AMETEK®
PROGRAMMABLE POWER

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California Instruments™

Sequoia / Tahoe Series AC/DC Power Source User Manual

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Important Safety Instructions

Before applying power to the system, verify that your product is configured properly for your application.

WARNING!

Hazardous voltages may be present when covers are removed. Qualified personnel must use extreme caution when servicing this equipment. Circuit boards, test points, and output voltages also may be floating at a high voltage relative to chassis ground.

CAUTION!

The equipment used contains Electrostatic discharge (ESD) sensitive parts. When installing equipment, follow ESD Safety Procedures. ESD might cause damage to the equipment.

Only qualified personnel, who deal with attendant hazards in power supplies, are allowed to perform installation and servicing.

Ensure that the AC input power line ground is connected properly to the unit safety ground chassis. Similarly, other AC power ground lines, including those for application and maintenance equipment, must be grounded properly for both personnel safety and equipment protection.

Always ensure that facility AC input power is de-energized prior to connecting or disconnecting any cable.

In normal operation, the operator does not have access to hazardous voltages within the chassis. However, depending on the user's application configuration, HIGH VOLTAGES HAZARDOUS TO HUMAN SAFETY may be normally generated on the output terminals. The customer/user must ensure that the output power lines are labeled properly as to the safety hazards and that any inadvertent contact with hazardous voltages is prevented.

Guard against risks of electrical shock during open cover checks by not touching any portion of the electrical circuits. Even when power is off, capacitors may retain an electrical charge. Use safety glasses and protective clothing during open cover checks to avoid personal injury by any sudden component failure.

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Safety Symbols

WARNING Risk of Electrical Shock	CAUTION Refer to Accompanying Documents
Off (Supply)	Direct Current (DC)
Standby (Supply)	Alternating Current (AC)
On (Supply)	3~ Three–Phase Alternating Current
Protective Conductor Terminal	Earth (Ground) Terminal
Fuse	Chassis Ground

Product: Sequoia / Tahoe Series Power Source
Warranty Period: 2 Years
Warranty Terms

AMETEK provides the following warranty for the product listed above ("Product"): If a defect in materials or workmanship is discovered and reported in writing within the applicable warranty period, AMETEK, at its discretion, will:

1. Repair or replace the defective Product,
2. Issue a credit note for the defective Product, or
3. Provide replacement parts for the defective Product.

The Buyer is responsible for returning the defective Product or parts to AMETEK at their own expense, following the specified return procedure. AMETEK will cover the costs of delivering the repaired or replaced Product or parts back to the Buyer.

4. The Product is damaged due to misuse, accident, negligence, or failure to maintain it as required by AMETEK's specifications.
5. The Product is modified, altered, or combined with unauthorized attachments.
6. The Product is installed or operated contrary to AMETEK's instructions.
7. The Product is opened, modified, or disassembled without AMETEK's prior written consent.
8. The Product is used with items, articles, or materials not authorized by AMETEK.

The Buyer may not make any warranty-related claims unless all payments under the Purchase Order Agreement have been completed.

Product Return Procedure

- Request a Return Material Authorization (RMA) number from the repair facility (**must originate in the country in which it where it was purchased**):
- **In the USA**, contact the AMETEK Customer Service Department prior to the return of the product to AMETEK for repair:
- Telephone: 800-733-5427, ext. 2295 or ext. 2463 (toll free North America) 858-450-0085, ext. 2295 or ext. 2463 (direct).
- **Outside the United States**, contact the nearest Authorized Service Center (ASC). A full listing can be found either through your local distributor, or on our website, www.programmablepower.com, by tapping the Support button or going to the Service Centers tab.
- When requesting an RMA, have the following information ready:
  Model number
  Serial number
  Description of the problem

NOTE: Unauthorized returns will not be accepted and will be returned at the shipper's expense.

