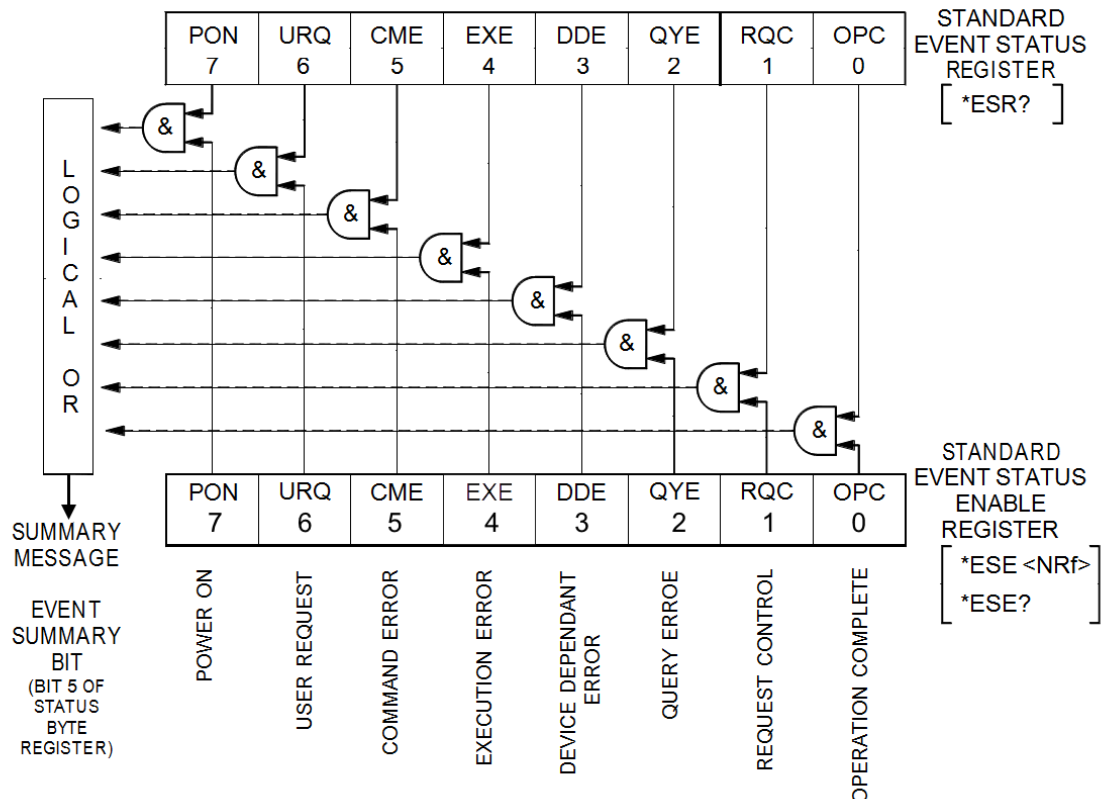


Figure 8-3: Standard Event Register (ESR) Model

8.17.3 SCPI Status Registers

The STATUS:OPERation and STATUS:QUESTIONable registers provide information about the present mode of operation.

- Transition of a CONDITION bit to the true state causes the EVENT bit to be set true.
- Unmasked ENABLE bits allow an EVENT bit to be reported in the summary bit for that EVENT register in the STATUS BYTE register.
- Setting an ENABLE bit true, unmask the corresponding EVENT bit.
- Reading an EVENT register clears it.
- All :STATUS registers are 16 bits (Figure 5.3).

The STATUS:OPERation register provides information about the present mode of operation.

Relevant commands for the STATUS:OPERation register are:

:STATUS:OPERation:CONDition?

:STATUS:OPERation:ENABle

:STATUS:OPERation:ENABle?

:STATUS:OPERation:EVENT?

The STATUS:QUESTIONABLE register provides information about errors and questionable measurements.

Relevant commands for the STATUS:QUESTIONABLE register are:

:STATUS:QUESTIONable:CONDition?

:STATUS:QUESTIONable:ENABle

:STATUS:QUESTIONable:ENABle?

:STATUS:QUESTIONable:EVENT?

Refer to Figure 8-5, “SCPI Status Registers Model” for details on registers.

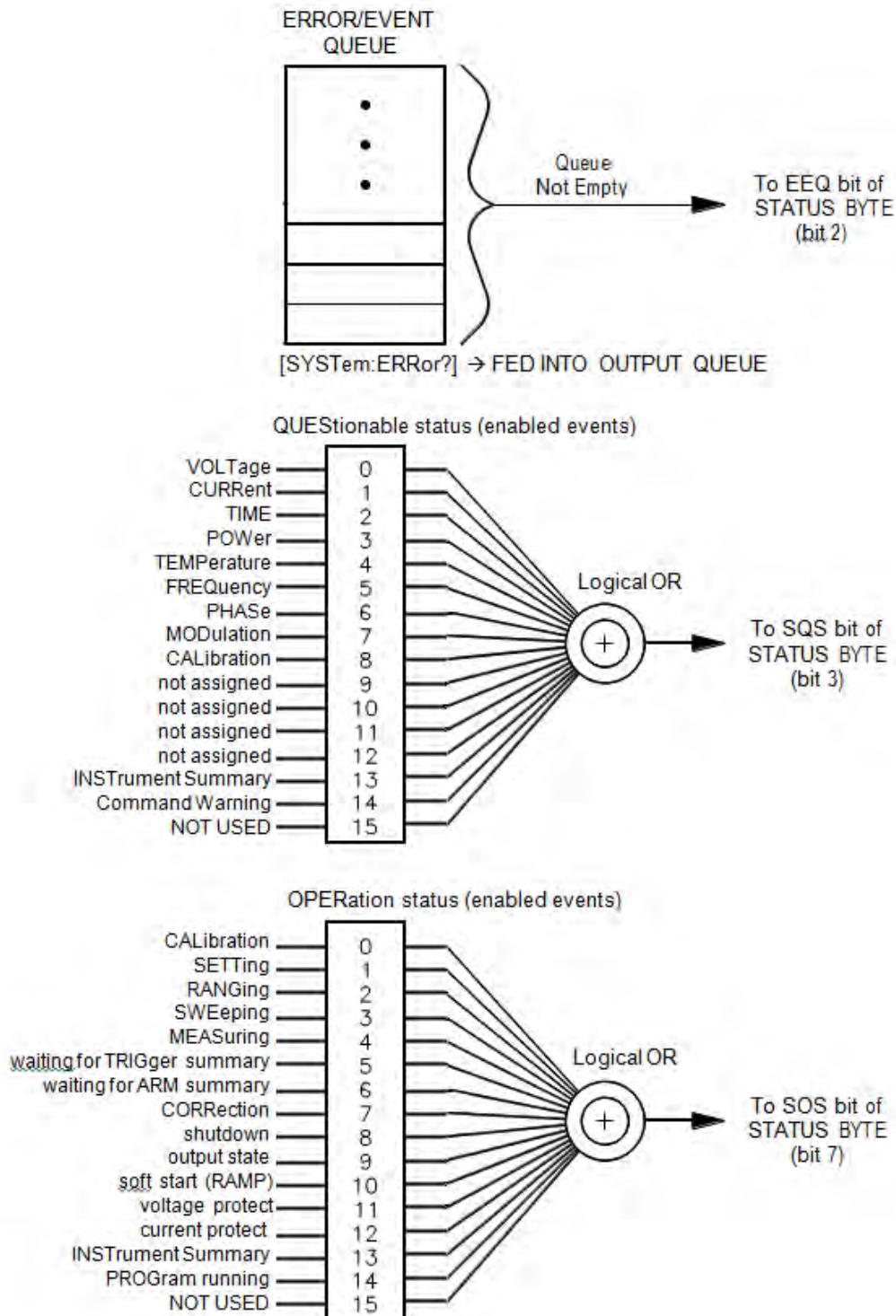


Figure 8-4: SCPI Status Registers Model

9 USB Driver Installation

9.1 Overview

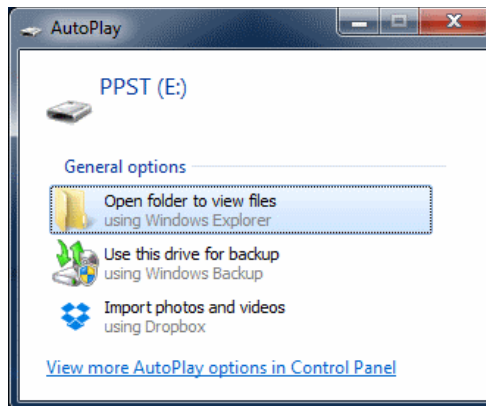
The USB interface provides a virtual COM port for the PC. Via this port, the unit can be controlled as a normal RS232 interface, e. g. with a terminal program or user application program. There are two drivers provided with the AGX units:

Virtual COM driver	This allows communication with the power sources using a virtual serial port (COMx).
Network Driver	This allows communication with the power source using a virtual IP address. Using this driver, all built-in web server functions are available via USB using a browser.

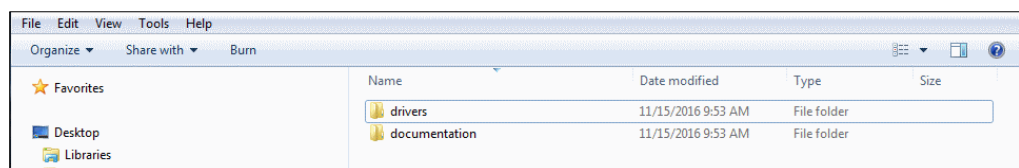
9.2 Installation

USB drivers are stored in the AGX controller and installed when the unit is first connected to a Windows PC. Proceed as follows:

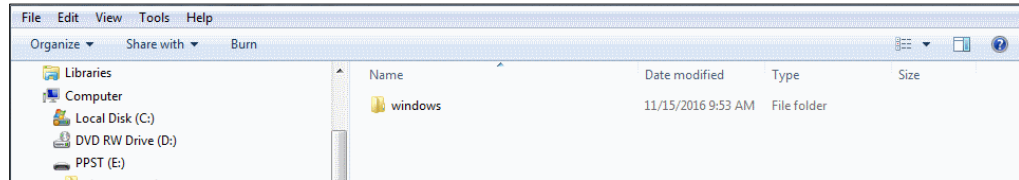
1. With the unit powered up, connect a USB cable between the unit's USB Device port on the rear panel and an available USB port on a Windows PC.
2. Once plugged it, the PC should detect the present of the unit. If this is the first time you connect to this PC, the drivers must be installed. This process should run automatically but if for some reason it does not, follow the subsequent steps.
3. On the drive popup shown below, select the "Open folder to view files" entry.



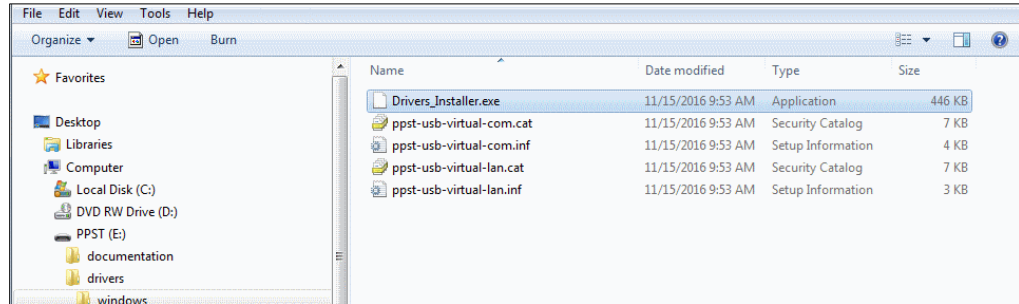
4. The directories shown below will be visible. Select the "drivers" directory



5. Next, select the “Windows” directory



6. Run the “Driver_Installer.exe” located in this directory as shown below.,



7. Allow the installation to complete.

At the end of this process, you should be able to see the two PPST USB drivers in the Windows Device Manager window under “Network Adaptors” and “Ports (COM & LPT)” respectively. The USB interface is now ready for use.

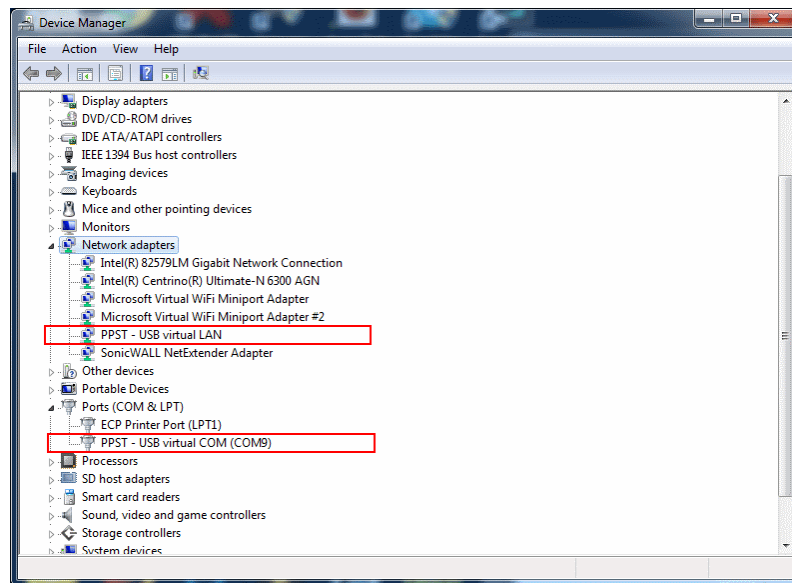


Figure 9-1: PPST USB Drivers visible in Windows Device Manager

10 LAN Interface Configuration

10.1 Overview

All models are equipped with a LAN (Ethernet) interface. As shipped, the unit automatically obtains an IP address from the network using the DHCP protocol. If the instrument is turned off for long periods, the IP address lease may expire and a new IP address will be assigned. If this is the case, it is possible to assign a fixed IP address instead.

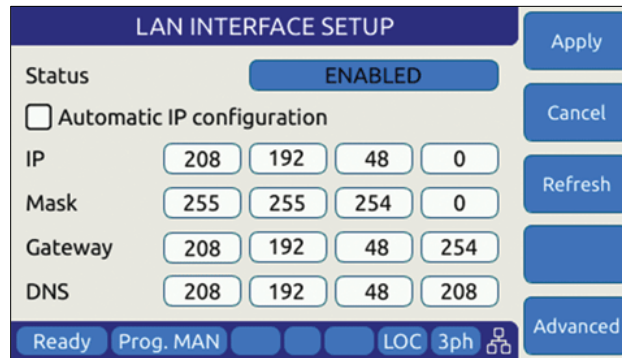
10.2 Web Browser Interface

The AGX, RGS and RLS Series® conform to the LXI (Lan eXtensions for Instrumentation) standard and as such has a built in web server. This allows communication with the unit from any web browser as long as the unit is on the same network.

Note: The built-in web server has been tested with Google Chrome and Mozilla Firefox browsers only. Microsoft Internet Explorer is now obsolete and is not supported. Other browsers like Edge or Safari may not fully operate or display information correctly.

Note: Web server use from a browser is **not** supported in *UPC Compatibility* mode. Disable this mode when operating the unit from a web browser.

Use the IP address shown in the LAN INTERFACE SETUP screen under the SYSTEM key to determine the IP address to type into the web browser.




CAUTION: BEFORE USING BROWSER CONTROL

Verify that the level of remote access control is appropriate for the situation at hand. The power source is capable of producing lethal output voltage and operating it without being physically in the same room or space present a safety risks to others. Refer to 10.3.2, “**Front Panel Access Control**”.

If the unit is on the same network or reachable through the internet, the home screen of the web server will appear.



Figure 10-1: LXI Web Server Home Screen

When permitted, the browser interface allows monitoring of measurements and/or full control of the power source. If the operator is not near the actual instruments being controlled, care must be taken to the appropriate access control limits.

10.3 Access Control

Since the power source is capable of producing hazardous voltages at its output terminals, remote operation of the product over a LAN connection or any other available remote control interface can be restricted by the user to include only monitoring functions rather than full programming controls.

This feature is provided to ensure the safety of anyone near the unit in its actual physical location. This access control mechanism requires granting specific access to certain functions and features from the front panel by a person present at the location of the power source and requesting permission first trying to access a unit remotely.

These access control functions can be set from the SYSTEM Menu, INTERFACE screen or via the webserver using any browser.



CAUTION

All Units are shipped from the factory with ACCESS CONTROL **DISABLED. It is the instrument's owner's responsibility to enable these features.**

10.3.1 Browser Access Control

When connecting to the power source via a browser on which access has been restricted, the following message will appear:

The browser Access dialog is shown below.

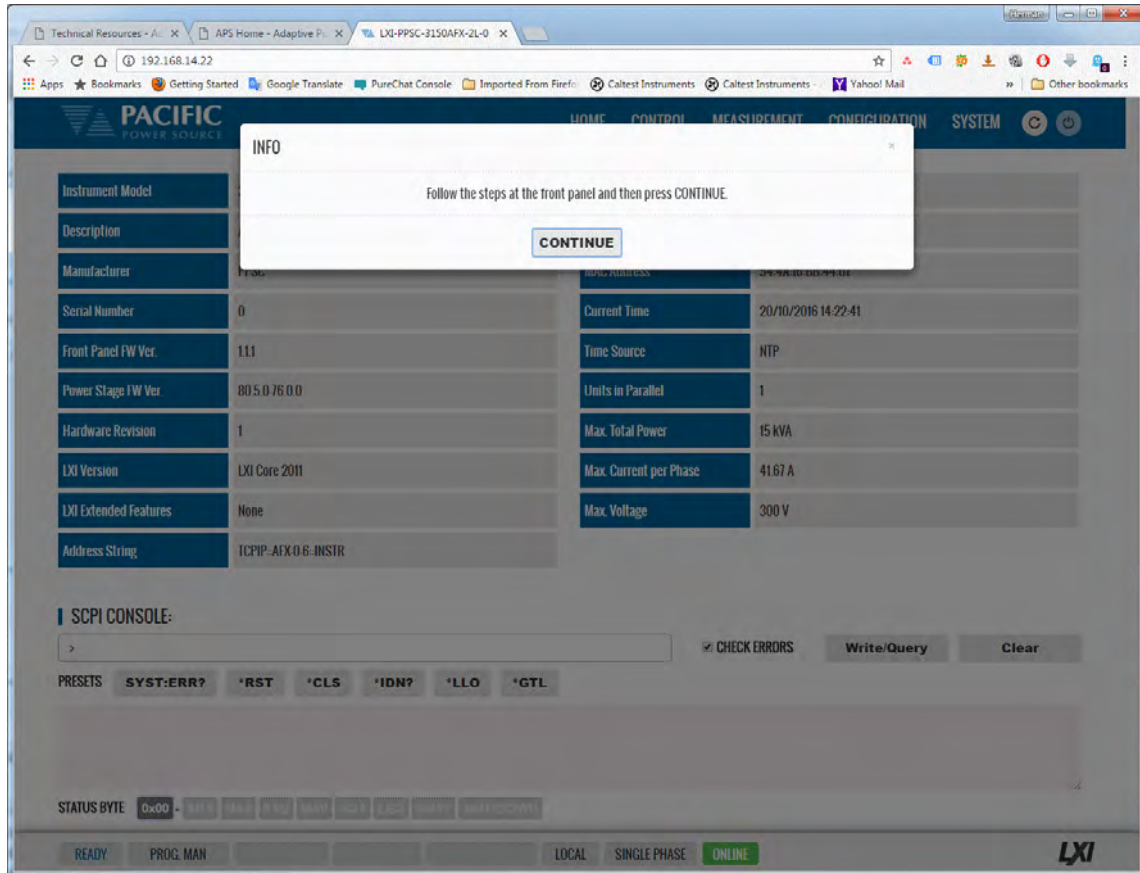


Figure 10-2: ACCESS CONTROL Dialog Screen

If the operator knows the four-digit access password that was set on the actual unit, he can enter the password code and gain full control of the source or Monitor⁸ only access depending on which mode was selected.

If the operator does not know the password, he can request access. Such a request can only be granted by a person who is in front of the actual unit however. This prevents unauthorized access from a remote location and protects the local user from possible harm. An Access Request will result in a Pop-Up message on the power source LCD screen.

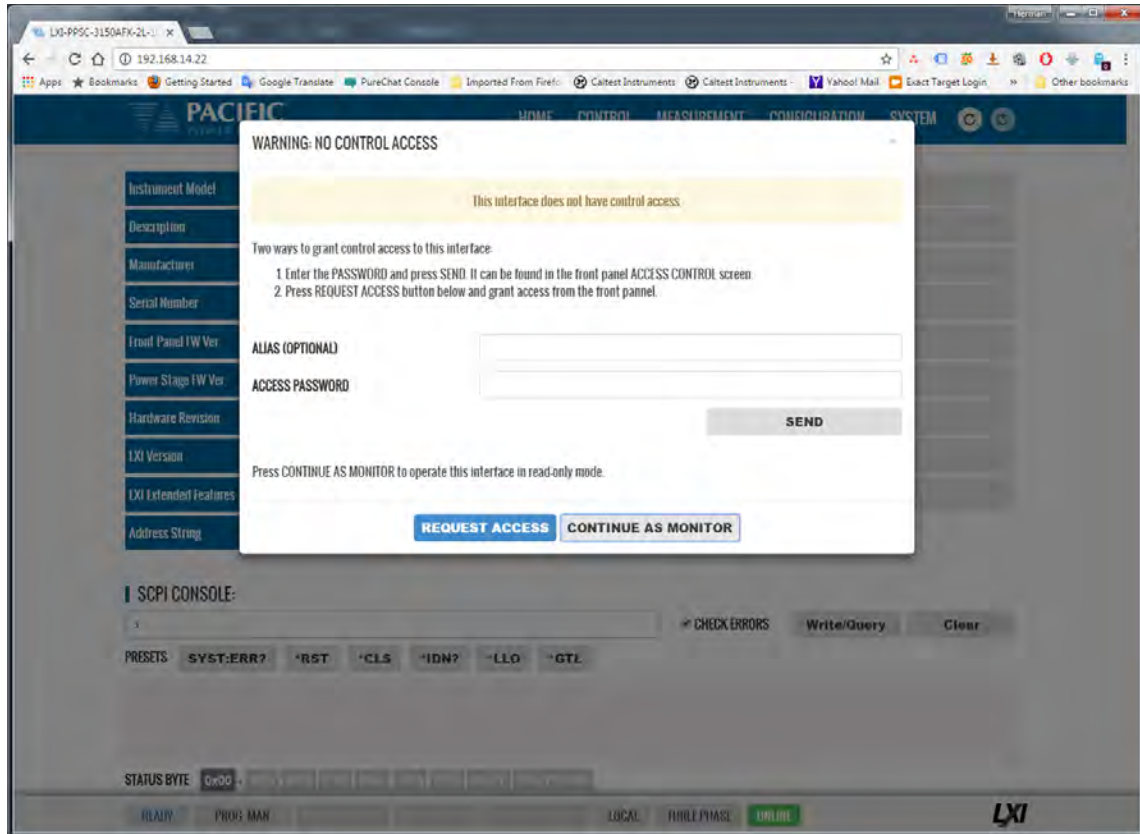
The access control password can be set/changed only by the person(s) present at the physical location of the unit. Factory default password is "1234" but it is strongly **advised** the end user changes this to his own code after receipt of the unit.

If access is denied, the browser interface will enter MONITOR only mode in which measurements and settings can be viewed remotely but control is possible. When in this mode, a user with knowledge of the access password can enter FULL CONTROL mode by supplying the

⁸ Note: Monitor Only access mode requires firmware revision 3.6.44 or higher.

correct password or request full access from a local operator that is present at the unit's location.

This dialog will appear when opening the browser interface while a unit is under ACCESS CONTROL.



Clicking on “REQUEST ACCESS” will result in a dialog box appearing on the unit’s LCD screen displaying the requestors IP address. A message on the browser will indicate action is needed by the local operator. Now, the local operator can either DENY or GRANT access.

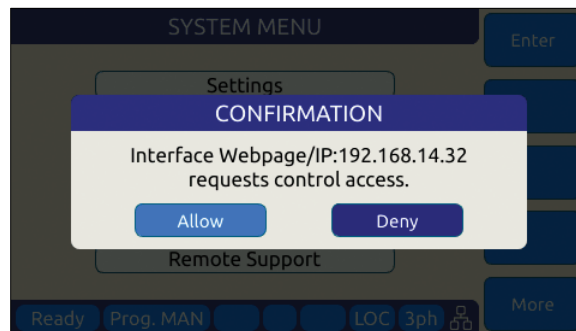
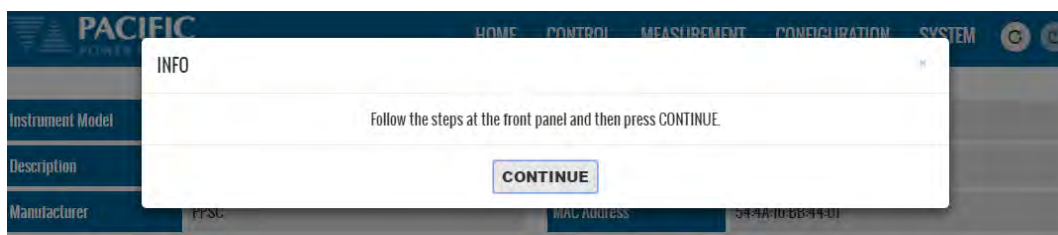


Figure 10-3: Remote Access Control Request Dialog

If remote access is granted, full control is provided. If denied, only monitoring is available.

Note: If the remote operator was given the ACCESS passcode, he can use it to gain access without a local operator’s intervention.



When granted, the requestor's IP address will be added to the whitelist IP. The operator can remove any of the white listed IP addresses at any time if needed. This will lock out remote access for that PC until access is re-granted anew.

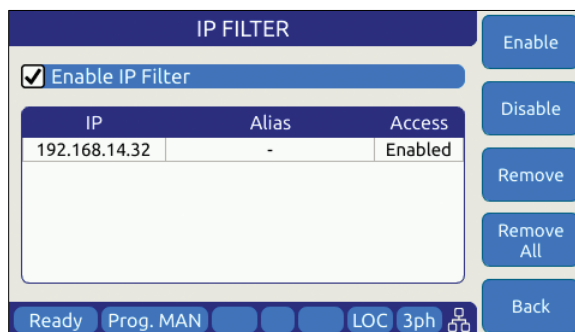
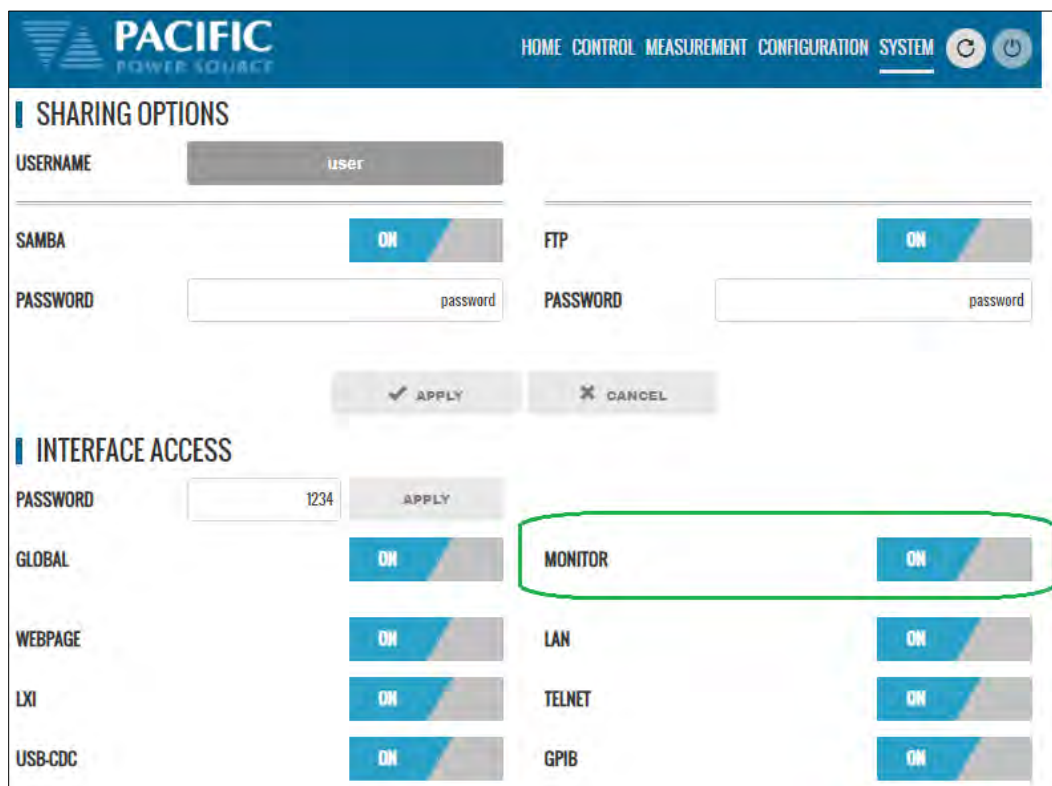


Figure 10-4: Remote Access Control IP Filter screen

Remote access can be configured from the System menu. To enable Monitor only mode, turn MONITOR on as shown below. In this mode, settings and measurements can be viewed but no changes can be made remotely.



Monitor mode can also be selected from the front panel using the System, Access Control screen as shown below.

ACCESS CONTROL

Password: 1234

☒ Monitor mode

Interface	Access
Webpage	Enabled
LAN	Enabled
LXI	Enabled
Telnet	Enabled
USB-CDC	Enabled
GPIOB	Enabled

Buttons: Disable All, Enable, Disable, IP Filter, Next Screen

Bottom bar: Ready, Prog. MAN, D, S/M, LOC, 3ph

If Monitor mode is disabled, the browser access control screen will look like this.

WARNING: NO CONTROL ACCESS

This interface does not have control access.

Two ways to grant control access to this interface:

1. Enter the PASSWORD and press SEND. It can be found in the front panel ACCESS CONTROL screen.
2. Press REQUEST ACCESS button below and grant access from the front panel.

ALIAS (OPTIONAL):

ACCESS PASSWORD:

SEND

Unit is used by John. Please contact 123456789.

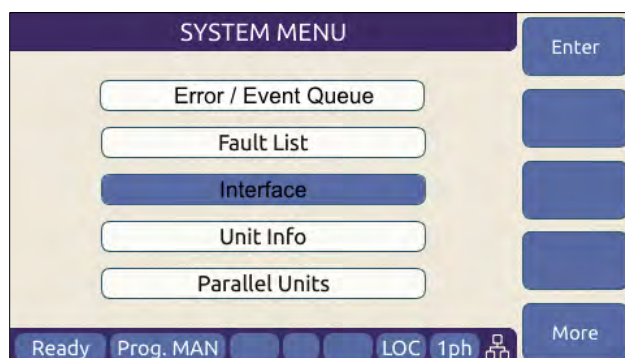
Monitor mode is disabled on frontpanel.

REQUEST ACCESS

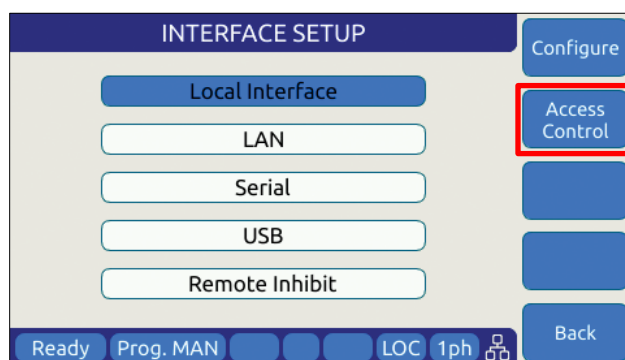
The message at the bottom of the screen can be set by the main user with the `SYSTem:REMOte:ACCESS:MESSage` SCPI command. In this example, the following command was used:
`SYSTem:REMOte:ACCESS:MESSage "Unit is used by John. Please contact 123456789."`

10.3.2 Front Panel Access Control

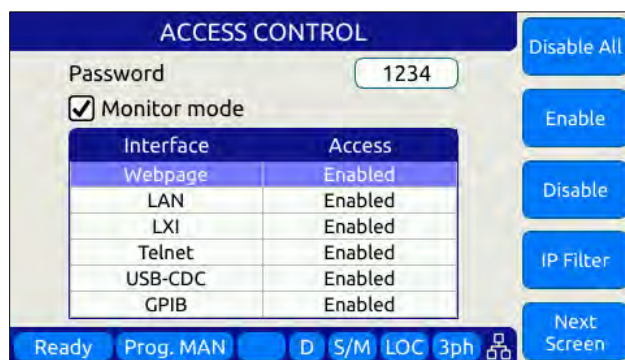
Setting remote control access levels and interface types is accomplished from the SYSTEM menu under Interfaces.



Scroll down to the INTERFACE entry and press Enter to access the available INTERFACE SETUP screen.



The second soft key is labelled “Access Control” and brings up the access control screen shown below.



The IP Filter list will provide access to the list of IP addresses that have been granted access by the local operator. This list can be erased if it is necessary to deny future access to the power source.

10.4 Web Browser Interface

The AGX, RGS and RLS Series® conform to the LXI (Lan eXtensions for Instrumentation) standard and features a built-in web server with a greatly expanded feature set. This allows communication with the unit from any web browser as long as the AGX is reachable through the network or internet. The expanded feature set of the web server often eliminates the need to use additional Windows or other platform based software.

10.5 Available Web Interface Menu Tree

The following areas of control, monitoring and configuration of the AGX power source are available through a web browser.

- Home Screen – Required for LXI compliance
- Home Screen SCPI Console Command Line Interface
- SOURCE CONTROL
 - PROGRAM
 - PROTECTIONS
 - TRANSIENTS
 - PROGRAM MEMORY
 - WAVEFORM
 - WAVEFORM EDITOR
 - SCPI SCRIPT
- MEASUREMENTS
 - MONITOR
 - REAL-TIME PLOT
 - V/I PLOT
 - DATALOGGER
 - SCOPE
 - HARMONICS
- CONFIGURATION
 - UNIT SETTINGS
 - USER LIMITS & PRESETS
 - RAMP & SLEW
- SYSTEM
 - ERROR/EVENT QUEUE
 - FAULT LIST
 - INTERFACE SETUP
 - ACCESS CONTROL
 - DIGITAL & ANALOG IOS
 - UNIT INFORMATION
 - PARALLEL UNITS
 - MEMORY MANAGER
 - CALIBRATION
 - REMOTE SUPPORT
 - IMPORT/EXPORT
 - FIRMWARE UPDATE
 - SANITIZE & REBOOT

Following sections provide an overview of each page of the web browser interface.

The Home screen contains all required information relating to the instrument and its LAN connection as required by the LXI standard. This includes hardware and firmware revision information. The NTP clock **SYNC** button in the Current Time field is yellow if it detects that the date, time or zone is different than the computer, otherwise is in gray. Press the button to sync to the NTP time server.

Near the bottom of the screen is an interactive command line interface that allows individual SCPI commands to be sent to the instrument. Any query results are shown in the text box below the command line. A drop-down list of all available commands is integrated in the command line and as you type a command, a match will be tracking in the drop down list allowing you to select the complete command without typing it out. See sample below after typing "SY".

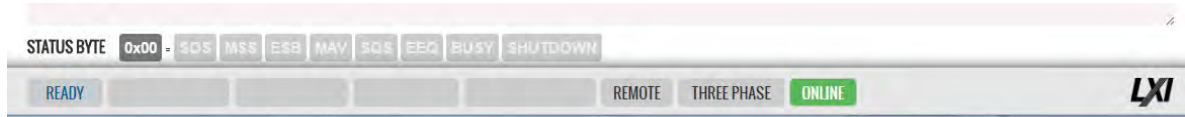


Note: All models also support a SCPI Command scripting function. See Section 10.7.9, “SCPI Script”, on page 597

10.6.2 Status Byte Display

At the very bottom of the Home Screen, the status byte register value and decoded fields are displayed for reference. Status byte fields are described in section 0, “

Status Byte Register (STB)” on page 560.



10.6.3 Browser Status Bar

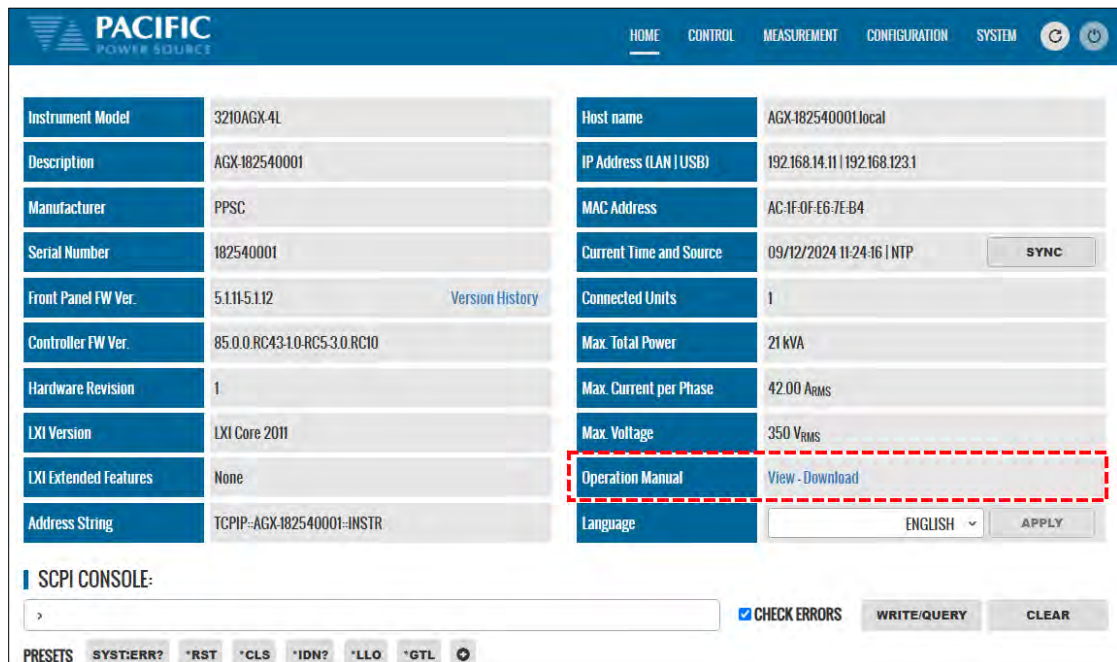
The browser status bar shows configuration information about the instrument. This includes any error or event flags, remote or local status, phase mode selection and on or offline status.



The first field will display **READY** while the power source output is OFF and **ENABLED** when it is ON (enabled).

10.6.4 Operation Manual PDF

The AGX Operation Manual is stored on the AGX’s internal memory and available for download to the user’s PC (“Download”) or for viewing using a suitable browser of PDF viewer (“View”).

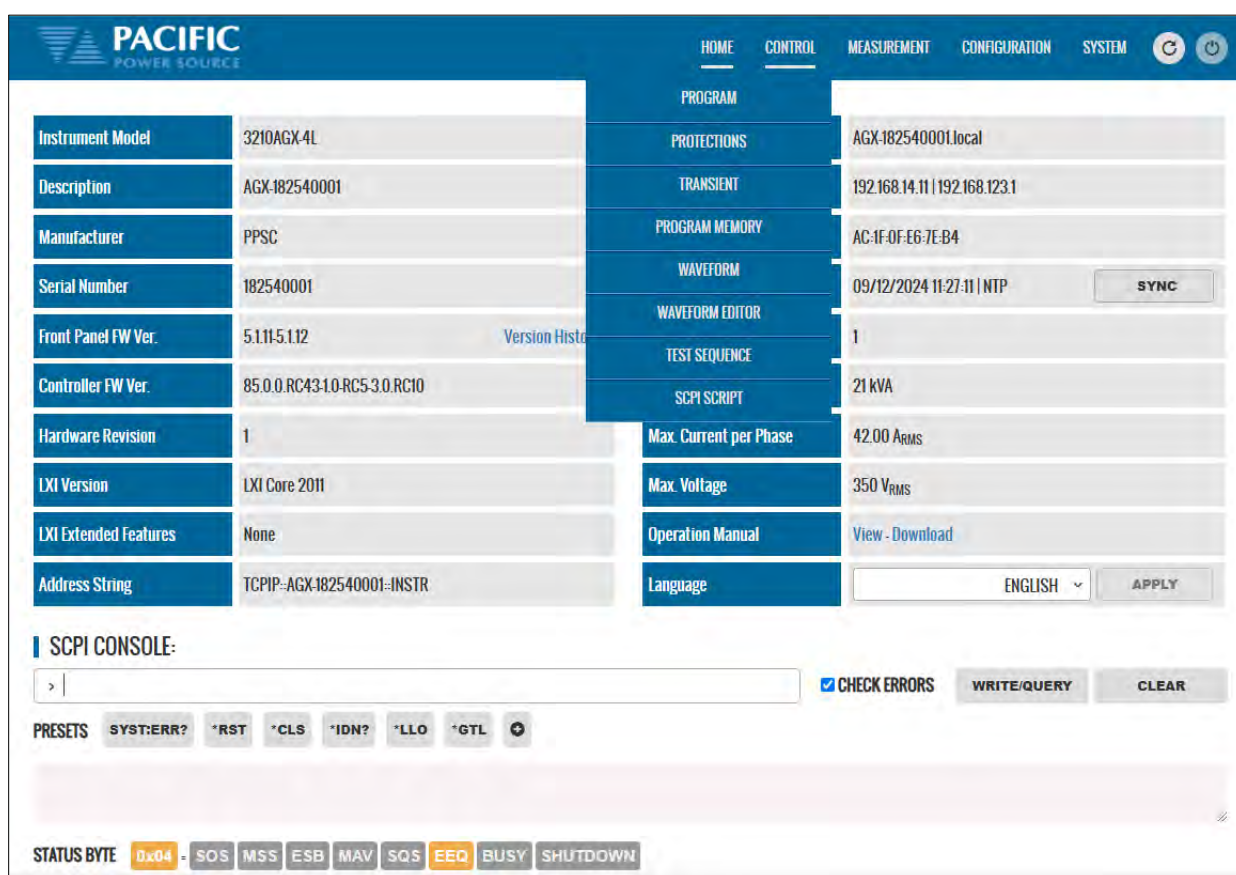


10.7 Source Control Screens

The CONTROL menu provides access to several screens that allow programming of the power source. Control Menu entries are as follows:

- PROGRAM
- PROTECTIONS
- TRANSIENT
- PROGRAM MEMORY
- WAVEFORM
- WAVEFORM EDITOR
- SCPI SCRIPT
- TEST SEQUENCE

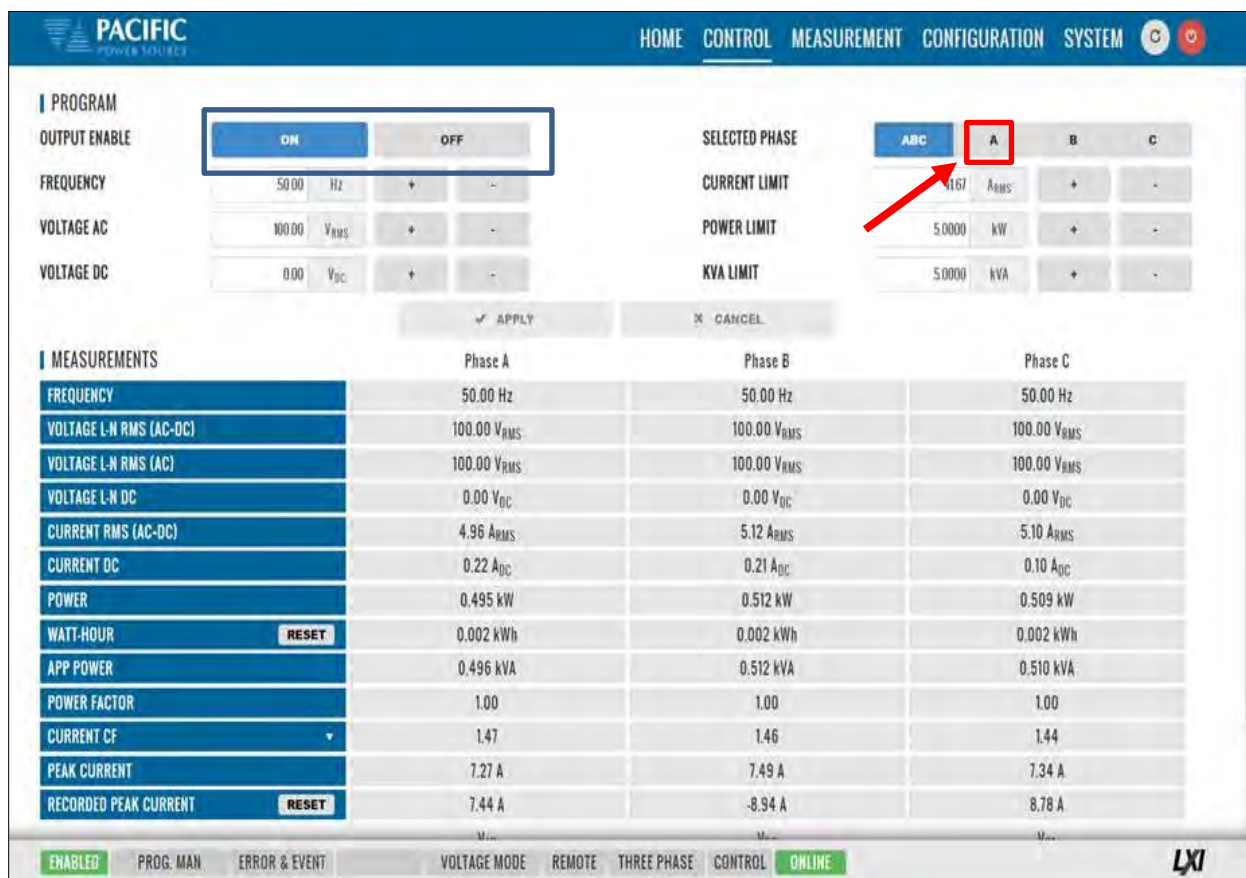
Each is described in subsequent sections.