NOTE: A returned product found upon inspection by AMETEK to be in the specification is subject to an evaluation fee and applicable freight charges

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1. INTRODUCTION

This manual provides instructions for installing, operating, and calibrating the Sequoia/Tahoe Series power source models with 1-phase/3-phase output. The Sequoia/Tahoe Series is a next-generation switched-mode power source, offering accurate output with low distortion, high precision, and fast dynamic response. It includes extensive programmability and a user-friendly interface, with features such as AC and DC output, a wide frequency range, arbitrary and harmonic waveform generation, transient list sequencing, digital power analyzer measurements, real-time waveform display, and the ability to configure multi-phase and parallel systems.

Figure 1-1: Sequoia / Tahoe Series Front View

1.1 General Description

The Sequoia / Tahoe Series AC and DC power source systems are high efficiency, floor standing AC and DC power sources that provide a precise output with low distortion. Available voltage ranges are 166 VAC, 333 VAC in AC and AC+DC modes and 220 VDC, 440 VDC in DC mode. The SQ0022/TA0022, SQ0030/TA0030, SQ0045/TA0045, and SQ0090/TA0090 can operate in either single or three-phase mode. All other models always operate in three-phase mode.

A wide range of AC and DC loads can be powered, including reactive loads (inductive and capacitive) running at full rated apparent power, and non-linear loads drawing current with high crest factor, up to 4.5:1.

Multiple remote digital communications interfaces are available: standard LAN (Ethernet), USB, and RS 232C, or the optional IEEE-488 (GPIB) interface. The Sequoia / Tahoe Virtual Panels GUI program provides a convenient graphical user interface, and the SCPI command set allows access to the full programmability and functionality. Extensive remote analog and discrete digital control interfaces are also provided for specialized control applications. The front panel display has capability for control, programming, and measurements of the power source, and features a menu-based interface with touchscreen data/command entry.

Waveform generation includes standard sine and square waves, as well as extensive programmability to create complex waveforms based on harmonics or arbitrary parameter/time relationships. A transient generator can combine sequences of voltage, frequency, and waveform shapes to simulate real-world AC or DC disturbances, automating a complex power stimulus profile for the unit under test.

The power analyzer utilizes DSP-based digitization of output parameters to implement measurement functions spanning single parameter values (voltage/current/frequency), power characteristics (true/apparent power, crest factor, power factor), and advanced computation using Fast Fourier transform (FFT) derivation of the harmonics and distortion contained in the voltage and current waveforms. Real-time display of output waveforms is possible through the Virtual Panels GUI.

The Sequoia / Tahoe Series units are contained in a compact floor standing enclosure on casters. This allows the units to be moved around more easily.

1.2 Key Benefits

1.2.1 Simple Operation

The Sequoia / Tahoe Series can be operated completely from its menu driven front panel controller. The full color-touch display shows menus, setup data, and read-back measurements. RS232C, USB and LAN remote control interfaces and instrument drivers for popular ATE programming environments are available. This allows the Sequoia / Tahoe Series to be easily integrated into an automated test system. With the programmable arbitrary waveform generator, the user can generate application specific waveforms, obtain time and frequency domain measurements, and capture actual voltage and current waveforms.

1.2.2 Configurations

The Sequoia / Tahoe Series offers five single chassis configurations: 15kVA, 22.5kVA, 30kVA, 45kVA and 90kVA. For higher power requirements, multi-cabinet models are available. These systems offer Reflex capability, allowing flexible user reconfiguration as needed. This ability to reconfigure the system greatly expands your test coverage and is not commonly found in power systems.

1.2.3 Choice of Voltage Range

The Sequoia / Tahoe Series offers dual range 0 – 166 V & 0 – 333 V line to neutral direct coupled output. These models provide a maximum 3 phase output capability of 287 VAC & 576 VAC line to line respectively. For applications requiring more than 333 V L-N (or 576 V L-L), the optional XVC444, XVC555, XVC666, and XVC721 output transformer provides an additional output range for use in AC mode only.

Line- Line voltage for XVC444, XVC555, XVC666, and XVC721 is 769 V, 961 V, 1153 V and 1248 V, respectively.

Note: The EHF loop is disabled for the XVC range. For custom applications, a user-defined XVC option is also available.

1.2.4 High Crest Factor

The Sequoia/Tahoe Series supports high crest factor loads, making it capable of driving difficult nonlinear loads with ease. Many modern products, which use switching power supplies, tend to draw high repetitive peak currents. For example, the SQ0030/TA0030, with a crest factor rating of 4.5, can deliver up to 300 Amps of repetitive peak current (in the 166 VAC range) per phase to handle three-phase loads. Refer to Section 2 for the peak repetitive current ratings for each model.

1.2.5 Remote Control

Standard RS232C, USB, and LAN interfaces, along with optional IEEE-488 remote control interfaces, enable programming of all instrument functions from an external computer. The widely used SCPI command protocol is employed for programming.

1.2.6 Hardware in the Loop

The External Drive (EXTD) feature allows external analog signal control of the source during AC operation, effectively turning the source into a high-bandwidth amplifier. Common applications include hardware-in-the-loop (HIL) simulations of power plants, hybrid electric vehicles, and renewable energy generation, as well as their impact on the utility grid. When combined with an HIL simulator, the Sequoia/Tahoe grid simulator offers a delay as short as 100 µs, ensuring the overall solution operates in real time.

1.3 Testing Applications

1.3.1 Power Conditioning Equipment Testing

With the ever-increasing demand for electrical power, power quality is becoming a global challenge and many power conversion solutions, whose functionalities are grid-interactive, should be thoroughly tested to ensure product performance and reliability. Thanks to the flexibility offered by Sequoia / Tahoe Series, it is now possible that a single solution can support a wide variety of roles within your test setup, including AC/DC Programmable Power source, AC/DC Grid Simulator, or AC/DC Resistive or Complex Electronic load for Sequoia Series and only AC/DC Programmable Power source for Tahoe Series. With the ability to change most parameters during the test and the ability to synchronize the waveform with internal and external, Sequoia / Tahoe provides multiple methods of validation for R&D Testing.

1.3.2 Grid Interactive Green Energy and Distributed Power Generation (only for Sequoia Series)

Global initiatives for green electrical energy generation are accelerating, and the number of devices that can export power to the grid in a distributed manner are on the rise. The Sequoia Series can uniquely act as an ideal grid, regenerating current from PV Inverters, Wind Turbines etc., with nearly complete power recovery. With seamless switchover between source and sink mode or its ability to program parallel RLC, Sequoia can emulate the test conditions mandated by international standards like IEC 61727 and IEC 62116.

1.3.3 Avionics and Shipboard Electronics Testing

Optional test suites for avionics power quality standards like MIL-STD 704, RTCA DO-160, and MIL STD 1399 shipboard power bus emulation save time in creation of test cases and help to quickly pre-validate the product compliance. With fundamental frequency support up to 905Hz with the high frequency (HF) option, Sequoia / Tahoe can simulate a wide array of electrical power supplies in most aircraft and shipboard electrical systems. With the ability to sink power from DC to 500Hz incoming frequency and programmability of load current waveform, the optional electronic load (only present in Sequoia Series) mode is your solution for validating onboard power conversion systems.

1.3.4 Regulatory Compliance Testing

As governments and regulatory bodies expand enforcement of product quality standards, regulatory compliance testing has become a requirement for manufacturers. The Sequoia / Tahoe Series is designed to meet AC source requirements for use in compliance testing such as IEC 61000-3-2, 3-3, 3-11, 3-12, to name a few. Tight integration with Virtual Panels software facilitates easy generation of test sequence for various safety, compliance, and EMI tests, as per various UL, IEC, IEEE standards, and national electric grid code of conduct/compatibility.