The screenshot displays the PACIFIC POWER SOURCE web interface. The top navigation bar includes links for HOME, CONTROL, MEASUREMENT, CONFIGURATION, and SYSTEM. The CONTROL menu is expanded, showing options: PROGRAM, PROTECTIONS, TRANSIENT, PROGRAM MEMORY, WAVEFORM, WAVEFORM EDITOR, TEST SEQUENCE, and SCPI SCRIPT. The left sidebar lists instrument details: Instrument Model (3210AGX-4L), Description (AGX-182540001), Manufacturer (PPSC), Serial Number (182540001), Front Panel FW Ver. (5.11f5.112), Controller FW Ver. (85.0.0.RC43-1.0.RC5-3.0.RC10), Hardware Revision (1), LXI Version (LXI Core 2011), LXI Extended Features (None), and Address String (TCPIP-AGX-182540001-INSTR). The right sidebar shows configuration settings: Max. Current per Phase (42.00 Arms), Max. Voltage (350 Vrms), Operation Manual (View - Download), and Language (ENGLISH). The SCPI CONSOLE section includes a command input field, a PRESETS dropdown, and a STATUS BYTE display showing 0x04, SOS, MSS, ESB, MAV, SQS, EEQ, BUSY, and SHUTDOWN.

10.7.1 Program

The program control screen allows programming of all output parameters, operating modes etc. It also displays measurement data for all available phases in the lower part of the screen. In three or two phase mode, Line-to-Line voltage measurements are displayed at the bottom of the screen. The Output can be enabled using the “OUTPUT ENABLE” controls in the upper PROGRAM screen. The Output can also be turned **OFF** from any screen using the RED On/Off symbol in the menu bar, which is accessible from all screens. This allows quick opening of the output relay if needed from any screen without have to first select the PROGRAM screen. Note that the output can only be turned **ON** (or OFF) from the PROGRAM screen however.



PROGRAM

OUTPUT ENABLE: **ON** **OFF**

FREQUENCY: 50.00 Hz

VOLTAGE AC: 100.00 V_{RMS}

VOLTAGE DC: 0.00 V_{DC}

SELECTED PHASE: **A** (highlighted with red box) | ABC | B | C

CURRENT LIMIT: 4.167 A_{RMS} (highlighted with red arrow)

POWER LIMIT: 5.000 kW

KVA LIMIT: 5.000 kVA

APPLY CANCEL

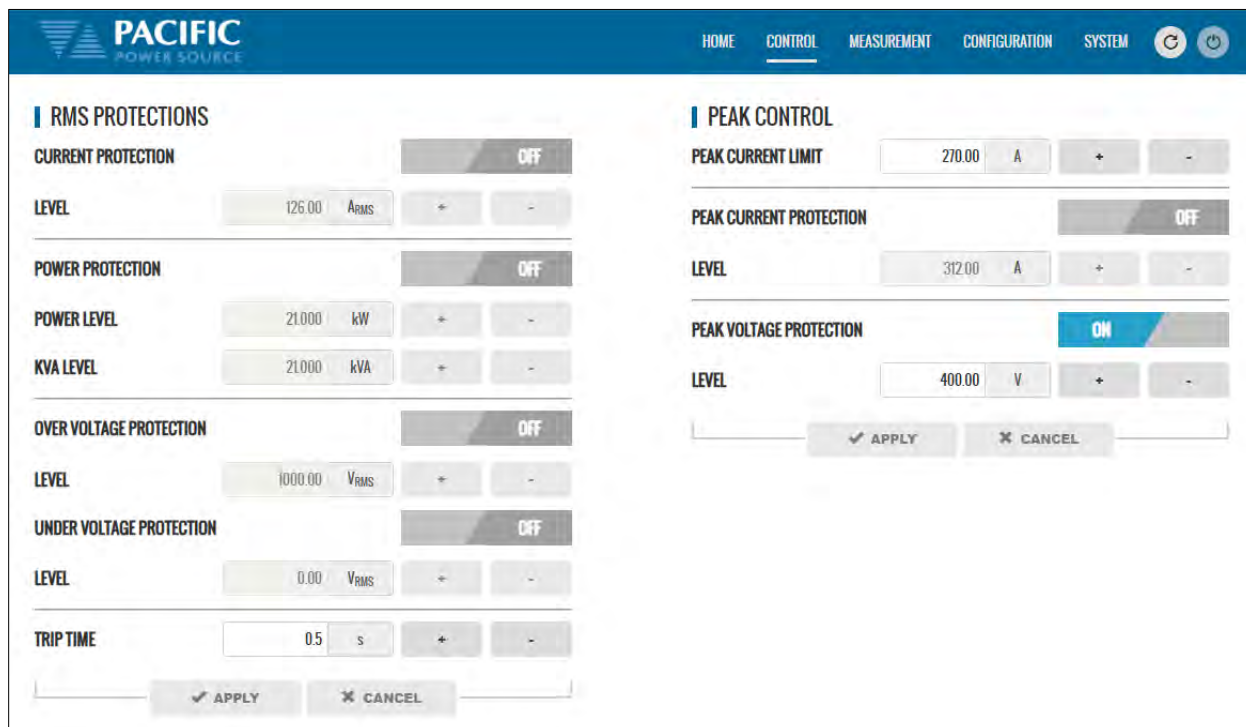
MEASUREMENTS

	Phase A	Phase B	Phase C
FREQUENCY	50.00 Hz	50.00 Hz	50.00 Hz
VOLTAGE L-N RMS (AC-DC)	100.00 V _{RMS}	100.00 V _{RMS}	100.00 V _{RMS}
VOLTAGE L-N RMS (AC)	100.00 V _{RMS}	100.00 V _{RMS}	100.00 V _{RMS}
VOLTAGE L-N DC	0.00 V _{DC}	0.00 V _{DC}	0.00 V _{DC}
CURRENT RMS (AC-DC)	4.96 A _{RMS}	5.12 A _{RMS}	5.10 A _{RMS}
CURRENT DC	0.22 A _{DC}	0.21 A _{DC}	0.10 A _{DC}
POWER	0.495 kW	0.512 kW	0.509 kW
WATT-HOUR	0.002 kWh	0.002 kWh	0.002 kWh
APP POWER	0.496 kVA	0.512 kVA	0.510 kVA
POWER FACTOR	1.00	1.00	1.00
CURRENT CF	1.47	1.46	1.44
PEAK CURRENT	7.27 A	7.49 A	7.34 A
RECORDED PEAK CURRENT	7.44 A	8.94 A	8.78 A

ENABLED PROG. MAN ERROR & EVENT VOLTAGE MODE REMOTE THREE PHASE CONTROL ONLINE LXI

10.7.2 Protections

The Protections screen may be used to change protection modes and threshold values. This includes RMS current, Peak Current, True Power and Apparent Power protection modes. Modes can be toggled on or off individually.



PACIFIC POWER SOURCE

HOME CONTROL MEASUREMENT CONFIGURATION SYSTEM

RMS PROTECTIONS

CURRENT PROTECTION **OFF**

LEVEL 126.00 Arms

POWER PROTECTION **OFF**

POWER LEVEL 21.000 kW

KVA LEVEL 21.000 kVA

OVER VOLTAGE PROTECTION **OFF**

LEVEL 1000.00 VRMS

UNDER VOLTAGE PROTECTION **OFF**

LEVEL 0.00 VRMS

TRIP TIME 0.5 s

PEAK CONTROL

PEAK CURRENT LIMIT 270.00 A

PEAK CURRENT PROTECTION **OFF**

LEVEL 312.00 A

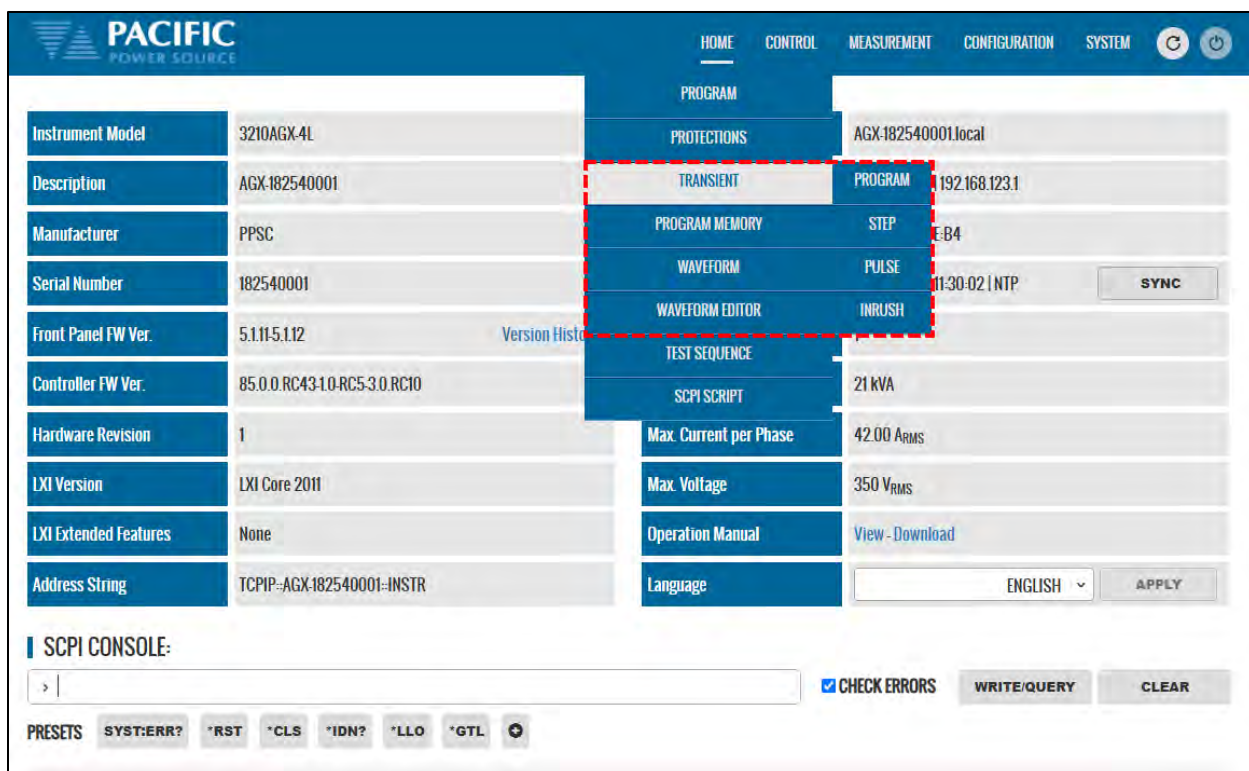
PEAK VOLTAGE PROTECTION **ON**

LEVEL 400.00 V

✓ APPLY ✗ CANCEL

10.7.3 Transients

The transient control screen allows programming of new transients or execution control of new or stored transient programs. The power source supports LIST, STEP and PULSE transient modes.



PACIFIC POWER SOURCE

HOME CONTROL MEASUREMENT CONFIGURATION SYSTEM

PROGRAM

Instrument Model: 3210AGX-4L

Description: AGX-182540001

Manufacturer: PPSC

Serial Number: 182540001

Front Panel FW Ver.: 5.1.11-5.1.12

Controller FW Ver.: 85.0.0.RC43-1.0.RC5-3.0.RC10

Hardware Revision: 1

LXI Version: LXI Core 2011

LXI Extended Features: None

Address String: TCPIP-AGX-182540001-INSTR

PROGRAM: AGX-182540001.local

PROTECTIONS: 192.168.123.1

TRANSIENT: E-B4

PROGRAM MEMORY: STEP

WAVEFORM: PULSE

WAVEFORM EDITOR: INRUSH

TEST SEQUENCE: 21 kVA

SCPI SCRIPT: 42.00 ARMS

Max. Current per Phase: 350 VRMS

Max. Voltage: View - Download

Language: ENGLISH

SCPI CONSOLE:

> |

☒ CHECK ERRORS WRITE/QUERY CLEAR

PRESETS SYST:ERR? *RST *CLS *IDN? *LLO *GTL

10.7.3.1 LIST Transients

For LIST transients, both STEP mode and SEGMENT mode is supported. The bottom part of the screen shows the editable transient table. Execution controls are located in the top part of the screen.

Data entry mode can be selected as either STEP or SEGMENT. Dwell times can be entered using msec (TIME BASED) or cycles (CYCLE BASED). A sample TIME BASED Segment mode list is shown below.

TRANSIENT EXECUTION

▶ RUN STOP STEP RESTART

STATE: STOPPED

PROGRESS: 0%

REPEAT TIMES COUNTER: 0

CONFIGURATION: SETTINGS

RUN FROM SEGMENT #: 1

RUN TO SEGMENT #: 4

REPEAT TIMES: Infinite

APPLY CANCEL

TRANSIENT TABLE

MODE: STEP **SEGMENT**

EDIT MODE: CYCLE BASED **TIME BASED**

#	TIME [ms]	FREQ [Hz]	V _{AC} [V _{RMS}] A/B/C	V _{DC} [V] A/B/C	Waveform [#] A/B/C	Phase [deg] B/C	
> 1	1000.0	60.00	120.00	0.02	1	120.00/240.00	+ ×
> 2	16.6	60.00	132.00/120.00/120.00	0.01	1	120.00/240.00	+ ×
> 3	5000.0	60.00	120.00	0.00	1	120.00/240.00	+ ×
> 4	100.0	60.00	120.00/132.00/108.00	0.00	1	120.00/240.00	+ ×

APPLY CANCEL IMPORT EXPORT + ADD ROW - DELETE ROW CLEAR

READY PROG. MAN REMOTE THREE PHASE CONTROL **ONLINE** LXI

Import / Export Function

List Transients can be saved to excel compatible CSV files using the EXPORT button at the bottom of the List transient screen. A sample is shown to the right.

These same files can be Imported later eliminate the need to re-enter the transient list. The IMPORT button opens a file browser so select and load previously save CSV transient files. This function automatically changes between step or segment mode and edit mode according to the CSV file content.

A sample CYCLE BASED Segment mode list is shown below.

```
transient.csv - Notepad
File Edit Format View Help
SEP=,
Mode=Segment
Edit Mode=Time based
Time[ms],Frequency [Hz],AC [RMS],DC,Phase [Deg], Waveform
10.0,60,5/6/7,30/20/10,0/120/240,1/1/1
200.0,65,5/6/7,30/20/10,0/120/240,1/1/1
200.0,75,0/0/0,0/0/0,0/120/240,2/2/2
```



HOME
CONTROL
MEASUREMENT
CONFIGURATION
SYSTEM

TRANSIENT EXECUTION

▶ RUN
■ STOP
⏮ STEP
⏪ RESTART

STATE

STOPPED

PROGRESS

0%

REPEAT TIMES COUNTER

0

CONFIGURATION

⚙ SETTINGS

RUN FROM SEGMENT #

0

RUN TO SEGMENT #

0

REPEAT TIMES

∞ Infinite

✓ APPLY

✗ CANCEL

TRANSIENT TABLE

MODE

STEP

SEGMENT

EDIT MODE

CYCLE BASED

TIME BASED

	#	CYCLES	FREQ [Hz]	V _{AC} [V _{RMS}] A/B/C	V _{DC} [V] A/B/C	Waveform [#] A/B/C	Phase [deg] B/C		
>	1	60	60.00	120.00	0.02	1/1/1	120.00/240.00	+	×
>	2	1	60.00	132.00/120.00/120.00	0.01	1/1/1	120.00/240.00	+	×
>	3	300	60.00	120.00	0.00	1/1/1	120.00/240.00	+	×
>	4	6	60.00	120.00/132.00/108.00	0.00	1/1/1	120.00/240.00	+	×

✓ APPLY

✗ CANCEL

📁 IMPORT

📁 EXPORT

+ ADD ROW

- DELETE ROW

🗑 CLEAR

READY
PROG. MAN

REMOTE
THREE PHASE
CONTROL

ONLINE



Continued on next page...

A sample TIME BASED STEP mode list is shown below. (Not to be confused with STEP Transient mode, see next section.)

TRANSIENT EXECUTION

STATE: **STOPPED**

PROGRESS: 0%

REPEAT TIMES COUNTER: 0

CONFIGURATION:

RUN FROM STEP #:

RUN TO STEP #:

REPEAT TIMES:

TRANSIENT TABLE

MODE: **STEP**

EDIT MODE:

#	RAMP [ms]	DWELL [ms]	FREQ [Hz]	V _{AC} [V _{RMS}] A/B/C	V _{DC} [V] A/B/C	Waveform [#] A/B/C	Phase [deg] B/C		
> 1	0.2	1000.0	60.00	120.00	0.02	1	120.00/240.00	+	✗
> 2	0.2	16.8	60.00	132.00/120.00/120.00	0.01	1	120.00/240.00	+	✗
> 3	100.0	5000.0	60.00	120.00	0.00	1	120.00/240.00	+	✗
> 4	100.0	0.0	60.00	120.00/132.00/108.00	0.00	1	120.00/240.00	+	✗

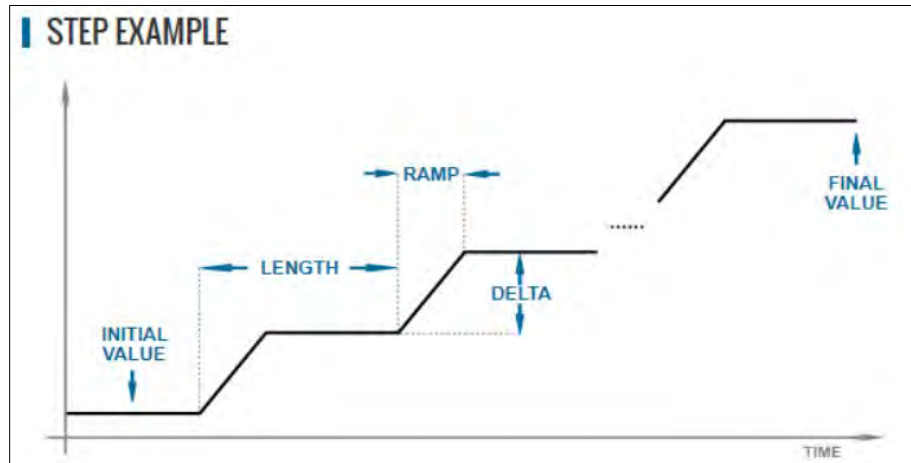
READY PROG MAN REMOTE THREE PHASE CONTROL **ONLINE** LXI

During transient execution, a progress indicator is visible showing percent completion.

10.7.3.2 STEP Transients

STEP transients allow a ramp or stairstep output profile to be programmed without creating LIST transients with multiple entries. In STEP transient mode, the user enters initial value, end value, delta step size, step duration, step count and no of repeats.

The STEP EXAMPLE shows the relationship between the various parameters.



This information is transformed to a standard Segment based transient list by the power source when the LOAD button is pressed.

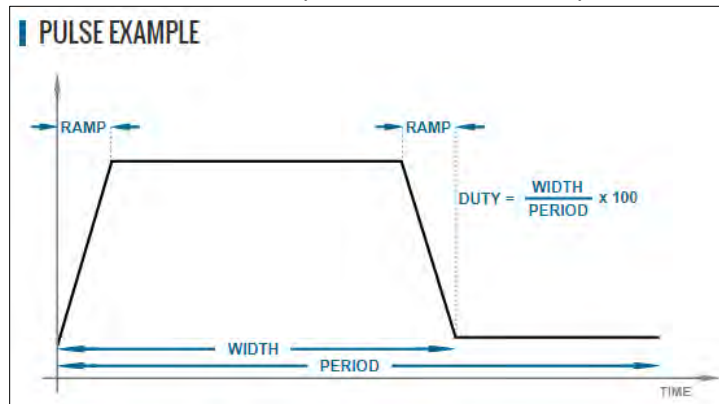
SELECTED PHASE	SETPOINT	INITIAL	DELTA	FINAL	UNIT
FREQUENCY	60.00	60.00	0.00	60.00	Hz
VOLTAGE AC	0.00	0.00	0.00	0.00	V _{RMS}
VOLTAGE DC	0.00	0.00	0.00	0.00	V _{DC}

During transient execution, a progress indicator is visible showing percent completion.

10.7.3.3 PULSE Transients

PULSE transients allow series of pulsed output levels to be programmed without creating LIST transients with repetitive entries. In PULSE transient mode, the user enters Level, duty cycle, ramp time, period initial value and pulse count. This mode is useful for high and low line testing for voltage and frequency operating limits of an EUT.

The PULSE EXAMPLE shows the relationship between the various parameters.



This information is transformed to a standard Segment based transient list by the power source when the LOAD button is pressed.

The screenshot displays the Pacific Power Source control interface. Key sections include:

- PULSE EXECUTION**: Contains buttons for RUN, STOP, STEP, and RESTART. The STATE is currently STOPPED. The PROGRESS is 0%. The PULSE COUNTER is 0. The TRANSIENT section has a LOAD button and a VIEW button.
- PULSE SETTINGS**: A section for configuring pulse parameters. It includes an EDIT MODE dropdown set to PERIOD & WIDTH. Parameters include:
 - PULSE PERIOD: 200.0 ms
 - PULSE WIDTH: 100.0 ms
 - PULSE DUTY CYCLE: 50.0 %
 - PULSE RAMP TIME: 0.2 ms
 - PULSE COUNT: 1
- PULSE VALUES**: A section for setting pulse characteristics. It includes:
 - SELECTED PHASE: ABC
 - PULSE FREQUENCY: 60.00 Hz
 - PULSE VOLTAGE AC: 0.00 V_{RMS}
 - PULSE VOLTAGE DC: 0.00 V_{DC}
 - PULSE WAVEFORM: 1
- PULSE EXAMPLE**: A diagram showing a pulse waveform with RAMP, WIDTH, and PERIOD labels, and the formula $DUTY = \frac{WIDTH}{PERIOD} \times 100$.

During transient execution, a progress indicator is visible showing percent completion.

10.7.4 Interharmonic

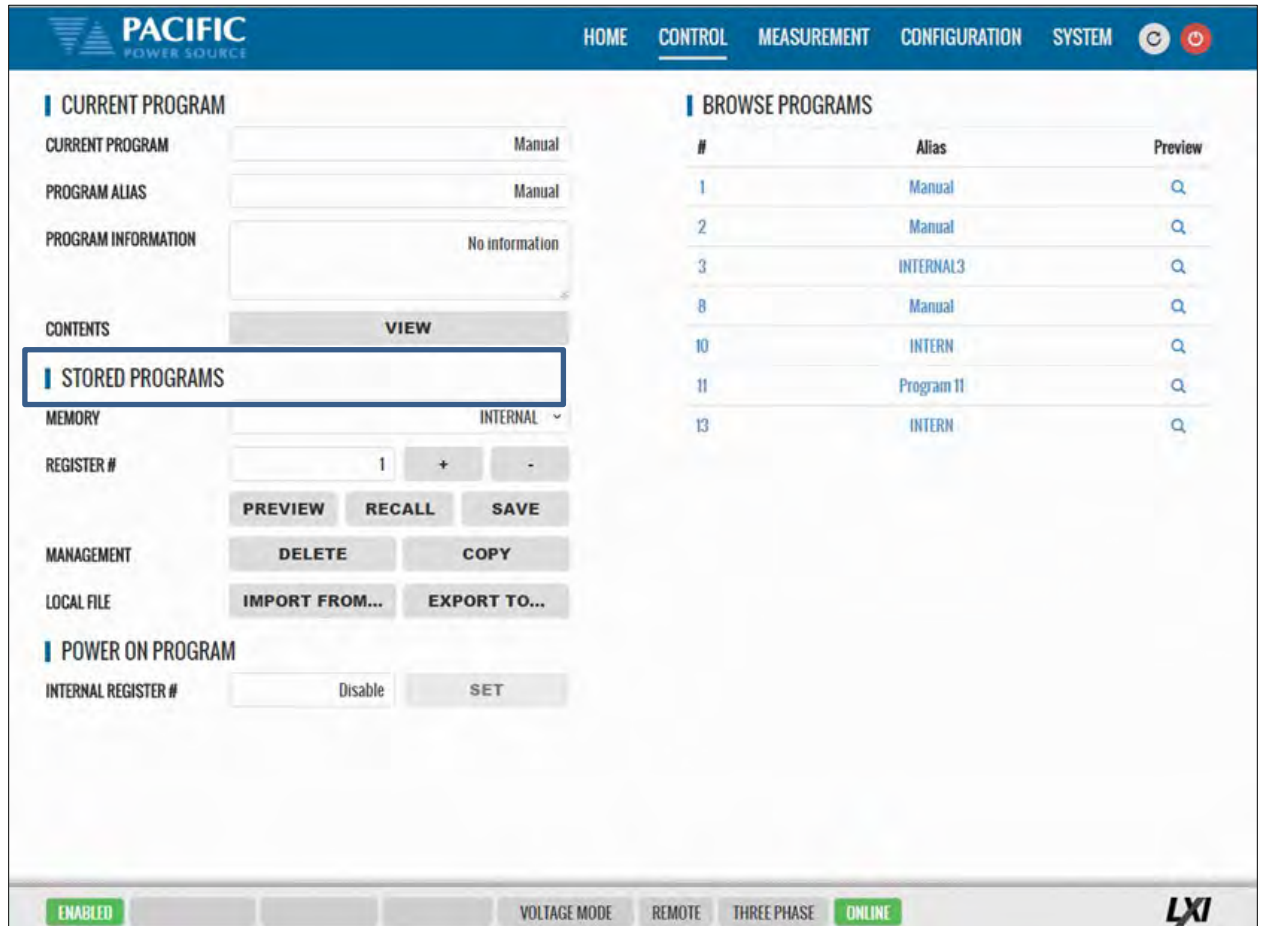
The Interharmonic screen allows the user to program one interharmonic¹ and up to 5 harmonic frequencies.

The interharmonics frequency and amplitude can be set in the upper part of the screen. The frequency set is independent of the programmed fundamental frequency. Amplitude can be set in absolute voltage. The controller uses a precision regulation loop for each of these five harmonics so harmonics amplitude is precisely regulated to compensate for load current and attenuation in the power source amplifiers. This results in a more precise amplitude accuracy for harmonics compared to using an arbitrary waveform.

Note 1: Interharmonics are only available and visible if the -413 Interharmonics option is installed. If installed, a “C” will be appended to the AGX model number.

10.7.5 Program Memory

Program settings and transients can be stored in a number of different memory types. The Program Memory screen allows the user to manage available stored programs. The program to be recalled on power up can be selected at the bottom of this screen in the “POWER ON PROGRAM” area.

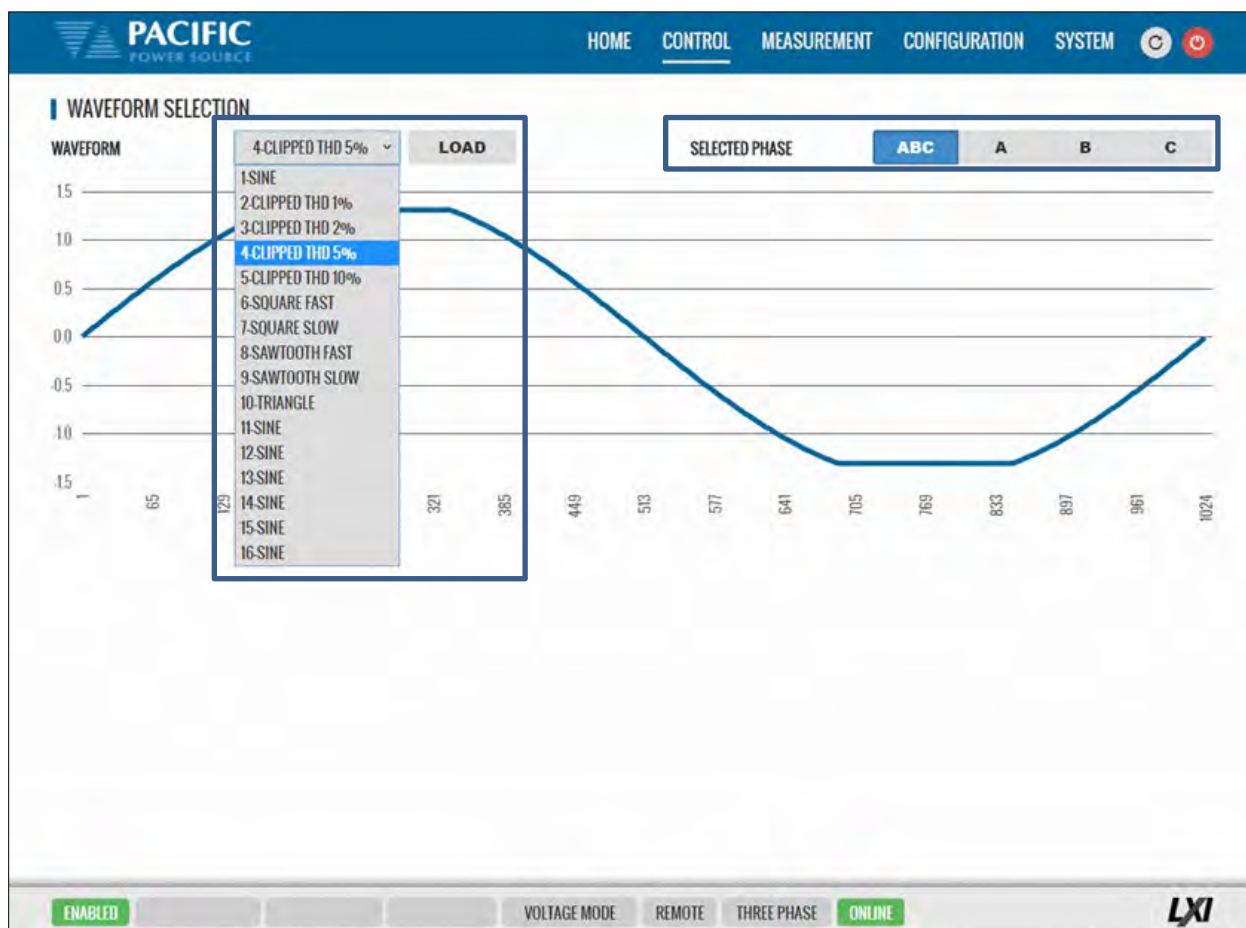


#	Alias	Preview
1	Manual	Q
2	Manual	Q
3	INTERNAL3	Q
8	Manual	Q
10	INTERN	Q
11	Program 11	Q
13	INTERN	Q

Note that external storage devices may be selected under “**STORED PROGRAMS**” using the MEMORY drop down list control.

10.7.6 Waveform

The power source supports a number of waveforms, most of which are user programmable arbitrary waveforms. The Waveform screen may be used to preview, select and download any of the waveforms stored in internal memory for output on one or more phases. The phase selection “ABC” or separate “A:”, “B” and “C” buttons on the upper right hand side are used to select all or an individual phase. The WAVEFORM drop down list will show all available waveforms.



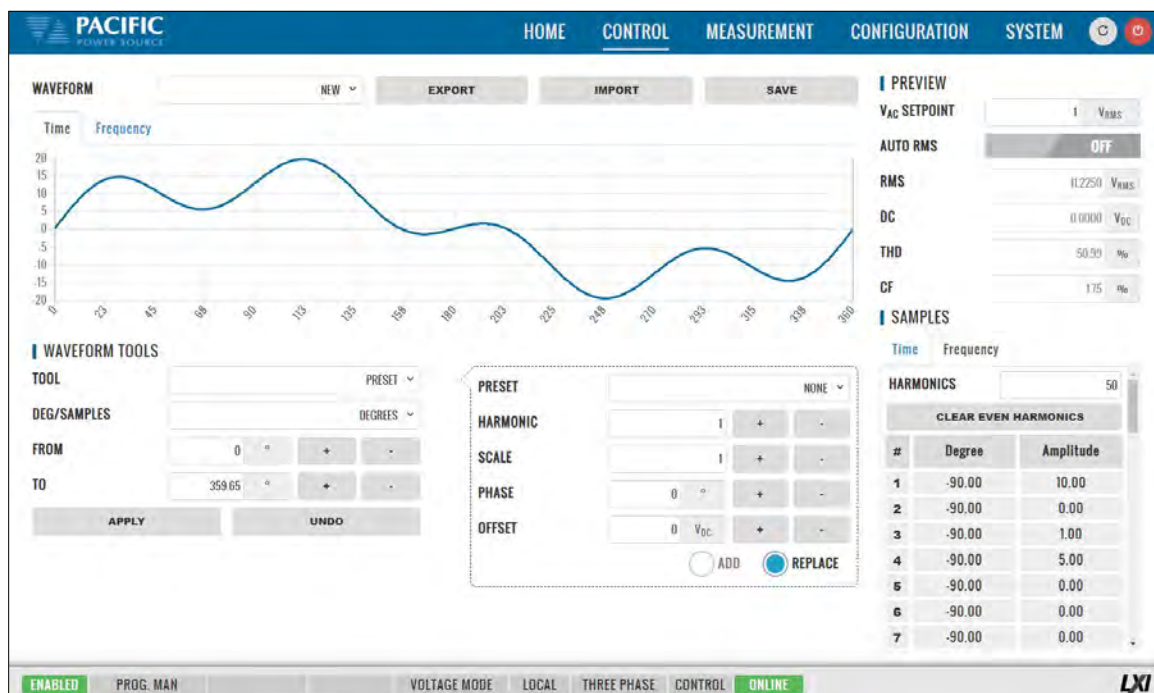
In addition to selecting the active waveform for output, the following controls are available to manage waveforms:



CONTROL	Purpose
IMPORT....	Import csv format waveform data files.
EXPORT...	Export selected waveform to csv format file
EDIT...	Access Waveform Edit screen to edit selected waveform. Also available from the CONTROL pull-down menu.
DELETE	Delete selected waveform. Note: Waveform 1-SINE cannot be deleted.
NEW...	Access the Waveform Edit screen to create a new waveform in the browser.

10.7.7 Waveform Editor

The waveform Editor function allows creation of custom waveforms. Each waveform records consists of 1024 data points (0.35° resolution). Data points can be indexed in Degrees or points. A value can be entered for each data point. There are several tools to generate hamonics, sum to a base sine wave or import a .csv file.



The following tools and controls are available in the Waveform Edit screen:

CONTROL	Purpose
WAVEFORM	Selects any available waveform to edit or select NEW to create a new waveform.
EXPORT	Export selected waveform to csv format file
IMPORT	Import csv format waveform data files.
SAVE	Saves selected waveform to power source memory
SAMPLES	Select no of data points used to defined wave shape. Available settings are 1024 through 2. For best definition, use 1024 data points. Lower point selections will result in interpolation of points in between. All waveforms are stored at 1024-point resolution. See examples on next page.
PREVIEW	
	Vac SETPOINT: Scales vertical axis to show voltage levels.
	AUTO RMS: Scales waveform levels to maintain Vac RMS value specified.
	RMS: Targeted Vac RMS level.
	THD: Shows total harmonic distortion in % of fundamental H1 for voltage waveform.
	DC: Targeted DC offset
	CF: Shows Crest Factor of voltage waveform.

10.7.7.1 Data Points

Waveform creation using direct data entry for each data point is faster when using fewer data points. Examples below show sine wave creation using either 16 or 4 data points. However, data is interpolated linearly for points not displayed in the table on the right hand side.

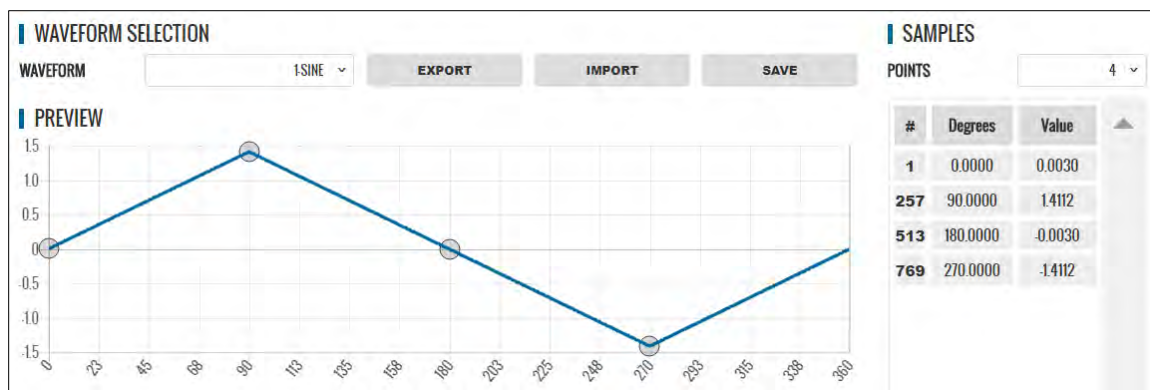


Figure 10-5: Waveform Edit defined using 4 data points

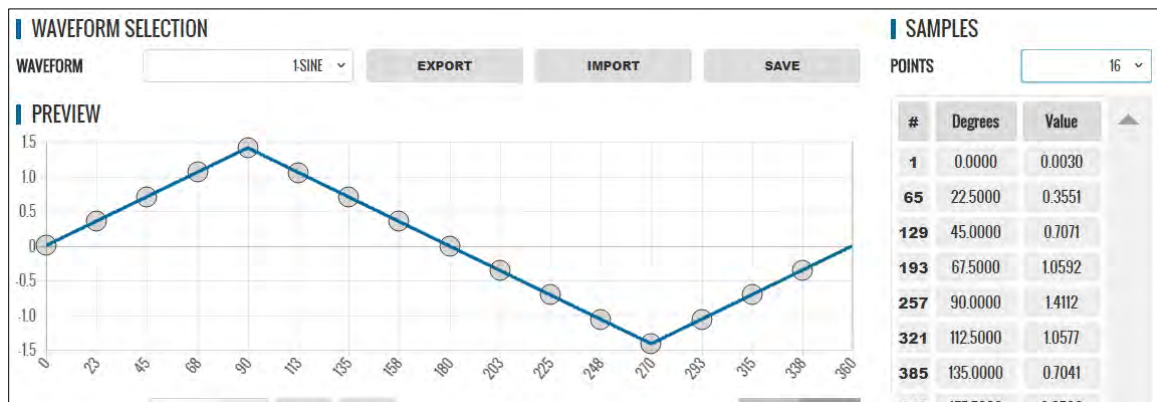


Figure 10-6: Waveform Edit defined using 16 data points

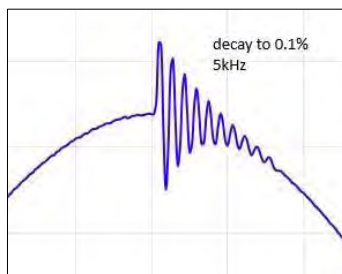
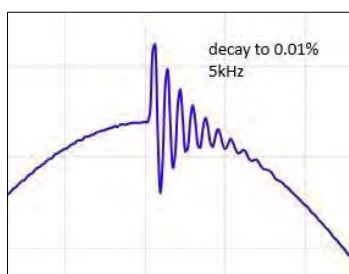
10.7.7.2 Waveform Tools

The following Waveform Tools are available:

CONTROL	Purpose
TOOLS	These selections created specific waveform types without having to define data values manually. Following functions are available from this drop-down: NORMALIZE Normalizes waveform for zero DC offset. RECTIFY Rectifies the waveform. Only positive data points remain. This implies a DC offset which is shown in the DC display field below the graph. FREQ MULTIPLY Creates specified number of periods to multiply fundamental frequency. Use caution with resulting higher frequency waveforms as power source has a finite bandwidth and output may fault if too much high frequency content is present. OFFSET Applies specified DC offset. SCALE Multiplies all data points by scale factor value. VERTICAL FLIP Flips waveform vertically. HORIZONTAL FLIP Flips waveform horizontally. SMOOTHING FILTER Smooths sharp edges to reduce bandwidth requirements. PRESET Selects built-in waveform types based on user parameters.
PRESETS	The following PRESET waveforms are available: NONE Default or no selection made. SINE, TRIANGLE, SQUARE, 6 STEPS, 12 STEPS, SINE POWER, CLIPPED SINE, SAWTOOTH, PULSE, IMPORTED WAVEFORM
PARAMETERS	The following parameters are settable for each PRESET selection: HARMONIC H1 through H32 SCALE Vertical Scale Multiplier PHASE Start phase angle OFFSET DC Offset EXPONENT 1 through 51. Applies to SINE POWER preset only. THD 0% through 100%. Applies to CLIPPED SINE only. RISE TIME 0° through 360°. Applies to PULSE preset only. PULSE WIDTH 0° through 360°. Applies to PULSE preset only. FALL TIME 0° through 360°. Applies to PULSE preset only. LOAD FROM FILE Available for IMPORTED WAVEFORM preset only. ADD Add to existing waveform (summation) REPLACE Replace existing waveform with selected PRESET

Example for UL 2231-2 Ringwave Test Waveform Creation.

This immunity test superimposes a decaying sine amplitude on an AC 50Hz or 60Hz line voltage at frequencies of 1kHz, 2kHz, 3kHz, 4kHz and 5kHz. This example shows how to add the 5kHz ring wave to a standard sinewave voltage using the Waveform Editor in the web browser interface.



From the Tools menu on the left, select the **RING WAVEFORM** type. The following parameters can be set to create the desired ring wave voltage waveform:

- DECAY:** Represents the decay constant based on the final amplitude value of the ringing signal (1%, 0.1% or 0.01%) of the initial amplitude.
- RING FREQUENCY** This is the frequency multiplier of the base frequency.
- RING AMPLITUDE** This is the (Ringing initial amplitude/Base signal amplitude) ratio.
- DEG (FROM / TO)** Determines the phase angle for the start and end of the ringing signal, as shown in this example, $126-90=36$ which is 10% Of the 360° period.



The waveform created using the editor can be downloaded to the power source using the **SAVE** button. Once loaded, the internal advanced scope function in the web browser interface can be used to capture the actual output waveform as shown below.

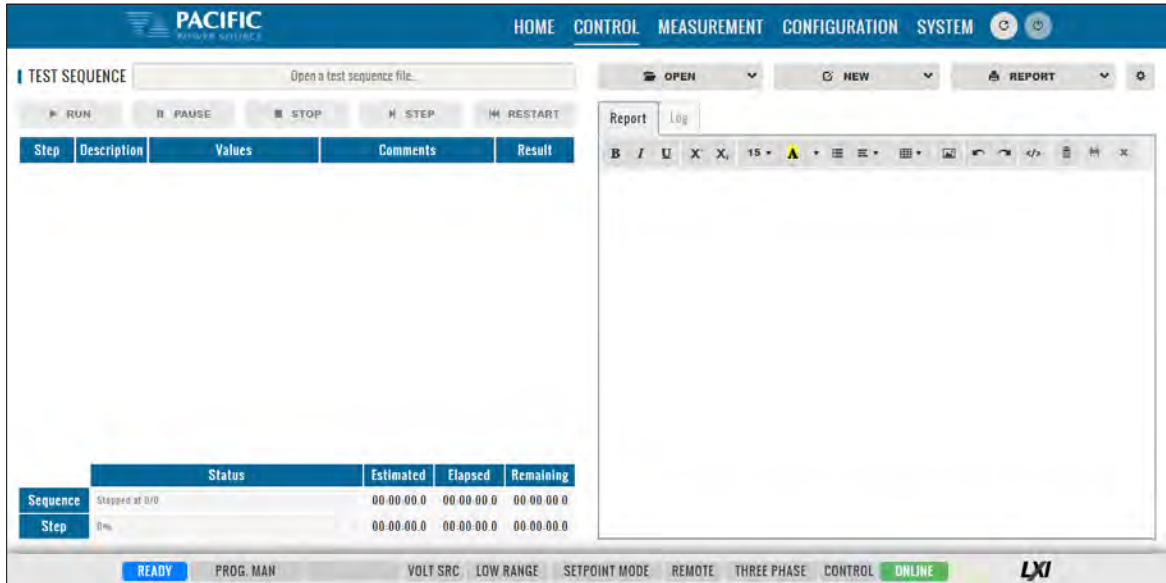


10.7.8 Test Sequence

The test sequence feature can be found on the webpage CONTROL menu under “TEST SEQUENCE”.

CONTROL -> TEST SEQUENCE.

It is off by default to save unit memory and takes a few seconds to start once the Test Sequence screen is open the first time after power on.



A Test Sequence consists of a group of steps that are executed sequentially. Each step logs the details of said step to a test report. After test execution, this test report can be downloaded or printed using the browser interface.

A Test Sequence step can be any of the following types:

- Configuration
- Steady state
- Transient
- Timer (To perform a delay)
- User prompt (Show information)
- Meter (Performs different measurements)
- Control (Power source control shortcut)
- User input
- Script (For custom procedures, the coding language is Javascript)
- SCPI list (Executes a list of SCPI commands)
- SCPI (Executes a SCPI command)

Note that the sequence engine runs on the power source controller. The browser based webpage only acts as the graphical user interface for test sequence development, execution and reporting. As such, the browser can be closed and reopened without losing any of the test sequence information.

The test sequence functions can also be fully controlled remotely using SCPI commands and the sequences can be stored in the power sources' nonvolatile flash memory. The file format is the industry standard 7z extension compressed file format.

To familiarize yourself with test sequence use and operation, it is recommended to study the four example files provided:

- Sample-test-1.7z
- Sample-test-2.7z
- Sample-test-3.7z
- Sample-test-4.7z

For example, sample-test number 4 performs an IEC 61000-4-11 short voltage interrupt test on any number of user selectable phases. It's content is shown in the browser screen below.

The screenshot displays the Pacific Power Source web interface for running a test sequence. The top navigation bar includes tabs for HOME, CONTROL, MEASUREMENT, CONFIGURATION, and SYSTEM. The main section is titled 'TEST SEQUENCE' and shows a dropdown menu set to 'sample-test-4'. Below this, a table lists the steps of the test sequence:

Step	Description	Values	Comments	Result
1	Configuration	Form/Frequency/Voltage/Coupl...	EN/IEC61000-4-11 - Short Interru...	Passed
2	Script	AC Mode	Check Voltage Mode	Passed
3	User Input	UUT Part Number:UUT Serial No...	EN/IEC61000-4-11 - Short Interru...	Passed
4	Control	Output Enable:Off,CSC:Off	Open Output Relays, Set to 0.0V...	Passed
5	User Prompt	Wait for user confirmation	EN/IEC61000-4-11 - Short Interru...	Passed
6	Steady State	A-115(VAC), f-60(Hz)	EN/IEC61000-4-11 - UUT Warm-Up	Running
7	User Prompt	Wait for user confirmation	Please allow UUT to warm-up an...	
8	Steady State	A-115(VAC), f-60(Hz)	EN/IEC61000-4-11 - Short Interru...	
9	Transient	Total time- 45s		
10	Meter	Vrms,Irms	Measure power source output IV...	
11	User Prompt	Wait for user confirmation	Caution: Output Disable	

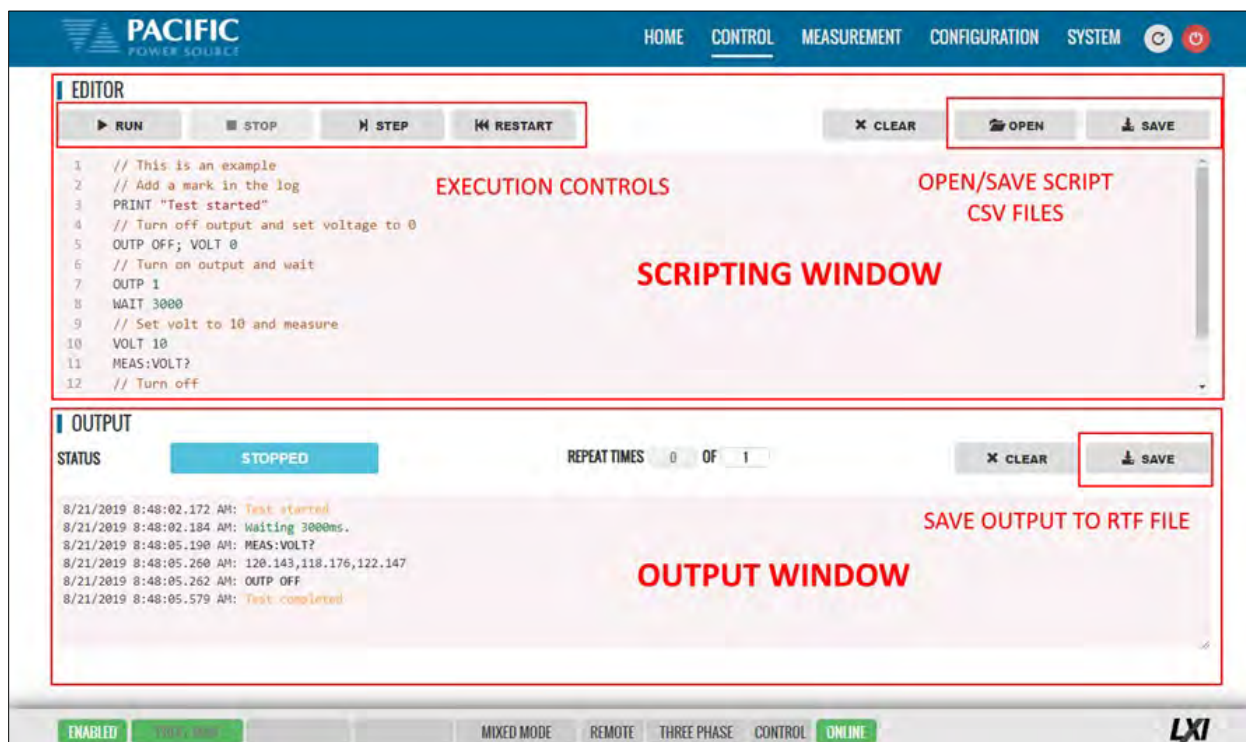
Below the table, a 'Status' section shows 'Sequence' as 'Running 6/12' and 'Step' as '11%'. To the right, a 'Report' section displays the test details, including the test name 'EN/IEC61000-4-11 - Short Interruptions, Class 2, 3, 60Hz Test' and a 'WARNING' box. The bottom status bar shows 'READY', 'PROG. MAN', 'VOLT SRC', 'LOW RANGE', 'SETPOINT MODE', 'REMOTE', 'THREE PHASE', 'CONTROL', and 'ONLINE'.

For an overview of the available Test Sequence SCPI control command syntax, refer to the Remote Control Programming Section of this manual. (Section 8.11).

10.7.9 SCPI Script

The SCPI Script menu entry displays the command scripting screen. These user generated scripts can contain any sequence of SCPI commands, comments and output statements to automate simple repetitive tasks. Scripts may be used to automate repetitive tasks more quickly and are simpler to write than an actual application program.

A script can be saved to the PC or tablet on which the browser runs.



10.7.9.1 Supported Keywords and Commands

The following script entries are supported:

Entry Type	Description
USER COMMENT	// Any test preceded by a two forward slash characters
PRINT	Sends text strings after PRINT key word to the OUTPUT window located at the bottom half of the browser window.
WAIT	Pauses script execution by no of msec specified.
SCPI COMMAND	Any support SCPI command. Data returned by a query command (?) will be printed in the output window.

Table 10-1: Supported Script Entries

10.7.9.2 Script Execution Control

To run a script, click the ► **RUN** button in the upper left corner of the Editor window. You can also single step through a script during development using the ► | **STEP** button. The ■ **STOP** button will abort execution of a running script. To run a script multiple times, set the REPEAT TIMES value to a value higher than the default 1 (one). Max. repeat count is 1e+54.

10.7.9.3 Managing multiple script files.

Script files can be saved to the PC or device on which the browser runs, i.e. Windows PC, Tablet, or Smartphone. Use the **OPEN** and **SAVE** buttons in the upper right corner of the Editor window to save and retrieve scripts. Scripts are saved in Comma Separated File format, which can be edited in Excel or any text editor like Notepad. The sample script csv file content (**scpi_script.csv**) is shown below. When saving a new script, replace the default scpi_script file name with a more descriptive file name.

```
// Available commands are:
// - WAIT MILLISECONDS, example -> WAIT 2000
// - PRINT "TEXT", example -> PRINT "Test started"
// - SCPI COMMAND/s, example -> OUTP OFF; VOLT 0
// Comments starts with // as this line
// The following is an example
// Add a mark in the log
PRINT "Test started"
// Turn off output and set voltage to 0
OUTP OFF; VOLT 0
// Turn on output
OUTP 1
// Wait three seconds
WAIT 3000
// Set output voltage to 10 volts
VOLT 10
// Get output voltage measurement
MEAS:VOLT?
// Turn off
OUTP OFF
PRINT "Test completed"
```

10.7.9.4 Script Execution Output

The OUTPUT window located in the bottom half of the browser window shows all script output, including any user comments, events like script start and stop as well as any PRINT commands. Each output entry is date and time stamped.

The content of the **OUTPUT** window can be saved to a Rich Text File using the **SAVE** button in the upper right corner of the OUTPUT window. (Do not confuse with the SAVE button in the script EDITOR window.) The default output file name is "**scpi_script_output.rtf**". A sequence number (1), (2) etc will be appended each time the output window content is saved.

A sample RFT file is shown below.

```
8/21/2019 8:48:02.172 AM: Test started
8/21/2019 8:48:02.184 AM: Waiting 3000ms.
8/21/2019 8:48:05.190 AM: MEAS:VOLT?
8/21/2019 8:48:05.260 AM: 120.143,118.176,122.147
8/21/2019 8:48:05.262 AM: OUTP OFF
8/21/2019 8:48:05.579 AM: Test completed
```

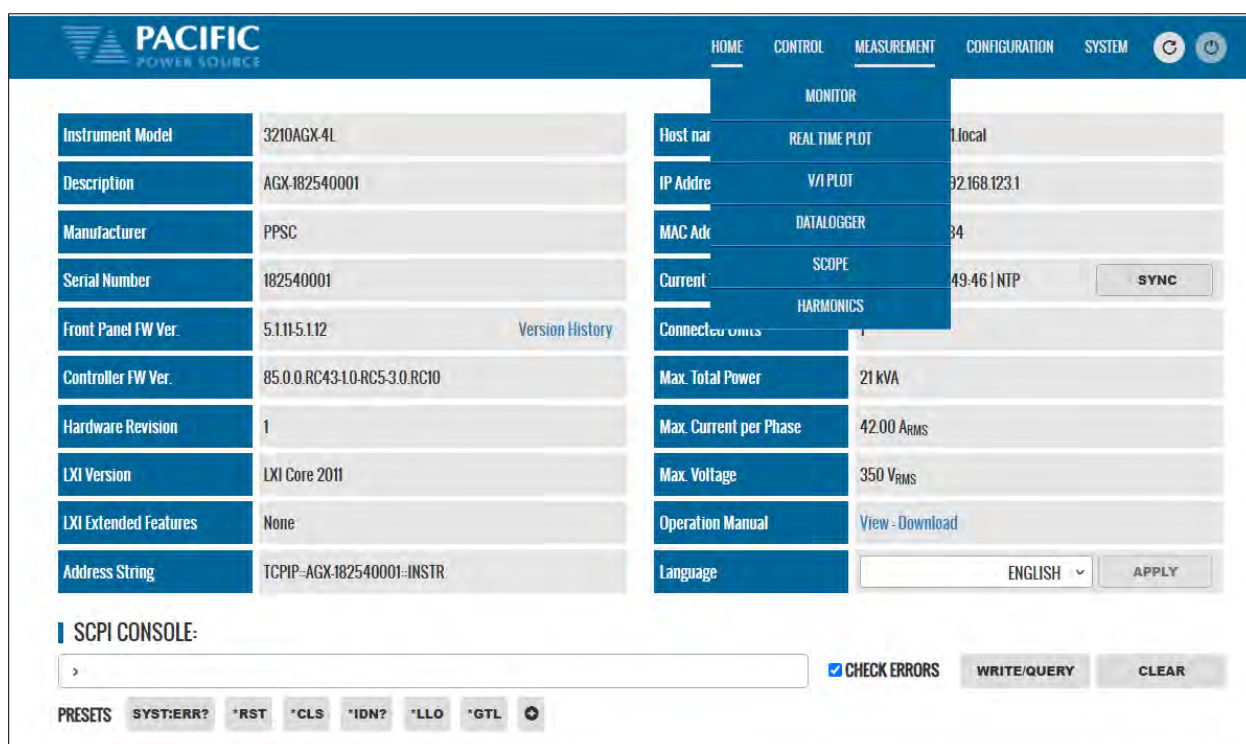
Note: All output files are saved to the default Download directory determined by the Browser setting.

10.8 Measurement Screens

The MEASUREMENT menu provides access to several measurement screens. Measurement screens available are:

- MONITOR
- REAL TIME PLOT
- V/I PLOT
- HARMONICS
- DATALOGGER
- SCOPE
- HARMONICS

Each is described in subsequent sections.



The screenshot displays the PACIFIC POWER SOURCE web interface. The top navigation bar includes links for HOME, CONTROL, MEASUREMENT, CONFIGURATION, and SYSTEM. The MEASUREMENT menu is expanded, showing options for MONITOR, REAL TIME PLOT, V/I PLOT, DATALOGGER, SCOPE, and HARMONICS. The MONITOR screen is currently selected, displaying a table of instrument information and a list of connected units.

Instrument Model	3210AGX-4L
Description	AGX-182540001
Manufacturer	PPSC
Serial Number	182540001
Front Panel FW Ver.	5.1.11.5.1.12 Version History
Controller FW Ver.	85.0.0.RC43-1.0.RC5-3.0.RC10
Hardware Revision	1
LXI Version	LXI Core 2011
LXI Extended Features	None
Address String	TCPIP-AGX-182540001-INSTR

Host name	192.168.123.1
IP Address	192.168.123.1
MAC Address	84:0D:5C:00:00:00
Current	49.46 NTP
Connected Units	1
Max. Total Power	21 kVA
Max. Current per Phase	42.00 Arms
Max. Voltage	350 VRMS
Operation Manual	View - Download
Language	ENGLISH APPLY

SCPI CONSOLE:

☒ CHECK ERRORS [WRITE/QUERY](#) [CLEAR](#)

PRESETS [*SYST:ERR?](#) [*RST](#) [*CLS](#) [*IDN?](#) [*LLO](#) [*GTL](#) [+](#)

10.8.1 Monitor

The measurement monitor screen replicates part of the CONTROL->PROGRAM screen and displays all measurement data for all available output phases. Measurements include both AC and DC components depending on selected operating mode.

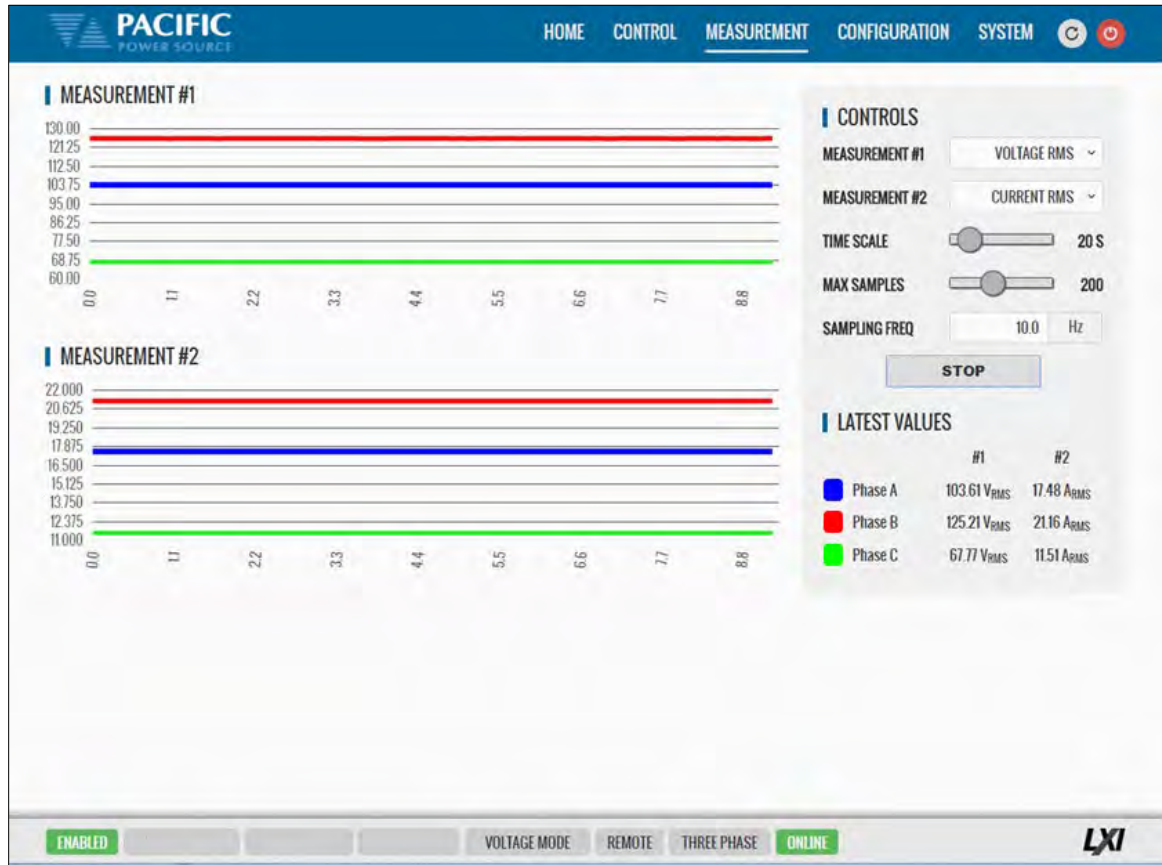
Note: There are no controls on this screen.

PACIFIC POWER SOURCE			
HOME CONTROL MEASUREMENT CONFIGURATION SYSTEM			
MEASUREMENTS	Phase A	Phase B	Phase C
FREQUENCY	50.00 Hz	50.00 Hz	50.00 Hz
VOLTAGE L-N RMS (AC-DC)	100.00 V _{RMS}	100.00 V _{RMS}	100.00 V _{RMS}
VOLTAGE L-N RMS (AC)	100.00 V _{RMS}	100.00 V _{RMS}	100.00 V _{RMS}
VOLTAGE L-N DC	0.00 V _{DC}	0.00 V _{DC}	0.00 V _{DC}
CURRENT RMS (AC-DC)	4.96 A _{RMS}	5.12 A _{RMS}	5.10 A _{RMS}
CURRENT DC	0.22 A _{DC}	0.21 A _{DC}	0.09 A _{DC}
POWER	0.496 kW	0.512 kW	0.509 kW
WATT-HOUR RESET	0.010 kWh	0.010 kWh	0.010 kWh
APP POWER	0.496 kVA	0.512 kVA	0.510 kVA
POWER FACTOR	1.00	1.00	1.00
CURRENT CF ▼	1.47	1.46	1.44
PEAK CURRENT	7.27 A	7.48 A	7.33 A
RECORDED PEAK CURRENT RESET	7.48 A	-8.94 A	8.78 A
	V _{AB}	V _{BC}	V _{CA}
VOLTAGE L-L RMS (AC-DC)	173.21 V _{RMS}	173.21 V _{RMS}	173.21 V _{RMS}
VOLTAGE L-L RMS (AC)	173.21 V _{RMS}	173.21 V _{RMS}	173.21 V _{RMS}
VOLTAGE L-L DC	0.00 V _{RMS}	0.00 V _{RMS}	0.00 V _{RMS}
ENABLED PROG. MAN VOLTAGE MODE REMOTE THREE PHASE CONTROL ONLINE LXI			

Note: The measurement screen readout background color is normally grey as shown in the examples above. See section 6.5.1 for the significance of alternative colors for measurement backgrounds.

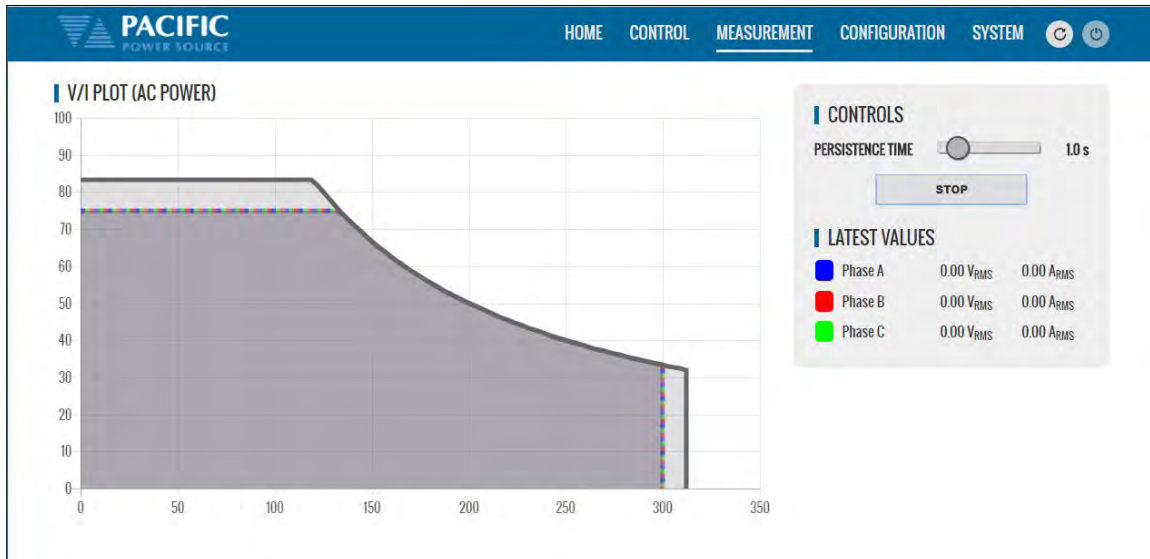
10.8.2 Real-Time Plot

This measurement screens provides a strip-chart style graphical display for up to two measurement parameters, #1 and #2. The CONTROLS allows selection of the desired parameter for each graph. Available choices are Voltage, Current and Power. Depending on phase mode, up to three phase values are displayed per chart.



10.8.3 V/I Plot

The V/I plot shows the power operating point at any moment in time by plotting measured Voltage as a function of measured Current. This plot has a persistence mode so the user can observe power fluctuations and changes over a set period.



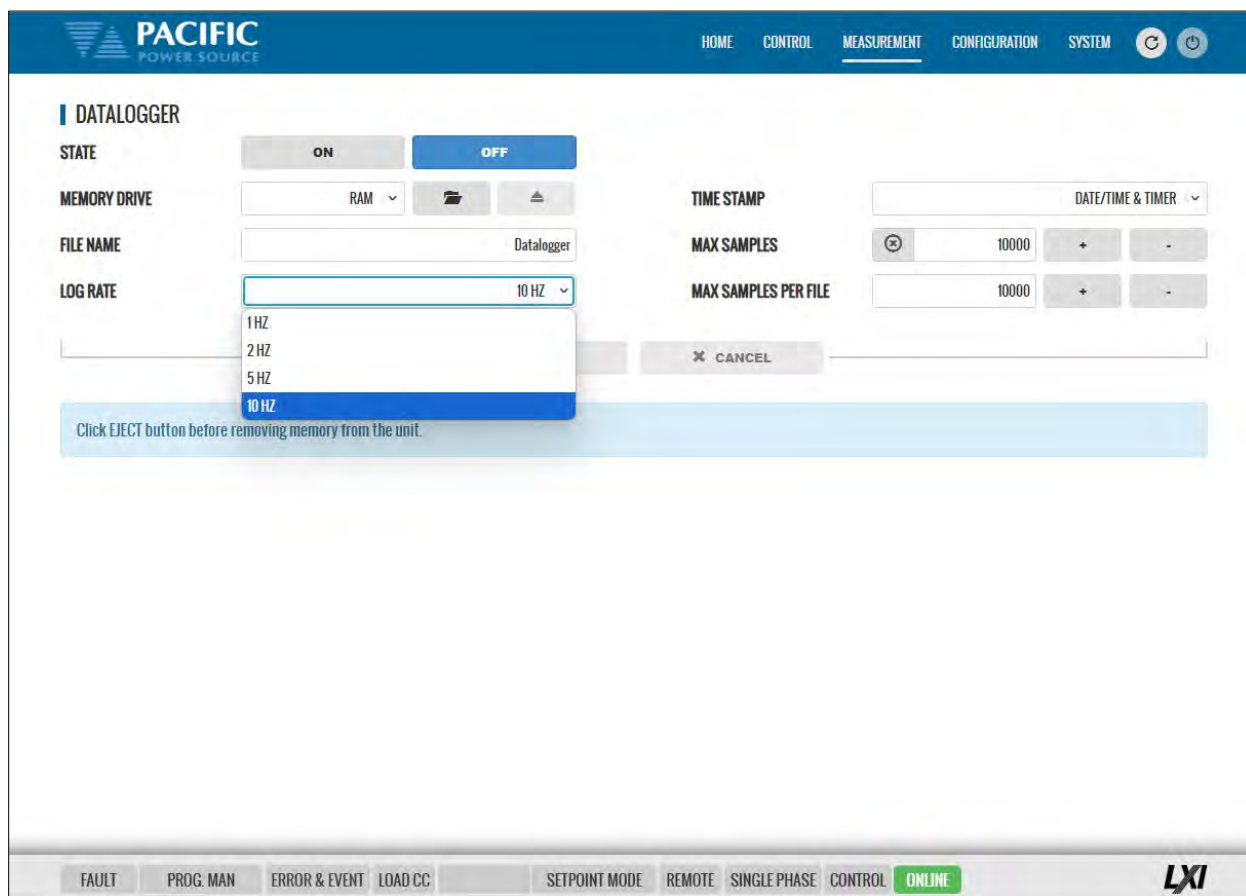
Available selections in this measurement screen are:

- Persistence Time: 1 ~ 60 sec

10.8.4 Data Logger

The measurement data logger screen allows measurement data to be written to a memory device, using a comma delimited file format. These files are easy to open in an Excel™ spreadsheet or other math oriented software program.

Available controls are for State on/off, memory destination device, file name assignment and data logging rate in Hz. All file entries are time stamped.



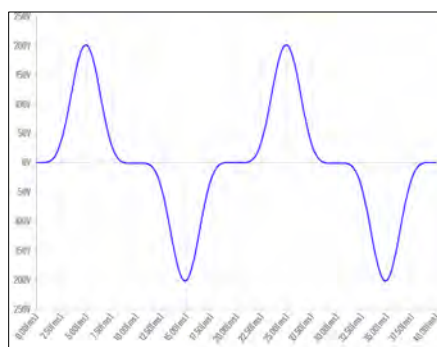
10.8.5 Scope

The Scope function captures voltage and current waveforms at the output of the power source on all phases. This screen allows a variety of captured waveforms to be displayed.

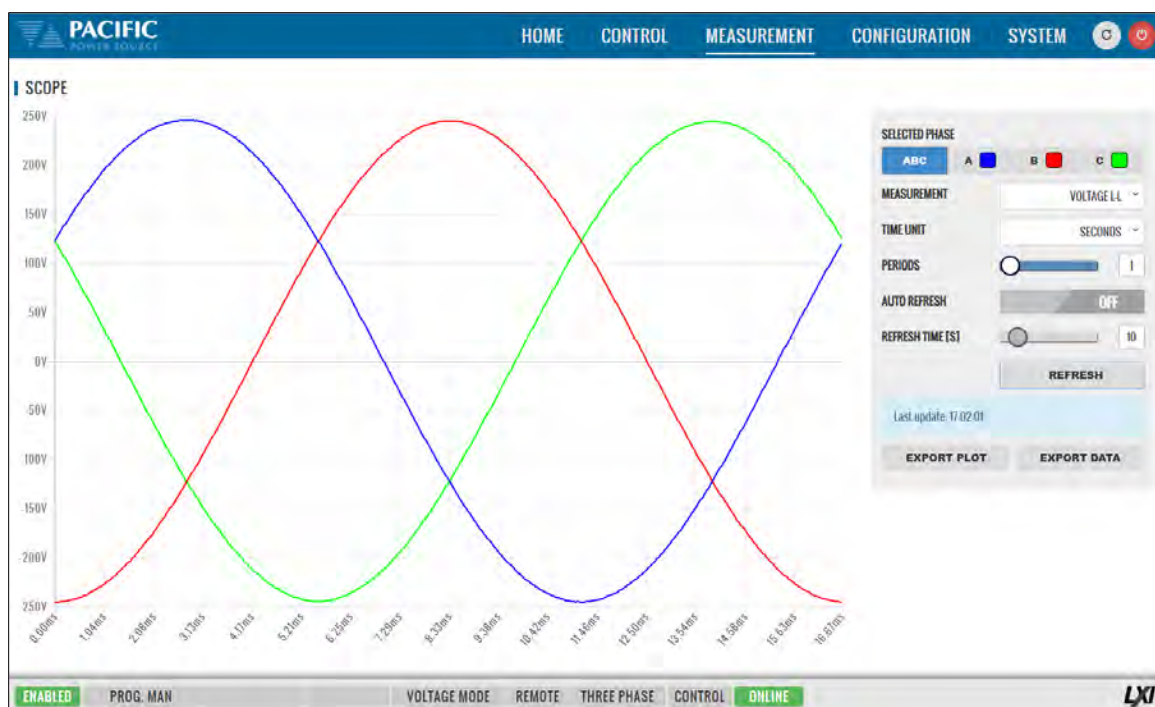


The following controls are available to customize the captured waveform display:

CONTROL	Purpose
MEASUREMENT	Selects Voltage L-N, Voltage L-L, Current or Both Voltage & Current
PHASE	Selects Phase A, B, C or all (ABC). Only visible in two or three phase mode.
TIME UNIT	Selects time scale in either TIME, SAMPLES or PHASE
PERIODS	Selects the number of periods to display. Range is 1~ 4
AUTO REFRESH	Turns AUTO REFRESH mode ON or OFF
REFRESH PERIOD	Sets interval time for AUTO REFRESH mode in seconds. Range is 5 ~ 100.
REFRESH	Manual REFRESH button
EXPORT GRAPH	Downloads image for displayed waveform(s). See sample below.
EXPORT DATA	Downloads captured data points for displayed waveform(s) in csv format text file. See sample below.

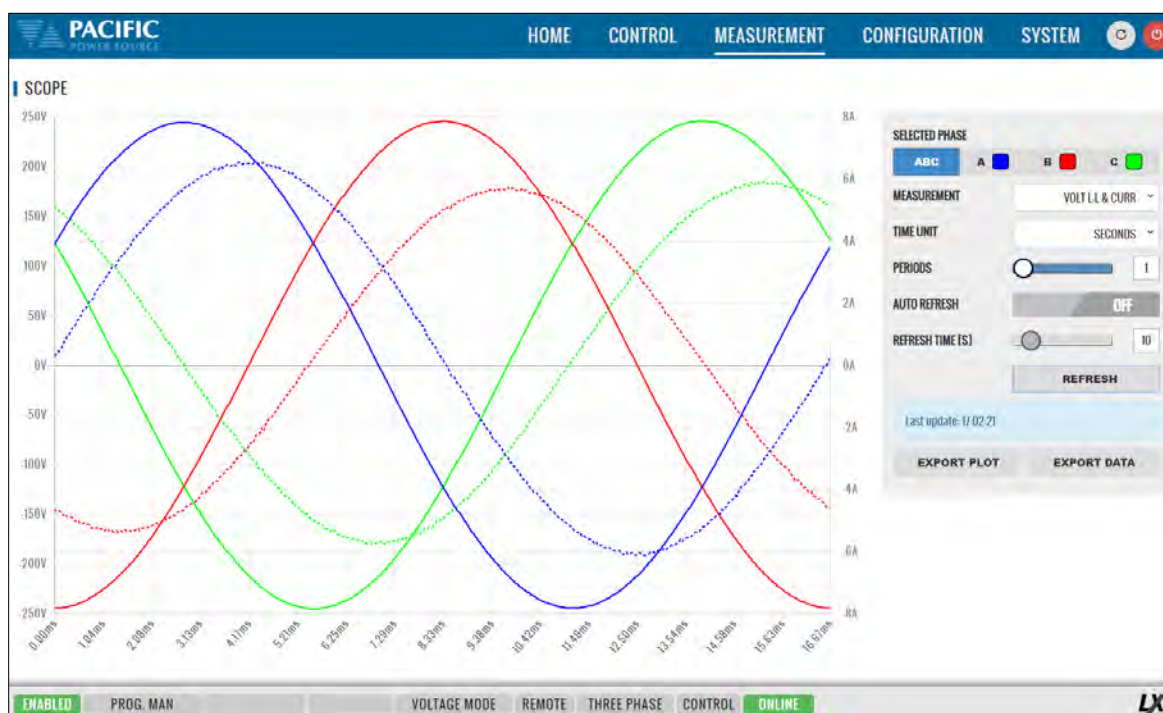


Sample	Degrees	Time[s]	Phase A - Voltage[V]
1	0	0	-0.12
2	0.7	3.91E-05	0.05
3	1.41	7.81E-05	0.02
4	2.11	0.000117	-0.1
5	2.81	0.000156	-0.03
6	3.52	0.000195	0



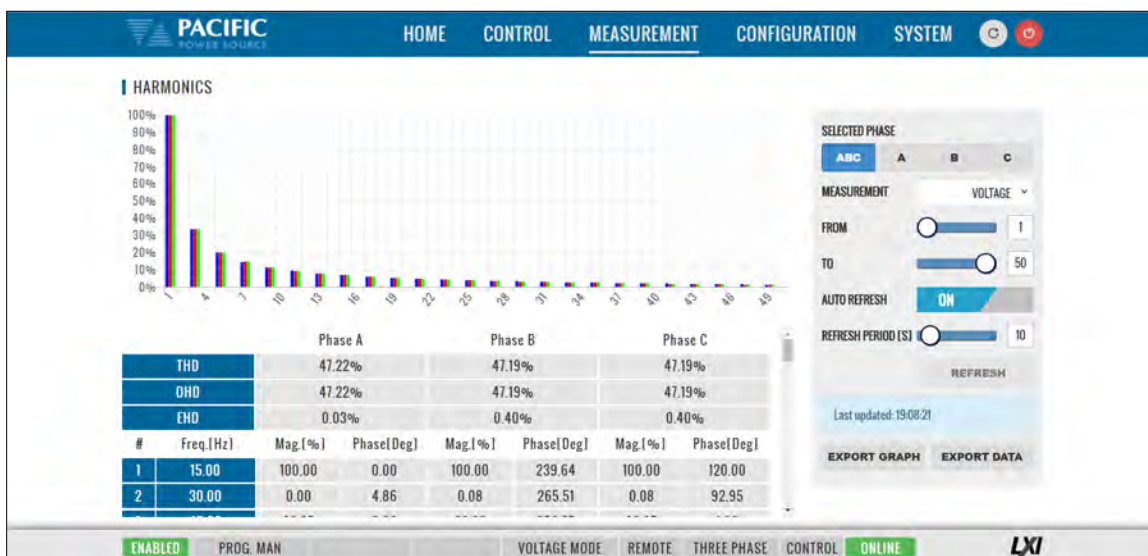
Line to Line Capture for all phases (source mode).

Voltage and Current can be displayed in one scope screen:



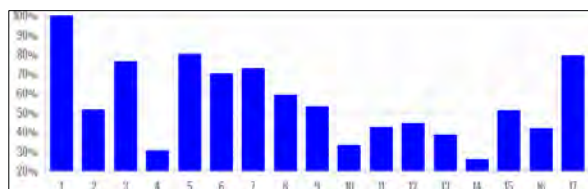
10.8.6 Harmonics

Harmonics measurements for voltage and current on all phases can be displayed using the Harmonics display screen as illustrated below. Both Bar Chart and Table displays are shown. The distortion values for the parameter selected (Voltage or Current) are display in a table directly below the Bar chart area.



Available selections in this measurement screen are:

CONTROL	Purpose
SELECTED PHASE	
MEASUREMENT TYPE	Selects Voltage L-N, Voltage L-L, Current or Both Voltage & Current
FROM	Selects the first harmonic number to display. Range is 1 ~ 49
TO	Selects the last harmonic number to display. Range is 2 ~ 50
AUTO REFRESH	Turns AUTO REFRESH mode ON or OFF
REFRESH PERIOD	Sets interval time for AUTO REFRESH mode in seconds. Range is 5 ~ 100.
REFRESH	Manual REFRESH button
EXPORT GRAPH	Downloads image for displayed Bar chart. See sample below.
EXPORT DATA	Downloads captured harmonics data in csv format text file. See sample below.



Measurement	Phase A[%]		
THD	455.98		
OHD	354.89		
EHD	286.32		
#	Freq.[Hz]	Phase A Mag.[%]	Phase A Phase.[Deg]
1	50	100	75.89
2	100	51.72	60.61
3	150	76.38	70.94
4	200	30.75	329.44
5	250	80.49	243.12
6	300	70.33	18.6
7	350	72.99	257.95
8	400	59.41	268.51

10.9 Configuration Screens

The CONFIGURATION menu provides access to secondary power source settings that are less frequency changed than those on the PROGRAM screen. Configuration screens available are:

- UNIT SETTINGS
- USER LIMITS & PRESETS
- RAMP & SLEW

Each is described in subsequent sections.



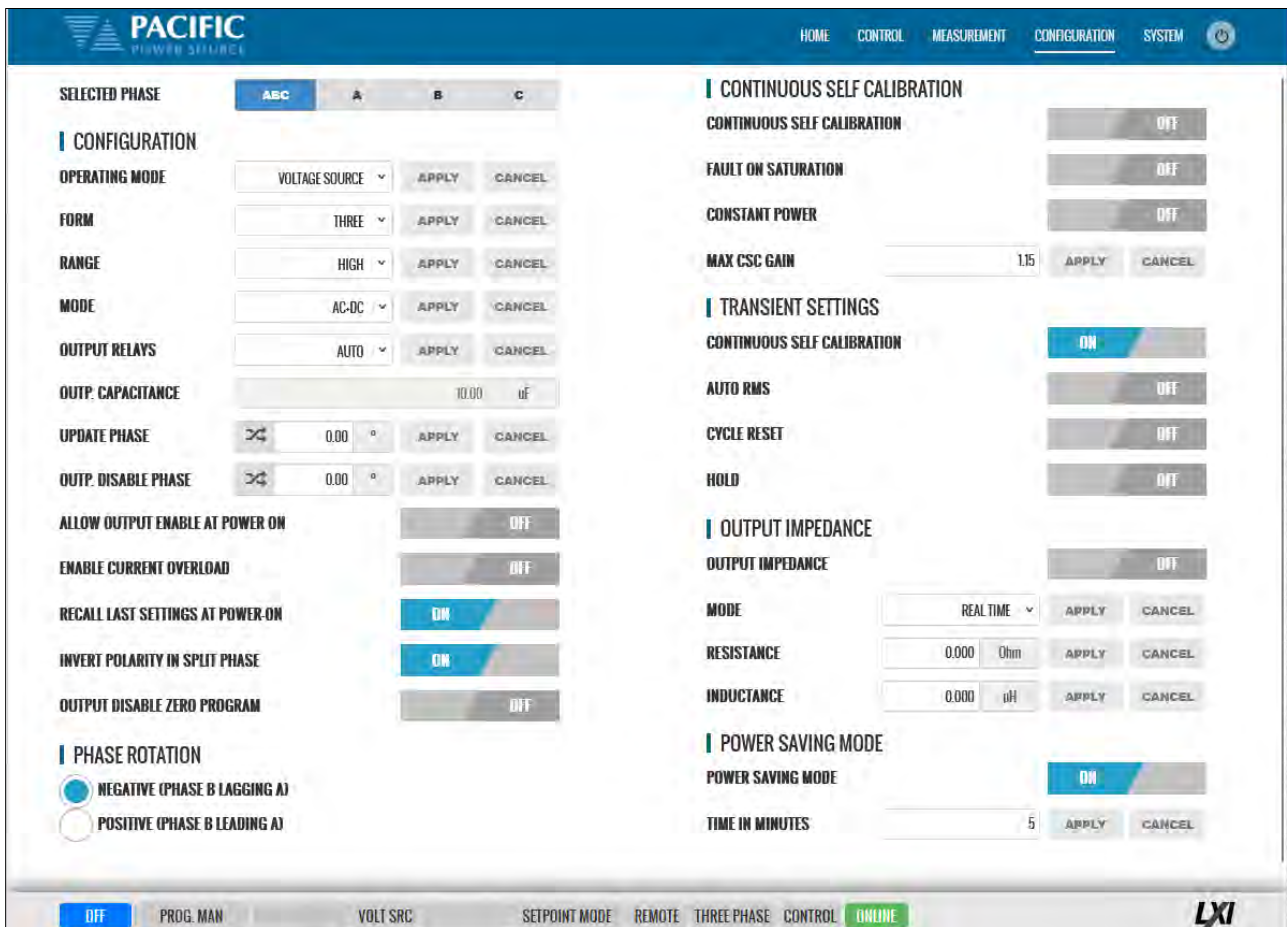
The screenshot displays the PACIFIC POWER SOURCE web interface in the CONFIGURATION menu. The top navigation bar includes HOME, CONTROL, MEASUREMENT, CONFIGURATION (active), and SYSTEM. The main content area is divided into two columns. The left column lists instrument details: Instrument Model (3210AGX-4L), Description (AGX-182540001), Manufacturer (PPSC), Serial Number (182540001), Front Panel FW Ver. (5.11.5.112), Controller FW Ver. (85.0.0.RC43-1.0.RC5-3.0.RC10), Hardware Revision (1), LXI Version (LXI Core 2011), LXI Extended Features (None), and Address String (TCPIP-AGX-182540001-INSTR). The right column shows configuration settings: Host name, IP Address (LAN | USB), MAC Address (AC:1F:0F:E6:7E:B4), Current Time and Source (09/12/2024 11:53:22 | NTP), Connected Units (1), Max. Total Power (21 kVA), Max. Current per Phase (42.00 Arms), Max. Voltage (350 V_{RMS}), Operation Manual (View - Download), and Language (ENGLISH). Below these columns is the SCPI CONSOLE with a command input field and buttons for CHECK ERRORS, WRITE/QUERY, and CLEAR. A PRESETS section includes buttons for SYST:ERR?, *RST, *CLS, *IDN?, *LLO, and *GTL. The STATUS BYTE section shows 0x04 with indicators for SOS, MSS, ESB, MAV, SQS, EEQ, BUSY, and SHUTDOWN. The bottom status bar includes FAULT, PROG. MAN, ERROR & EVENT, LOAD CC, SETPOINT MODE, REMOTE, SINGLE PHASE, CONTROL, and ONLINE. The LXI logo is in the bottom right corner.

10.9.1 Unit Settings

Unit settings determine the mode of operation of the power source. This includes phase mode, voltage range, output mode, update phase angle and ramp time for any output value changes made.

- Output enable at power on allows the unit to power up with the output enabled.
- The Enable Current Overload setting allows short duration overloads up to 30% over the normal continuous mode current limit set point.
- Phase Rotation selection changes output phasing between positive (leading) and negative (lagging) phase rotation in three phase output mode.
- The maximum adjustment limit for continuous self-calibration mode and fault generation on saturation can be set from this screen as well.
- The right hand side of the screen contains Transient mode execution settings, Output Impedance settings and Series Connection enable / disable (Series mode is only available on AGXS models).
- Language selections are either ENGLISH or CHINESE.

These can all be set from the CONFIGURATION -> UNIT SETTINGS screen shown below.