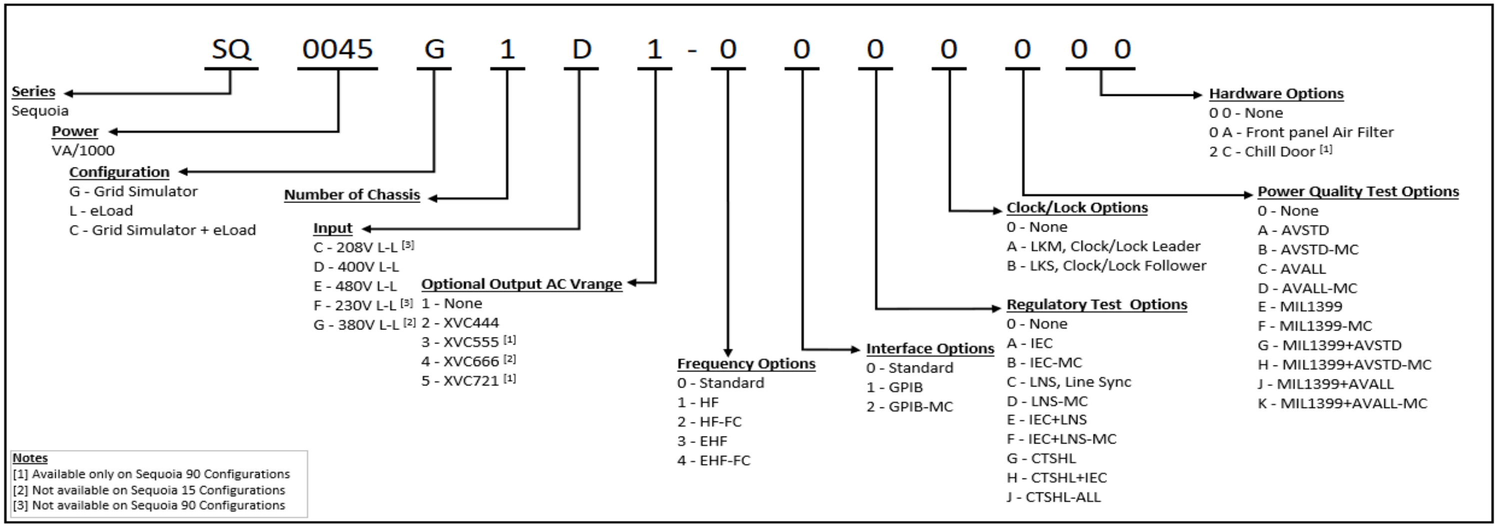
1.3.5 Electric Vehicle (EVSE, V2G) Testing (only for Sequoia Series)

With the vast expansion of EV infrastructure, the inter-compatibility between various vendors' equipment is a key to success. This can be ensured only by testing the charging infrastructure in compliance with standards. While the Sequoia Series grid simulator mode can help simulate various grid conditions from strong grid to weak grid, its Electronic Load Mode can help emulate the car’s On-Board battery charger load. With 85% power recovery efficiency, the Sequoia Series not only helps by saving electricity, but also minimizing heat emissions inside the lab. In addition, the DC source mode and AC sink mode operations of the Sequoia Series make it ready for the bidirectional Vehicle-to-Grid testing.