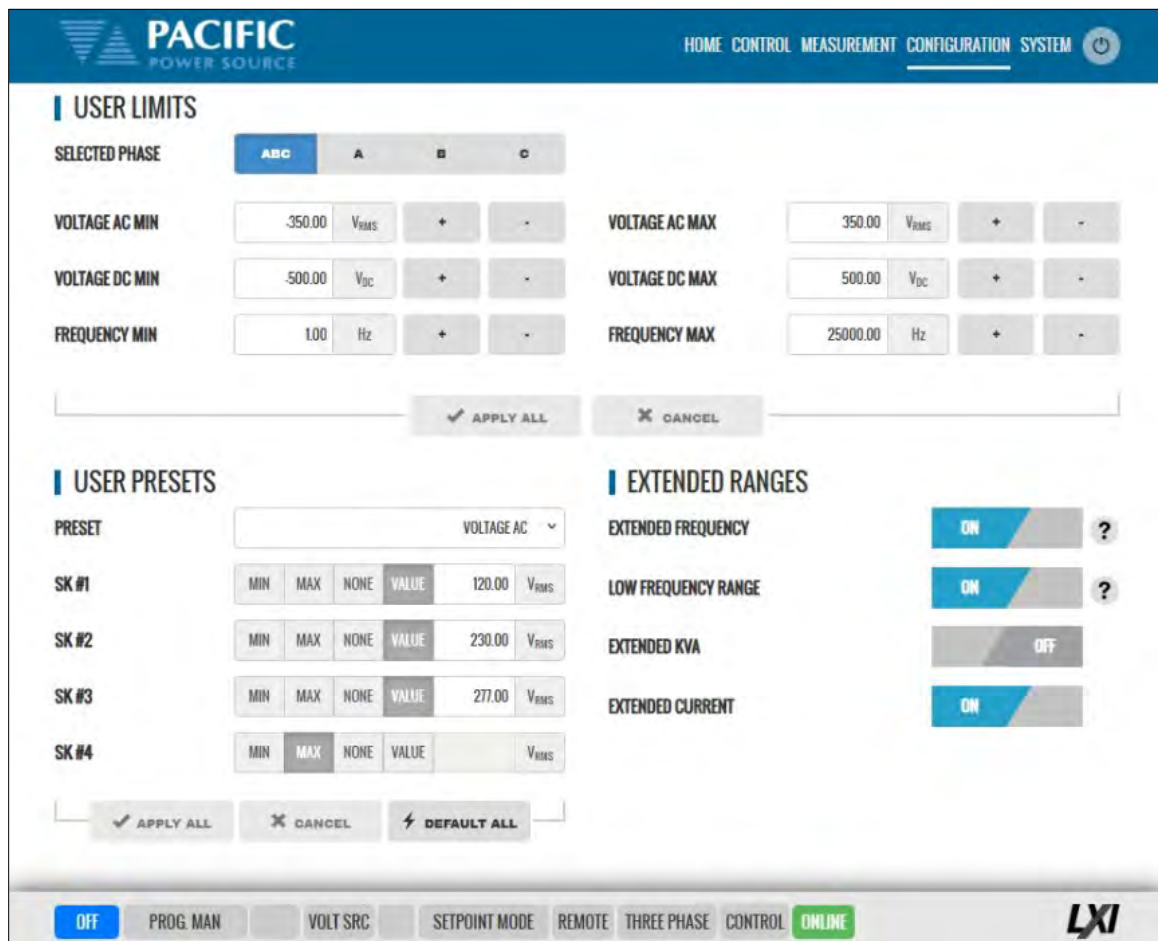
10.9.2 User Limits & Presets

User limits can be used to minimize operator error by setting upper and/or lower limits on programmable parameter ranges.

Limits can be set for Voltage AC, Voltage DC and Frequency.

Note: When changing user limits, make sure programmed parameter settings in effect are not outside the new upper and lower limits entered.

All user limits can be set from the CONFIGURATION -> USER LIMITS& PRESETS screen shown below. Extended range for voltage, frequency or current may be selected as needed. Some restrictions apply when operating in extended range mode See section 3, “Product Overview” page 24 for details on Extended Ranges operation.



PACIFIC POWER SOURCE HOME CONTROL MEASUREMENT CONFIGURATION SYSTEM

USER LIMITS

SELECTED PHASE: **ABC** | A | B | C

VOLTAGE AC MIN	-350.00	V _{RMS}	+	-	VOLTAGE AC MAX	350.00	V _{RMS}	+	-
VOLTAGE DC MIN	-500.00	V _{DC}	+	-	VOLTAGE DC MAX	500.00	V _{DC}	+	-
FREQUENCY MIN	1.00	Hz	+	-	FREQUENCY MAX	25000.00	Hz	+	-

✓ APPLY ALL ✗ CANCEL

USER PRESETS

PRESET	MIN	MAX	NONE	VALUE	UNIT
SK #1				120.00	V _{RMS}
SK #2				230.00	V _{RMS}
SK #3				277.00	V _{RMS}
SK #4					V _{RMS}

✓ APPLY ALL ✗ CANCEL ⚡ DEFAULT ALL

EXTENDED RANGES

EXTENDED FREQUENCY	ON	?
LOW FREQUENCY RANGE	ON	?
EXTENDED KVA	OFF	
EXTENDED CURRENT	ON	

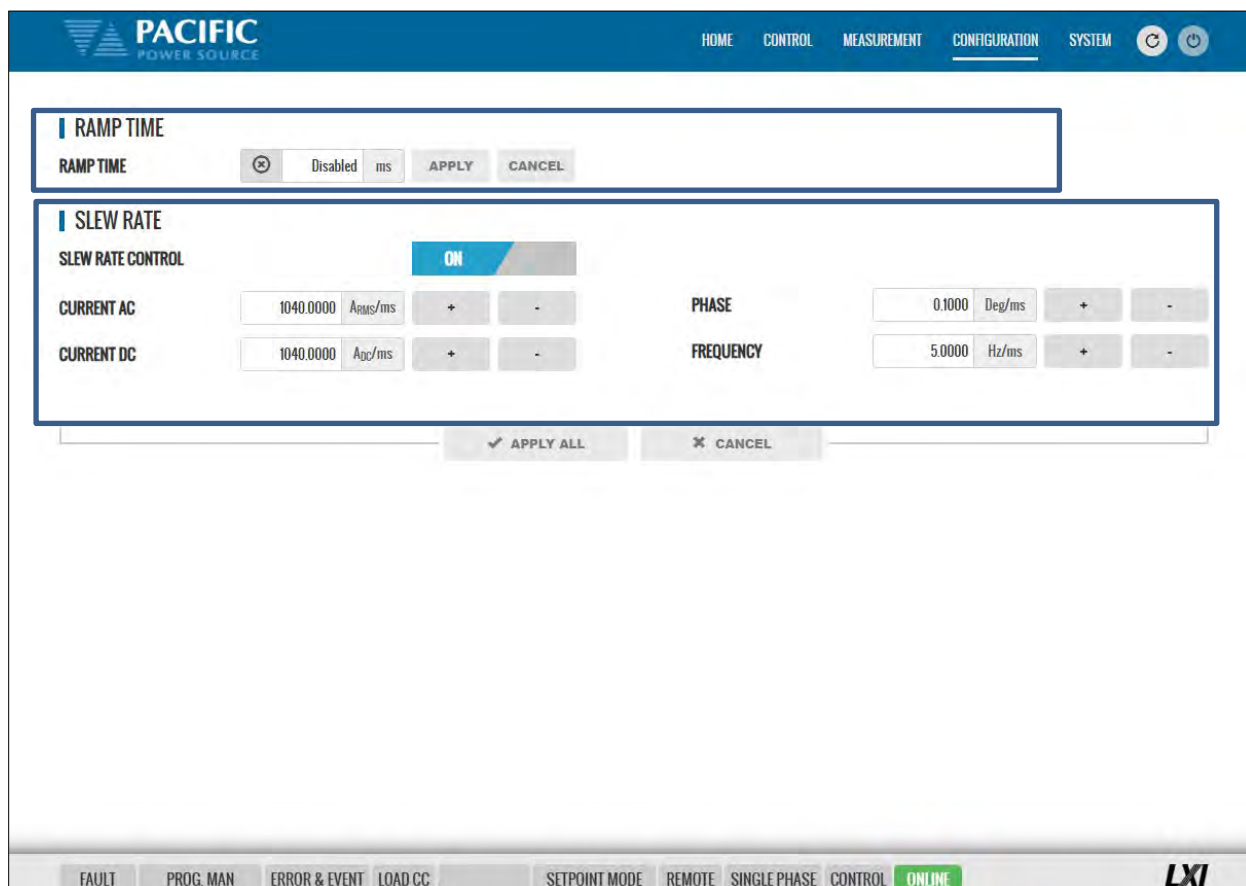
OFF | PROG MAN | VOLT SRC | SETPOINT MODE | REMOTE | THREE PHASE | CONTROL | ONLINE

User programmable presets can be set to define the set values of the Soft keys in the program screens. This allows commonly used setting values to be selected by an operator by just pressing a single soft key. See image above for samples.

10.9.3 Ramp Time & Slew Rate

The Slew Rate screen has entries for all available programmable slew rate settings. This includes Voltage AC, Voltage DC, Frequency and Phase Angle. Note that both are mutually exclusive as they would conflict with each other. To use programmable slew rates, the RAMP TIME must be disabled.

Slew Rates can be set for Voltage AC, Voltage DC and Frequency.

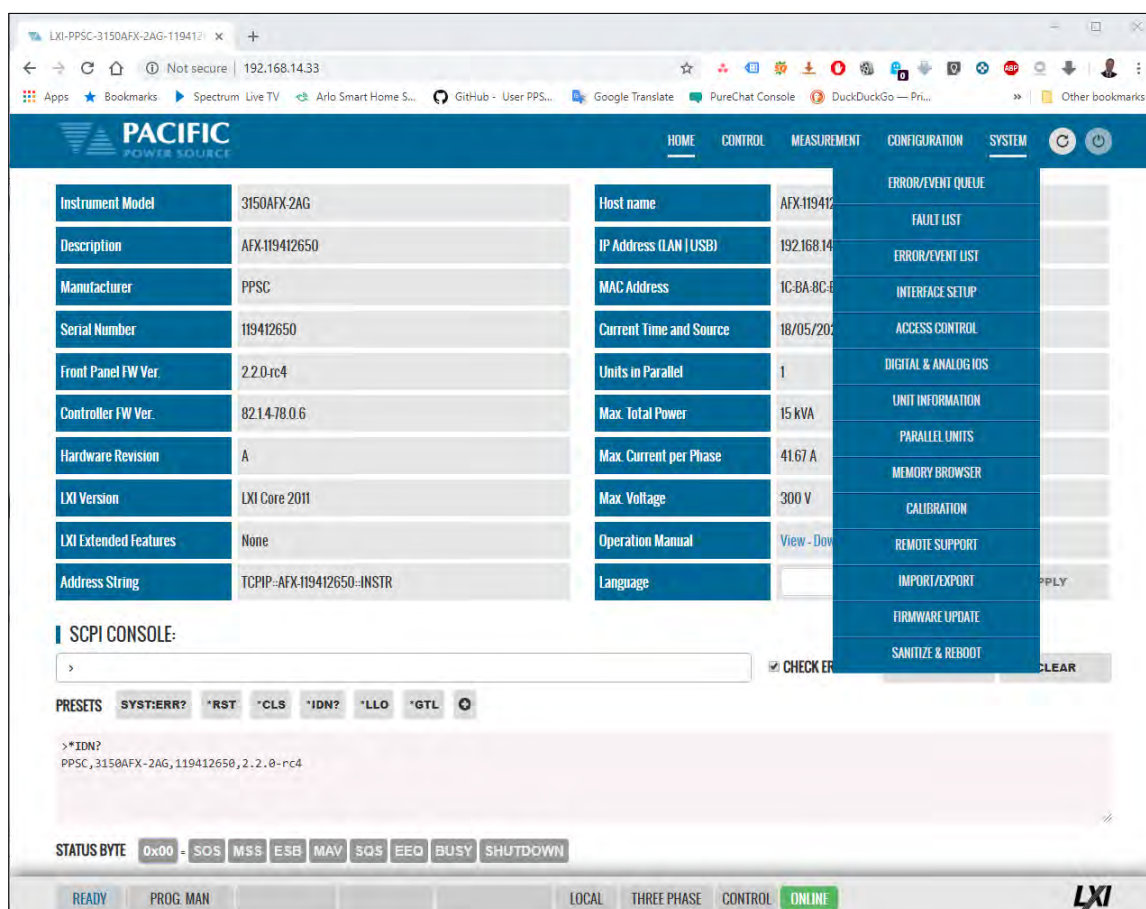


10.10 System Screens

The SYSTEM menu provides access to system level settings. System setting screens available are:

- ERROR/EVENT QUEUE
- FAULT LIST
- ERROR/EVENT LIST
- INTERFACE SETUP
- ACCESS CONTROL
- DIGITAL & ANALOG IOS
- UNIT INFORMATION
- PARALLEL UNITS
- MEMORY BROWSER
- CALIBRATION
- REMOTE SUPPORT
- IMPORT/EXPORT
- FIRMWARE UPDATE
- SANITIZE & REBOOT

Each is described in subsequent sections.

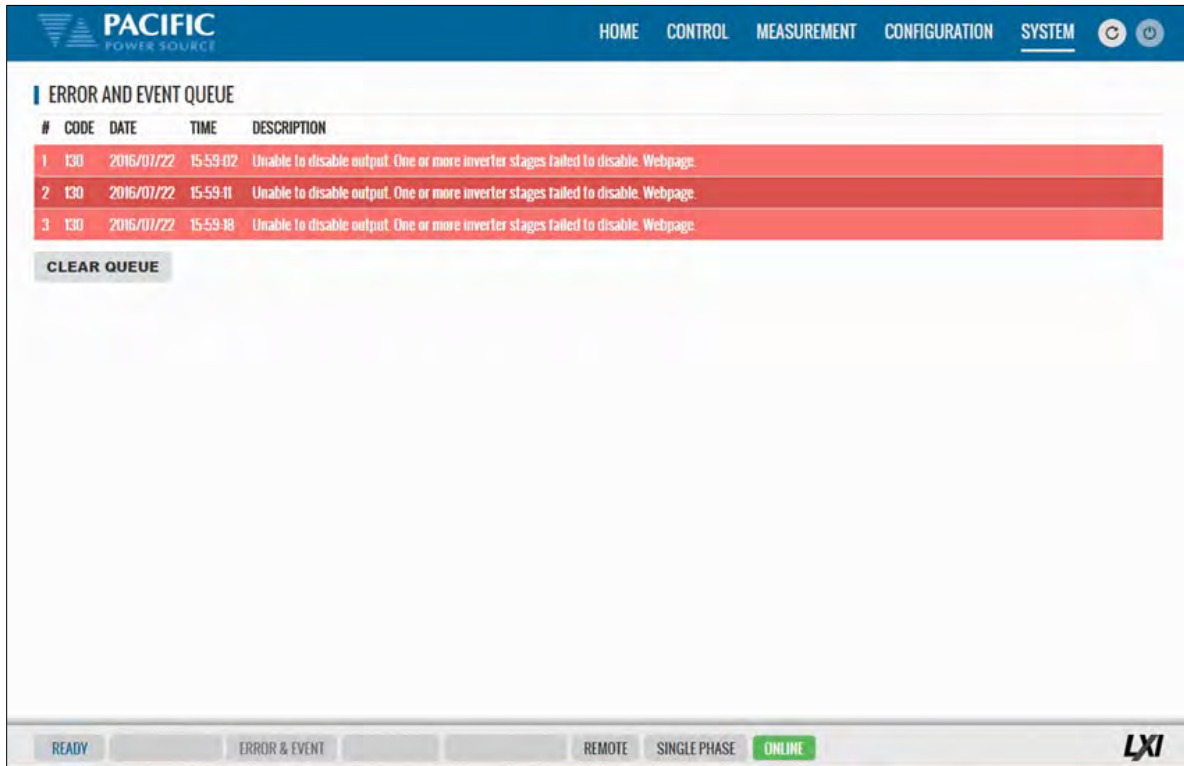


10.10.1 Error/Event Queue

The Error and Event Queue tracks internal errors or communication errors that may occur during normal user. Generally, such errors are the results of programming conflicts or setting conflicts and are no cause for concern. Other events may be normal, such as a power-on event and will be recorded in the same queue. The user can clear the queue at any time using the

CLEAR QUEUE button.

Actual hardware faults are tracked in the FAULT queue. See next section.



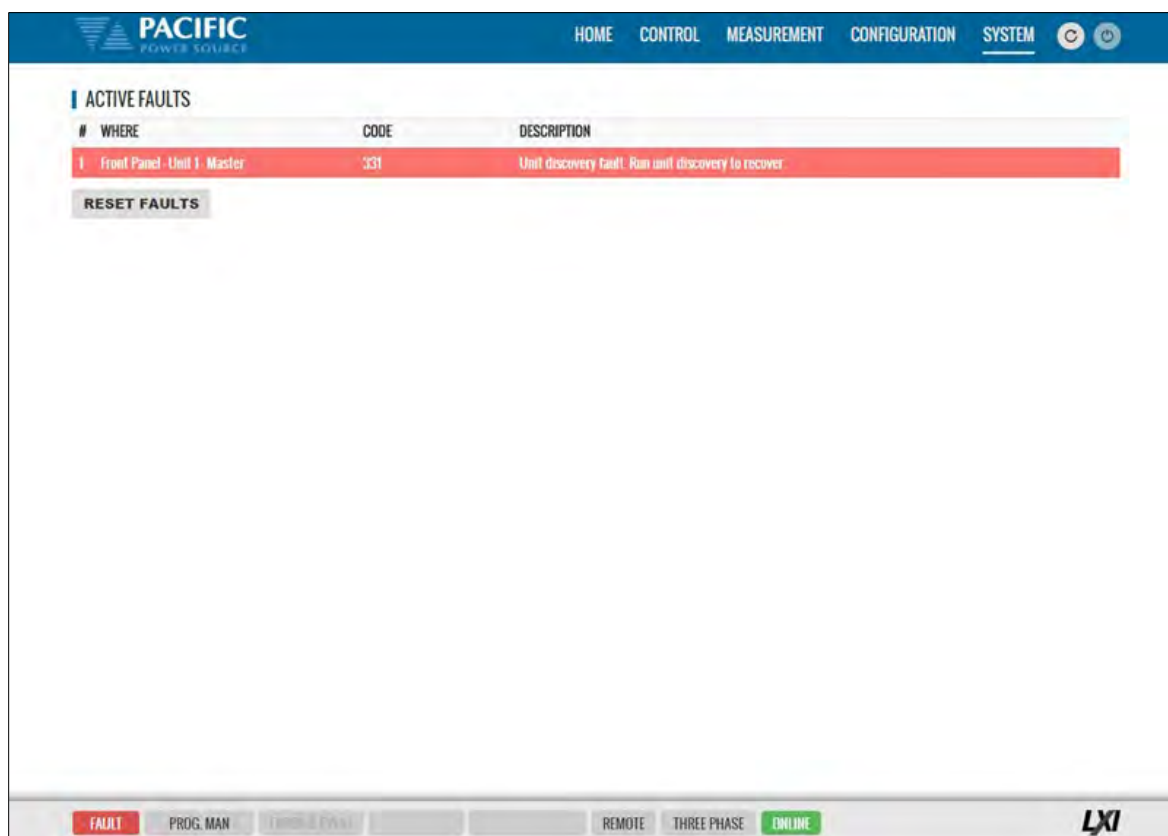
#	CODE	DATE	TIME	DESCRIPTION
1	I30	2016/01/22	15:59:02	Unable to disable output. One or more inverter stages failed to disable. Webpage.
2	I30	2016/01/22	15:59:11	Unable to disable output. One or more inverter stages failed to disable. Webpage.
3	I30	2016/01/22	15:59:38	Unable to disable output. One or more inverter stages failed to disable. Webpage.

CLEAR QUEUE

READY ERROR & EVENT REMOTE SINGLE PHASE **ONLINE** LXI

10.10.2 Fault List

The Fault List tracks hardware faults that may occur in the power conversion stages. This information may be useful for PPS engineering staff.



#	WHERE	CODE	DESCRIPTION
1	Front Panel - Unit 1 - Master	331	Unit discovery fault. Run unit discovery to recover.

RESET FAULTS

FAULT PROG. MAN (disabled) REMOTE THREE PHASE ONLINE LXI

10.10.3 Error/Event List

The Error Event list provides a complete listing of all possible error and event messages. The description may include possible troubleshooting hints to resolve any error conditions.

Errors are listed in numerical order.

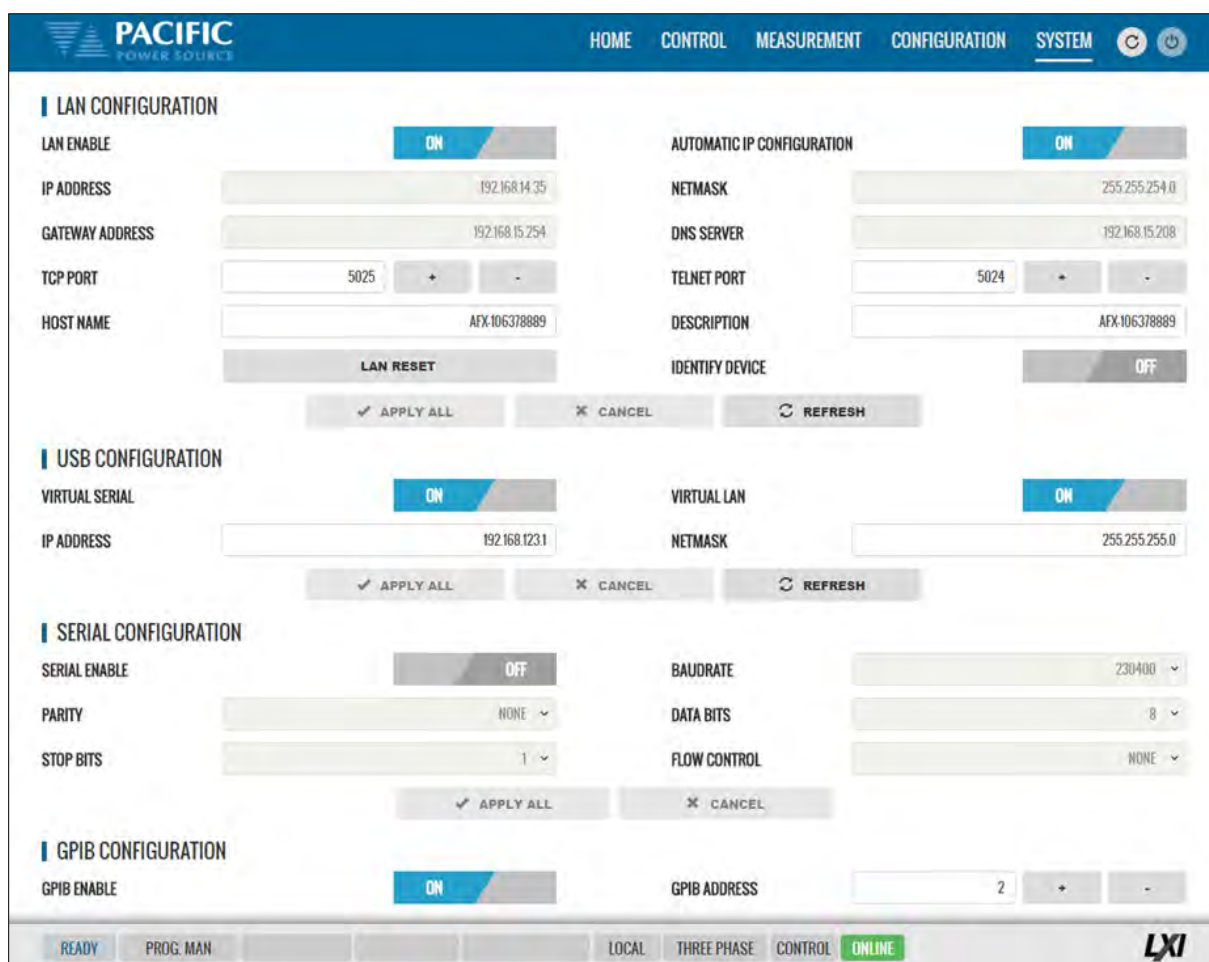
PACIFIC POWER SOURCE				HOME	CONTROL	MEASUREMENT	CONFIGURATION	SYSTEM		
ERROR/EVENTS LIST										
CODE	TYPE	SOURCE	DESCRIPTION							ERROR/EVENT QUEUE
527	Error	Frontpanel	Internal connection error with the power stage.							FAULT LIST
526	Error	Frontpanel	Version mismatch error.							ERROR/EVENT LIST
525	Error	Frontpanel	Cannot import configurations.							INTERFACE SETUP
524	Error	Frontpanel	Cannot export configurations.							ACCESS CONTROL
523	Warning	Frontpanel	Warning: Ambient temperature approaching limit.							UNIT INFORMATION
522	Error	Frontpanel	Argument requires more decimals.							PARALLEL UNITS
521	Error	Frontpanel	Read only file or folder.							MEMORY BROWSER
520	Error	Frontpanel	Inductive impedance not available in UPC compatible mode.							CALIBRATION
519	Error	Frontpanel	Cannot change output impedance mode with output enabled.							REMOTE SUPPORT
518	Error	Frontpanel	Cannot change output impedance state with output enabled.							IMPORT/EXPORT
517	Warning	Frontpanel	Inductive impedance was automatically reduced.							FIRMWARE UPDATE
516	Warning	Frontpanel	Resistive impedance was automatically reduced.							SANITIZE & REBOOT
515	Error	Frontpanel	Too many commands per line.							
514	Error	Frontpanel	Serial port flow control not available in this unit.							
513	Error	Frontpanel	Cannot change split phase mode with output enabled.							
512	Error	Frontpanel	Phase rotation is always negative in UPC compatible mode.							
511	Error	Frontpanel	Error during power stage firmware update.							
510	Error	Frontpanel	Unable to update setpoint because it is outside the allowed range of extended frequency mode.							
509	Error	Frontpanel	Setpoint out of range due to extended frequency mode.							
508	Warning	Frontpanel	Current limits were reduced due to extended frequency mode.							
ENABLED				PROG. MAN		VOLTAGE MODE	LOCAL	THREE PHASE	CONTROL	ONLINE

10.10.4 Interface Setup

The Interface setup screen allows enabling or disabling of several available interfaces and operating modes. The interfaces are arranged by type:

- LAN
- USB
- RS232 Serial
- GPIB

Interfaces that are not used can be turned off to avoid conflicts caused by multiple active interfaces at the user's discretion.



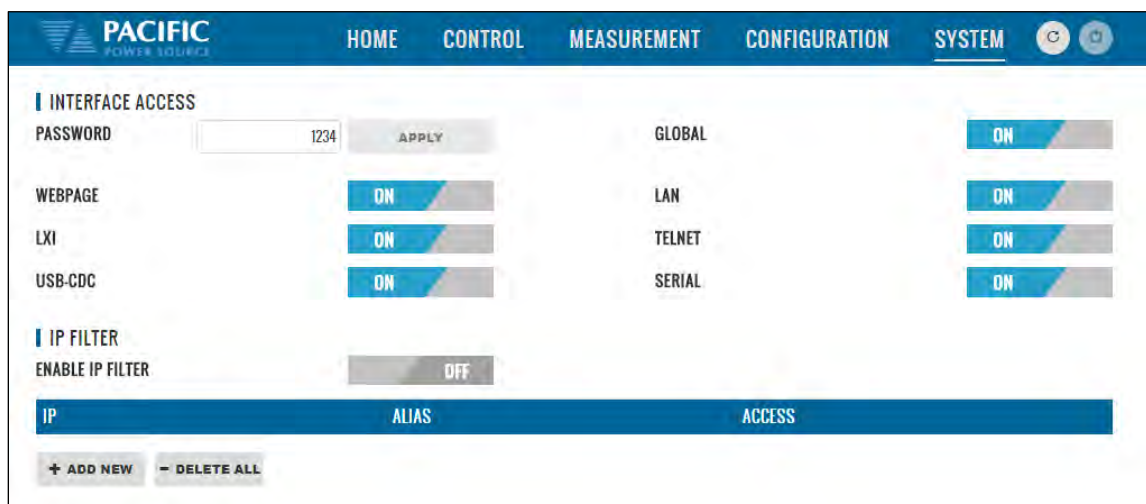
The screenshot displays the Pacific Power Source web interface with the 'CONFIGURATION' tab selected. The interface is divided into four main configuration sections:

- LAN CONFIGURATION:** Includes fields for IP ADDRESS (192.168.14.35), GATEWAY ADDRESS (192.168.15.254), TCP PORT (5025), HOST NAME (AFX106378889), AUTOMATIC IP CONFIGURATION (ON), NETMASK (255.255.254.0), DNS SERVER (192.168.15.208), TELNET PORT (5024), DESCRIPTION (AFX106378889), and IDENTIFY DEVICE (OFF). Buttons for LAN RESET, APPLY ALL, CANCEL, and REFRESH are present.
- USB CONFIGURATION:** Includes fields for VIRTUAL SERIAL (ON), IP ADDRESS (192.168.123.1), VIRTUAL LAN (ON), and NETMASK (255.255.255.0). Buttons for APPLY ALL, CANCEL, and REFRESH are present.
- SERIAL CONFIGURATION:** Includes fields for SERIAL ENABLE (OFF), PARITY (NONE), STOP BITS (1), BAUDRATE (230400), DATA BITS (8), and FLOW CONTROL (NONE). Buttons for APPLY ALL and CANCEL are present.
- GPIB CONFIGURATION:** Includes fields for GPIB ENABLE (ON) and GPIB ADDRESS (2). Buttons for APPLY ALL and CANCEL are present.

At the bottom of the interface, there is a status bar with buttons for READY, PROG. MAN, LOCAL, THREE PHASE, CONTROL, and ONLINE (highlighted in green). The LXI logo is also visible in the bottom right corner.

10.10.5 Access Control

The access control screen allows restricting access to the power source over the LAN interface. This is an important requirement for power sources connected to a company wide Ethernet network. Without access restrictions, persons not present where the power source is located could inadvertently cause a dangerous condition by either enabling the OUTPUT or changing programmed settings.



Access control can limit access from specific IP addresses only and requires someone physically present where the power source is to grant access to anyone else.

For more details, refer to section 10.3, “Access Control” on page 569 of this manual.

10.10.6 Digital & Analog IO's

The Digital and Analog IO screen allows configuration of the available Auxiliary I/O functions. Note that this feature is not available on AGX-2L and AGX-4L models.

The screenshot displays the 'SYSTEM' configuration page of the Pacific Power Source interface. The page is divided into two main columns for configuring Analog and Digital I/O functions.

ANALOG INPUTS:

- CHANNEL:** 1
- INPUT VOLTAGE:** [Field]
- COMMAND:** OFF
- RANGE (-/+):** 1000 V
- GAIN:** [Field]
- OFFSET:** [Field]
- DIGITAL INPUTS:**
 - CHANNEL:** 1
 - STATE:** LOW
 - RISING COMMAND:** [Field]
 - FALLING COMMAND:** [Field]
 - FILTER SIZE:** 0 MS
- TRIGGER INPUT:**
 - STATUS:** OFF
 - IMMEDIATE:** OFF
 - AUTORUN:** OFF
- EXTERNAL SYNC:**
 - STATUS:** OFF
 - EXTERNAL SYNC:** OFF
 - SYNC SOURCE:** LINE
 - PHASE SHIFT:** 0.00 Deg
 - SPEED:** 250 Hz
 - RANGE:** 1000 Hz
 - EXTERNAL SYNC:** ON

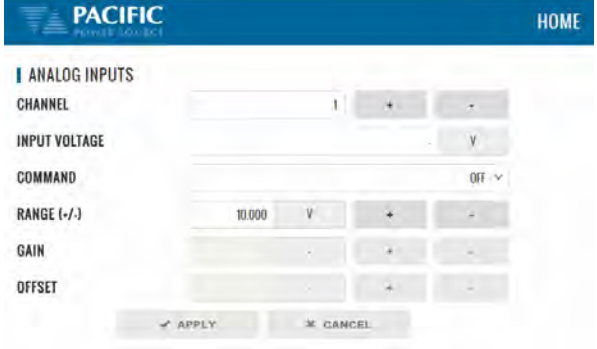
ANALOG OUTPUTS:

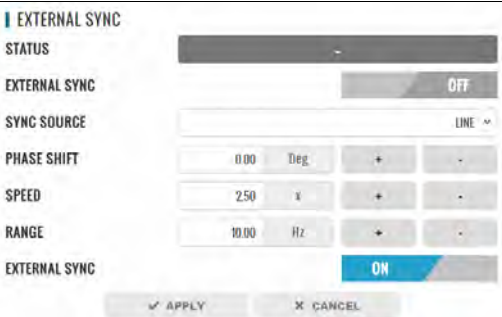
- CHANNEL:** 1
- OUTPUT VOLTAGE:** 1.00 V
- MEASUREMENT:** [Field]
- RANGE:** 5.000 V
- GAIN:** 5.000000 V
- OFFSET:** 0.000000 V
- DIGITAL OUTPUTS:**
 - CHANNEL:** 1
 - STATE:** LOW
 - FUNCTION:** LOW
 - INVERTING LOGIC:** OFF
- STROBE OUTPUT:**
 - TRANSIENT:** OFF
 - OUTPUT STATE:** OFF
 - SOURCE:** OFF
- REMOTE CONTROL:**
 - DISABLED:** (Selected)
 - REMOTE INHIBIT:** (Unselected)
 - REMOTE ENABLE:** (Unselected)

The bottom status bar shows: READY, PROG. MAN, LOCAL, THREE PHASE, CONTROL, and ONLINE (highlighted in green). The LXI logo is in the bottom right corner.

10.10.6.1 Function Groups

There are eight groups of functions that are available to be configured with the selectable settings listed in the table below.

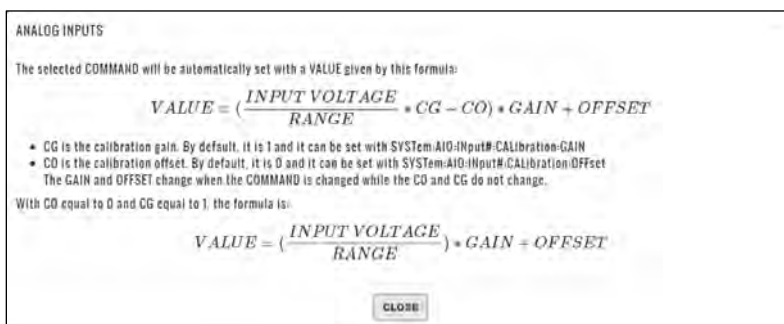
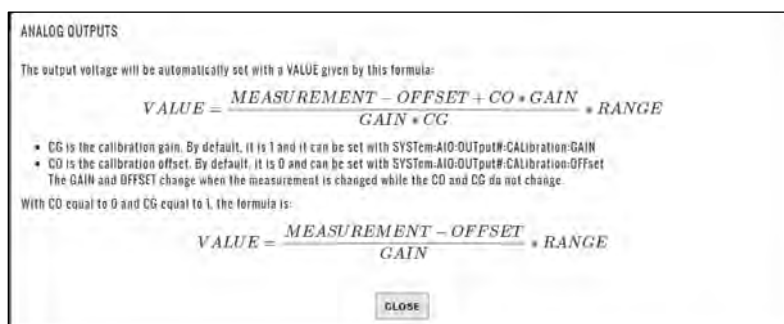
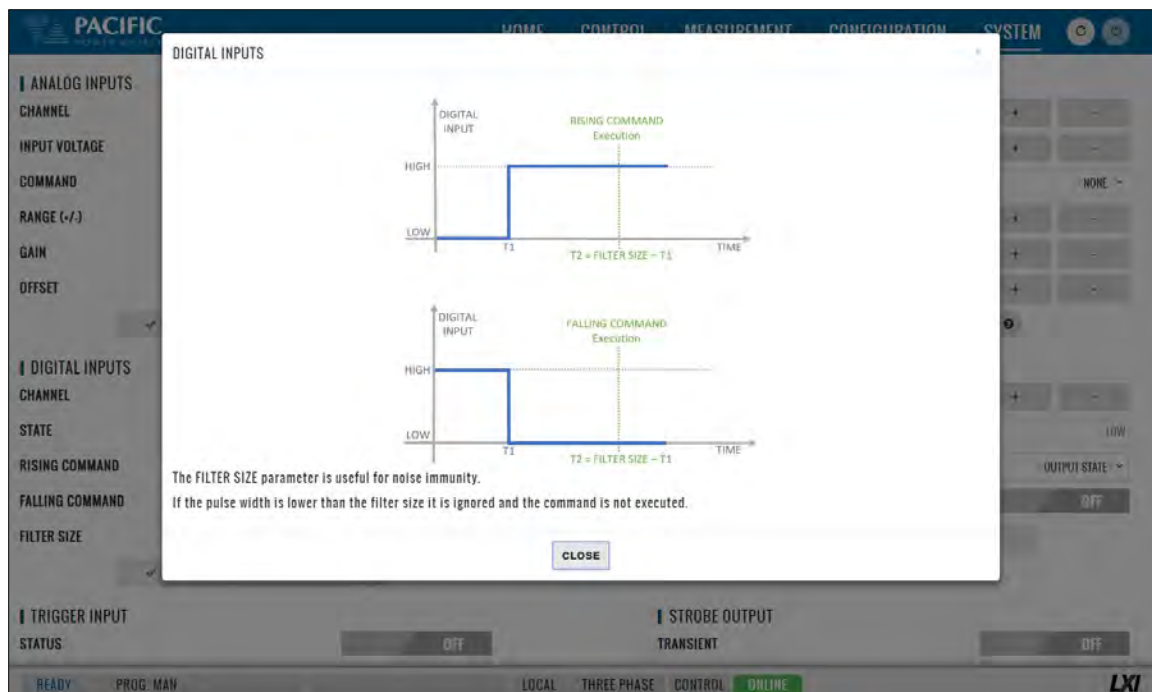
Grouping	Controls
Analog Inputs: CHANNEL [1 2 3 4] INPUT VOLTAGE Displays read back voltage COMMAND Select command from dropdown list or OFF for none RANGE 0.0000 – 10.000 V GAIN Gain OFFSET Offset value	
Analog Outputs: CHANNEL [1 2 3 4] OUTPUT VOLTAGE Output setting MEASUREMENT Select measurement to be assigned to output RANGE 0.0000 – 5.000 V GAIN Gain 0.000 - 1000 OFFSET Offset value – 1000 ~+1000	
Digital Inputs: CHANNEL [1 2 3] STATE Displays input state RISING CMD Set command string to execute on rising edge FALLING CMD Set command string to execute on falling edge FILTER SIZE 0 – 10,000,000 msec	
Digital Outputs: CHANNEL [1 2 3 4] STATE Displays current state FUNCTION Assigns state to selected channel. Available states are: FAULT FORM HIGH LOW OUTPUT STATE PROGRAM REMOTE TRANSIENT INV. LOGIC [ON OFF] Reverses polarity	

Grouping	Controls
Trigger Input: STATUS [ON OFF] Enabled or disabled IMMEDIATE [ON OFF] Ignore phase update setting if ON AUTORUN [ON OFF] No RUN command required if ON	
—Strobe Output: TRANSIENT ON = Strobe output on transient start OUTPUT STATE ON = Strobe output on relay close SOURCE ON = Strobe output on any program parameter change	
External Sync: STATUS Display SYNC Status EXTERNAL SYNC [ON OFF] SYNC SOURCE Select Sync source Available sources are: - External sync input on I/O connector - LINE (AC input to power source) PHASE SHIFT Offset Phase A angle SPEED 1.00 ~ 10.00 RANGE 0.10 ~ 500 Hz EXTERNAL SYNC [ON OFF]	
Remote Controls: DISABLED No remote output control REMOTE INHIBIT Contact closure needed to close output relay REMOTE ENABLE Contact closure or front panel can control output relay	

10.10.6.2 On-line Analog and Digital I/O help screens.

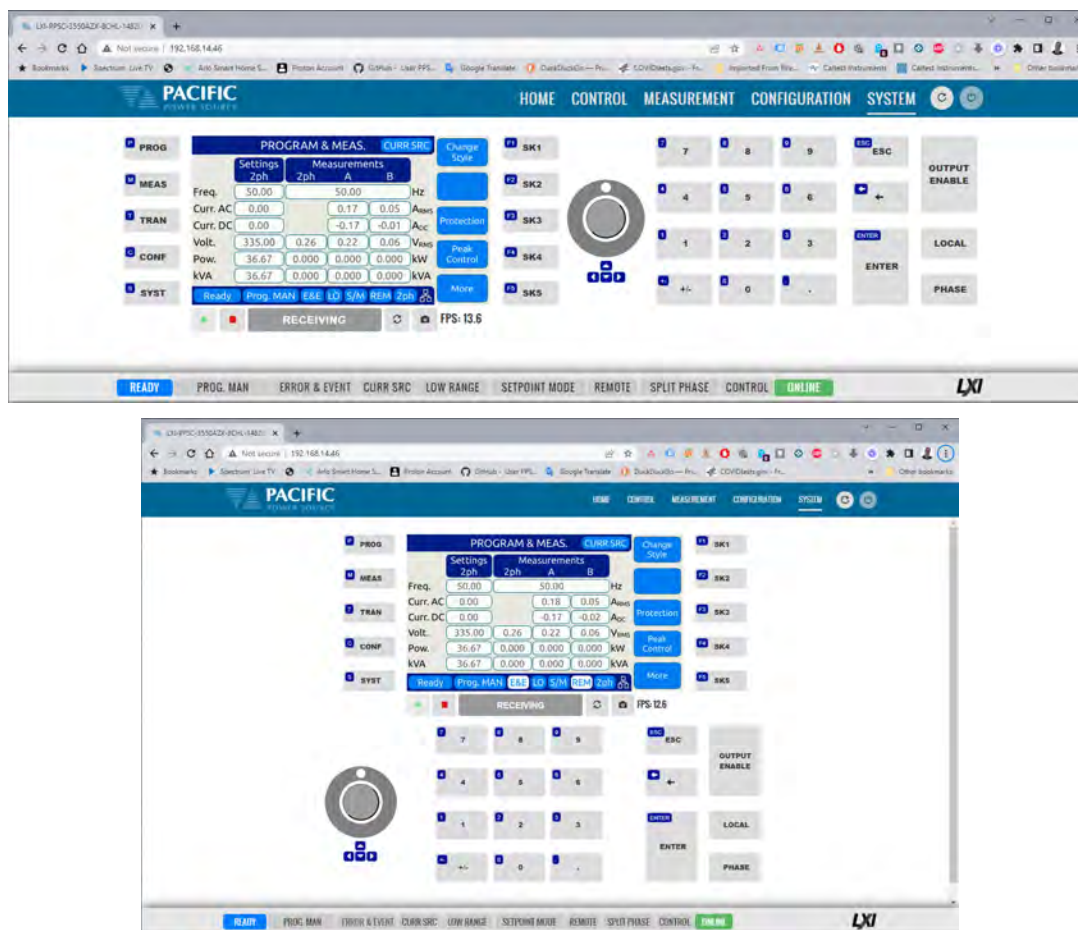
To aid in configuring and using the many I/O capabilities of the power source, a series of on-line help screens containing formulas and graphs for digital and analog I/Os settings are provided.

Some screens are shown below for reference.



10.10.7 Remote Interface (Virtual Front Panel)

The Remote Interface browser screen provides a virtual front panel that allows controlling the power source from a remote location using a PC, tablet or smart phone. The screen layout is a function of the web hosting device screen width. If wide enough, the layout will match that of the actual front panel of the power source. If too narrow for a landscape view, the front panel will be divided between the LCD screen, function and soft keys on top and the know plug decimal keypad and other control beneath it. Both layouts are shown below.



The operation of this Virtual Front panel is identical of that of the physical front panel so refer to Section 6, “Front Panel Operation” on page 112 for user information. The operation of this Virtual Front panel is identical of that of the physical front panel so refer to Section 6, “Front Panel Operation” on page 112 for user information. The controls located directly below the virtual LCD screen may be used when the internet connection used is slow or there is too much latency.



Available controls are:

-  Enable continuous update mode. In this mode, the status bar will show .
-  Stop continuous updated mode. The connection status will show .

RECEIVING Status Bar shows state of connection to the power source. Clicking on it will toggle connections status between **DISCONNECTED** and **CONNECTED**.

 Refresh button may be used when continuous updates are off to refresh the display

 Click to download a .png image of the virtual LCD display.

The status field to the right of the control buttons display the measurement frame update rate. In the example shown here the frame rate is 14.6 frames per second.

10.10.8 Unit Information

The Unit Information screen contains some of the same information as is found on the HOME screen but it can be used to query this information from one or more auxiliary unit as well in a parallel system. The HOME screen will only display information for the Master unit of a parallel configured system. Use the SELECTED UNIT control to select units downstream from the master (1).



10.10.9 Connected Units

The Connected⁹ Units screen displays the number of powered on units connected in either a Parallel or Series system. It also allows the expected number of units to be set so the master can determine if all connected units are indeed turned on before starting operation.

The MANUAL DISCOVERY can be run to refresh the system configuration if a unit has been turned on or off without power cycling the master.

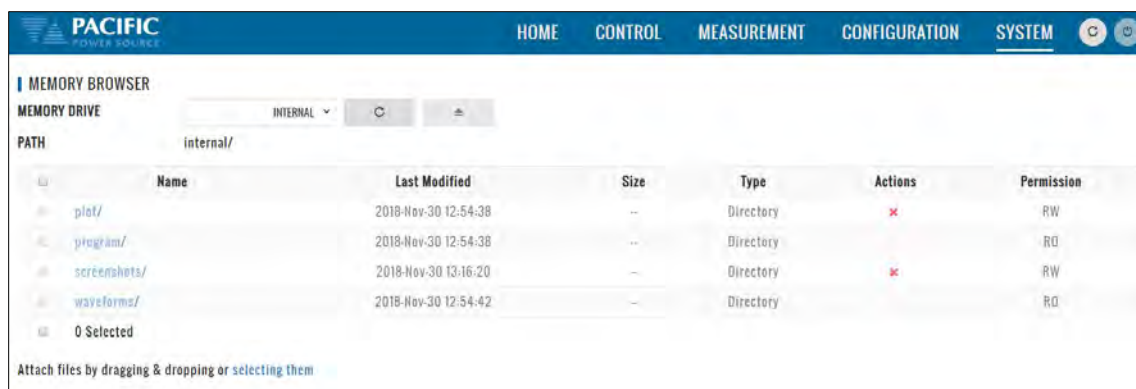


⁹ On Models with older firmware, this menu entry was shown as "Parallel Units".

10.10.10 Memory Browser

The Memory Browser screen shows available memory devices connected to the instrument including internal memory and available directories and files. All data and setup files are in XML format. Waveform files are stored in CSV format. Screen captures are stored in PNG image format.

Available MEMORY DRIVES are INTERNAL, RAM and any USB or SD-Card memory devices that are mounted. Files can be copied or move from other drives by using drag & drop or by selecting them. Files can also be uploading using a file selection window dialog.



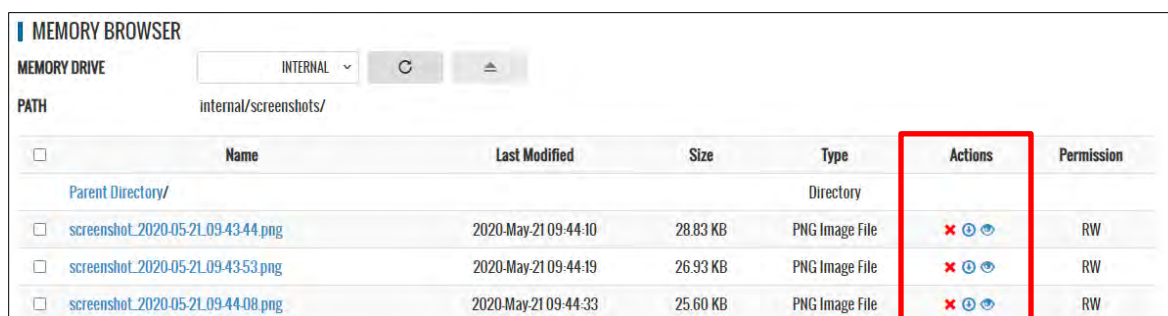
Useful directories for the user are:

DIRECTOR	FILES IN THIS DIRECTORY
plot/	Data logger plots in csv file format with date and time stamp
program/	Power source program settings
screenshots/	Screen capture image files in .png format with date and time stamp. To capture any LCD display, press the LOCAL key and the number 1 key on the decimal keypad at the same time.
waveforms/	User waveform data points in csv file format.

10.10.10.1 Screenshots

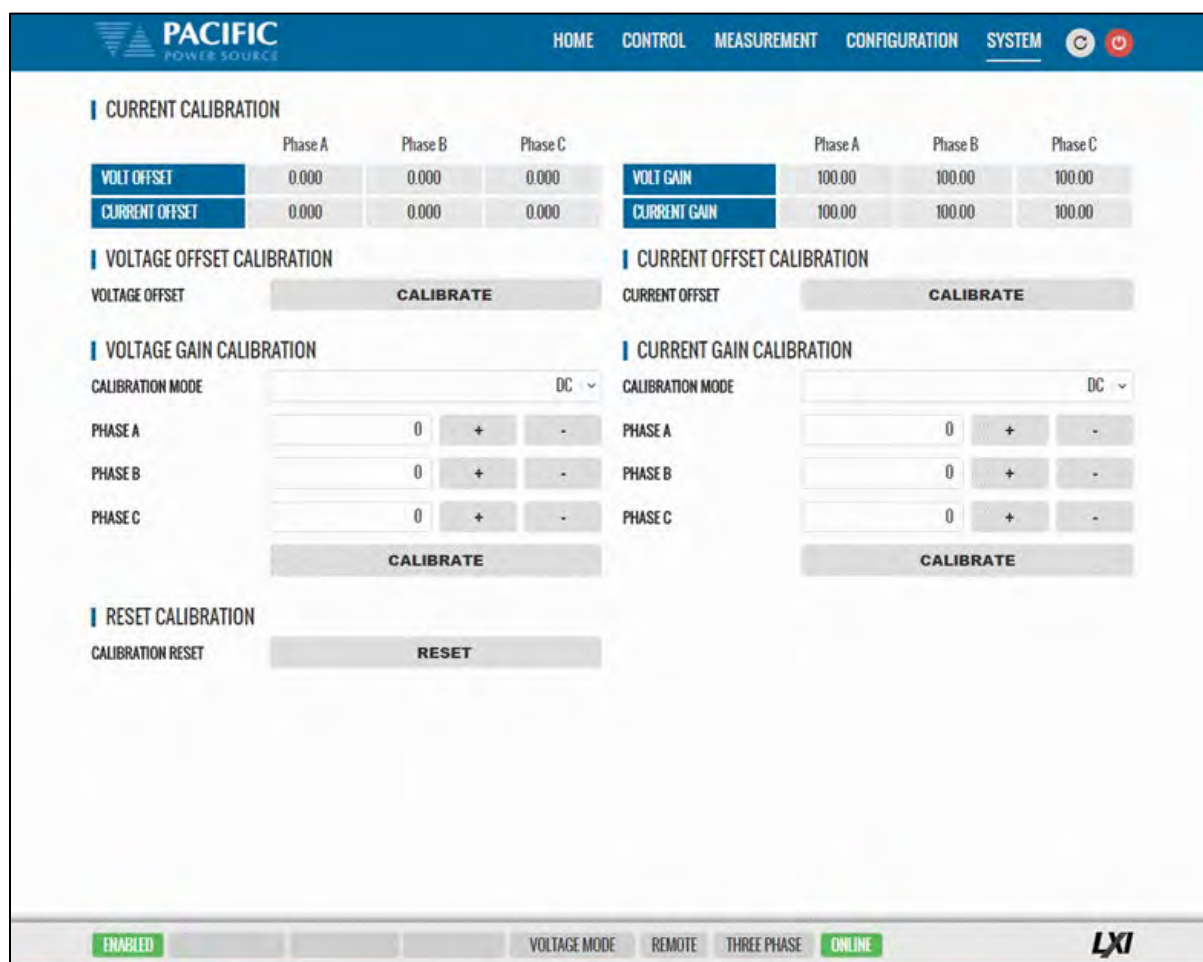
Screenshots of the LDC display saved by pressing the LOCAL + 1 key simultaneously are saved in the screenshots subdirectory. The controls in the Actions column allow the user to:

Delete Download Preview



10.10.11 Calibration

The Calibration screen shows all user accessible calibration coefficients. It also allows for user calibration of voltage and current to be performed. The Web Browser user interface is specific but the procedures and equipment are the same as calibration from the front panel. Refer to Section 11.4, “Calibration Procedures” for details.



PACIFIC POWER SOURCE | HOME | CONTROL | MEASUREMENT | CONFIGURATION | **SYSTEM** |  

| CURRENT CALIBRATION

	Phase A	Phase B	Phase C		Phase A	Phase B	Phase C
VOLT OFFSET	0.000	0.000	0.000	VOLT GAIN	100.00	100.00	100.00
CURRENT OFFSET	0.000	0.000	0.000	CURRENT GAIN	100.00	100.00	100.00

| VOLTAGE OFFSET CALIBRATION | **| CURRENT OFFSET CALIBRATION**

VOLTAGE OFFSET **CALIBRATE** | CURRENT OFFSET **CALIBRATE**

| VOLTAGE GAIN CALIBRATION | **| CURRENT GAIN CALIBRATION**

CALIBRATION MODE **DC** | CALIBRATION MODE **DC**

PHASE A **+** **-** | PHASE A **+** **-**

PHASE B **+** **-** | PHASE B **+** **-**

PHASE C **+** **-** | PHASE C **+** **-**

CALIBRATE | **CALIBRATE**

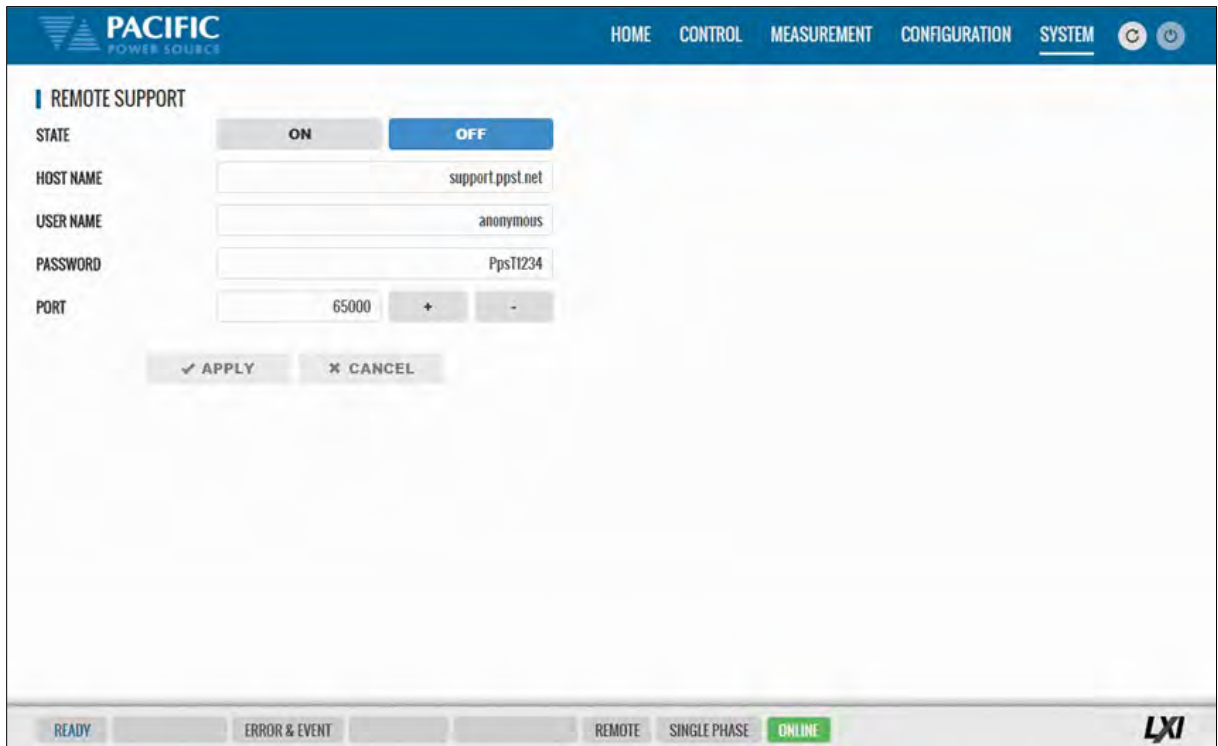
| RESET CALIBRATION

CALIBRATION RESET **RESET**

ENABLED **VOLTAGE MODE** **REMOTE** **THREE PHASE** **ONLINE** 

10.10.12 Remote Support

The Remote Control screen allows Pacific Power's technical support staff to access the unit remotely if granted permission. Internet access is required for this feature.



The screenshot shows the 'REMOTE SUPPORT' configuration page. At the top, there is a navigation bar with 'HOME', 'CONTROL', 'MEASUREMENT', 'CONFIGURATION', and 'SYSTEM' (selected). Below the navigation bar, the 'REMOTE SUPPORT' section is active. It contains a 'STATE' toggle with 'ON' and 'OFF' buttons, where 'OFF' is currently selected. Below the toggle are input fields for 'HOST NAME' (containing 'support.ppst.net'), 'USER NAME' (containing 'anonymous'), 'PASSWORD' (containing 'Ppst1234'), and 'PORT' (containing '65000' with '+' and '-' buttons). At the bottom of this section are '✓ APPLY' and '✗ CANCEL' buttons. The bottom status bar shows 'READY', 'ERROR & EVENT', 'REMOTE', 'SINGLE PHASE', and 'ONLINE' (highlighted in green), along with the LXI logo.

10.10.13 Import / Export

A compressed file containing complete system configuration data for the power source can be exported to a file and imported back into the unit as needed. Files are .7z compressed to maximize storage space. Use the Export button on the right to export (save) current configuration data. Use the Browse button to select and import (load) a previously saved configuration file.



The screenshot shows the 'SYSTEM IMPORT' and 'SYSTEM EXPORT' section. On the left, under 'SYSTEM IMPORT', there is a 'SYSTEM FILE' input field with a 'Browse' button. A blue informational box below states: 'The system importation uses a compressed file (.7z) that could include unit configurations, waveforms, programs and setpoints. After an importation process the unit will perform a reboot.' On the right, under 'SYSTEM EXPORT', there is a 'SYSTEM FILE' input field and an 'EXPORT' button. The top navigation bar is the same as in the previous screenshot, with 'SYSTEM' selected.

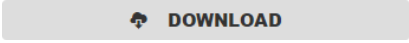
10.10.14 Firmware Update

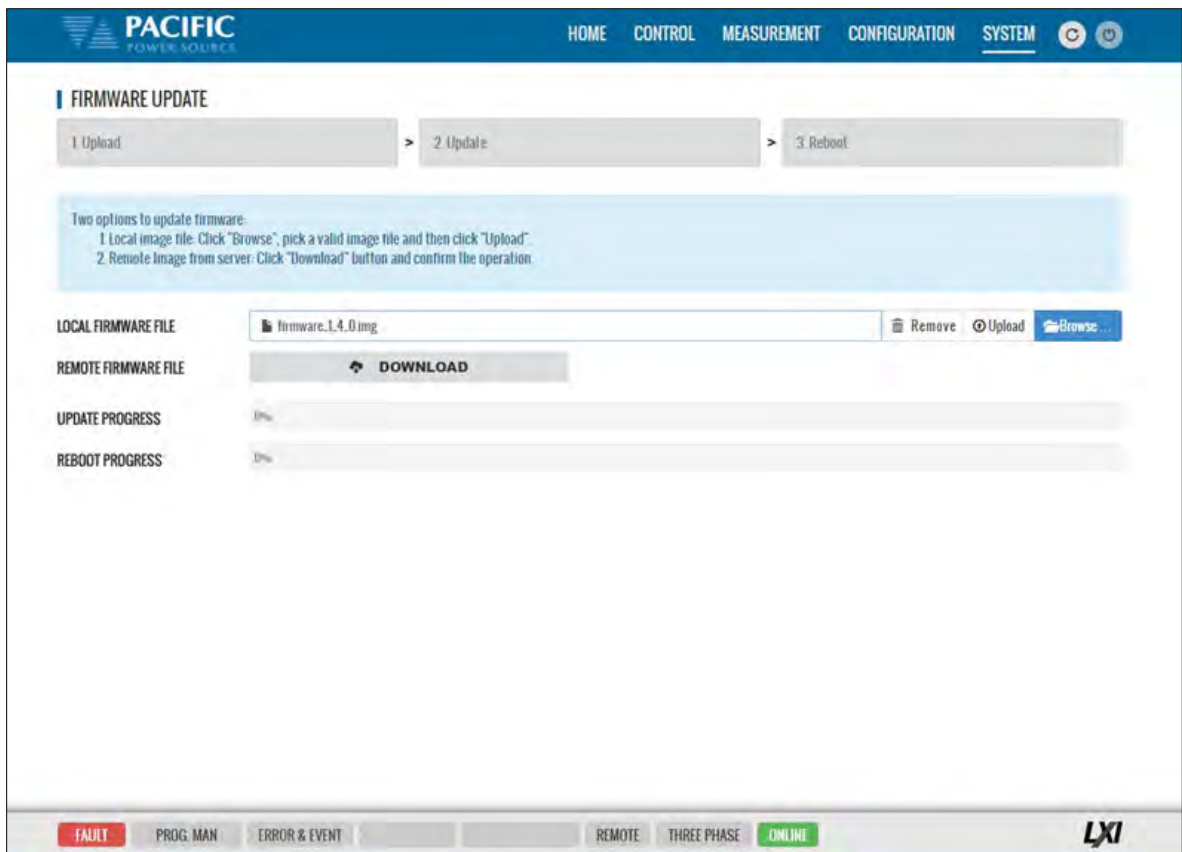
The Firmware update screen can be used to install new firmware for a file. New firmware may be distributed by email or from Pacific's FTP site. Note that the OUTPUT of the unit must be OFF to perform a firmware update.

If you received a firmware image file (.img extension):

- Use the  button to select it from the drive location you saved it to.
- Then use the  button to upload new firmware to the power source.

To install new firmware from the Pacific Power FTP server:

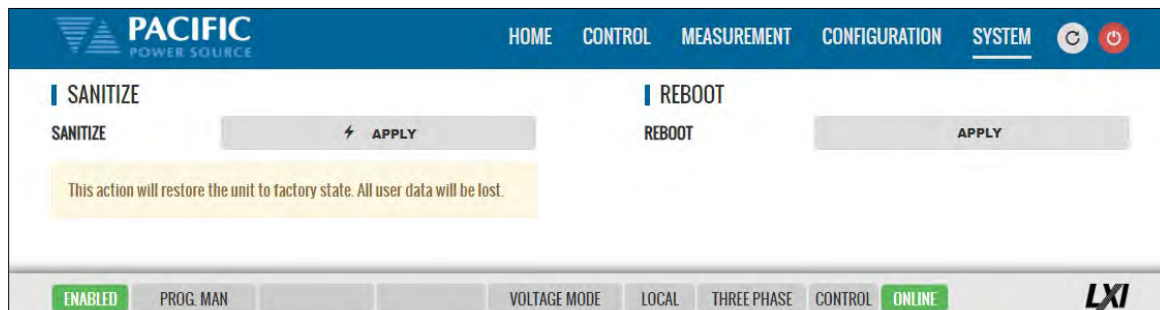
- Click the  button.



10.10.15 Sanitize and Reboot

This screen allows the unit to be cleared of all user settings. This applies to waveforms, settings, transients etc. The unit will be reset to factory default conditions.

The Reboot allows the power source to be rebooted (reset) without cycling AC input power.

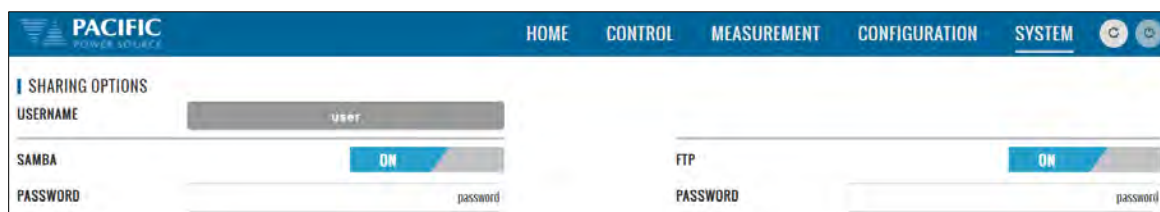


10.11 Additional Functions

Additional functions may be added over time through firmware updates that may not be covered by this user manual revision. If so, check the Pacific Power website for update manual versions. (www.pacificpower.com).

10.11.1 Sharing Options – FTP & SAMBA

This series supports a network based sharing feature using one of two protocols. These can be enabled from the Sharing Options screen. For more details, refer to Section 6.8.5.10, “REMOTE SHARING” on page 196.



11 Calibration

11.1 Calibration Interval

All units are shipped new from the factory with NIST traceable calibration. It is recommended to perform an annual calibration check to ensure performance to specifications. Under normal circumstances, no adjustment will be needed but can be made as part of the user calibration coefficients.

11.2 Closed Case User Calibration

This section covers routine calibration that can be performed by the user. User calibration does not affect the factory set calibration coefficients that were determined and set at the time of shipment to ensure compliance with published specifications. Rather, user calibration can be used to obtain enhanced performance at typical operating conditions by adjusting these user coefficients at these conditions. For example, if the unit is used primary for testing 400Hz, three phase 115V L-N three phase operation, calibrating the user coefficients to these operating conditions against an external precision reference can provide enhanced performance versus published specifications (See Section 4, “Technical Specifications”).

Since user calibration does not affect factory calibration settings, resetting all user calibration coefficients does not invalidate the units specified performance and it can be used with all user coefficients reset as needed.

Note: There are no analog adjustment pots in this instrument and all calibration can be performed from the front panel or over one of the digital control interfaces.

11.3 Equipment Required

The following list of equipment or equivalent is required to perform routine annual calibration of the instrument. Current sensor options are determined by need for AC, DC or both.

Item	Make	Model	Notes
1	Keysight	34465A	6 ½ Digit DMM or equivalent
2	Current Transformer (AC Only)	Pearson	Model 110, 65 Arms Max. 5000Apk Max. 0.1V/A +1/-0%, Rout = 50 Ohms http://www.pearsonelectronics.com/products/current-monitors
3	Current Sensor (AC and DC)	LEM	IT 200-S ULTRASTAB, 200 A, ± 0.0086% Accuracy, 50 kHz BW or equivalent. https://www.lem.com/en/product-list/it-200s-ultrastab Requires precision burden resistor for direct DMM measurements, i.e. Reidon, P/N SM10-100RX, 0.01% 100 Ohm, 0.3W, qty 2 or 3 in parallel for 50 Ohm or 33.3 Ohm burden https://www.digikey.com/product-detail/en/riedon/SM10-100RX/696-1568-ND/4832952
4	Current Shunt (DC)	Ohm-Labs	CS-200, Shunt, 1 mOhm, 0.02% Accuracy @ DC to 50/60 Hz or equivalent http://www.ohm-labs.com

Table 11-1: Required Calibration Equipment

11.4 Calibration Procedures

Calibration of output and measurements is performed by a single procedure so there is no need to calibrate each separately. Calibration involves voltage and current full scale and offset on each phase. For three-phase mode, this means there are twelve calibration points, for single-phase mode, there are four.

The calibration can be performed manually using the Calibration menu (refer to Section 6.8.9 for the location of the Calibration menu) or through the built-in web server using the web browser interface. Refer to Section 10.10.11, "Calibration" for access to the Web based calibration screens.

11.4.1 Voltage Calibration - Offset

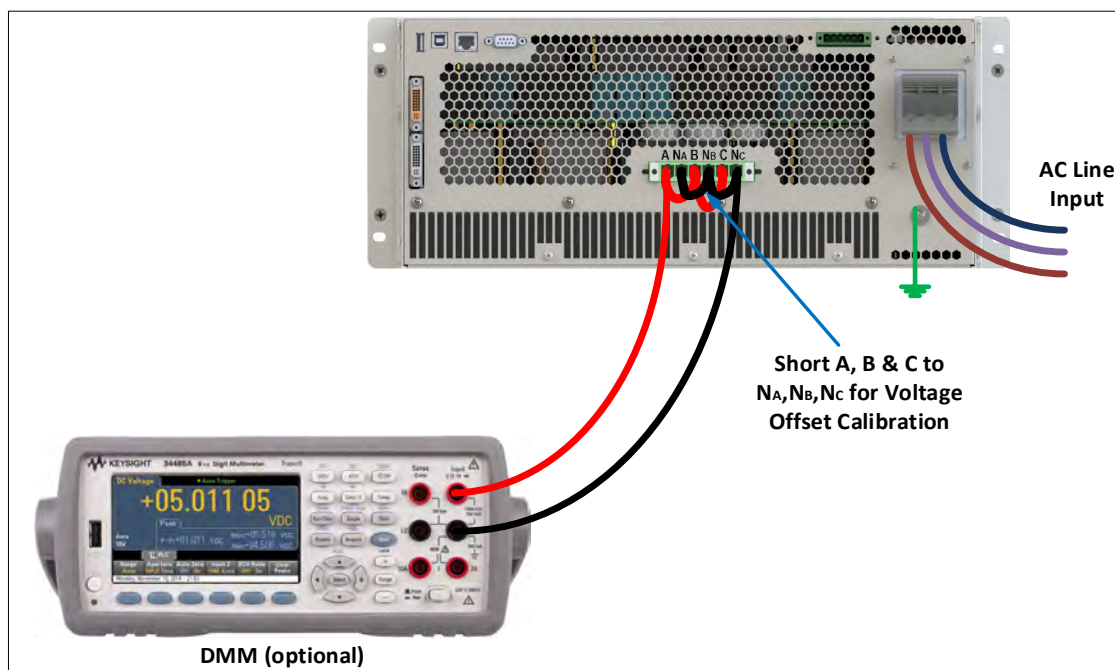


Table 11-2: Setup for Voltage Offset Calibration

The procedure to calibrate voltage offset is:



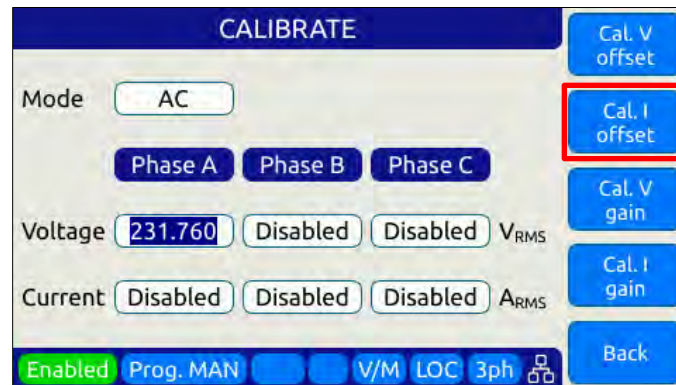
1. Select the Calibration entry from the "System" menu

2. Press the "Calibrate" soft key to enter calibration mode
3. Short all phases to neutral using a shorting jumper
4. You can connect the DMM to the output of phase A as shown in the figure above but it is not required for this calibration step.
5. **IMPORTANT:** Program both AC and DC voltage (depending on voltage mode) to all **zero volts** to avoid any current from flowing into the shorted outputs. Use PROGRAM screen to make sure both AC and DC settings are zero.
6. Enable the Output with the output shored.
7. Press "Cal V. offset" soft key
8. Wait for the V offset coefficients for all phases to be calculated and displayed
9. Remove the shorting jumper when done

Note: The Mode, Voltage and Current edit boxes do not affect this function.

11.4.2 Current Calibration - Offset

The procedure to calibrate current offset is:



1. Select the Calibration entry from the "System" menu
2. Press the "Calibrate" soft key to enter calibration mode
3. Do not connect any load to the output
4. Enable the Output with no load connected
5. Press "Cal I. offset" soft key
6. Wait for the I offset coefficients for all phases to be calculated and displayed

Note: The Mode, Voltage and Current edit boxes do not affect this function.

11.4.3 Voltage Calibration - Gain

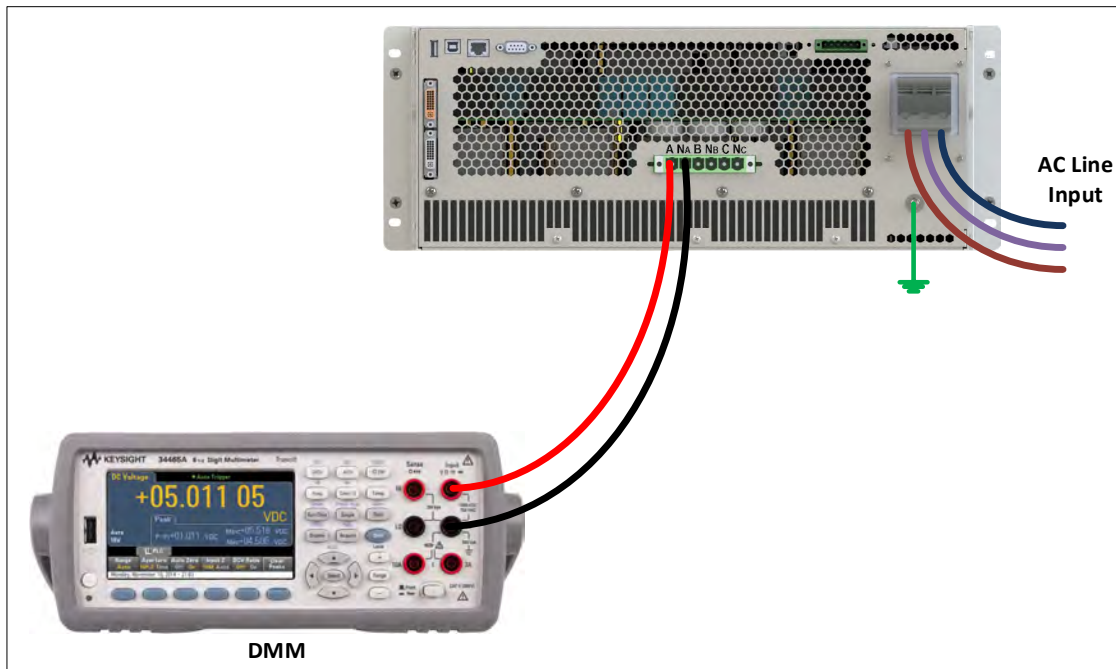
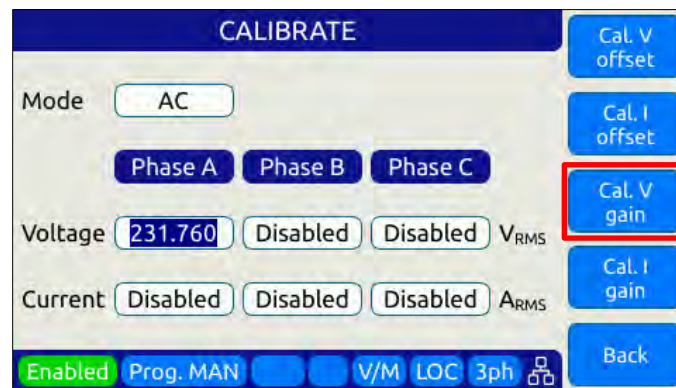


Figure 11-1: Voltage Calibration Equipment Setup – 1 or 3 Phase Mode – Phase A

The procedure to calibrate voltage gain is:



1. Select the Calibration entry from the “System” menu
2. Press the “Calibrate” soft key to enter calibration mode
3. Do not connect any load to the output
4. Program AC voltage to full scale 300.0 Vrms L-N for AC mode calibration or 425Vdc for DC mode calibration on all phases. Use the PROGRAM screen for this.
5. For AC mode calibration, set the Frequency to the most commonly used value depending on typical applications
6. NOTE: If the user calibration is targeted for specific operating conditions, for example Vac = 115V L-N and Freq = 400 Hz, use these settings instead of those suggested in steps 4 and 5

7. Enable the Output with no load connected
8. Enter the DMM VAC readings for all three phase in the respective Voltage data entry text boxes in the Calibration screen. Move the DMM probe from phase A, to B to C respectively to obtain each phase reading.
9. Press "Cal V. gain" soft key
10. Wait for the V gain coefficients for all phases to be calculated and displayed

Note: Voltage gain can be calibrated in DC mode as well if this is the predominant mode of use. Use the MODE fields at the top to select the desired mode.

11.4.4 Current Gain Calibration Setup Diagrams

For current calibration, a resistive load equivalent to 90% of maximum available RMS phase current for the phase mode selected is recommended. It is permissible to use only one load and move it between phases for three-phase mode calibration. For single-phase mode current calibration, a load capable of supporting 90% of maximum available single-phase current is recommended. The A, B and C outputs must be shorted together for single-phase mode operation. The optional Single Phase Shorting Connector (P/N 160086) can be used to accomplish this.

Note: To guarantee that the current doesn't change during the calibration process, it is recommended that the unit is operated at current limit, but reducing its set point to the desired value. It is also recommended to use a stable load that provides a constant linear impedance to the unit.

A suitable current shunt must be connected in series with the load as shown below for three-phase mode. The sense terminals of the current shunt must be connected to the DMM Voltage input.

Three Phase Mode Setup

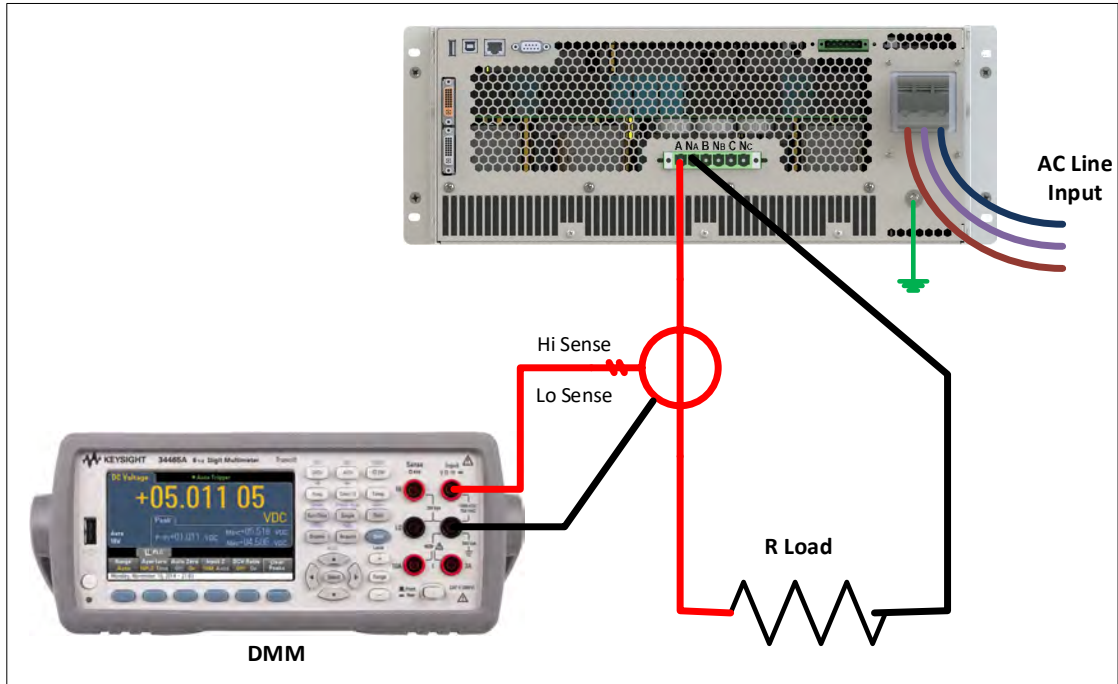


Figure 11-2: Current Calibration Equipment Setup – 3 Phase Mode – Phase A

Single Phase Mode Setup

For Single-phase mode current Calibration, the load must have the appropriate size. See next section for recommended load value by model and phase mode.

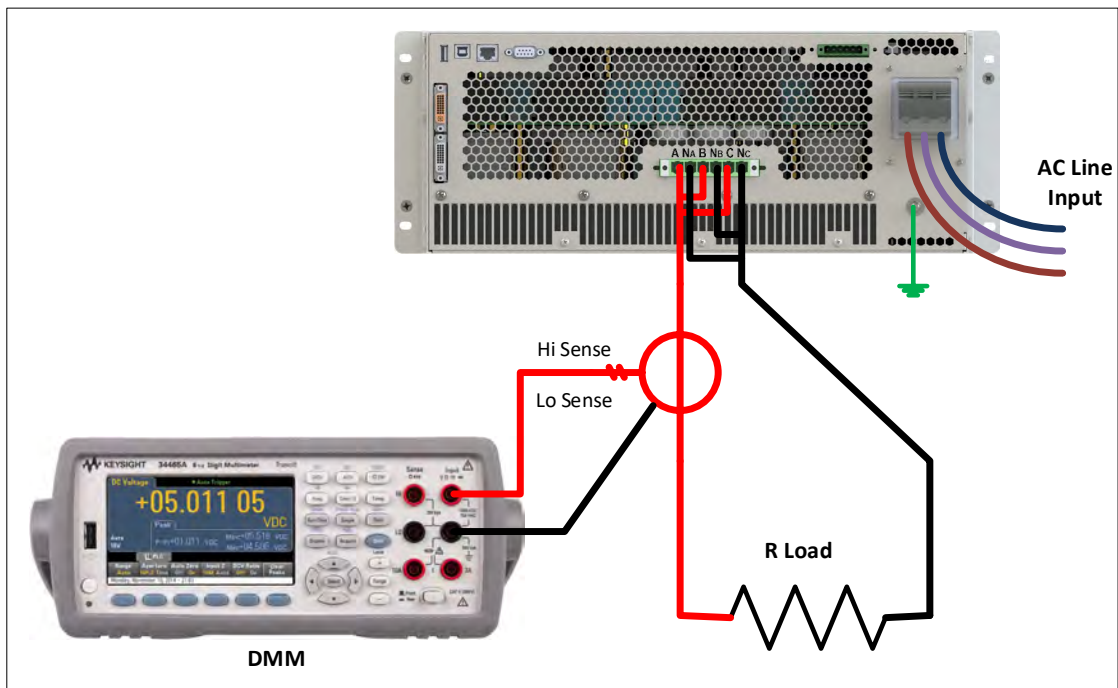


Figure 11-3: Current Calibration Equipment Setup – 1 Phase Mode

11.4.5 Current Calibration Load Values

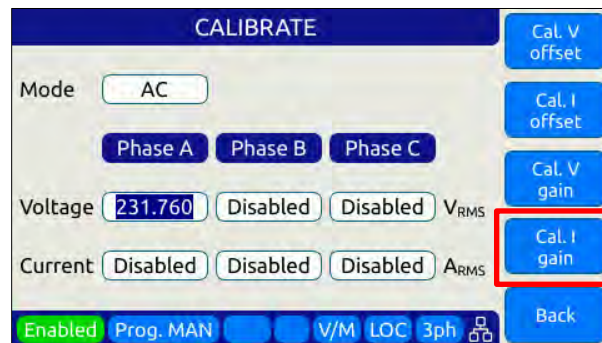
Full-scale current gain calibration is best performed at current levels that are around 90% of full scale current. Since the AGX Series® has only a single voltage range, maximum RMS current is available at 120Vrms L-N for each phase. For single-phase mode, the current is three times higher. Thus, to obtain 90% of load current, resistor value that is sized to draw this current level at around 120Vrms is required. Since the maximum current varies by model and phase mode, the table below shows the recommended resistor values or resistive load bank settings.

Model	Rating/phs VA/W	Three & Two Phase Mode Calibration			Single Phase Mode Calibration		
		Max. I _{rms} /phs	Current (90%)	Recommended R Load (Ohm)	Max/ I _{rms}	Current (90%)	Recommended R Load (Ohm)
360AGX	2000	17.0	15	8.0	51	46	2.61
390AGX	3000	25.0	23	5.3	75	68	1.78
3120AGX	4000	34.0	31	4.0	102	92	1.31
3150AGX	5000	42.0	38	3.2	126	113	1.06
3180AGX	6000	42.0	38	3.2	126	113	1.06
3210AGX	7000	42.0	38	3.2	126	113	1.06
3240AGX	8000	68.0	61	2.0	204	184	0.65
3300AGX	10000	84.0	76	1.6	252	227	0.53
3360AGX	12000	84.0	76	1.6	252	227	0.53
3420AGX	14000	84.0	76	1.6	252	227	0.53
3630AGX	21000	126.0	113	1.1	378	340	0.35
3840AGX	28000	168.0	151	0.8	504	454	0.26
31050AGX	35000	210.0	189	0.6	630	567	0.21
31260AGX	42000	252.0	227	0.5	756	680	0.18
31470AGX	49000	294.0	265	0.5	882	794	0.15
31680AGX	56000	336.0	302	0.4	1008	907	0.13

Table 11-3: Calibration Load Values by Model and Phase Mode

11.4.6 Current Calibration - Gain

The procedure to calibrate current gain is:



1. Select the Calibration entry from the “System” menu
2. Press the “Calibrate” soft key to enter calibration mode

3. Connect the required resistive load value to the output of phase A or all three outputs if three loads are available.
4. Program AC voltage to 120.0 Vrms L-N on all phases
5. Set the Frequency to the most commonly used value depending on typical applications
6. Enable the Output
7. Allow the load current to stabilize by monitoring the DMM current reading for each phase.
8. Enter the DMM VAC readings for all three phase in the respective Current data entry text boxes in the Calibration screen. If only one shunt and load is available, repeat the above steps for phase B and C making sure to turn OFF the output before moving the load and shunt to the next phase.
9. Press "Cal I. gain" soft key
10. Wait for the I gain coefficients for all phases to be calculated and displayed

Note: Current gain can be calibrated in DC mode as well if this is the predominant mode of use. Use the MODE fields at the top to select the desired mode.

11.4.7 Exit Calibration Mode

To exit the calibration mode once done, press the **“Back”** software.

12 Warnings & Error Messages

12.1 Preface

During normal operation, a series of error and/ or warning messages may be displayed on the front panel LCD display or reported by the error queue over one of the remote control interfaces. This section of the manual lists available warning and error messages in numerical order and provided some additional information on their meaning and possible causes. Where relevant, suggested remedies to resolve any conditions are included as well.

Note: There are some Error and Warning messages that may appear in the Errors & Events that are **NOT** listed in the next section. In case you encounter an unlisted error or warning message and code, contact Pacific Power customer service (support@pacificpower.com) and describe the number and description to obtain further information.

After reporting such an event, try rebooting the power sources by cycling power as most of these conditions will clear up with a reboot.

12.2 Errors & Warnings Messages in Numeric Order

Source	Code	Type	Description	Possible cause
Frontpanel	-500	"SCPI standard event"	"Event: Power ON."	Power on event detected. Normal after power on
Frontpanel	-350	"SCPI standard event"	"E&E queue overflow."	
Frontpanel	-360	"SCPI standard error"	"Communication error with an interface."	
Frontpanel	-320	"SCPI standard error"	"Storage fault."	
Frontpanel	-310	"SCPI standard error"	"System error"	
Frontpanel	-290	"SCPI standard error"	"Execution error: Memory use error."	
Frontpanel	-286	"SCPI standard error"	"Execution error: Not allowed command with the current configuration."	
Frontpanel	-285	"SCPI standard error"	"Execution error: Program syntax error."	
Frontpanel	-284	"SCPI standard error"	"Execution error: Program is currently running."	
Frontpanel	-282	"SCPI standard error"	"Execution error: Invalid program name."	
Frontpanel	-281	"SCPI standard error"	"Execution error: Cannot create program."	
Frontpanel	-256	"SCPI standard error"	"Execution error: File not found."	
Frontpanel	-253	"SCPI standard error"	"Execution error: Media is corrupted."	
Frontpanel	-240	"SCPI standard error"	"Execution error: Hardware error."	
Frontpanel	-224	"SCPI standard error"	"Execution error: Illegal parameter value."	
Frontpanel	-222	"SCPI standard error"	"Execution error: Argument out of range."	
Frontpanel	-221	"SCPI standard error"	"Execution error: Conflict in configuration setting."	
Frontpanel	-203	"SCPI standard error"	"Execution error: Permission denied."	
Frontpanel	-158	"SCPI standard error"	"Command error: String data is not allowed."	
Frontpanel	-138	"SCPI standard error"	"Command error: Numeric suffix is invalid."	

Source	Code	Type	Description	Possible cause
Frontpanel	-131	"SCPI standard error"	"Command error: Numeric suffix is out of range."	
Frontpanel	-113	"SCPI standard error"	"Command error: Undefined header."	
Frontpanel	-109	"SCPI standard error"	"Command error: Invalid number of parameters."	
Frontpanel	-108	"SCPI standard error"	"Command error: Parameters error."	
Frontpanel	-103	"SCPI standard error"	"Command error: Invalid separator."	
Frontpanel	-102	"SCPI standard error"	"Command error: Syntax error."	
Frontpanel	18	"Error"	"Unavailable transient element."	
Frontpanel	19	"Error"	"Maximum number of transient elements."	
Frontpanel	21	"Error"	"Internal communication: error during SDO upload."	
Frontpanel	22	"Error"	"Internal communication: error during SDO download."	
Frontpanel	29	"Error"	"USB interface unknown state."	
Frontpanel	31	"Error"	"Interface request packet"	Not empty."
Frontpanel	32	"Error"	"Interface request packet"	Unknown type"
Frontpanel	33	"Error"	"Interface request packet"	Incompatible type."
Frontpanel	34	"Error"	"Interface request packet out of space."	
Frontpanel	35	"Error"	"Interface request packet"	Unavailable command request
Frontpanel	36	"Error"	"Interface request packet has invalid arguments."	
Frontpanel	37	"Error"	"Interface response packet out of space."	
Frontpanel	42	"Error"	"Memory in use was removed."	
Frontpanel	47	"Error"	"Front panel is shutting down."	
Frontpanel	48	"Error"	"Fault state cannot be automatically reset."	
Frontpanel	51	"Error"	"The command cannot be executed in auxiliary unit."	
Frontpanel	53	"Error"	"Error during firmware update."	
Frontpanel	54	"Error"	"Calibration coefficient cannot be negative."	
Frontpanel	57	"Error"	"Waveform is not available."	
Frontpanel	58	"Error"	"Waveforms lengths are different between inverter controllers."	
Frontpanel	59	"Error"	"Unit does not exist."	
Frontpanel	60	"Error"	"Cannot read ambient temperature."	
Frontpanel	64	"Error"	"Unexpected reset."	
Frontpanel	65	"Error"	"Front panel is in passive mode."	
Frontpanel	66	"Error"	"Invalid host name."	
Frontpanel	67	"Error"	"DC voltage setpoint cannot change due to waveform saturation."	
Frontpanel	68	"Error"	"AC voltage setpoint cannot change due to waveform saturation."	
Frontpanel	69	"Error"	"Maximum user limit is lower than setpoint."	