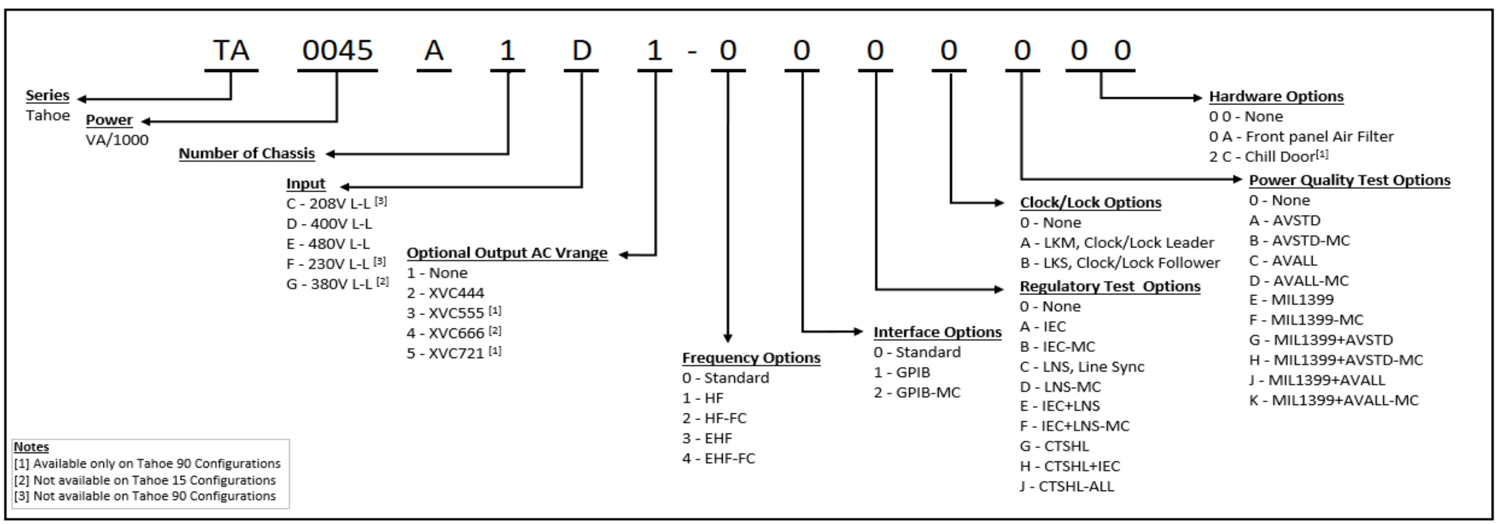
1.3.6 Manufacturing Line Testers

The Sequoia / Tahoe Series are a good fit for end of production line functional testers, as they offer many benefits for test developers, operators, and quality teams. The automatic paralleling option helps to scale-up / scale-down the power capacities, dynamically, to safeguard the investment on infrastructure. Full support for SCPI commands, availability of NI LabVIEW drivers, and IVI Drivers, helps test automation developers to choose their comfortable development environment. Load dependent variable fans help reduce the acoustic noise and improve occupational health.

1.4 SEQUOIA Series Models



1.5 TAHOE Series Models



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2. SPECIFICATIONS

Unless otherwise noted, the specifications are valid under the following conditions:

a) Ambient temperature of 25 ± 5°C; after a 30-minute warm-up; fixed AC input line and load.

b) Individual unit and individual output phase, with sine wave output, and into a resistive load.

c) For system configurations, specifications are for phase output, line-to-neutral; phase angle specifications are valid under balanced resistive load conditions.

d) Specifications are valid from 10% of the rated voltage, rated current and rated power unless otherwise noted.

2.1 Operating modes

The SEQUOIA series supports two operating modes, Source and SINK.

The TAHOE series only provides Source mode.

2.1.1 Source Mode:

Energy is flowing from facility AC input to the Unit Under Test (UUT) through Sequoia / Tahoe as shown in Figure 2-1: Energy flow in source mode operation. In this operating mode, the user can program output voltage with the following possible regulation settings.

- **Constant Voltage/ Constant Current:** Output voltage is regulated as per the user set value; on reaching the current limit, the power supply regulates at the programmed current limit.
- **Constant Voltage/ Current Limit:** Output voltage is regulated as per the user set value; on reaching the current limit, the power supply output voltage is programmed to zero.