Source	Code	Type	Description	Possible cause
Frontpanel	70	"Error"	"Minimum user limit is higher than setpoint."	
Frontpanel	72	"Error"	"Minimum limit is higher than maximum."	
Frontpanel	73	"Error"	"Maximum limit is lower than minimum."	
Frontpanel	75	"Error"	"IP address conflict. May be duplicated."	
Frontpanel	76	"Error"	"Invalid filename."	
Frontpanel	77	"Error"	"External memory storage is not available."	
Frontpanel	78	"Error"	"Datalogger rate not allowed."	
Frontpanel	79	"Error"	"Datalogger is running"	Yyou must stop it to change the configuration
Frontpanel	80	"Error"	"Datalogger execution error."	
Frontpanel	83	"Error"	"Internal error: File system partition blocked."	
Frontpanel	84	"Error"	"Unable to change form while output is enabled."	
Frontpanel	85	"Error"	"Unable to clear one or more fault."	
Frontpanel	86	"Error"	"Unable to enable output. One or more primary stages failed to enable."	
Frontpanel	89	"Error"	"Digital I/Os interface conflict: Remote inhibit is active."	
Frontpanel	90	"Error"	"Digital I/Os interface conflict: Remote enable is active."	
Frontpanel	91	"Error"	"Internal error: Unknown phase mode."	
Frontpanel	92	"Error"	"Unable to disable output. One or more primary stages failed to disable."	
Frontpanel	95	"Error"	"Digital I/Os interface conflict: Serial interface flow control is active."	
Frontpanel	96	"Error"	"Datalogger storage error."	
Frontpanel	97	"Error"	"Output enable in progress."	
Frontpanel	98	"Error"	"DC Voltage not allowed in "AC mode"."	
Frontpanel	99	"Error"	"AC Voltage not allowed in "DC mode"."	
Frontpanel	100	"Error"	"DC voltage setpoint cannot change due to user limit."	
Frontpanel	101	"Error"	"AC voltage setpoint cannot change due to user limit."	
Frontpanel	102	"Error"	"DC voltage setpoint cannot change due to low range."	
Frontpanel	103	"Error"	"AC voltage setpoint cannot change due to low range."	
Frontpanel	104	"Error"	"Waveform change in progress."	
Frontpanel	105	"Error"	"Error changing service name"	
Frontpanel	106	"Error"	"Error getting service name"	
Frontpanel	109	"Error"	"Transient step mode not available on UPC compatible mode."	
Frontpanel	110	"Error"	"System is about to reboot."	
Frontpanel	111	"Error"	"Cannot reboot system."	
Frontpanel	115	"Error"	"Unable to renew the DHCP lease. Changing to Auto-IP mode."	

Source	Code	Type	Description	Possible cause
Frontpanel	116	"Error"	"Failed starting firmware update."	
Frontpanel	117	"Error"	"Unable to execute this action with output enabled."	
Frontpanel	118	"Error"	"Frequency setpoint cannot change due to waveform saturation."	
Frontpanel	119	"Error"	"Frequency setpoint cannot change due to user limit."	
Frontpanel	120	"Error"	"Frequency not allowed in "DC mode"."	
Frontpanel	121	"Error"	"Waveform setpoint cannot change due to waveform saturation."	
Frontpanel	122	"Error"	"Cannot load program. Run PROG:CHECK? for more information."	
Frontpanel	125	"Error"	"Remote inhibit cannot be disabled in this model."	
Frontpanel	126	"Error"	"Line to line measurements only available with sinewaves."	
Frontpanel	127	"Error"	"Digital I/Os interface conflict: Single-Phase relay control is active."	
Frontpanel	128	"Error"	"Digital I/Os interface conflict: Single-Phase relay cannot change with output enabled."	
Frontpanel	129	"Error"	"Digital I/Os interface conflict: Single-Phase relay cannot change due relay closed."	
Frontpanel	130	"Error"	"Unable to disable output. One or more inverter stages failed to disable."	
Frontpanel	131	"Error"	"Cannot set EEPROM field"	
Frontpanel	132	"Error"	"EEPROM field already set"	
Frontpanel	133	"Error"	"Cannot read EEPROM field"	
Frontpanel	148	"Error"	"Serial number mismatch: Front panel does not match power stages."	
Frontpanel	150	"Error"	"Suffix not allowed in single form."	
Frontpanel	151	"Error"	"Suffix not allowed in split form."	
Frontpanel	152	"Error"	"Peak current limit setting is too low for the desired voltage and frequency."	
Frontpanel	153	"Error"	"Program transient trigger input is disabled."	
Frontpanel	154	"Error"	"Steady state not yet stabilized."	
Frontpanel	155	"Error"	"Trigger output not available in this model."	
Frontpanel	156	"Error"	"Trigger input not available in this model."	
Frontpanel	157	"Error"	"Filter size must be an odd number."	
Frontpanel	158	"Error"	"Voltage mode not available in UPC compatible mode."	
Frontpanel	159	"Error"	"Waveform is unique in UPC compatible mode."	
Frontpanel	160	"Error"	"Phase is 180 for split in UPC compatible mode."	
Frontpanel	161	"Error"	"Voltage AC is unique in UPC compatible mode."	
Frontpanel	162	"Error"	"CSC is always disabled during transient in UPC compatible mode."	
Frontpanel	163	"Error"	"Auto RMS is always enabled in UPC compatible mode."	

Source	Code	Type	Description	Possible cause
Frontpanel	166	"Error"	"Unable to set extended voltage because frequency is outside the allowed range."	
Frontpanel	169	"Error"	"Unable to update setpoint because it is outside the allowed range of extended voltage mode."	
Frontpanel	172	"Error"	"Command not allowed during power stage firmware update."	
Frontpanel	173	"Error"	"Cannot change Current RMS Overload mode with output enabled."	
Frontpanel	174	"Error"	"Strobe feature not available in this model."	
Frontpanel	175	"Error"	"Feature not available in this model."	
Frontpanel	176	"Error"	"Setpoints cannot be changed while transient program is running."	
Frontpanel	177	"Error"	"Cycle reset is always enabled in UPC compatible mode."	
Frontpanel	178	"Error"	"Command not available in this unit model."	
Frontpanel	179	"Error"	"Digital output is being used for transformer option."	
Frontpanel	180	"Error"	"Unknown processor type detected. Run unit discovery to recover."	
Frontpanel	181	"Error"	"Undiscovered node detected. Run unit discovery to recover."	
Frontpanel	182	"Error"	"Incorrect parallel unit count"	
Frontpanel	183	"Error"	"Invalid processor type"	
Frontpanel	184	"Error"	"Daisy chain invalid type"	
Frontpanel	185	"Error"	"Undiscovered controller node was detected. "	
Frontpanel	186	"Error"	"No master front panel was detected."	
Frontpanel	187	"Error"	"More than enabled master controller is was detected. Going to inactive state."	
Frontpanel	188	"Error"	"One or more units are not energized or have a failure."	
Frontpanel	189	"Error"	"Incompatible node detected."	
Frontpanel	190	"Error"	"Master unit nodes not found."	
Frontpanel	191	"Error"	"Fastscan failed."	
Frontpanel	192	"Error"	"Undetectable node exists."	
Frontpanel	193	"Error"	"An invalid firmare type exists."	
Frontpanel	501	"Error"	"Frequency is too high to enable xfmr coupling."	
Frontpanel	502	"Error"	"Extended voltage range is not allowed when overload modes are enabled."	
Frontpanel	503	"Error"	"Frequency is too high for extended voltage mode."	
Frontpanel	504	"Error"	"Cannot change extended voltage mode with output enabled."	
Frontpanel	505	"Error"	"Cannot enable current overload mode when extended voltage range is enabled."	
Frontpanel	506	"Error"	"Cannot enable extended frequency when extended voltage range is enabled."	
Frontpanel	509	"Error"	"Setpoint out of range due to extended frequency mode."	

Source	Code	Type	Description	Possible cause
Frontpanel	510	"Error"	"Unable to update setpoint because it is outside the allowed range of extended frequency mode."	
Frontpanel	511	"Error"	"Error during power stage firmware update."	
Frontpanel	512	"Error"	"Phase rotation is always negative in UPC compatible mode."	
Frontpanel	513	"Error"	"Cannot change split phase mode with output enabled."	
Frontpanel	514	"Error"	"Serial port flow control not available in this unit."	
Frontpanel	515	"Error"	"Too many commands per line."	
Frontpanel	518	"Error"	"Cannot change output impedance state with output enabled."	
Frontpanel	519	"Error"	"Cannot change output impedance mode with output enabled."	
Frontpanel	520	"Error"	"Inductive impedance not available in UPC compatible mode."	
Frontpanel	521	"Error"	"Read only file or folder."	
Frontpanel	522	"Error"	"Argument requires more decimals."	
Frontpanel	524	"Error"	"Digital I/Os interface conflict: Serial interface is active."	
Frontpanel	525	"Error"	"New IO firmware available. Must split system in two to perform update."	
Frontpanel	526	"Error"	"Cannot export configurations."	
Frontpanel	527	"Error"	"Cannot import configurations."	
Frontpanel	528	"Error"	"Version mismatch error."	
Frontpanel	529	"Error"	"Internal connection error with the power stage."	
Frontpanel	530	"Error"	"Fault during output enable."	
Frontpanel	531	"Error"	"Incorrect password."	
Frontpanel	533	"Error"	"This setpoint is being set by an analog input."	
Frontpanel	534	"Error"	"Image model not compatible."	
Frontpanel	535	"Error"	"Frontpanel not compatible."	
Frontpanel	536	"Error"	"Cannot convert cycle based transient to time based."	
Frontpanel	537	"Error"	"Cannot load pulse."	
Frontpanel	539	"Error"	"Parameter below minimum saturation."	
Frontpanel	540	"Error"	"Parameter below minimum range."	
Frontpanel	541	"Error"	"Parameter below minimum unit scope."	
Frontpanel	542	"Error"	"Parameter below minimum user limit."	
Frontpanel	543	"Error"	"Parameter below voltage mode."	
Frontpanel	544	"Error"	"Parameter above maximum saturation."	
Frontpanel	545	"Error"	"Parameter above maximum range."	
Frontpanel	546	"Error"	"Parameter above maximum unit scope."	
Frontpanel	547	"Error"	"Parameter above maximum user limit."	
Frontpanel	548	"Error"	"Parameter above voltage mode."	

Source	Code	Type	Description	Possible cause
Frontpanel	549	"Error"	"Locked unit"	Please unlock with command SYST:UNLOCK PASSWORD
Frontpanel	550	"Error"	"Unit model changed to ADF."	
Frontpanel	551	"Error"	"Series parallel mode switch not available."	
Frontpanel	552	"Error"	"Series connection requires an even number of units."	
Frontpanel	553	"Error"	"Digital output is being used for series units option."	
Frontpanel	554	"Error"	"Series connection is disabled. A Series connection should be set with SYSTem:SERIES command."	
Frontpanel	555	"Error"	"Transformer option is configured."	
Frontpanel	556	"Error"	"Series connection option is configured."	
Frontpanel	557	"Error"	"Series connection not detected."	
Frontpanel	558	"Error"	"Series connection inhibit."	
Frontpanel	559	"Error"	"Digital input 3 is fixed to series connection inhibit."	
Frontpanel	560	"Error"	"Series connection requires series remote sense board."	
Frontpanel	561	"Error"	"Series connection incorrect units order."	
Frontpanel	562	"Error"	"Series connection protection cannot be disabled."	
Frontpanel	71	"Warning"	"Setpoint reduced due to low range."	
Frontpanel	107	"Warning"	"Redundant segments were combined."	
Frontpanel	108	"Warning"	"Redundant steps were combined."	
Frontpanel	144	"Warning"	"Internal battery needs to be replaced."	
Frontpanel	164	"Warning"	"Warning: CSC is enabled and Auto-RMS is disabled. Output RMS may not be regulated properly."	
Frontpanel	165	"Warning"	"Maximum AC voltage limit was reduced due to extended voltage range."	
Frontpanel	167	"Warning"	"Power limits were reduced due to extended voltage range."	
Frontpanel	168	"Warning"	"AC voltage setpoints and/or AC voltage maximum limit were reduced due to extended voltage range."	
Frontpanel	171	"Warning"	"Warning: Repeated waveform alias."	
Frontpanel	500	"Warning"	"AC voltage setpoint was automatically reduced to 0 Vrms."	
Frontpanel	507	"Warning"	"Power limits were reduced due to extended frequency mode."	
Frontpanel	508	"Warning"	"Current limits were reduced due to extended frequency mode."	
Frontpanel	516	"Warning"	"Resistive impedance was automatically reduced."	
Frontpanel	517	"Warning"	"Inductive impedance was automatically reduced."	
Frontpanel	523	"Warning"	"Warning: Ambient temperature approaching limit."	

Source	Code	Type	Description	Possible cause
Frontpanel	532	"Warning"	"Frontpanel firmware image model do not match frontpanel model."	
Frontpanel	563	"Warning"	"VLL estimation accuracy is lower."	
Frontpanel	331	"Fault"	"Unit discovery fault. Run unit discovery to recover."	
Frontpanel	332	"Fault"	"Undiscovered unit/node detected. Run unit discovery to recover."	
Frontpanel	334	"Fault"	"Power failure."	
Frontpanel	335	"Fault"	"Remote inhibit was issued from remote interface."	
Frontpanel	336	"Fault"	"System about to reboot."	
Frontpanel	338	"Fault"	"One or more inverters did not get enabled."	
Frontpanel	339	"Fault"	"One or more primaries did not get enabled."	
Frontpanel	342	"Fault"	"Mismatch between hardware revision of units in parallel."	
Frontpanel	343	"Fault"	"Power stage firmware update failed. Run SYSTem:FW:INT:UPDATE:STAT? for more information. Run unit discovery to recover."	
Frontpanel	344	"Fault"	"Firmware update was interrupted"	Recovery is needed. Run unit discovery to recover."
Frontpanel	345	"Fault"	"GPIB hardware not found in this unit."	
Frontpanel	346	"Fault"	"GPIB hardware detected"	Unit model mismatch."
Frontpanel	347	"Fault"	"IO hardware not found in this unit."	
Frontpanel	348	"Fault"	"IO hardware detected"	Unit model mismatch."
Frontpanel	350	"Fault"	"Transformer hardware detected"	Unit model mismatch."
Frontpanel	351	"Fault"	"Ambient temperature exceeded maximum limit."	
Frontpanel	352	"Fault"	"Mismatch between models of units in parallel."	
Frontpanel	353	"Fault"	"Unit model mismatch."	
Frontpanel	355	"Fault"	"Series connection hardware detected"	Unit model mismatch."
Frontpanel	329	"Internal fault"	"Global fault detected."	
Frontpanel	330	"Internal fault"	"Global fault detected. Possible unenergized unit or node."	
Frontpanel	333	"Internal fault"	"Node in non-operational mode. Run unit discovery to recover."	
Frontpanel	337	"Internal fault"	"Missed node."	
Frontpanel	340	"Internal fault"	"Firmware version mismatch. Power stage version is older than expected. Contact technical support."	
Frontpanel	341	"Internal fault"	"Firmware version mismatch. Front panel version is older than expected. Contact technical support."	
Frontpanel	349	"Internal fault"	"Analog inputs cannot be read."	

Source	Code	Type	Description	Possible cause
Frontpanel	354	"Internal fault"	"Digital inputs cannot be read."	
Frontpanel	356	"Internal fault"	"Did not receive MDO 1 - Inverter A."	
Frontpanel	357	"Internal fault"	"Did not receive MDO 2 - Inverter A."	
Frontpanel	358	"Internal fault"	"Did not receive MDO 3 - Inverter A."	
Frontpanel	359	"Internal fault"	"Did not receive MDO 4 - Inverter A."	
Frontpanel	360	"Internal fault"	"Did not receive MDO 5 - Inverter A."	
Frontpanel	361	"Internal fault"	"Did not receive MDO 6 - Inverter A."	
Frontpanel	362	"Internal fault"	"Did not receive MDO 7 - Inverter A."	
Frontpanel	363	"Internal fault"	"Did not receive MDO 8 - Inverter A."	
Frontpanel	364	"Internal fault"	"Did not receive MDO 9 - Inverter A."	
Frontpanel	365	"Internal fault"	"Did not receive MDO 10 - Inverter A."	
Frontpanel	366	"Internal fault"	"Did not receive MDO 1 - Inverter B."	
Frontpanel	367	"Internal fault"	"Did not receive MDO 2 - Inverter B."	
Frontpanel	368	"Internal fault"	"Did not receive MDO 3 - Inverter B."	
Frontpanel	369	"Internal fault"	"Did not receive MDO 4 - Inverter B."	
Frontpanel	370	"Internal fault"	"Did not receive MDO 5 - Inverter B."	
Frontpanel	371	"Internal fault"	"Did not receive MDO 6 - Inverter B."	
Frontpanel	372	"Internal fault"	"Did not receive MDO 7 - Inverter B."	
Frontpanel	373	"Internal fault"	"Did not receive MDO 8 - Inverter B."	
Frontpanel	374	"Internal fault"	"Did not receive MDO 1 - Inverter C."	
Frontpanel	375	"Internal fault"	"Did not receive MDO 2 - Inverter C."	
Frontpanel	376	"Internal fault"	"Did not receive MDO 3 - Inverter C."	
Frontpanel	377	"Internal fault"	"Did not receive MDO 4 - Inverter C."	
Frontpanel	378	"Internal fault"	"Did not receive MDO 5 - Inverter C."	
Frontpanel	379	"Internal fault"	"Did not receive MDO 6 - Inverter C."	
Frontpanel	380	"Internal fault"	"Did not receive MDO 7 - Inverter C."	
Frontpanel	381	"Internal fault"	"Did not receive MDO 8 - Inverter C."	
Frontpanel	1	"Internal error"	"Unknown fault or error."	
Frontpanel	2	"Internal error"	"Cannot initialize command thread."	
Frontpanel	3	"Internal error"	"Cannot initialize global semaphore."	
Frontpanel	4	"Internal error"	"Cannot create SCPI status object."	
Frontpanel	5	"Internal error"	"Cannot create network manager object."	
Frontpanel	6	"Internal error"	"Cannot initialize CANOpen stack."	
Frontpanel	7	"Internal error"	"Cannot initialize process class array."	
Frontpanel	8	"Internal error"	"Cannot initialize local CANOpen object dictionary."	
Frontpanel	9	"Internal error"	"Cannot create FastCGI interface."	
Frontpanel	10	"Internal error"	"Cannot create TCP interface."	
Frontpanel	11	"Internal error"	"Cannot create TELNET interface."	
Frontpanel	12	"Internal error"	"Cannot create UART serial interface."	
Frontpanel	13	"Internal error"	"Cannot create USB serial interface."	

Source	Code	Type	Description	Possible cause
Frontpanel	14	"Internal error"	"Cannot create keyboard interface."	
Frontpanel	15	"Internal error"	"Cannot create front panel interface."	
Frontpanel	16	"Internal error"	"Cannot create SCPI program interface."	
Frontpanel	17	"Internal error"	"Cannot cast process class in runtime."	
Frontpanel	20	"Internal error"	"Unknown operation."	
Frontpanel	23	"Internal error"	"Unavailable node."	
Frontpanel	24	"Internal error"	"Cannot initialize GPIO library."	
Frontpanel	25	"Internal error"	"Process class: not implemented type."	
Frontpanel	25	"Internal error"	"Cannot attach GPIO."	
Frontpanel	26	"Internal error"	"Process class: invalid initialization."	
Frontpanel	27	"Internal error"	"SCPI program dynamic cast."	
Frontpanel	28	"Internal error"	"Cannot initialize node discovery."	
Frontpanel	38	"Internal error"	"Static null pointer."	
Frontpanel	39	"Internal error"	"Cannot create file system object"	
Frontpanel	40	"Internal error"	"Linux system call error"	
Frontpanel	41	"Internal error"	"XML library error."	
Frontpanel	43	"Internal error"	"Cannot create fault manager interface."	
Frontpanel	44	"Internal error"	"Global fault UIO driver."	
Frontpanel	45	"Internal error"	"Global fault interrupt disabled."	
Frontpanel	46	"Internal error"	"Cannot create global fault thread."	
Frontpanel	49	"Internal error"	"Cannot initialize communications reset mutex."	
Frontpanel	50	"Internal error"	"Cannot initialize communications reset condition variable."	
Frontpanel	52	"Internal error"	"Error in internal communications heartbeat."	
Frontpanel	55	"Internal error"	"Cannot initialize waveform manager."	
Frontpanel	61	"Internal error"	"Cannot initialize firmware update manager."	
Frontpanel	62	"Internal error"	"Cannot initialize buffer manager."	
Frontpanel	81	"Internal error"	"Internal error: Socket send error."	
Frontpanel	82	"Internal error"	"Internal error: Interface request packet has incorrect CRC."	
Frontpanel	87	"Internal error"	"Internal error: Cannot get system time."	
Frontpanel	88	"Internal error"	"Internal error: Unknown sequence."	
Frontpanel	93	"Internal error"	"Internal error: Cannot configure timer."	
Frontpanel	94	"Internal error"	"Internal error: Cannot create timer."	
Frontpanel	136	"Internal error"	"NVRAM CRC mismatch"	
Frontpanel	137	"Internal error"	"NVRAM cannot open."	
Frontpanel	138	"Internal error"	"NVRAM cannot close."	
Frontpanel	139	"Internal error"	"NVRAM cannot lock."	
Frontpanel	140	"Internal error"	"NVRAM cannot unlock."	
Frontpanel	141	"Internal error"	"NVRAM cannot read."	

Source	Code	Type	Description	Possible cause
Frontpanel	142	"Internal error"	"NVRAM cannot write."	
Frontpanel	143	"Internal error"	"Cannot reset EEPROM."	
Frontpanel	145	"Internal error"	"NVRAM hardware error. Using temporal storage."	
Frontpanel	146	"Internal error"	"Invalid command ID."	
Frontpanel	147	"Internal error"	"Command argument not exist."	
Frontpanel	149	"Internal error"	"This does not seems to be a front panel."	
Frontpanel	2000	"Internal error"	"Command request argument: argument cannot be null."	
Frontpanel	2001	"Internal error"	"Command request argument: cannot parse unknown argument."	
Frontpanel	2002	"Internal error"	"Command request argument: cannot parse argument."	
Frontpanel	2003	"Internal error"	"Command request argument: cannot append string to non string argument."	
Frontpanel	2004	"Internal error"	"Command request argument: cannot serialize due to small buffer."	
Frontpanel	2005	"Internal error"	"Command request argument: cannot deserialize due to small buffer."	
Frontpanel	2006	"Internal error"	"Command request argument: cannot get string due non string argument."	
Frontpanel	2007	"Internal error"	"EEPROM Data: Write header error."	
Frontpanel	2008	"Internal error"	"EEPROM Data: Write data error."	
Frontpanel	2009	"Internal error"	"EEPROM Data: Data too big."	
Frontpanel	2010	"Internal error"	"EEPROM Data: Cannot open temporal file."	
Frontpanel	2011	"Internal error"	"EEPROM Data: Close error."	
Frontpanel	2012	"Internal error"	"EEPROM Data: Offset error."	
Frontpanel	2013	"Internal error"	"EEPROM Data: Read error."	
Frontpanel	2014	"Internal error"	"Transformer: Corrupted internal database."	
Frontpanel	2015	"Internal error"	"XFMR ratio not found."	
Frontpanel	2016	"Internal error"	"Coupling cannot be changed with output enabled."	
Frontpanel	2017	"Internal error"	"XFMR ratio cannot be changed with output enabled."	
Frontpanel	2018	"Internal error"	"Transformer option not available in this model."	
Frontpanel	2019	"Internal error"	"XFMR ratio is disabled. A XFMR ratio should be set with SYSTem:XFMRratio command."	
Frontpanel	2020	"Internal error"	"Transformer control circuits not detected."	
Frontpanel	2021	"Internal error"	"DC voltage not allowed with transformer coupling."	
Frontpanel	2022	"Internal error"	"Command request: command request cannot be null."	
Frontpanel	2023	"Internal error"	"Command request: command request argument is null."	
Frontpanel	2024	"Internal error"	"Command request: argument is null."	
Frontpanel	2025	"Internal error"	"Command request: argument number is null."	

Source	Code	Type	Description	Possible cause
Frontpanel	2026	"Internal error"	"Command request: argument number does not exist."	
Frontpanel	2027	"Internal error"	"Command request: there are no arguments."	
Frontpanel	2028	"Internal error"	"Command request: cannot serialize due small buffer."	
Frontpanel	2029	"Internal error"	"Command request: cannot deserialize due small buffer."	
Frontpanel	2030	"Internal error"	"Command request: cannot deserialize due argument count mismatch."	
Frontpanel	2031	"Internal error"	"Command request: cannot deserialize due size mismatch."	
Frontpanel	2032	"Internal error"	"Command request vector: request number does not exist."	
Frontpanel	2033	"Internal error"	"Command request vector: request number is null."	
Frontpanel	2034	"Internal error"	"Command request vector: request is null."	
Frontpanel	2035	"Internal error"	"Command request vector: vector is empty."	
Frontpanel	2036	"Internal error"	"Command request vector: cannot serialize due small buffer."	
Frontpanel	2037	"Internal error"	"Command request vector: cannot deserialize due small buffer."	
Frontpanel	2038	"Internal error"	"Command request vector: cannot deserialize due command count mismatch."	
Frontpanel	2039	"Internal error"	"Command request vector: cannot deserialize due size mismatch."	
Frontpanel	2040	"Internal error"	"Interface request packet: cannot deserialize due size mismatch."	
Frontpanel	2041	"Internal error"	"Command thread: cannot post command semaphore."	
Frontpanel	2042	"Internal error"	"Command thread: cannot initialize command semaphore."	
Frontpanel	2043	"Internal error"	"Debug message file: seek file error."	
Frontpanel	2044	"Internal error"	"Debug message file: tell file error."	
Frontpanel	2045	"Internal error"	"Debug message file: close file error."	
Frontpanel	2046	"Internal error"	"Debug message file: open file error."	
Frontpanel	2047	"Internal error"	"Debug message file: write file error."	
Frontpanel	2048	"Internal error"	"Debug message file: flush file error."	
Frontpanel	2049	"Internal error"	"Debug message file: unlink file error."	
Frontpanel	2050	"Internal error"	"Debug message ring buffer: cannot allocate buffer."	
Frontpanel	2051	"Internal error"	"Debug message ring buffer: seek file error."	
Frontpanel	2052	"Internal error"	"Debug message ring buffer: tell file error."	
Frontpanel	2053	"Internal error"	"Debug message ring buffer: close file error."	
Frontpanel	2054	"Internal error"	"Debug message ring buffer: open file error."	
Frontpanel	2055	"Internal error"	"Debug message ring buffer: write file error."	

Source	Code	Type	Description	Possible cause
Frontpanel	2056	"Internal error"	"Debug message ring buffer: flush file error."	
Frontpanel	2057	"Internal error"	"Debug message ring buffer: unlink file error."	
Frontpanel	2058	"Internal error"	"Debug message system: print error failed."	
Frontpanel	2059	"Internal error"	"Debug message system: print output failed."	
Frontpanel	2060	"Internal error"	"Debug: cannot get core limit."	
Frontpanel	2061	"Internal error"	"Debug: cannot set core limit."	
Frontpanel	2062	"Internal error"	"Debug: cannot initialize mutex attributes."	
Frontpanel	2063	"Internal error"	"Debug: cannot set mutex attributes."	
Frontpanel	2064	"Internal error"	"Debug: cannot initialize mutex."	
Frontpanel	2065	"Internal error"	"Debug: cannot destroy mutex."	
Frontpanel	2066	"Internal error"	"Debug: cannot lock mutex."	
Frontpanel	2067	"Internal error"	"Debug: cannot unlock mutex."	
Frontpanel	2068	"Internal error"	"Debug: cannot allocate debug message system."	
Frontpanel	2069	"Internal error"	"Debug: cannot allocate debug message ring buffer."	
Frontpanel	2070	"Internal error"	"Debug: cannot allocate debug message file."	
Frontpanel	2071	"Internal error"	"Timer: cannot initialize mutex attributes."	
Frontpanel	2072	"Internal error"	"Timer: cannot set mutex attributes."	
Frontpanel	2073	"Internal error"	"Timer: cannot initialize mutex."	
Frontpanel	2074	"Internal error"	"Timer: cannot destroy mutex."	
Frontpanel	2075	"Internal error"	"Timer: cannot lock mutex."	
Frontpanel	2076	"Internal error"	"Timer: cannot unlock mutex."	
Frontpanel	2077	"Internal error"	"Timer: cannot allocate mark."	
Frontpanel	2078	"Internal error"	"Timer: cannot get time."	
Frontpanel	2079	"Internal error"	"Timing: cannot initialize mutex attributes."	
Frontpanel	2080	"Internal error"	"Timing: cannot set mutex attributes."	
Frontpanel	2081	"Internal error"	"Timing: cannot initialize mutex."	
Frontpanel	2082	"Internal error"	"Timing: cannot destroy mutex."	
Frontpanel	2083	"Internal error"	"Timing: cannot lock mutex."	
Frontpanel	2084	"Internal error"	"Timing: cannot unlock mutex."	
Frontpanel	2085	"Internal error"	"Timing: cannot allocate timer."	
Frontpanel	2086	"Internal error"	"Timing: timer not found."	
Frontpanel	2087	"Internal error"	"Command response item: cannot get string of non string type."	
Frontpanel	2088	"Internal error"	"Command response item: cannot get two items."	
Frontpanel	2089	"Internal error"	"Command response item: cannot get three items."	
Frontpanel	2090	"Internal error"	"Command response item: cannot get item."	

Source	Code	Type	Description	Possible cause
Frontpanel	2091	"Internal error"	"Command response item: cannot set null item."	
Frontpanel	2092	"Internal error"	"Command response item: cannot set item with null data."	
Frontpanel	2093	"Internal error"	"Command response item: cannot set null item vector."	
Frontpanel	2094	"Internal error"	"Command response item: cannot append item of different type."	
Frontpanel	2095	"Internal error"	"Command response item: item not compatible."	
Frontpanel	2096	"Internal error"	"Command response item: cannot serialize due small buffer."	
Frontpanel	2097	"Internal error"	"Command response item: cannot deserialize due small buffer."	
Frontpanel	2098	"Internal error"	"Command response vector: vector is empty."	
Frontpanel	2099	"Internal error"	"Command response vector: last response is null."	
Frontpanel	2100	"Internal error"	"Command response vector: response does not exist."	
Frontpanel	2101	"Internal error"	"Command response vector: cannot serialize due small buffer"	
Frontpanel	2102	"Internal error"	"Command response vector: cannot deserialize due response count mismatch."	
Frontpanel	2103	"Internal error"	"Command response vector: cannot deserialize due size mismatch."	
Frontpanel	2104	"Internal error"	"Command response: cannot set null response."	
Frontpanel	2105	"Internal error"	"Command response: cannot append null data."	
Frontpanel	2106	"Internal error"	"Command response: vector is empty."	
Frontpanel	2107	"Internal error"	"Command response: last item is null."	
Frontpanel	2108	"Internal error"	"Command response: item does not exist."	
Frontpanel	2109	"Internal error"	"Command response: cannot serialize due small buffer."	
Frontpanel	2110	"Internal error"	"Command response: cannot deserialize due item count mismatch."	
Frontpanel	2111	"Internal error"	"Command response: cannot deserialize due size mismatch."	
Frontpanel	2112	"Internal error"	"Interface response packet: cannot convert due small buffer."	
Frontpanel	2113	"Internal error"	"Interface response packet: cannot deserialize due size mismatch."	
Frontpanel	2114	"Internal error"	"DB9 GPIOs: owner not allowed."	
Frontpanel	2115	"Internal error"	"Signals: system call sigemptyset."	
Frontpanel	2116	"Internal error"	"Signals: system call sigaddset."	
Frontpanel	2117	"Internal error"	"Signals: system call pthread_sigmask."	
Frontpanel	2118	"Internal error"	"Signals: system call sigaction."	
Frontpanel	2119	"Internal error"	"Signals: cannot initialize destructor semaphore."	
Frontpanel	2120	"Internal error"	"Signals: cannot destroy destructor semaphore."	

Source	Code	Type	Description	Possible cause
Frontpanel	2121	"Internal error"	"Thread: cannot initialize mutex."	
Frontpanel	2122	"Internal error"	"Thread: cannot create thread."	
Frontpanel	2123	"Internal error"	"Thread: cannot cancel thread."	
Frontpanel	2124	"Internal error"	"Thread: cannot join thread."	
Frontpanel	2125	"Internal error"	"NVRAM: field is not double."	
Frontpanel	2126	"Internal error"	"NVRAM: field is not bool."	
Frontpanel	2127	"Internal error"	"NVRAM: field is not unsigned char."	
Frontpanel	2128	"Internal error"	"XML file: default document is null."	
Frontpanel	2129	"Internal error"	"XML file: cannot lock mutex."	
Frontpanel	2130	"Internal error"	"XML file: cannot unlock mutex."	
Frontpanel	2131	"Internal error"	"XML file: cannot lock file."	
Frontpanel	2132	"Internal error"	"XML file: cannot truncate file."	
Frontpanel	2133	"Internal error"	"XML file: cannot seek file."	
Frontpanel	2134	"Internal error"	"XML file: cannot write file."	
Frontpanel	2135	"Internal error"	"XML file: cannot flush file."	
Frontpanel	2136	"Internal error"	"XML file: cannot sync file."	
Frontpanel	2137	"Internal error"	"XML file: cannot initialize mutex attributes."	
Frontpanel	2138	"Internal error"	"XML file: cannot set mutex attribute."	
Frontpanel	2139	"Internal error"	"XML file: cannot initialize mutex."	
Frontpanel	2140	"Internal error"	"XML file: cannot unlink file."	
Frontpanel	2141	"Internal error"	"XML file: cannot convert to double."	
Frontpanel	2142	"Internal error"	"XML file: cannot convert to float."	
Frontpanel	2143	"Internal error"	"XML file: cannot convert to int."	
Frontpanel	2144	"Internal error"	"XML file: cannot convert to unsigned int."	
Frontpanel	2145	"Internal error"	"XML file: cannot convert to bool."	
Frontpanel	2146	"Internal error"	"XML file: cannot convert attribute."	
Frontpanel	2147	"Internal error"	"XML file: cannot convert attribute to bool"	
Frontpanel	2148	"Internal error"	"XML file: document is null."	
Frontpanel	2149	"Internal error"	"XML file: element is null."	
Frontpanel	2150	"Internal error"	"XML file: element data is null."	
Frontpanel	2151	"Internal error"	"XML file: attribute is null."	
Frontpanel	2152	"Internal error"	"XML file: attribute data is null."	
Frontpanel	2153	"Internal error"	"XML file: system call access failed."	
Frontpanel	2154	"Internal error"	"XML file: cannot rename file."	
Frontpanel	2155	"Internal error"	"XML file: cannot allocate document."	
Frontpanel	2156	"Internal error"	"XML file: CRC mismatch."	
Frontpanel	2157	"Internal error"	"XML file: version mismatch."	
Frontpanel	2158	"Internal error"	"XML file: cannot amend file."	
Frontpanel	2159	"Internal error"	"XML file: data out of range."	
Frontpanel	2160	"Internal error"	"XML file: cannot insert element."	

Source	Code	Type	Description	Possible cause
Frontpanel	2161	"Internal error"	"XML file: cannot clone element."	
Frontpanel	2162	"Internal error"	"CAN interface: cannot initialize mutex."	
Frontpanel	2163	"Internal error"	"CAN open stack: cannot initialize running mutex."	
Frontpanel	2164	"Internal error"	"CAN open stack: cannot initialize reset mutex."	
Frontpanel	2165	"Internal error"	"CAN open stack: cannot initialize CO mutex."	
Frontpanel	2166	"Internal error"	"CAN open stack: cannot initialize READ mutex."	
Frontpanel	2167	"Internal error"	"CAN open stack: cannot destroy CO mutex."	
Frontpanel	2168	"Internal error"	"CAN open stack: cannot destroy reset mutex."	
Frontpanel	2169	"Internal error"	"CAN open stack: cannot destroy running mutex."	
Frontpanel	2170	"Internal error"	"CAN open stack: cannot initialize CO."	
Frontpanel	2171	"Internal error"	"CAN open stack: cannot create timer thread."	
Frontpanel	2172	"Internal error"	"CAN open stack: cannot create RX thread."	
Frontpanel	2173	"Internal error"	"CAN open stack: cannot CAN socket."	
Frontpanel	2174	"Internal error"	"CAN open stack: cannot configure CAN socket."	
Frontpanel	2175	"Internal error"	"CAN open stack: cannot bind CAN socket."	
Frontpanel	2176	"Internal error"	"CAN open stack: cannot close CAN socket."	
Frontpanel	2177	"Internal error"	"CAN open stack: cannot write CAN socket."	
Frontpanel	2178	"Internal error"	"CAN open stack: write CAN socket size mismatch."	
Frontpanel	2179	"Internal error"	"CAN open stack: CAN socket not initialized."	
Frontpanel	2180	"Internal error"	"CAN open stack: cannot initialize CO timer semaphore."	
Frontpanel	2181	"Internal error"	"CAN open stack: cannot destroy CO timer semaphore."	
Frontpanel	2182	"Internal error"	"CAN main: cannot initialize background semaphore mutex."	
Frontpanel	2183	"Internal error"	"CAN main: cannot destroy background semaphore mutex."	
Frontpanel	2184	"Internal error"	"CAN main: cannot initialize background semaphore."	
Frontpanel	2185	"Internal error"	"CAN main: cannot destroy background semaphore."	
Frontpanel	2186	"Internal error"	"Discovery: cannot initialize daisy chain GPIO."	
Frontpanel	2187	"Internal error"	"Discovery: daisy chain GPIO not initialized."	
Frontpanel	2188	"Internal error"	"Discovery: cannot get processor types due small vector."	
Frontpanel	2189	"Internal error"	"Discovery: cannot get inverters due small vector."	
Frontpanel	2190	"Internal error"	"Discovery: cannot get primaries due small vector."	
Frontpanel	2191	"Internal error"	"Discovery: cannot allocate discovery."	

Source	Code	Type	Description	Possible cause
Frontpanel	2192	"Internal error"	"DSP commands: NMT."	
Frontpanel	2193	"Internal error"	"DSP commands: SDO download."	
Frontpanel	2194	"Internal error"	"DSP commands: SDO upload."	
Frontpanel	2195	"Internal error"	"DSP commands: LSS INCRS."	
Frontpanel	2196	"Internal error"	"DSP commands: LSS SSDC."	
Frontpanel	2197	"Internal error"	"DSP commands: LSS CNI."	
Frontpanel	2198	"Internal error"	"DSP commands: LSS SC."	
Frontpanel	2199	"Internal error"	"DSP commands: LSS FS."	
Frontpanel	2200	"Internal error"	"DSP commands: LSS PPSTFS."	
Frontpanel	2201	"Internal error"	"DSP commands: invalid node ID."	
Frontpanel	2202	"Internal error"	"DSP commands: invalid DSP type."	
Frontpanel	2203	"Internal error"	"DSP commands: invalid mapping number."	
Frontpanel	2204	"Internal error"	"DSP commands: invalid COB ID."	
Frontpanel	2205	"Internal error"	"DSP commands: invalid heart beat number."	
Frontpanel	2206	"Internal error"	"DSP commands: invalid tries number."	
Frontpanel	2207	"Internal error"	"DSP commands: read SDO buffer length."	
Frontpanel	2208	"Internal error"	"DSP commands: read bootloader DSP types."	
Frontpanel	2209	"Internal error"	"DSP commands: read bootloader state."	
Frontpanel	2210	"Internal error"	"DSP update commands: flag for update."	
Frontpanel	2211	"Internal error"	"DSP update commands: check device type."	
Frontpanel	2212	"Internal error"	"DSP update commands: check bootloader update state."	
Frontpanel	2213	"Internal error"	"DSP update commands: unlock flash CSM."	
Frontpanel	2214	"Internal error"	"DSP update commands: lock flash CSM."	
Frontpanel	2215	"Internal error"	"DSP update commands: erase flash sector."	
Frontpanel	2216	"Internal error"	"DSP update commands: write flash block."	
Frontpanel	2217	"Internal error"	"DSP update commands: firmware run."	
Frontpanel	2218	"Internal error"	"Condition comparison: unknown condition."	
Frontpanel	2219	"Internal error"	"Observer program: SCPI program not initialized."	
Frontpanel	2220	"Internal error"	"Command vector: invalid initialization order."	
Frontpanel	2221	"Internal error"	"Command vector: incomplete initialization."	
Frontpanel	2222	"Internal error"	"Observer vector: invalid initialization order."	
Frontpanel	2223	"Internal error"	"Observer vector: incomplete initialization."	
Frontpanel	2224	"Internal error"	"Operation file system: XML file not initialized."	
Frontpanel	2225	"Internal error"	"Operation SDO: cannot get node ID."	
Frontpanel	2226	"Internal error"	"Operation generic: command ID vector empty."	

Source	Code	Type	Description	Possible cause
Frontpanel	2227	"Internal error"	"Operation IEEE4882: long IDN string."	
Frontpanel	2228	"Internal error"	"Operation system: DB9 GPIOs invalid state."	
Frontpanel	2229	"Internal error"	"Operation source: DB9 GPIOs invalid state."	
Frontpanel	2230	"Internal error"	"Operation source: waveform invalid state."	
Frontpanel	2231	"Internal error"	"Operation source: XML configuration file not initialized."	
Frontpanel	2232	"Internal error"	"Operation source: XML program file not initialized."	
Frontpanel	2233	"Internal error"	"Operation simulation: invalid variable ID."	
Frontpanel	2234	"Internal error"	"Operation program: invalid transient status"	
Frontpanel	2235	"Internal error"	"Operation program: command not available."	
Frontpanel	2236	"Internal error"	"Firmware update manager: firmware up to date."	
Frontpanel	2237	"Internal error"	"DSP firmware update log: mutex lock error."	
Frontpanel	2238	"Internal error"	"DSP firmware update log: mutex unlock error."	
Frontpanel	2239	"Internal error"	"DSP firmware update log: error opening log file."	
Frontpanel	2240	"Internal error"	"DSP firmware update log: error flushing log file."	
Frontpanel	2241	"Internal error"	"DSP firmware update log: error closing log file."	
Frontpanel	2242	"Internal error"	"DSP firmware update log: error writing log file."	
Frontpanel	2243	"Internal error"	"DSP firmware update log: no file open to write."	
Frontpanel	2244	"Internal error"	"DSP firmware update log: class null."	
Frontpanel	2245	"Internal error"	"Application: invalid application command."	
Frontpanel	2246	"Internal error"	"Application: cannot initialize running mutex."	
Frontpanel	2247	"Internal error"	"Application: cannot initialize application mutex."	
Frontpanel	2248	"Internal error"	"Application: cannot create timer."	
Frontpanel	2249	"Internal error"	"Application: cannot configure timer."	
Frontpanel	2250	"Internal error"	"Application: cannot close timer."	
Frontpanel	2251	"Internal error"	"XML handler: cannot load XML."	
Frontpanel	2252	"Internal error"	"Application: cannot save XML."	
Frontpanel	2253	"Internal error"	"Avahi XML: folder does not exist."	
Frontpanel	2254	"Internal error"	"Avahi XML: file does not exist."	
Frontpanel	2255	"Internal error"	"Avahi XML: invalid field number."	
Frontpanel	2256	"Internal error"	"Network manager: thread not initialized."	
Frontpanel	2257	"Internal error"	"Network manager: invalid variable ID."	
Frontpanel	2258	"Internal error"	"Network manager: invalid configuration type."	
Frontpanel	2259	"Internal error"	"Network manager: netconfig call failed."	

Source	Code	Type	Description	Possible cause
Frontpanel	2260	"Internal error"	"Network manager: avahi call failed."	
Frontpanel	2261	"Internal error"	"Network manager: udhcp call failed."	
Frontpanel	2262	"Internal error"	"Network manager: netconfig field not found."	
Frontpanel	2263	"Internal error"	"Network manager: invalid service name."	
Frontpanel	2264	"Internal error"	"Network manager: avahi close process."	
Frontpanel	2265	"Internal error"	"External interface: invalid socket path."	
Frontpanel	2266	"Internal error"	"External interface: cannot create from socket."	
Frontpanel	2267	"Internal error"	"External interface: cannot bind from socket."	
Frontpanel	2268	"Internal error"	"External interface: cannot listen from socket."	
Frontpanel	2269	"Internal error"	"External interface: cannot create to socket."	
Frontpanel	2270	"Internal error"	"External interface: cannot bind to socket."	
Frontpanel	2271	"Internal error"	"External interface: cannot listen to socket."	
Frontpanel	2272	"Internal error"	"External interface: cannot initialize to socket mutex."	
Frontpanel	2273	"Internal error"	"External interface: cannot allocate thread."	
Frontpanel	2274	"Internal error"	"External interface: invalid packet type."	
Frontpanel	2275	"Internal error"	"External interface: invalid response type."	
Frontpanel	2276	"Internal error"	"XML SCPI program file: buffer is null."	
Frontpanel	2277	"Internal error"	"XML SCPI program file: buffer is small."	
Frontpanel	2278	"Internal error"	"Program is undefined."	
Frontpanel	2279	"Internal error"	"XML SCPI program file: element is null."	
Frontpanel	2280	"Internal error"	"EEPROM: call failed."	
Frontpanel	2281	"Internal error"	"EEPROM: field not found."	
Frontpanel	2282	"Internal error"	"Memories: invalid folder."	
Frontpanel	2283	"Internal error"	"Memories: invalid name."	
Frontpanel	2284	"Internal error"	"XML access file: invalid IP."	
Frontpanel	2285	"Internal error"	"XML access file: invalid alias size."	
Frontpanel	2286	"Internal error"	"XML access file: cannot convert to bool."	
Frontpanel	2287	"Internal error"	"XML access file: invalid tag."	
Frontpanel	2288	"Internal error"	"Temperature: cannot open file."	
Frontpanel	2289	"Internal error"	"Temperature: file not opened."	
Frontpanel	2290	"Internal error"	"Temperature: cannot seek file."	
Frontpanel	2291	"Internal error"	"Temperature: cannot read file."	
Frontpanel	2292	"Internal error"	"Remote: DB9 GPIO not initialized."	
Frontpanel	2293	"Internal error"	"Remote: cannot open UIO."	
Frontpanel	2294	"Internal error"	"Remote: cannot write UIO."	
Frontpanel	2295	"Internal error"	"Interface vector: cannot initialize mutex attributes."	
Frontpanel	2296	"Internal error"	"Interface vector: cannot set mutex attributes."	

Source	Code	Type	Description	Possible cause
Frontpanel	2297	"Internal error"	"Interface vector: cannot initialize mutex."	
Frontpanel	2298	"Internal error"	"Interface vector: cannot allocate VXI interface."	
Frontpanel	2299	"Internal error"	"Interface vector: cannot lock mutex."	
Frontpanel	2300	"Internal error"	"Interface vector: cannot unlock mutex."	
Frontpanel	2301	"Internal error"	"SCPI program: destination program cannot be manual mode."	
Frontpanel	2302	"Internal error"	"SCPI program: invalid define string."	
Frontpanel	2303	"Internal error"	"SCPI program: missing voltage A."	
Frontpanel	2304	"Internal error"	"SCPI program: missing voltage B."	
Frontpanel	2305	"Internal error"	"Cannot get waveform field."	
Frontpanel	2306	"Internal error"	"Cannot delete waveform in use."	
Frontpanel	2307	"Internal error"	"Waveform #1 cannot be deleted or modified."	
Frontpanel	2308	"Internal error"	"Sequential interface: cannot initialize command executed semaphore."	
Frontpanel	2309	"Internal error"	"Sequential interface: cannot initialize execute command semaphore."	
Frontpanel	2310	"Internal error"	"Sequential interface: cannot initialize pending commands mutex."	
Frontpanel	2311	"Internal error"	"IEEE488.2 status: cannot initialize mutex."	
Frontpanel	2312	"Internal error"	"IEEE488.2 status: item does not exist."	
Frontpanel	2313	"Internal error"	"Fault manager: MDO not received."	
Frontpanel	2314	"Internal error"	"Measurement logger manager: cannot write file."	
Frontpanel	2315	"Internal error"	"Synchronization: cannot initialize operation complete mutex."	
Frontpanel	2316	"Internal error"	"Synchronization: cannot initialize operation complete mutex attributes."	
Frontpanel	2317	"Internal error"	"Synchronization: cannot set operation complete mutex attributes."	
Frontpanel	2318	"Internal error"	"Synchronization: cannot initialize operation complete condition variable."	
Frontpanel	2319	"Internal error"	"SCPI parser: cannot initialize mutex."	
Frontpanel	2320	"Internal error"	"SCPI parser: cannot lock mutex."	
Frontpanel	2321	"Internal error"	"SCPI parser: cannot unlock mutex."	
Frontpanel	113	"Internal warning"	"Missed second heartbeat."	
Frontpanel	114	"Internal warning"	"Missed first heartbeat."	
Frontpanel	123	"Internal warning"	"Warning: input voltage in EEPROM does not match the Primary DSP. Using DSP value."	
Frontpanel	0	"Success"	"No error"	
Inverter	265	"Fault"	"Inverter gate driver fault."	
Inverter	266	"Fault"	"Internal bias supply fault."	
Inverter	267	"Fault"	"No waveform loaded. Load waveform before enabling arbitrary waveform mode."	
Inverter	268	"Fault"	"Exceeded RMS current limit."	
Inverter	269	"Fault"	"Exceeded active power limit."	

Source	Code	Type	Description	Possible cause
Inverter	270	"Fault"	"Exceeded apparent power limit."	
Inverter	271	"Fault"	"Internal SCIA communication error."	
Inverter	272	"Fault"	"Internal McBSP communication CRC error."	
Inverter	273	"Fault"	"Inverter current negative peak protection."	
Inverter	274	"Fault"	"Inverter current positive peak protection."	
Inverter	275	"Fault"	"DC bus voltage minimum limit exceeded."	
Inverter	276	"Fault"	"DC bus voltage maximum limit exceeded."	
Inverter	277	"Fault"	"Temperature protection"	Mmaximum limit
Inverter	278	"Fault"	"Temperature protection"	Minimum limit
Inverter	279	"Fault"	"Output relay voltage protection"	Minimum limit
Inverter	280	"Fault"	"Output relay voltage protection"	Maximum limit
Inverter	281	"Fault"	"Output terminals common mode voltage protection"	Minimum limit
Inverter	282	"Fault"	"Output terminals common mode voltage protection"	Maximum limit
Inverter	283	"Fault"	"Inductor current RMS protection"	Exceeded maximum limit for too long
Inverter	284	"Fault"	"Inductor current DC protection"	Exceeded maximum limit for too long
Inverter	285	"Fault"	"Global fault input signal detected."	
Inverter	286	"Fault"	"Fan under voltage protection."	
Inverter	287	"Fault"	"Inductor current cycle-by-cycle protection trip limit."	
Inverter	288	"Fault"	"Fan current consumption is abnormal"	Fan may be blocked
Inverter	292	"Fault"	"Output current has too much high frequency content"	Possible oscillation. RQ monitor fault
Inverter	293	"Fault"	"Controller missed heartbeats from master front panel."	
Inverter	294	"Fault"	"Output over-voltage protection."	
Inverter	296	"Fault"	"Output current peak protection."	
Inverter	297	"Fault"	"Remote voltage sensing fault."	
Inverter	298	"Fault"	"Internal capacitors over-current protection."	
Inverter	299	"Fault"	"Internal bus over-voltage protection. Possible regenerative load."	
Inverter	300	"Fault"	"CSC loop has saturated"	
Inverter	301	"Fault"	"Output current overload. RMS current exceeded limit."	
Inverter	302	"Fault"	"Internal muxed ADC protection fault."	
Inverter	303	"Fault"	"Internal fan current regulation fault."	
Inverter	304	"Fault"	"Parallel units model mismatch."	
Inverter	289	"Internal fault"	"Hardware revision does not match expected by firmware. Firmware must be reloaded."	

Source	Code	Type	Description	Possible cause
Inverter	290	"Internal fault"	"Invalid node ID. Run unit discovery to recover."	
Inverter	291	"Internal fault"	"Incorrect DSP type detected. Cycle-power to re-try."	
Inverter	295	"Internal fault"	"Invalid constants loaded from EEPROM."	
Inverter	326	"Internal fault"	"Controller is not in operational node."	
Inverter	327	"Internal fault"	"Missing controller node."	
Inverter	328	"Internal fault"	"Cannot read fault information."	
Primary	200	"Fault"	"LLC primary/auxiliary current peak limit exceeded."	
Primary	201	"Fault"	"LLC/PFC gate driver fault or hardware OVP."	
Primary	202	"Fault"	"Controller missed heartbeats from master front panel."	
Primary	203	"Fault"	"LLC primary current average limit exceeded."	
Primary	204	"Fault"	"LLC auxiliary current average limit exceeded."	
Primary	205	"Fault"	"PFC current peak limit exceeded."	
Primary	206	"Fault"	"PFC DC bus voltage limit exceeded."	
Primary	207	"Fault"	"Gate driver fault"	Input buck converter
Primary	208	"Fault"	"Input buck switching time."	
Primary	209	"Fault"	"AC input current exceeded RMS limit for too long."	
Primary	210	"Fault"	"Unbalanced current in PFC boost converters."	
Primary	211	"Fault"	"PFC efficiency protection."	
Primary	212	"Fault"	"AC input: voltage is below minimum."	
Primary	213	"Fault"	"AC input: missing phase."	
Primary	214	"Fault"	"PFC DC bus voltage regulation lost."	
Primary	215	"Fault"	"PFC DC bus voltage limit exceeded. CLA OVP Trip"	
Primary	216	"Fault"	"Temperature 1 protection (input stage)"	Exceeded maximum limit
Primary	217	"Fault"	"Temperature 1 protection (input stage)"	Exceeded minimum limit
Primary	218	"Fault"	"Temperature 2 protection (PFC/LLC)"	Exceeded maximum limit
Primary	219	"Fault"	"Temperature 2 protection (PFC/LLC)"	Exceeded minimum limit
Primary	220	"Fault"	"Temperature 3 protection (PFC/LLC)"	Exceeded maximum limit
Primary	221	"Fault"	"Temperature 3 protection (PFC/LLC) exceeded minimum limit."	
Primary	222	"Fault"	"Temperature 4 protection (main transformer)"	Exceeded maximum limit
Primary	223	"Fault"	"Temperature 4 protection (main transformer)"	Exceeded minimum limit
Primary	224	"Fault"	"Internal bias supply fault."	
Primary	230	"Fault"	"PFC output current peak protection."	

Source	Code	Type	Description	Possible cause
Primary	231	"Fault"	"PFC output current slow protection"	
Primary	232	"Fault"	"AC input: voltage is above maximum."	
Primary	234	"Fault"	"Firmware task execution error."	
Primary	225	"Internal fault"	"Global fault input signal detected."	
Primary	226	"Internal fault"	"Hardware does not match input voltage setting."	
Primary	227	"Internal fault"	"Primary capacitor board not detected."	
Primary	228	"Internal fault"	"Invalid node ID. Run unit discovery to recover."	
Primary	229	"Internal fault"	"Incorrect DSP type detected. Cycle-power to re-try."	
Primary	233	"Internal fault"	"Invalid constants loaded from EEPROM."	
Primary	261	"Internal fault"	"Controller is not in operational node."	
Primary	262	"Internal fault"	"Missing controller node."	
Primary	263	"Internal fault"	"Cannot read fault information."	
IO board	399	"Fault"	"Transformer coupling / series connection circuits hardware fault."	
IO board	400	"Fault"	"Transformer coupling / series connection circuits not detected."	
IO board	401	"Fault"	"Remote inhibit was issued from remote interface."	
IO board	393	"Internal fault"	"Global fault detected."	
IO board	394	"Internal fault"	"Internal board fault."	
IO board	395	"Internal fault"	"Invalid node ID. Run unit discovery to recover."	
IO board	396	"Internal fault"	"Incorrect DSP type detected. Cycle-power to re-try."	
IO board	397	"Internal fault"	"Invalid constants loaded from EEPROM."	
IO board	398	"Internal fault"	"Controller is not in operational node."	
IO board	454	"Internal fault"	"Controller is not in operational node."	
IO board	455	"Internal fault"	"Missing controller node."	
IO board	456	"Internal fault"	"Cannot read fault information."	

Table 12-1: Warnings and Error Messages Listing

13 Service and Maintenance

13.1 Warnings



CAUTION

THIS EQUIPMENT CONTAINS HIGH ENERGY, LOW IMPEDANCE CIRCUITS! LETHAL POTENTIALS ARE CONTAINED WITHIN THIS UNIT.

CARE MUST BE EXERCISED WHEN SERVICING THIS EQUIPMENT IN ORDER TO PREVENT SERIOUS SERVICE PERSONNEL INJURY OR EQUIPMENT DAMAGE.

OBSERVE THE FOLLOWING WHEN SERVICE OR MAINTENANCE ARE REQUIRED:

- 1. REMOVE ALL JEWELRY FROM ARMS AND NECK WHEN SERVICING THIS EQUIPMENT. THIS PREVENTS THE POSSIBILITY OF SHORTING THROUGH THE JEWELRY AND CAUSING BURNS TO SERVICE PERSONNEL.**
- 2. WEAR SAFETY GLASSES WHEN SERVICING THIS EQUIPMENT TO PREVENT EYE INJURY DUE TO FLYING PARTICLES CAUSED BY ACCIDENTAL SHORT CIRCUIT CONDITIONS.**
- 3. DO NOT REMOVE ANY PANEL OR COVER WITHOUT FIRST REMOVING THE INPUT SERVICE BY OPENING ALL CIRCUIT BREAKERS.**
- 4. DO NOT REMOVE ANY PANEL OR COVER WITHOUT FIRST WAITING 20 MINUTES FOR ALL INTERNAL CHARGES TO DISSIPATE TO A SAFE LEVEL.**
- 5. SERVICE OTHER THAN EXTERNAL CLEANING SHOULD BE REFERRED TO PERSONNEL AUTHORIZED BY THE FACTORY TO SERVICE THIS EQUIPMENT.**



AVERTISSEMENT

CET ÉQUIPEMENT CONTIENT DES CIRCUITS À HAUTE ÉNERGIE ET À BASSE IMPÉDANCE ! LES POTENTIELS MORTELS SONT CONTENUS DANS CETTE UNITÉ.

IL FAUT FAIRE ATTENTION LORS DE L'ENTRETIEN DE CET ÉQUIPEMENT AFIN D'ÉVITER DES BLESSURES GRAVES DU PERSONNEL D'ENTRETIEN OU DES DOMMAGES À L'ÉQUIPEMENT.

OBSERVEZ CE QUI SUIT LORSQUE L'ENTRETIEN OU LA MAINTENANCE SONT NÉCESSAIRES :

- 1. RETIREZ TOUS LES BIJOUX DES BRAS ET DU COU LORS DE L'ENTRETIEN DE CET ÉQUIPEMENT. CELA EMPÊCHE LA POSSIBILITÉ DE COURT-CIRCUIT À TRAVERS LES BIJOUX ET DE CAUSER DES BRÛLURES AU PERSONNEL D'ENTRETIEN.**
- 2. PORTEZ DES LUNETTES DE SÉCURITÉ LORS DE L'ENTRETIEN DE CET ÉQUIPEMENT AFIN D'ÉVITER LES BLESSURES OCULAIRES DUES AUX PARTICULES VOLANTES CAUSÉES PAR DES CONDITIONS DE COURT-CIRCUIT ACCIDENTELS.**
- 3. NE RETIREZ AUCUN PANNEAU OU COUVERCLE SANS D'ABORD RETIRER LE SERVICE D'ENTRÉE EN OUVRANT TOUS LES DISJONCTEURS.**
- 4. NE RETIREZ AUCUN PANNEAU OU COUVERCLE SANS AVOIR D'ABORD ATTENDU 20 MINUTES QUE TOUTES LES CHARGES INTERNES SE DISSIPENT À UN NIVEAU SÛR.**



AVERTISSEMENT

- 5 TOUTE RÉPARATION AUTRE QUE LE NETTOYAGE EXTERNE DOIT ÊTRE RÉFÉRÉE AU PERSONNEL AUTORISÉ PAR L'USINE POUR RÉPARER CET ÉQUIPEMENT.**

13.2 Authorized Service Centers

There are **NO** end-user serviceable parts in this product. In case of a problem or malfunction, **DO NOT ATTEMPT TO REPAIR!** Instead, contact one of Pacific Power Source's authorized service centers or your local Pacific Power Source distributor. For a list of authorized service centers, refer to section 1, "Contact Information".

14 ModBus TCP Server / Slave Interface

14.1 TCP ModBus Interface

The ModBus TCP Server/Slave Interface provides a means to communicate with industrial bus protocols. This is a register based interface so no SCPI programming commands apply. Instead of sending commands, the user can write to specific register addresses to change various settings and read from other registers to obtain readings such as measurements or settings.

To use this interface, the user needs to reference the register addresses provided in the next section.

Note: The Modbus TCP protocol is included in all units without the need for any adapter or hardware option. Third party protocol converter adaptors may be used to support other protocols like CAN, Profibus or other fieldbus interfaces to the built-in Modbus TCP of the power source. However, Pacific Power **does not** do any programming or provide support to use these.

14.2 Modbus TCP Register Tables

The following tables apply to AGX and RGS Series power source or RLS load models. Some functions may not be supported on specific model series depending on supported modes of operation and feature sets.

Note: The information contained in the table below is available for download in MS Excel file [modbustcp-registers.xlsx](#) at the following link under 'documentation':

https://github.com/PPST-Inc/ModbusTCP_Examples

If the power source is connected to a network with internet access, this table can also be downloaded using the web browser interface from the SYSTEM -> INTERFACE SETUP -> MODBUS-TCP -> Download (Registers)

See tables on subsequent pages.

Note: Entries with **RED background** may not be implemented at the time of this manual revision and may require a firmware update.

Command Processing Times

Some operations like changing operating mode, form, range, reset, and others are operations that may take several seconds to complete due to the number of internal operations required.

The unit processes the request received sequentially. The unit can reply to a new command only after the operation finishes. Make sure any timeout set in your application program is sufficient to allow for this processing time. If you experience time-outs, it may be necessary to set a longer timeout request.

	Modbus address (dec)	Modbus address (hex)	Read coils	Read holding registers	Read input registers (0x06)	Write single coil (0x05)	Write single register (0x06)	Write multiple registers (0x10)	Description	Access	Data type	Data length in bytes	Number of registers	Data	Example
Modbus Interface	0	0000													
	1	0001			x				Modbus Ver	R	uint(16)	2	1		
	2	0002			x				Modbus Info	R	uint(16)	2	1		
Measurements	1000	03E8			x				Frequency	R	float	4	2	Floating point number IEEE754	60
	1002	03EA			x				Output A frequency	R	float	4	2	Floating point number IEEE754	
	1004	03EC			x				Output B frequency	R	float	4	2	Floating point number IEEE754	
	1006	03EE			x				Output C frequency	R	float	4	2	Floating point number IEEE754	
	1008	03F0			x				Voltage line to line ACDC	R	float	4	2	Floating point number IEEE754	
	1010	03F2			x				Output A voltage line to line ACDC	R	float	4	2	Floating point number IEEE754	
	1012	03F4			x				Output B voltage line to line ACDC	R	float	4	2	Floating point number IEEE754	
	1014	03F6			x				Output C voltage line to line ACDC	R	float	4	2	Floating point number IEEE754	
	1016	03F8			x				Voltage line to line AC	R	float	4	2	Floating point number IEEE754	
	1018	03FA			x				Output A voltage line to line AC	R	float	4	2	Floating point number IEEE754	
	1020	03FC			x				Output B voltage line to line AC	R	float	4	2	Floating point number IEEE754	
	1022	03FE			x				Output C voltage line to line AC	R	float	4	2	Floating point number IEEE754	
	1024	0400			x				Voltage line to line DC	R	float	4	2	Floating point number IEEE754	
	1026	0402			x				Output A voltage line to line DC	R	float	4	2	Floating point number IEEE754	
	1028	0404			x				Output B voltage line to line DC	R	float	4	2	Floating point number IEEE754	
	1030	0406			x				Output C voltage line to line DC	R	float	4	2	Floating point number IEEE754	

	Modbus address (dec)	Modbus address (hex)	Read coils	Read holding registers	Read input registers (0x06)	Write single coil (0x05)	Write single register (0x06)	Write multiple registers (0x10)	Description	Access	Data type	Data length in bytes	Number of registers	Data	Example
	1032	0408			x				Voltage ACDC	R	float	4	2	Floating point number IEEE754	
	1034	040A			x				Output A voltage ACDC	R	float	4	2	Floating point number IEEE754	
	1036	040C			x				Output B voltage ACDC	R	float	4	2	Floating point number IEEE754	
	1038	040E			x				Output C voltage ACDC	R	float	4	2	Floating point number IEEE754	
	1040	0410			x				Voltage AC	R	float	4	2	Floating point number IEEE754	
	1042	0412			x				Output A voltage AC	R	float	4	2	Floating point number IEEE754	
	1044	0414			x				Output B voltage AC	R	float	4	2	Floating point number IEEE754	
	1046	0416			x				Output C voltage AC	R	float	4	2	Floating point number IEEE754	
	1048	0418			x				Voltage DC	R	float	4	2	Floating point number IEEE754	
	1050	041A			x				Output A voltage DC	R	float	4	2	Floating point number IEEE754	
	1052	041C			x				Output B voltage DC	R	float	4	2	Floating point number IEEE754	
	1054	041E			x				Output C voltage DC	R	float	4	2	Floating point number IEEE754	
	1056	0420			x				Current ACDC	R	float	4	2	Floating point number IEEE754	
	1058	0422			x				Output A current ACDC	R	float	4	2	Floating point number IEEE754	
	1060	0424			x				Output B current ACDC	R	float	4	2	Floating point number IEEE754	
	1062	0426			x				Output C current ACDC	R	float	4	2	Floating point number IEEE754	
	1064	0428			x				Current DC	R	float	4	2	Floating point number IEEE754	
	1066	042A			x				Output A current DC	R	float	4	2	Floating point number IEEE754	
	1068	042C			x				Output B current DC	R	float	4	2	Floating point number IEEE754	

	Modbus address (dec)	Modbus address (hex)	Read coils	Read holding registers	Read input registers (0x06)	Write single coil (0x05)	Write single register (0x06)	Write multiple registers (0x10)	Description	Access	Data type	Data length in bytes	Number of registers	Data	Example
	1070	042E			x				Output C current DC	R	float	4	2	Floating point number IEEE754	
	1072	0430			x				Active power	R	float	4	2	Floating point number IEEE754	
	1074	0432			x				Output A active power	R	float	4	2	Floating point number IEEE754	
	1076	0434			x				Output B active power	R	float	4	2	Floating point number IEEE754	
	1078	0436			x				Output C active power	R	float	4	2	Floating point number IEEE754	
	1080	0438			x				Apparent power	R	float	4	2	Floating point number IEEE754	
	1082	043A			x				Output A apparent power	R	float	4	2	Floating point number IEEE754	
	1084	043C			x				Output B apparent power	R	float	4	2	Floating point number IEEE754	
	1086	043E			x				Output C apparent power	R	float	4	2	Floating point number IEEE754	
	1088	0440			x				Peak current	R	float	4	2	Floating point number IEEE754	
	1090	0442			x				Output A peak current	R	float	4	2	Floating point number IEEE754	
	1092	0444			x				Output B peak current	R	float	4	2	Floating point number IEEE754	
	1094	0446			x				Output C peak current	R	float	4	2	Floating point number IEEE754	
	1096	0448			x				Power factor	R	float	4	2	Floating point number IEEE754	
	1098	044A			x				Output A power factor	R	float	4	2	Floating point number IEEE754	
	1100	044C			x				Output B power factor	R	float	4	2	Floating point number IEEE754	
	1102	044E			x				Output C power factor	R	float	4	2	Floating point number IEEE754	
	1104	0450			x				Crest factor	R	float	4	2	Floating point number IEEE754	
1106	0452			x				Output A crest factor	R	float	4	2	Floating point number IEEE754		

	Modbus address (dec)	Modbus address (hex)	Read coils	Read holding registers	Read input registers (0x06)	Write single coil (0x05)	Write single register (0x06)	Write multiple registers (0x10)	Description	Access	Data type	Data length in bytes	Number of registers	Data	Example
	1108	0454			x				Output B crest factor	R	float	4	2	Floating point number IEEE754	
	1110	0456			x				Output C crest factor	R	float	4	2	Floating point number IEEE754	
	1112	0458			x				Peak current recorded	R	float	4	2	Floating point number IEEE754	
	1114	045A			x				Output A peak current recorded	R	float	4	2	Floating point number IEEE754	
	1116	045C			x				Output B peak current recorded	R	float	4	2	Floating point number IEEE754	
	1118	045E			x				Output C peak current recorded	R	float	4	2	Floating point number IEEE754	
	1120	0460			x				Voltage thd	R	float	4	2	Floating point number IEEE754	
	1122	0462			x				Output A voltage thd	R	float	4	2	Floating point number IEEE754	
	1124	0464			x				Output B voltage thd	R	float	4	2	Floating point number IEEE754	
	1126	0466			x				Output C voltage thd	R	float	4	2	Floating point number IEEE754	
	1128	0468			x				Current thd	R	float	4	2	Floating point number IEEE754	
	1130	046A			x				Output A current thd	R	float	4	2	Floating point number IEEE754	
	1132	046C			x				Output B current thd	R	float	4	2	Floating point number IEEE754	
	1134	046E			x				Output C current thd	R	float	4	2	Floating point number IEEE754	
	1136	0470			x				Power factor angle	R	float	4	2	Floating point number IEEE754	
	1138	0472			x				Output A power factor angle	R	float	4	2	Floating point number IEEE754	
	1140	0474			x				Output B power factor angle	R	float	4	2	Floating point number IEEE754	
	1142	0476			x				Output C power factor angle	R	float	4	2	Floating point number IEEE754	
	1144	0478			x				Displacement factor	R	float	4	2	Floating point number IEEE754	

	Modbus address (dec)	Modbus address (hex)	Read coils	Read holding registers	Read input registers (0x06)	Write single coil (0x05)	Write single register (0x06)	Write multiple registers (0x10)	Description	Access	Data type	Data length in bytes	Number of registers	Data	Example
	1146	047A			x				Output A displacement factor	R	float	4	2	Floating point number IEEE754	
	1148	047C			x				Output B displacement factor	R	float	4	2	Floating point number IEEE754	
	1150	047E			x				Output C displacement factor	R	float	4	2	Floating point number IEEE754	
	1152	0480			x				Distortion factor	R	float	4	2	Floating point number IEEE754	
	1154	0482			x				Output A distortion factor	R	float	4	2	Floating point number IEEE754	
	1156	0484			x				Output B distortion factor	R	float	4	2	Floating point number IEEE754	
	1158	0486			x				Output C distortion factor	R	float	4	2	Floating point number IEEE754	
	1160	0488			x				Kilowatt hour	R	float	4	2	Floating point number IEEE754	
	1162	048A			x				Output A kilowatt hour	R	float	4	2	Floating point number IEEE754	
	1164	048C			x				Output B kilowatt hour	R	float	4	2	Floating point number IEEE754	
	1166	048E			x				Output C kilowatt hour	R	float	4	2	Floating point number IEEE754	
	1168	0490			x				Kilowatt hour elapsed time	R	float	4	2	Floating point number IEEE754	
	1170	0492			x				Output A kilowatt hour elapsed time	R	float	4	2	Floating point number IEEE754	
	1172	0494			x				Output B kilowatt hour elapsed time	R	float	4	2	Floating point number IEEE754	
	1174	0496			x				Output C kilowatt hour elapsed time	R	float	4	2	Floating point number IEEE754	
	2800	0AF0	x			x			Reset KWH	RW	bool			Coils : Kreset	ON=reset, self clear
	2801	0AF1	x			x			Enable KWH	RW	bool			Coils : Kwhenable	ON=enable, OFF=disable
Setpoints Program	3000	0BB8							Program frequency	RW	float	4	2	Floating point number IEEE754	

	Modbus address (dec)	Modbus address (hex)	Read coils	Read holding registers	Read input registers (0x06)	Write single coil (0x05)	Write single register (0x06)	Write multiple registers (0x10)	Description	Access	Data type	Data length in bytes	Number of registers	Data	Example
	3002	0BBA							Program frequency A	RW	float	4	2	Floating point number IEEE754	
	3004	0BBC							Program frequency B	RW	float	4	2	Floating point number IEEE754	
	3006	0BBE							Program frequency C	RW	float	4	2	Floating point number IEEE754	
	3008	0BC0							Program voltage AC	RW	float	4	2	Floating point number IEEE754	
	3010	0BC2							Program voltage AC output A	RW	float	4	2	Floating point number IEEE754	
	3012	0BC4							Program voltage AC output B	RW	float	4	2	Floating point number IEEE754	
	3014	0BC6							Program voltage AC output C	RW	float	4	2	Floating point number IEEE754	
	3016	0BC8							Program voltage DC	RW	float	4	2	Floating point number IEEE754	
	3018	0BCA							Program voltage DC output A	RW	float	4	2	Floating point number IEEE754	
	3020	0BCC							Program voltage DC output B	RW	float	4	2	Floating point number IEEE754	
	3022	0BCE							Program voltage DC output C	RW	float	4	2	Floating point number IEEE754	
	3024	0BD0							Power limit	RW	float	4	2	Floating point number IEEE754	
	3026	0BD2							Power limit output A	RW	float	4	2	Floating point number IEEE754	
	3028	0BD4							Power limit output B	RW	float	4	2	Floating point number IEEE754	
	3030	0BD6							Power limit output C	RW	float	4	2	Floating point number IEEE754	
	3032	0BD8							Current limit ABC	RW	float	4	2	Floating point number IEEE754	
	3034	0BDA							Current limit output A	RW	float	4	2	Floating point number IEEE754	
	3036	0BDC							Current limit output B	RW	float	4	2	Floating point number IEEE754	
	3038	0BDE							Current limit output C	RW	float	4	2	Floating point number IEEE754	

	Modbus address (dec)	Modbus address (hex)	Read coils	Read holding registers	Read input registers (0x06)	Write single coil (0x05)	Write single register (0x06)	Write multiple registers (0x10)	Description	Access	Data type	Data length in bytes	Number of registers	Data	Example
	3040	0BE0							KVA Limit	RW	float	4	2	Floating point number IEEE754	
	3042	0BE2							KVA Limit output A	RW	float	4	2	Floating point number IEEE754	
	3044	0BE4							KVA Limit output B	RW	float	4	2	Floating point number IEEE754	
	3046	0BE6							KVA Limit output C	RW	float	4	2	Floating point number IEEE754	
	3048	0BE8							Phase offset output	RW	float	4	2	Floating point number IEEE754	
	3050	0BEA							Phase offset output A	RW	float	4	2	Floating point number IEEE754	
	3052	0BEC							Phase offset output B	RW	float	4	2	Floating point number IEEE754	
	3054	0BEE							Phase offset output C	RW	float	4	2	Floating point number IEEE754	
	3056	0BF0							Waveform	RW	uint(16)	2	1	unsigned int 16 bits	
	3057	0BF1							Waveform output A	RW	uint(16)	2	1	unsigned int 16 bits	
	3058	0BF2							Waveform output B	RW	uint(16)	2	1	unsigned int 16 bits	
	3059	0BF3							Waveform output C	RW	uint(16)	2	1	unsigned int 16 bits	
	3060	0BF4							Waveform smoothing filter	RW	uint(16)	2	1	unsigned int 16 bits	Min=1, Max=101
	3061	0BF5							Waveform smoothing filter output A	RW	uint(16)	2	1	unsigned int 16 bits	
	3062	0BF6							Waveform smoothing filter output B	RW	uint(16)	2	1	unsigned int 16 bits	
	3063	0BF7							Waveform smoothing filter output C	RW	uint(16)	2	1	unsigned int 16 bits	
Setpoints Current source	3128	0C38							Program current AC	RW	float	4	2	Floating point number IEEE754	
	3130	0C3A							Program current AC output A	RW	float	4	2	Floating point number IEEE754	
	3132	0C3C							Program current AC output B	RW	float	4	2	Floating point number IEEE754	

	Modbus address (dec)	Modbus address (hex)	Read coils	Read holding registers	Read input registers (0x06)	Write single coil (0x05)	Write single register (0x06)	Write multiple registers (0x10)	Description	Access	Data type	Data length in bytes	Number of registers	Data	Example
	3134	0C3E							Program current AC output C	RW	float	4	2	Floating point number IEEE754	
	3136	0C40							Program current DC	RW	float	4	2	Floating point number IEEE754	
	3138	0C42							Program current DC output A	RW	float	4	2	Floating point number IEEE754	
	3140	0C44							Program current DC output B	RW	float	4	2	Floating point number IEEE754	
	3142	0C46							Program current DC output C	RW	float	4	2	Floating point number IEEE754	
	3144	0C48							Voltage limit	RW	float	4	2	Floating point number IEEE754	
	3146	0C4A							Voltage limit output A	RW	float	4	2	Floating point number IEEE754	
	3148	0C4C							Voltage limit output B	RW	float	4	2	Floating point number IEEE754	
	3150	0C4E							Voltage limit output C	RW	float	4	2	Floating point number IEEE754	
Setpoints Load Constant Resistance	3256	0CB8							Resistance type	RW	uint(16)	2	1	unsigned int 16 bits	0=RESISTANCE RMS, 1=CONDUCTANCE RMS, 2=INSTANTANEOUS RESISTANCE, 3=INSTANTANEOUS CONDUCTANCE
	3257	0CB9							Resistance type output A	RW	uint(16)	2	1	unsigned int 16 bits	
	3258	0CBA							Resistance type output B	RW	uint(16)	2	1	unsigned int 16 bits	
	3259	0CBB							Resistance type output C	RW	uint(16)	2	1	unsigned int 16 bits	
	3260	0CBC							Resistance modulation	RW	uint(16)	2	1	unsigned int 16 bits	0=AC, 1=DC, 2=AC&DC, 3=AC=DC
	3261	0CBD							Resistance modulation output A	RW	uint(16)	2	1	unsigned int 16 bits	
	3262	0CBE							Resistance modulation output B	RW	uint(16)	2	1	unsigned int 16 bits	
	3263	0CBF							Resistance modulation output A	RW	uint(16)	2	1	unsigned int 16 bits	

	Modbus address (dec)	Modbus address (hex)	Read coils	Read holding registers	Read input registers (0x06)	Write single coil (0x05)	Write single register (0x06)	Write multiple registers (0x10)	Description	Access	Data type	Data length in bytes	Number of registers	Data	Example
	3264	0CC0							Resistance AC	RW	float	4	2	Floating point number IEEE754	
	3266	0CC2							Resistance AC output A	RW	float	4	2	Floating point number IEEE754	
	3268	0CC4							Resistance AC output B	RW	float	4	2	Floating point number IEEE754	
	3270	0CC6							Resistance AC output C	RW	float	4	2	Floating point number IEEE754	
	3272	0CC8							Resistance DC	RW	float	4	2	Floating point number IEEE754	
	3274	0CCA							Resistance DC output A	RW	float	4	2	Floating point number IEEE754	
	3276	0CCC							Resistance DC output B	RW	float	4	2	Floating point number IEEE754	
	3278	0CCE							Resistance DC output C	RW	float	4	2	Floating point number IEEE754	
	3280	0CD0							Conductance AC	RW	float	4	2	Floating point number IEEE754	
	3282	0CD2							Conductance AC output A	RW	float	4	2	Floating point number IEEE754	
	3284	0CD4							Conductance AC output B	RW	float	4	2	Floating point number IEEE754	
	3286	0CD6							Conductance AC output C	RW	float	4	2	Floating point number IEEE754	
	3288	0CD8							Conductance DC	RW	float	4	2	Floating point number IEEE754	
	3290	0CDA							Conductance DC output A	RW	float	4	2	Floating point number IEEE754	
	3292	0CDC							Conductance DC output B	RW	float	4	2	Floating point number IEEE754	
	3294	0CDE							Conductance DC output C	RW	float	4	2	Floating point number IEEE754	
	3296	0CE0							Filter frequency	RW	float	4	2	Floating point number IEEE754	
	3298	0CE2							Filter frequency output A	RW	float	4	2	Floating point number IEEE754	
	3300	0CE4							Filter frequency output B	RW	float	4	2	Floating point number IEEE754	

	Modbus address (dec)	Modbus address (hex)	Read coils	Read holding registers	Read input registers (0x06)	Write single coil (0x05)	Write single register (0x06)	Write multiple registers (0x10)	Description	Access	Data type	Data length in bytes	Number of registers	Data	Example
	3302	0CE6							Filter frequency output C	RW	float	4	2	Floating point number IEEE754	
	3304	0CE8							Stabilization factor	RW	float	4	2	Floating point number IEEE754	
	3306	0CEA							Stabilization factor output A	RW	float	4	2	Floating point number IEEE754	
	3308	0CEC							Stabilization factor output B	RW	float	4	2	Floating point number IEEE754	
	3310	0CEE							Stabilization factor output C	RW	float	4	2	Floating point number IEEE754	
Setpoints Load Constant Power	3384	0D38							Power type	RW	uint(16)	2	1	unsigned int 16 bits	0=APPARENT POWER RMS, 1=ACTIVE POWER RMS
	3385	0D39							Power type output A	RW	uint(16)	2	1	unsigned int 16 bits	
	3386	0D3A							Power type output B	RW	uint(16)	2	1	unsigned int 16 bits	
	3387	0D3B							Power type output C	RW	uint(16)	2	1	unsigned int 16 bits	
	3388	0D3C							Power modulation	RW	uint(16)	2	1	unsigned int 16 bits	0=AC, 1=DC, 2=AC&DC
	3389	0D3D							Power modulation output A	RW	uint(16)	2	1	unsigned int 16 bits	
	3390	0D3E							Power modulation output B	RW	uint(16)	2	1	unsigned int 16 bits	
	3391	0D3F							Power modulation output A	RW	uint(16)	2	1	unsigned int 16 bits	
	3392	0D40							Power AC	RW	float	4	2	Floating point number IEEE754	
	3394	0D42							Power AC output A	RW	float	4	2	Floating point number IEEE754	
	3396	0D44							Power AC output B	RW	float	4	2	Floating point number IEEE754	
	3398	0D46							Power AC output C	RW	float	4	2	Floating point number IEEE754	
	3400	0D48							Power DC	RW	float	4	2	Floating point number IEEE754	
	3402	0D4A							Power DC output A	RW	float	4	2	Floating point number IEEE754	

	Modbus address (dec)	Modbus address (hex)	Read coils	Read holding registers	Read input registers (0x06)	Write single coil (0x05)	Write single register (0x06)	Write multiple registers (0x10)	Description	Access	Data type	Data length in bytes	Number of registers	Data	Example
	3404	0D4C							Power DC output B	RW	float	4	2	Floating point number IEEE754	
	3406	0D4E							Power DC output C	RW	float	4	2	Floating point number IEEE754	
	3408	0D50							kVA AC	RW	float	4	2	Floating point number IEEE754	
	3410	0D52							kVA AC output A	RW	float	4	2	Floating point number IEEE754	
	3412	0D54							kVA AC output B	RW	float	4	2	Floating point number IEEE754	
	3414	0D56							kVA AC output C	RW	float	4	2	Floating point number IEEE754	
	3416	0D58							kVA DC	RW	float	4	2	Floating point number IEEE754	
	3418	0D5A							kVA DC output A	RW	float	4	2	Floating point number IEEE754	
	3420	0D5C							kVA DC output B	RW	float	4	2	Floating point number IEEE754	
	3422	0D5E							kVA DC output C	RW	float	4	2	Floating point number IEEE754	
Setpoints Load Circuit Emulation															0=R, 1=SERIES RL, 2=SERIES RC, 3=R // SERIES RL, 4=R // SERIES RC, 5=R (L // C), 6.L (R // C), 7=C (R // L), 8=SERIES RLC, 9=R // SERIES RLC, 10=SERIES RL // SERIES RC, 11=R // SERIES RL // SERIES RC, 12=SERIES RL (R // C), 13=RECTIFIER SINGLE PHASE, 14=RECTIFIER THREE PHASE
	3512	0DB8							Circuit emulation type	RW	uint(16)	2	1	unsigned int 16 bits	
	3513	0DB9							Circuit emulation type output A	RW	uint(16)	2	1	unsigned int 16 bits	
	3514	0DBA							Circuit emulation type output B	RW	uint(16)	2	1	unsigned int 16 bits	

	Modbus address (dec)	Modbus address (hex)	Read coils	Read holding registers	Read input registers (0x06)	Write single coil (0x05)	Write single register (0x06)	Write multiple registers (0x10)	Description	Access	Data type	Data length in bytes	Number of registers	Data	Example
	3515	0DBB							Circuit emulation type output C	RW	uint(16)	2	1	unsigned int 16 bits	
	3516	0DBC							Resistance	RW	float	4	2	Floating point number IEEE754	
	3518	0DBE							Resistance output A	RW	float	4	2	Floating point number IEEE754	
	3520	0DC0							Resistance output B	RW	float	4	2	Floating point number IEEE754	
	3522	0DC2							Resistance output C	RW	float	4	2	Floating point number IEEE754	
	3524	0DC4							Resistance (RL)	RW	float	4	2	Floating point number IEEE754	
	3526	0DC6							Resistance (RL) output A	RW	float	4	2	Floating point number IEEE754	
	3528	0DC8							Resistance (RL) output B	RW	float	4	2	Floating point number IEEE754	
	3530	0DCA							Resistance (RL) output C	RW	float	4	2	Floating point number IEEE754	
	3532	0DCC							Resistance (RC)	RW	float	4	2	Floating point number IEEE754	
	3534	0DCE							Resistance (RC) output A	RW	float	4	2	Floating point number IEEE754	
	3536	0DD0							Resistance (RC) output B	RW	float	4	2	Floating point number IEEE754	
	3538	0DD2							Resistance (RC) output C	RW	float	4	2	Floating point number IEEE754	
	3540	0DD4							Inductance	RW	float	4	2	Floating point number IEEE754	
	3542	0DD6							Inductance output A	RW	float	4	2	Floating point number IEEE754	
	3544	0DD8							Inductance output B	RW	float	4	2	Floating point number IEEE754	
	3546	0DDA							Inductance output C	RW	float	4	2	Floating point number IEEE754	
	3548	0DDC							Capacitance	RW	float	4	2	Floating point number IEEE754	
	3550	0DDE							Capacitance output A	RW	float	4	2	Floating point number IEEE754	

	Modbus address (dec)	Modbus address (hex)	Read coils	Read holding registers	Read input registers (0x06)	Write single coil (0x05)	Write single register (0x06)	Write multiple registers (0x10)	Description	Access	Data type	Data length in bytes	Number of registers	Data	Example	
	3552	0DE0							Capacitance output B	RW	float	4	2	Floating point number IEEE754		
	3554	0DE2							Capacitance output C	RW	float	4	2	Floating point number IEEE754		
	3556	0DE4							Initial voltage	RW	float	4	2	Floating point number IEEE754		
	3558	0DE6							Initial voltage output A	RW	float	4	2	Floating point number IEEE754		
	3560	0DE8							Initial voltage output B	RW	float	4	2	Floating point number IEEE754		
	3562	0DEA							Initial voltage output C	RW	float	4	2	Floating point number IEEE754		
	3564	0DEC							Filter frequency	RW	float	4	2	Floating point number IEEE754		
	3566	0DEE							Filter frequency output A	RW	float	4	2	Floating point number IEEE754		
	3568	0DF0							Filter frequency output B	RW	float	4	2	Floating point number IEEE754		
	3570	0DF2							Filter frequency output C	RW	float	4	2	Floating point number IEEE754		
	4000	0FA0	x			x			Enable output	RW	bool			Coils: Output	ON=enable, OFF=disable	
	4001	0FA1	x			x			Enable output A	RW	bool			Coils: Output		
	4002	0FA2	x			x			Enable output B	RW	bool			Coils: Output		
	4003	0FA3	x			x			Enable output C	RW	bool			Coils: Output		
	4004	0FA4	x			x			Sync frequency	RW	bool			Coils: Sync frequency	ON=enable, OFF=disable	
	4005	0FA5	x			x			Sync frequency	RW	bool			Coils: Sync frequency		
	4006	0FA6	x			x			Sync frequency	RW	bool			Coils: Sync frequency		
	4007	0FA7	x			x			Sync frequency	RW	bool			Coils: Sync frequency		
	4008	0FA8	x			x			Circuit emulation	RW	bool			Coils: Circuit emulation	ON=enable, OFF=disable	
4009	0FA9	x			x			Circuit emulation output A	RW	bool			Coils: Circuit emulation			

	Modbus address (dec)	Modbus address (hex)	Read coils	Read holding registers	Read input registers (0x06)	Write single coil (0x05)	Write single register (0x06)	Write multiple registers (0x10)	Description	Access	Data type	Data length in bytes	Number of registers	Data	Example
	4010	0FAA	x			x			Circuit emulation output B	RW	bool			Coils: Circuit emulation	
	4011	0FAB	x			x			Circuit emulation output C	RW	bool			Coils: Circuit emulation	
Protection	5000	1388	x			x			RMS Current protection	RW	bool				
	5001	1389	x			x			Output A RMS Current protection	RW	bool				
	5002	138A	x			x			Output B RMS Current protection	RW	bool				
	5003	138B	x			x			Output C RMS Current protection	RW	bool				
	5004	138C	x			x			RMS Power protection	RW	bool				
	5005	138D	x			x			Output A RMS Power protection	RW	bool				
	5006	138E	x			x			Output B RMS Power protection	RW	bool				
	5007	138F	x			x			Output C RMS Power protection	RW	bool				
	5008	1390	x			x			Peak current protection	RW	bool				
	5009	1391	x			x			Output A Peak current protection	RW	bool				
	5010	1392	x			x			Output B Peak current protection	RW	bool				
	5011	1393	x			x			Output C Peak current protection	RW	bool				
	5012	1394	x			x			Peak voltage protection	RW	bool				
	5013	1395	x			x			Output A Peak voltage protection	RW	bool				
	5014	1396	x			x			Output B Peak voltage protection	RW	bool				
	5015	1397	x			x			Output C Peak voltage protection	RW	bool				
	5016	1398	x			x			Peak power protection	RW	bool				

	Modbus address (dec)	Modbus address (hex)	Read coils	Read holding registers	Read input registers (0x06)	Write single coil (0x05)	Write single register (0x06)	Write multiple registers (0x10)	Description	Access	Data type	Data length in bytes	Number of registers	Data	Example
	5017	1399	x			x			Output A Peak power protection	RW	bool				
	5018	139A	x			x			Output B Peak power protection	RW	bool				
	5019	139B	x			x			Output C Peak power protection	RW	bool				
	5024	13A0							Current level	RW	float	4	2	Floating point number IEEE754	
	5026	13A2							Output A Current level	RW	float	4	2	Floating point number IEEE754	
	5028	13A4							Output B Current level	RW	float	4	2	Floating point number IEEE754	
	5030	13A6							Output C Current level	RW	float	4	2	Floating point number IEEE754	
	5032	13A8							Power level	RW	float	4	2	Floating point number IEEE754	
	5034	13AA							Output A Power level	RW	float	4	2	Floating point number IEEE754	
	5036	13AC							Output B Power level	RW	float	4	2	Floating point number IEEE754	
	5038	13AE							Output C Power level	RW	float	4	2	Floating point number IEEE754	
	5040	13B0							KVA Level	RW	float	4	2	Floating point number IEEE754	
	5042	13B2							Output A KVA Level	RW	float	4	2	Floating point number IEEE754	
	5044	13B4							Output B KVA Level	RW	float	4	2	Floating point number IEEE754	
	5046	13B6							Output C KVA Level	RW	float	4	2	Floating point number IEEE754	
	5048	13B8							Trip time	RW	float	4	2	Floating point number IEEE754	minimum step of 0.1 seconds
	5050	13BA							Output A Trip time	RW	float	4	2	Floating point number IEEE754	
	5052	13BC							Output B Trip time	RW	float	4	2	Floating point number IEEE754	
	5054	13BE							Output C Trip time	RW	float	4	2	Floating point number IEEE754	

	Modbus address (dec)	Modbus address (hex)	Read coils	Read holding registers	Read input registers (0x06)	Write single coil (0x05)	Write single register (0x06)	Write multiple registers (0x10)	Description	Access	Data type	Data length in bytes	Number of registers	Data	Example
	5056	13C0							Peak current limit	RW	float	4	2	Floating point number IEEE754	
	5058	13C2							Output A Peak current limit	RW	float	4	2	Floating point number IEEE754	
	5060	13C4							Output B Peak current limit	RW	float	4	2	Floating point number IEEE754	
	5062	13C6							Output C Peak current limit	RW	float	4	2	Floating point number IEEE754	
	5064	13C8							Peak current protection level	RW	float	4	2	Floating point number IEEE754	
	5066	13CA							Output A Peak current protection level	RW	float	4	2	Floating point number IEEE754	
	5068	13CC							Output B Peak current protection level	RW	float	4	2	Floating point number IEEE754	
	5070	13CE							Output C Peak current protection level	RW	float	4	2	Floating point number IEEE754	
	5072	13D0							Peak voltage protection margin	RW	float	4	2	Floating point number IEEE754	
	5074	13D2							Output A Peak voltage protection margin	RW	float	4	2	Floating point number IEEE754	
	5076	13D4							Output B Peak voltage protection margin	RW	float	4	2	Floating point number IEEE754	
	5078	13D6							Output C Peak voltage protection margin	RW	float	4	2	Floating point number IEEE754	
	5080	13D8							Peak voltage protection level	RW	float	4	2	Floating point number IEEE754	
	5082	13DA							Output A Peak voltage protection level	RW	float	4	2	Floating point number IEEE754	
	5084	13DC							Output B Peak voltage protection level	RW	float	4	2	Floating point number IEEE754	
	5086	13DE							Output C Peak voltage protection level	RW	float	4	2	Floating point number IEEE754	
	5088	13E0							Peak voltage protection mode	RW	uint(16)	2	1	unsigned int 16 bits	0=MARGIN, 1=LEVEL, 2=MARGIN&LEVEL
	5089	13E1							Output A Peak voltage protection mode	RW	uint(16)	2	1	unsigned int 16 bits	
	5090	13E2							Output B Peak voltage protection mode	RW	uint(16)	2	1	unsigned int 16 bits	

	Modbus address (dec)	Modbus address (hex)	Read coils	Read holding registers	Read input registers (0x06)	Write single coil (0x05)	Write single register (0x06)	Write multiple registers (0x10)	Description	Access	Data type	Data length in bytes	Number of registers	Data	Example
	5091	13E3							Output C Peak voltage protection mode	RW	uint(16)	2	1	unsigned int 16 bits	
	5092	13E4							Peak current protection margin	RW	float	4	2	Floating point number IEEE754	
	5094	13E6							Output A Peak current protection margin	RW	float	4	2	Floating point number IEEE754	
	5096	13E8							Output B Peak current protection margin	RW	float	4	2	Floating point number IEEE754	
	5098	13EA							Output C Peak current protection margin	RW	float	4	2	Floating point number IEEE754	
	5100	13EC							Peak current protection mode	RW	uint(16)	2	1	unsigned int 16 bits	0=MARGIN, 1=LEVEL, 2=MARGIN&LEVEL
	5101	13ED							Output A Peak current protection mode	RW	uint(16)	2	1	unsigned int 16 bits	
	5102	13EE							Output B Peak current protection mode	RW	uint(16)	2	1	unsigned int 16 bits	
	5103	13EF							Output C Peak current protection mode	RW	uint(16)	2	1	unsigned int 16 bits	
	5104	13F0							Peak power protection level	RW	float	4	2	Floating point number IEEE754	
	5106	13F2							Output A Peak power protection level	RW	float	4	2	Floating point number IEEE754	
	5108	13F4							Output B Peak power protection level	RW	float	4	2	Floating point number IEEE754	
	5110	13F6							Output C Peak power protection level	RW	float	4	2	Floating point number IEEE754	
	5112	13F8	x			x			Over voltage protection	RW	bool				
	5113	13F9	x			x			Output A Over voltage protection	RW	bool				
	5114	13FA	x			x			Output B Over voltage protection	RW	bool				
	5115	13FB	x			x			Output C Over voltage protection	RW	bool				
	5116	13FC	x			x			Under voltage protection	RW	bool				
5117	13FD	x			x			Output A Under voltage protection	RW	bool					

	Modbus address (dec)	Modbus address (hex)	Read coils	Read holding registers	Read input registers (0x06)	Write single coil (0x05)	Write single register (0x06)	Write multiple registers (0x10)	Description	Access	Data type	Data length in bytes	Number of registers	Data	Example
	5118	13FE	x			x			Output B Under voltage protection	RW	bool				
	5119	13FF	x			x			Output C Under voltage protection	RW	bool				
	5120	1400	x			x			Over frequency protection	RW	bool				
	5121	1401	x			x			Output A Over frequency protection	RW	bool				
	5122	1402	x			x			Output B Over frequency protection	RW	bool				
	5123	1403	x			x			Output C Over frequency protection	RW	bool				
	5124	1404	x			x			Under frequency protection	RW	bool				
	5125	1405	x			x			Output A Under frequency protection	RW	bool				
	5126	1406	x			x			Output B Under frequency protection	RW	bool				
	5127	1407	x			x			Output C Under frequency protection	RW	bool				
	5128	1408							Over voltage protection level	RW	float	4	2	Floating point number IEEE754	
	5130	140A							Output A Over voltage protection level	RW	float	4	2	Floating point number IEEE754	
	5132	140C							Output B Over voltage protection level	RW	float	4	2	Floating point number IEEE754	
	5134	140E							Output C Over voltage protection level	RW	float	4	2	Floating point number IEEE754	
	5136	1410							Under voltage protection level	RW	float	4	2	Floating point number IEEE754	
	5138	1412							Output A Under voltage protection level	RW	float	4	2	Floating point number IEEE754	
	5140	1414							Output B Under voltage protection level	RW	float	4	2	Floating point number IEEE754	
	5142	1416							Output C Under voltage protection level	RW	float	4	2	Floating point number IEEE754	
	5144	1418							Over frequency protection level	RW	float	4	2	Floating point number IEEE754	

	Modbus address (dec)	Modbus address (hex)	Read coils	Read holding registers	Read input registers (0x06)	Write single coil (0x05)	Write single register (0x06)	Write multiple registers (0x10)	Description	Access	Data type	Data length in bytes	Number of registers	Data	Example
	5146	141A							Output A Over frequency protection level	RW	float	4	2	Floating point number IEEE754	
	5148	141C							Output B Over frequency protection level	RW	float	4	2	Floating point number IEEE754	
	5150	141E							Output C Over frequency protection level	RW	float	4	2	Floating point number IEEE754	
	5152	1420							Under frequency protection level	RW	float	4	2	Floating point number IEEE754	
	5154	1422							Output A Under frequency protection level	RW	float	4	2	Floating point number IEEE754	
	5156	1424							Output B Under frequency protection level	RW	float	4	2	Floating point number IEEE754	
	5158	1426							Output C Under frequency protection level	RW	float	4	2	Floating point number IEEE754	
Configuration Slew	6000	1770							Ramp time	RW	float	4	2	Floating point number IEEE754	0.222 Seconds
	6002	1772							Output A Ramp time	RW	float	4	2	Floating point number IEEE754	
	6004	1774							Output B Ramp time	RW	float	4	2	Floating point number IEEE754	
	6006	1776							Output C Ramp time	RW	float	4	2	Floating point number IEEE754	
	6008	1778							Voltage AC	RW	float	4	2	Floating point number IEEE754	
	6010	177A							Output A Voltage AC	RW	float	4	2	Floating point number IEEE754	
	6012	177C							Output B Voltage AC	RW	float	4	2	Floating point number IEEE754	
	6014	177E							Output C Voltage AC	RW	float	4	2	Floating point number IEEE754	
	6016	1780							Frequency	RW	float	4	2	Floating point number IEEE754	
	6018	1782							Output A Frequency	RW	float	4	2	Floating point number IEEE754	
	6020	1784							Output B Frequency	RW	float	4	2	Floating point number IEEE754	

	Modbus address (dec)	Modbus address (hex)	Read coils	Read holding registers	Read input registers (0x06)	Write single coil (0x05)	Write single register (0x06)	Write multiple registers (0x10)	Description	Access	Data type	Data length in bytes	Number of registers	Data	Example
	6022	1786							Output C Frequency	RW	float	4	2	Floating point number IEEE754	
	6024	1788							Voltage DC	RW	float	4	2	Floating point number IEEE754	
	6026	178A							Output A Voltage DC	RW	float	4	2	Floating point number IEEE754	
	6028	178C							Output B Voltage DC	RW	float	4	2	Floating point number IEEE754	
	6030	178E							Output C Voltage DC	RW	float	4	2	Floating point number IEEE754	
	6032	1790							Phase	RW	float	4	2	Floating point number IEEE754	
	6034	1792							Output A Phase	RW	float	4	2	Floating point number IEEE754	
	6036	1794							Output B Phase	RW	float	4	2	Floating point number IEEE754	
	6038	1796							Output C Phase	RW	float	4	2	Floating point number IEEE754	
	6040	1798	x			x			Slew rate control	RW	bool				
	6041	1799	x			x			Output A Slew rate control	RW	bool				
	6042	179A	x			x			Output B Slew rate control	RW	bool				
	6043	179B	x			x			Output C Slew rate control	RW	bool				
	6048	17A0							Voltage	RW	float	4	2	Floating point number IEEE754	
	6050	17A2							Output A Voltage	RW	float	4	2	Floating point number IEEE754	
	6052	17A4							Output B Voltage	RW	float	4	2	Floating point number IEEE754	
	6054	17A6							Output C Voltage	RW	float	4	2	Floating point number IEEE754	
	6056	17A8							Current	RW	float	4	2	Floating point number IEEE754	
	6058	17AA							Output A Current	RW	float	4	2	Floating point number IEEE754	

	Modbus address (dec)	Modbus address (hex)	Read coils	Read holding registers	Read input registers (0x06)	Write single coil (0x05)	Write single register (0x06)	Write multiple registers (0x10)	Description	Access	Data type	Data length in bytes	Number of registers	Data	Example
	6060	17AC							Output B Current	RW	float	4	2	Floating point number IEEE754	
	6062	17AE							Output C Current	RW	float	4	2	Floating point number IEEE754	
	6064	17B0							Current AC	RW	float	4	2	Floating point number IEEE754	
	6066	17B2							Output A Current AC	RW	float	4	2	Floating point number IEEE754	
	6068	17B4							Output B Current AC	RW	float	4	2	Floating point number IEEE754	
	6070	17B6							Output C Current AC	RW	float	4	2	Floating point number IEEE754	
	6072	17B8							Current DC	RW	float	4	2	Floating point number IEEE754	
	6074	17BA							Output A Current DC	RW	float	4	2	Floating point number IEEE754	
	6076	17BC							Output B Current DC	RW	float	4	2	Floating point number IEEE754	
	6078	17BE							Output C Current DC	RW	float	4	2	Floating point number IEEE754	
	6080	17C0							Resistance AC	RW	float	4	2	Floating point number IEEE754	
	6082	17C2							Output A Resistance AC	RW	float	4	2	Floating point number IEEE754	
	6084	17C4							Output B Resistance AC	RW	float	4	2	Floating point number IEEE754	
	6086	17C6							Output C Resistance AC	RW	float	4	2	Floating point number IEEE754	
	6088	17C8							Resistance DC	RW	float	4	2	Floating point number IEEE754	
	6090	17CA							Output A Resistance DC	RW	float	4	2	Floating point number IEEE754	
	6092	17CC							Output B Resistance DC	RW	float	4	2	Floating point number IEEE754	
	6094	17CE							Output C Resistance DC	RW	float	4	2	Floating point number IEEE754	
	6096	17D0							Conductance AC	RW	float	4	2	Floating point number IEEE754	

	Modbus address (dec)	Modbus address (hex)	Read coils	Read holding registers	Read input registers (0x06)	Write single coil (0x05)	Write single register (0x06)	Write multiple registers (0x10)	Description	Access	Data type	Data length in bytes	Number of registers	Data	Example
	6098	17D2							Output A Conductance AC	RW	float	4	2	Floating point number IEEE754	
	6100	17D4							Output B Conductance AC	RW	float	4	2	Floating point number IEEE754	
	6102	17D6							Output C Conductance AC	RW	float	4	2	Floating point number IEEE754	
	6104	17D8							Conductance DC	RW	float	4	2	Floating point number IEEE754	
	6106	17DA							Output A Conductance DC	RW	float	4	2	Floating point number IEEE754	
	6108	17DC							Output B Conductance DC	RW	float	4	2	Floating point number IEEE754	
	6110	17DE							Output C Conductance DC	RW	float	4	2	Floating point number IEEE754	
	6112	17E0							Power AC	RW	float	4	2	Floating point number IEEE754	
	6114	17E2							Output A Power AC	RW	float	4	2	Floating point number IEEE754	
	6116	17E4							Output B Power AC	RW	float	4	2	Floating point number IEEE754	
	6118	17E6							Output C Power AC	RW	float	4	2	Floating point number IEEE754	
	6120	17E8							Power DC	RW	float	4	2	Floating point number IEEE754	
	6122	17EA							Output A Power DC	RW	float	4	2	Floating point number IEEE754	
	6124	17EC							Output B Power DC	RW	float	4	2	Floating point number IEEE754	
	6126	17EE							Output C Power DC	RW	float	4	2	Floating point number IEEE754	
	6128	17F0							kVA AC	RW	float	4	2	Floating point number IEEE754	
	6130	17F2							Output A kVA AC	RW	float	4	2	Floating point number IEEE754	
	6132	17F4							Output B kVA AC	RW	float	4	2	Floating point number IEEE754	
	6134	17F6							Output C kVA AC	RW	float	4	2	Floating point number IEEE754	

	Modbus address (dec)	Modbus address (hex)	Read coils	Read holding registers	Read input registers (0x06)	Write single coil (0x05)	Write single register (0x06)	Write multiple registers (0x10)	Description	Access	Data type	Data length in bytes	Number of registers	Data	Example
	6136	17F8							kVA DC	RW	float	4	2	Floating point number IEEE754	
	6138	17FA							Output A kVA DC	RW	float	4	2	Floating point number IEEE754	
	6140	17FC							Output B kVA DC	RW	float	4	2	Floating point number IEEE754	
	6142	17FE							Output C kVA DC	RW	float	4	2	Floating point number IEEE754	
Configuration Unit Settings	8000	1F40							Configuration form	RW	uint(16)	2	1	unsigned int 16 bits	1=SINGLE, 2=SPLIT, 3=THREE, 4=TWO OUTP, 5=THREE OUTP, 6=SPLIT+ONE
	8001	1F41							Configuration voltage range	RW	uint(16)	2	1	unsigned int 16 bits	0=LOW, 1=HIGH
	8002	1F42							Configuration mode	RW	uint(16)	2	1	unsigned int 16 bits	0=AC, 1=DC, 2=AC-DC
	8003	1F43							Phase rotation	RW	uint(16)	2	1	unsigned int 16 bits	0=NEGATIVE, 1=POSITIVE
	8004	1F44							Output impedance mode	RW	uint(16)	2	1	unsigned int 16 bits	0=REAL TIME, 1=RMS
	8005	1F45							Output A impedance mode	RW	uint(16)	2	1	unsigned int 16 bits	
	8006	1F46							Output B impedance mode	RW	uint(16)	2	1	unsigned int 16 bits	
	8007	1F47							Output C impedance mode	RW	uint(16)	2	1	unsigned int 16 bits	
	8016	1F50							Update phase	RW	float	4	2	Floating point number IEEE754	
	8018	1F52							Output A update phase	RW	float	4	2	Floating point number IEEE754	
	8020	1F54							Output B update phase	RW	float	4	2	Floating point number IEEE754	
	8022	1F56							Output C update phase	RW	float	4	2	Floating point number IEEE754	
	8024	1F58							Output phase disable	RW	float	4	2	Floating point number IEEE754	
	8026	1F5A							Output A phase disable	RW	float	4	2	Floating point number IEEE754	

	Modbus address (dec)	Modbus address (hex)	Read coils	Read holding registers	Read input registers (0x06)	Write single coil (0x05)	Write single register (0x06)	Write multiple registers (0x10)	Description	Access	Data type	Data length in bytes	Number of registers	Data	Example
	8028	1F5C							Output B phase disable	RW	float	4	2	Floating point number IEEE754	
	8030	1F5E							Output C phase disable	RW	float	4	2	Floating point number IEEE754	
	8032	1F60							Max CSC gain	RW	float	4	2	Floating point number IEEE754	
	8034	1F62							Output A max CSC gain	RW	float	4	2	Floating point number IEEE754	
	8036	1F64							Output B max CSC gain	RW	float	4	2	Floating point number IEEE754	
	8038	1F66							Output C max CSC gain	RW	float	4	2	Floating point number IEEE754	
	8048	1F70	x			x			Continuous self calibration	RW	bool				
	8049	1F71	x			x			Output A continuous self calibration	RW	bool				
	8050	1F72	x			x			Output B continuous self calibration	RW	bool				
	8051	1F73	x			x			Output C continuous self calibration	RW	bool				
	8052	1F74	x			x			Fault on saturation	RW	bool				
	8053	1F75	x			x			Output A fault on saturation	RW	bool				
	8054	1F76	x			x			Output B fault on saturation	RW	bool				
	8055	1F77	x			x			Output C fault on saturation	RW	bool				
	8056	1F78							Operating mode	RW	uint(16)	2	1	unsigned int 16 bits	0=VOLTAGE SOURCE, 1=CURRENT SOURCE, 2=ACTIVE LOAD
	8057	1F79							Output A Operating mode	RW	uint(16)	2	1	unsigned int 16 bits	Requires FORM to be set to 4, 5, or 6. (4 = Two outputs, 5 = Three outputs, 6 = Split plus one output)
	8058	1F7A							Output B Operating mode	RW	uint(16)	2	1	unsigned int 16 bits	
8059	1F7B							Output C Operating mode	RW	uint(16)	2	1	unsigned int 16 bits		
8060	1F7C							Load type	RW	uint(16)	2	1	unsigned int 16 bits	0=CONSTANT CURRENT, 1=CONSTANT	

	Modbus address (dec)	Modbus address (hex)	Read coils	Read holding registers	Read input registers (0x06)	Write single coil (0x05)	Write single register (0x06)	Write multiple registers (0x10)	Description	Access	Data type	Data length in bytes	Number of registers	Data	Example
															RESISTANCE, 2=CONSTANT POWER, 3=CIRCUIT EMULATION
	8061	1F7D							Output A Load type	RW	uint(16)	2	1	unsigned int 16 bits	
	8062	1F7E							Output B Load type	RW	uint(16)	2	1	unsigned int 16 bits	
	8063	1F7F							Output C Load type	RW	uint(16)	2	1	unsigned int 16 bits	
Unit Status	10000	2710	x						Active Faults	R	bool				
	10001	2711	x			x			Reset Faults	RW	bool				ON=reset, self clear
	10002	2712		x					Error and Event Queue	R	uint(16)	2	1	unsigned int 16 bits	
	10003	2713	x			x			Clear Error and Event Queue	RW	bool				ON=reset, self clear
SCPI	64000	FA00							SCPI Write/query	RW	char	246	123	ASCII	MEASure:VOLTage:DC:NC#?
	64256	FB00							SCPI Command last answer			1024	512	ASCII	0.000,0.000,0.000,0.000
	64769	FD01	x			x			SCPI Char 16 endianness	RW	bool			Coils : Endianness	OFF= little; ON= Inverted
	64770	FD02	x			x			SCPI Response next page	RW	bool			Coils : Next Page	ON=next, self clear

14.3 ModBus Control Example using Python

For those not familiar with using the ModBus TCP protocols, the example code shown here using Python may be of assistance in getting started.

Note: The example code named “modbustcp-example-1.py” referenced below is available for download at the following link in the ‘python’ directory:

https://github.com/PPST-Inc/ModbusTCP_Examples

This example code performs the following tasks in the order shown below.

```
> python.exe modbustcp-example-1.py
Enter the IP address of the unit: 192.168.107.183
Connecting
Setting voltage AC to 0 Vrms
Setting frequency to 50 Hz
Turning output on...
Setting voltage AC to 30 Vrms
Reading RMS voltage measurement
Voltage RMS measurement: 29.93 Vrms
Reading RMS current measurement
Current RMS measurement: 2.74 Arms
Turning output off
Disconnecting
Done
```

The dependencies and requirements to run the sample code are shown in the program comments and are:

```
# PPST ModbusTCP python example 1
# Version: 1.0.0
# Date: 11/07/2022
# Dependences:
# - pip install pymodbus
# - pip install pyModbusTCP
# Last tested with:
# - Python 3.10.5
# - pymodbus 3.0.2
# - pyModbusTCP 0.2.0
```

More advanced samples can be found using the link referenced above.

15 CAN / CAN-FD Interface

15.1 CAN / CAN-FD Interface Option

The “FD” in CAN-FD stands for “Flexible Data” rates. The Classical CAN offers 11-bit (standard) and 29-bit (extended) data rates, whereas CAN FD as the name suggests, offers flexible data rates, ranging from 0-64 bytes per frame. BOSCH had developed both these technologies to support the ever-growing need for data and technology in the automotive industry.

The basic differences are summarized in the table below for reference.

	Classic CAN	CAN FD
1	Initial Controlled Area Network bus (CAN bus). A communication protocol for automotive applications.	Launched as an advanced version of Classical CAN bus. Offers upgrades to almost every feature of CAN.
2	Fixed DCL rate of 8 bytes	Supports a flexible message payload, ranging from 0, 8, 12, 16, 20, 24, 32, 48, 64 bytes
3	Ideal choice for applications where the number of ECU's is more than and the bandwidth utilization is less.	Flexible signal transmission provides better functionality for advanced data and bandwidth applications.
4	Offers maximum data rate of 1 Mbps	Offers 2, 5 and 8 Mbps data rates.
5	No upward compatibility.	Downward compatible with Classic CAN.

15.2 USB to CAN Bus Adaptor Required

On Pacific Power Source products, CAN / CAN-FD is implemented using a USB to CAN / CAN-FD adapter available from Peak Systems, Inc.

<https://www.peak-system.com/PCAN-USB-FD.365.0.html?&L=1>

The USB to CAN-FD external adaptor is connected to the power source using one of the USB type A connectors.



15.2.1 Key features and Specifications are:

- Adapter for High-speed USB 2.0 (compatible to USB 1.1 and USB 3.0)
- Complies with CAN specifications 2.0 A/B and FD 1.0
- CAN FD bit rates for the data field (64 bytes max.) from 40 kbit/s up to 12 Mbit/s
- CAN bit rates from 40 kbit/s up to 1 Mbit/s
- Time stamp resolution 1 μ s
- CAN bus connection via D-Sub, 9-pin
- (in accordance with CiA® 102)
- FPGA implementation of the CAN FD controller
- NXP TJA1044GT CAN transceiver
- Galvanic isolation up to 500 V
- CAN termination can be activated through a solder jumper
- Measurement of bus load including error frames and overload frames
- Induced error generation for incoming and outgoing CAN messages
- 5-Volt supply to the CAN connection can be connected through a solder jumper, e.g. for external bus converter
- Voltage supply via USB
- Extended operating temperature range from -40 to 85 °C (-40 to 185 °F)
- DB9 Pin Assignments

Pin	Signal
1	not connected / optional +5V
2	CAN-L
3	GND
4	not connected
5	not connected
6	GND
7	CAN-H
8	not connected
9	not connected

Table 15-1: CAN-FD USB adaptor DB9 Pin Assignments

15.2.2 CAN-FD Adaptor Technical Specifications

Item	Specifications
Dimensions	75 x 43 x 22 mm
Product Weight	68 grams
Baud Rate	CAN: 40 kBit/s - 1 MBit/s, CAN FD: 40 kBit/s - 12 MBit/s
Storage Specifications	Temperature: -40°C to +100°C
Power Consumption	max. 100 mA
Certifications	CE, RoHS
Pinout	C.I.A. DS-102 (CAN_H = 7, CAN_L = 2, CAN_GND = 3)
Enclosure	IP20, Plastic Enclosure

Item	Specifications
Transceiver	CAN: NXP TJA1044GT
EMC Directive	EN 55024:2011-09, EN 55022:2011-12, EC directive 2004/108/EG
Software	Driver: Windows® 10, 8.1, 7 and Linux (32/64-bit) Tools: PCAN-View for Windows®
Controller(s)	FPGA implementation
Time stamp resolution	1 microsecond
Specification	CAN FD 1.0 (compatible with CAN 2.0)
Connector(s)	PC: High-Speed USB 2.0 (compatible to USB 1.1 and 3.0) CAN: ISO 11898-2, complies with CiA-recommendation DS 102
Operating Conditions	Temp. Range: -40°C to +85°C Humidity: 15% to 90% (non-condensing)

Table 15-2: CAN-FD USB Adaptor Technical Specs

15.3 CAN / CAN-FD Configuration File

A CAN DBC file (CAN database) is a text file that contains information for decoding raw CAN bus data to 'physical values'. To understand what 'raw CAN data' looks like, see the below example CAN frame from a truck:

CAN ID	Data bytes
0CF00400	FF FF FF 68 13 FF FF FF

If you have a CAN DBC that contains decoding rules for the CAN ID, you can 'extract' parameters (signals) from the data bytes. One such signal could be EngineSpeed:

Message	Signal	Value	Unit
EEC1	EngineSpeed	621	rpm

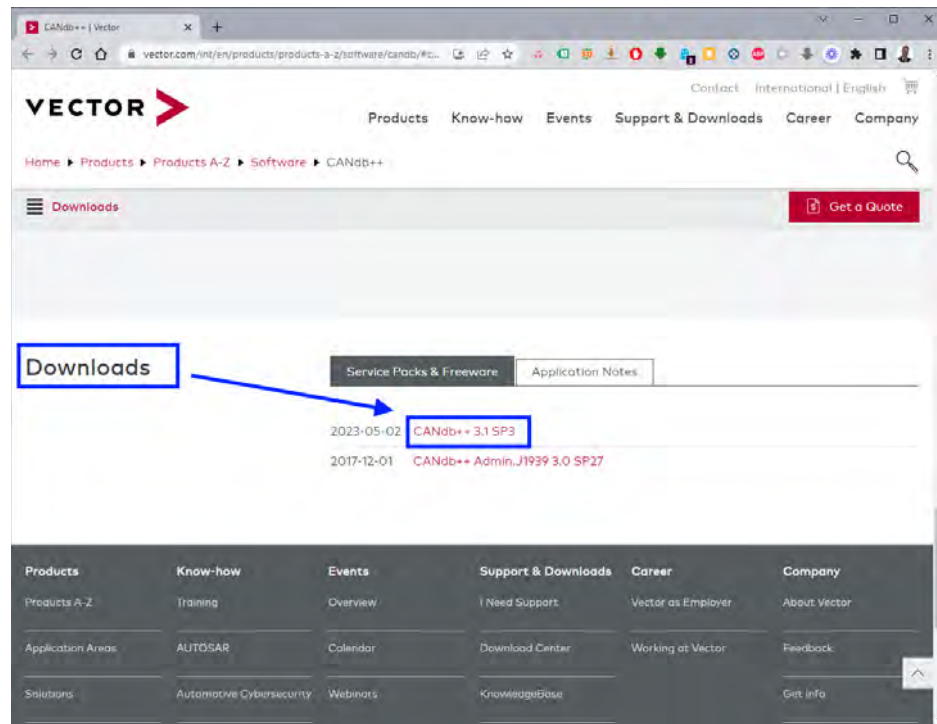
On a CAN or CAN FD network, the messages used on the CAN bus are defined by the user. Each message has an ID and specific signals that apply to it. Pacific Power only provides all the signals available for the interface adaptor device.

There are some environment variables that need to be configured such as the baud-rate and the CAN or CAN FD protocol. This information is provided in a database file that must be loaded on the interface adaptor, so it is configured based on its content.

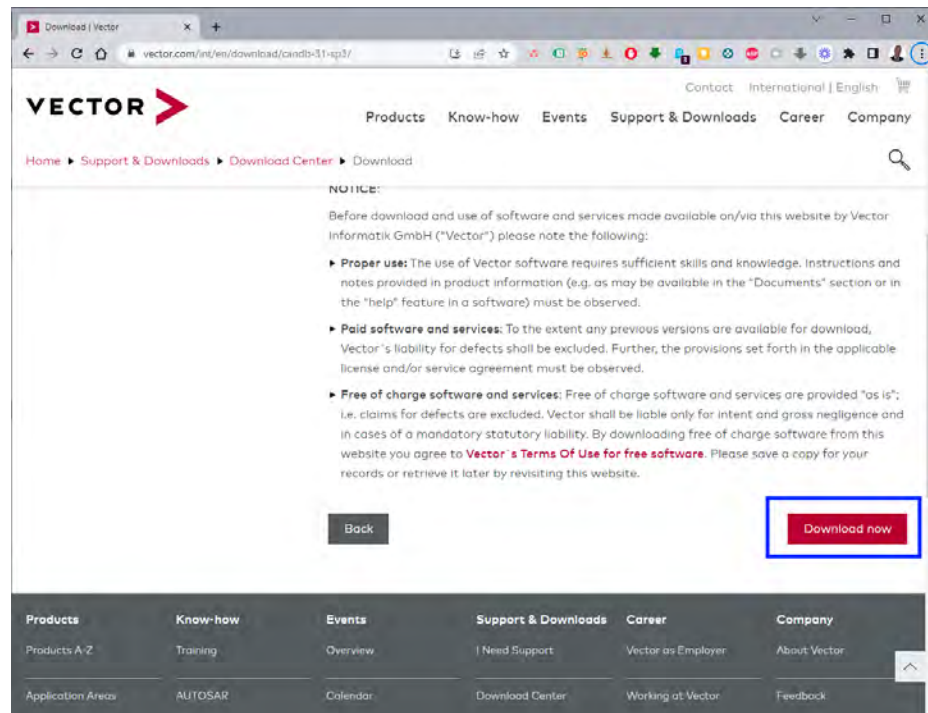
15.4 Downloading and installing the canfd.dcb file

The file can be opened with Vector CANdb++ Editor which is free to use.

<https://www.vector.com/int/en/products/products-a-z/software/canbd/>



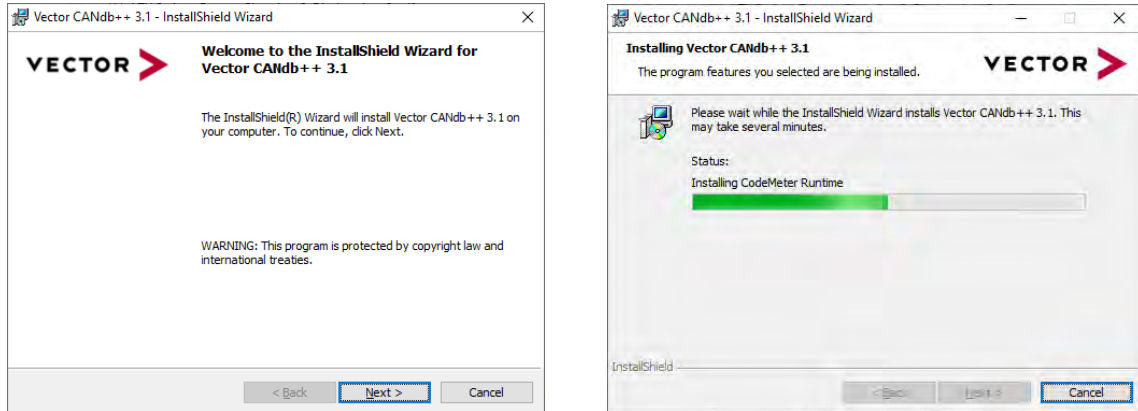
Scroll Down to bottom of the page:



When pressing **download** you should get the default canfd.dbc with all available signals.

15.5 Vector CANdb++ Editor Windows Software

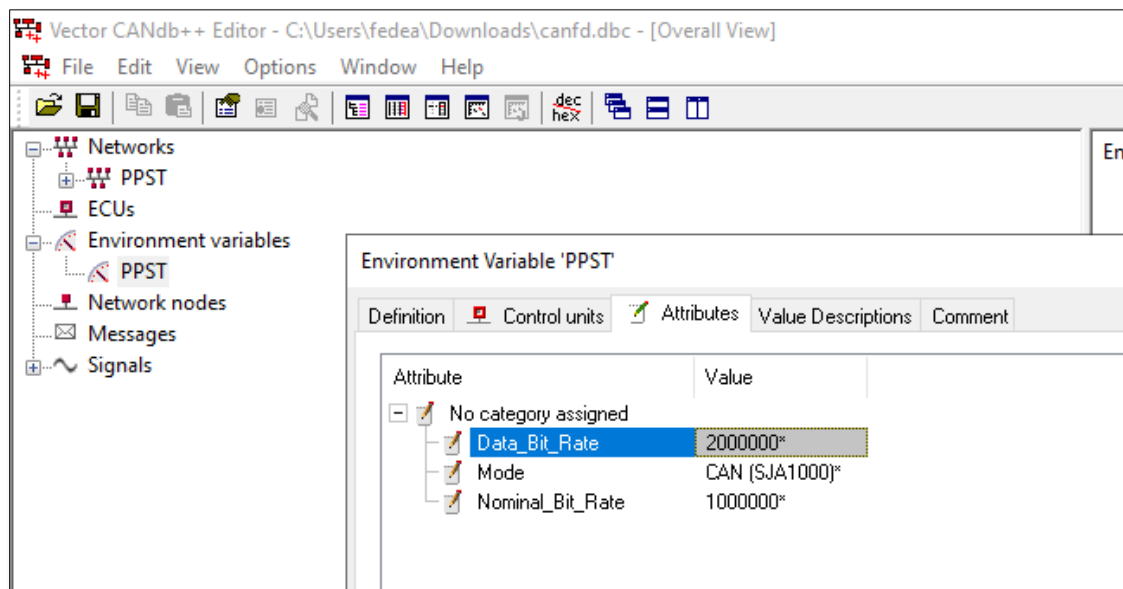
To install the Editor, run the “VectorCANdb-plusplus_3.1.025_SP3.exe” installation from your download folder. Run the Installer when prompted. Either English or German version is selectable.

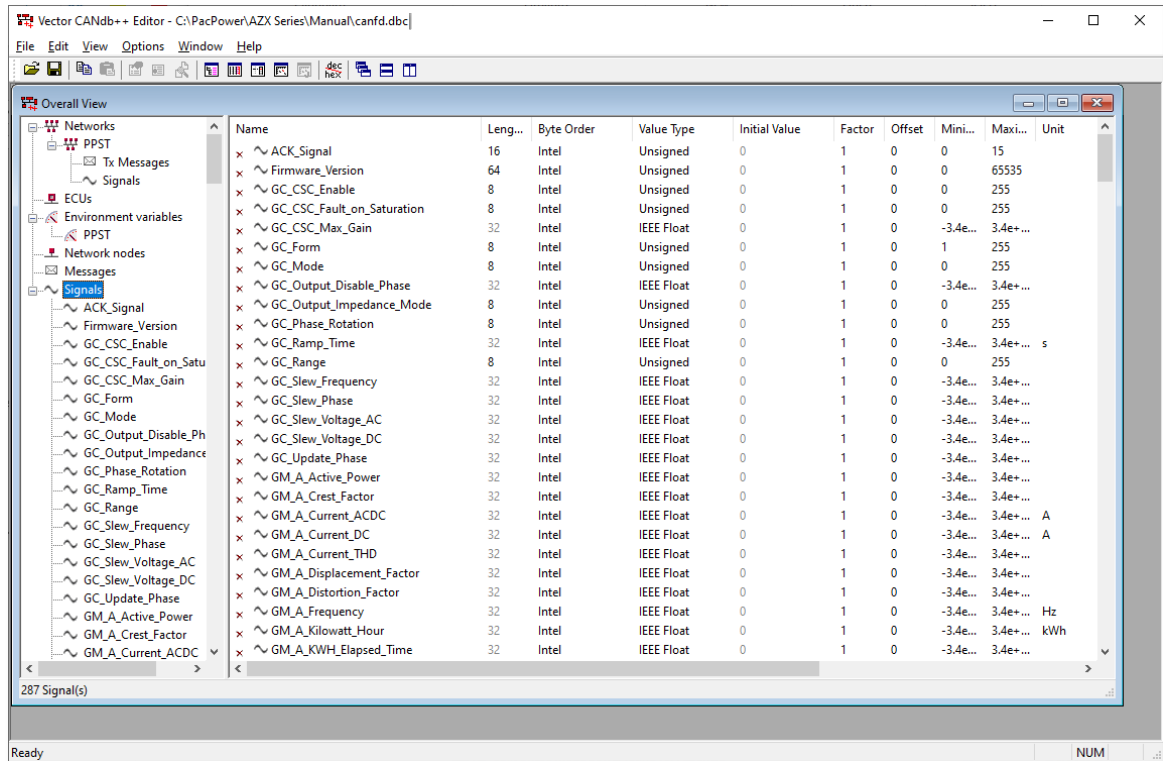


Signals should be self-explanatory and have a description. Once downloaded, this database can be uploaded and will automatically load it and persist.

The next download will download the modified database.

The speed and CAN standard (regular CAN or CAN FD) can be selected with environment variables.





The messages must be created by the user using any of the available signals.

Signals starting with PM_* are periodic measurements. If the MEASURE ENABLE checkbox is enabled the unit will periodically emit the measurements.

The rate is given by the MEASURE RATE and is in multiples of the RMS windows which is close to 100ms. So for example, if the rate is 1 it will emit the measurements at 100ms, if the rate is 2 at 200ms, and so on.

15.6 Enabling or Disabling the CAN / CAN-FD interface

The CAN/CAN-FD interface can be enabled from the browser interface. If connected to the power source via LAN, enter the IP address for the power source in the address bar. Then go to SYSTEM -> INTERFACE SETUP and locate the CAN FD settings. Use the CANDF ENABLE slider to turn the interface ON or OFF.



The DCB Configuration file can be uploaded or downloaded using the “UPLOAD” or “DOWNLOAD” buttons.

The MEASURE ENABLE function - when enabled - provides measurements from the CAN/CAN based on signals starting with PM_* These are periodic measurements.

If the MEASURE ENABLE checkbox is enabled the unit will periodically emit the measurements.

The rate is given by the MEASURE RATE and is in multiples of the RMS windows which is close to 100ms. So for example, if the rate is 1 it will emit the measurements at 100ms, if the rate is 2 at 200ms, and so on.

SCPI Commands for CAN-FD Interface

The CAN/CAN-FD interface can also be enabled by sending a SCPI command to the power source from its web browser interface.

Relevant SCPI commands are listed in section “CAN / CAN-FD Interface” of this manual.

16 CE MARK Declaration of Conformity

The Manufacturer hereby declares that the products:

Product Name: AGX & RGS Series® Power Sources, RLS Series® Electronic Loads

Conforms to the following standards or other normative documents:

RoHS (DIRECTIVE 2015/863/EU)

Standard applied EN IEC 63000:2018

SAFETY (DIRECTIVE 2014/35/EU):

Standard applied EN 61010-1: 2010; ED3/A1:2019

EMC (DIRECTIVE 2014/30/EU):

Standard applied EN 61326-1: 2013

Reference Standards:

ELECTROMAGNETIC EMISSIONS:

Radiated Emissions CISPR 11/22, CLASS A LIMITS
Conducted Emissions CISPR 11/22, CLASS A LIMITS

ELECTROMAGNETIC IMMUNITY:

RF Electromagnetic Field IEC 61000-4-3:2006+A1:2007+A2:2010
80 – 1000 MHz, 10 V/m
1 Khz sinewave (80% AM) 1.4 – 2 GHz, 3 V/m
2.0 – 2.7 GHz, 1 V/m
Conducted RF Immunity IEC 61000-4-6:2013
Conducted RF Immunity 0.15 – 80 MHz @ 3 Vrms
Electrostatic Discharge IEC 61000-4-2:2008
± 4 kV contact discharge
± 8 kV air discharge
Electrical Fast Transient/Burst IEC 61000-4-4:2004+A1:2010
AC or DC power ports, ± 2.0 kV
Signal and I/O ports, ± 1.0 kV
Surge IEC 61000-4-5:2006
AC or DC power ports, ± 2.0 kV Line to ground and ± 1.0 kV Line to Line
Power Frequency Magnetic Field IEC 61000-4-8:2009
30 A/m

Supplemental Information:

When and Where Issued May 28, 2024
Irvine, California, USA

Authorized Signatory



Mitchel Orr,
Quality Manager, acting.
Pacific Power Source

Responsible Person

Mitchel Orr,
Pacific Power Source, Inc.
2802 Kelvin Ave, Suite 100
Irvine CA, 92614 - USA

Mark of Compliance



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