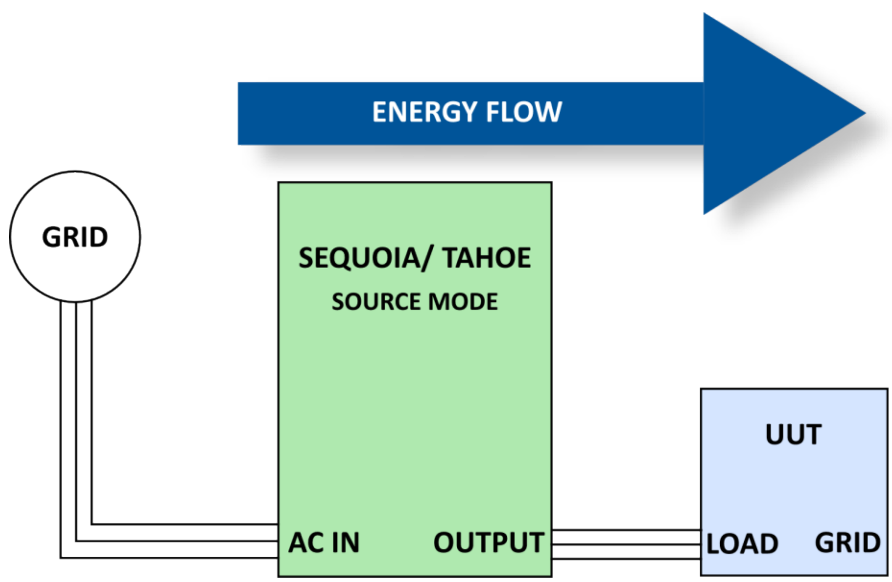

Figure 2-1: Energy flow in source mode operation

2.1.2 SINK - Grid Simulator Mode:

This mode is applicable only for the SEQUOIA series. The TAHOE series does not support this mode. Energy flow is from the UUT to the facility AC power distribution through the SEQUOIA as shown in Figure 2-2: Energy flow in SINK operating mode. In Grid Simulator Mode the SEQUOIA regulates the output voltage to the user set value and works as the grid to UUT. The SEQUOIA serves as the grid and sinks the current generated by UUT. This allows the user to test current source type UUT such as Photo Voltaic Solar inverter or any grid tied inverter. The user can change the grid parameters such as voltage, frequency, and phase as per the requirement. The energy received from the UUT is fed back to the grid instead of dissipating as heat.

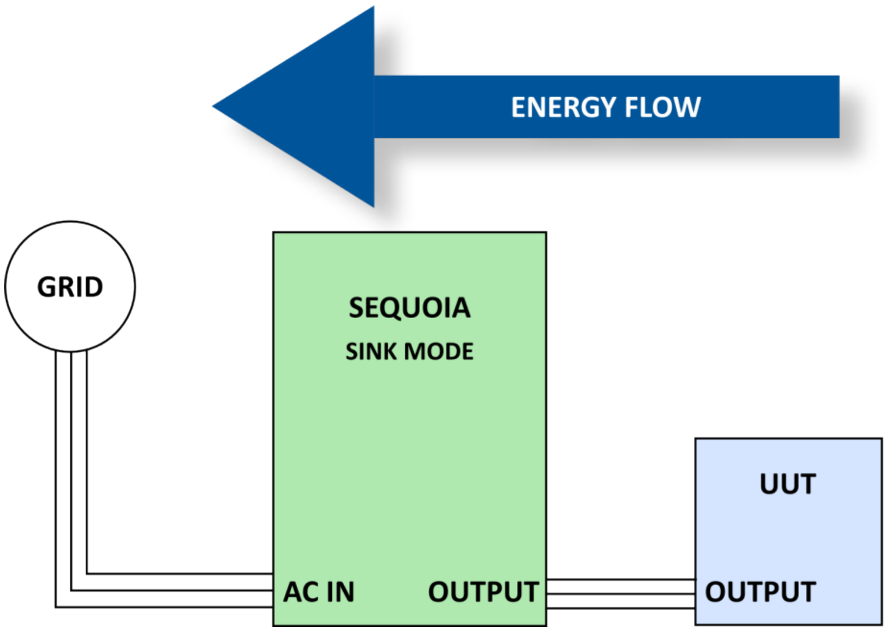

Figure 2-2: Energy flow in SINK operating mode

2.1.3 SINK - Electronic Load Mode:

This mode is applicable only for the SEQUOIA series. The TAHOE series does not support this mode. Energy flow is from the UUT to the facility AC power distribution through the SEQUOIA as shown in Figure 2-2. In Electronic Load Mode, the SEQUOIA regulates the RMS current set by the user and works as the load for UUT.

Note: Electronic Load Mode is not supported with XVC output ranges.

Note: For -XVC options, limit the DC offset from the Unit Under Test (UUT) to less than 1.5 V when operating in Electronic Load Mode. A DC offset of 1.5 V or higher will trip the unit.

In this operating mode, users can program the load to be applied to the UUT using the following programming types:

- **Current Programming:** User can program the RMS current, and phase required as load for the UUT.
- **Active and Reactive Power programming:** User can program the Active power, and the Reactive Power required as load for the UUT.
- **Parallel RLC programming:** User can program the Resistance, Inductance and Capacitance required as load for the UUT.

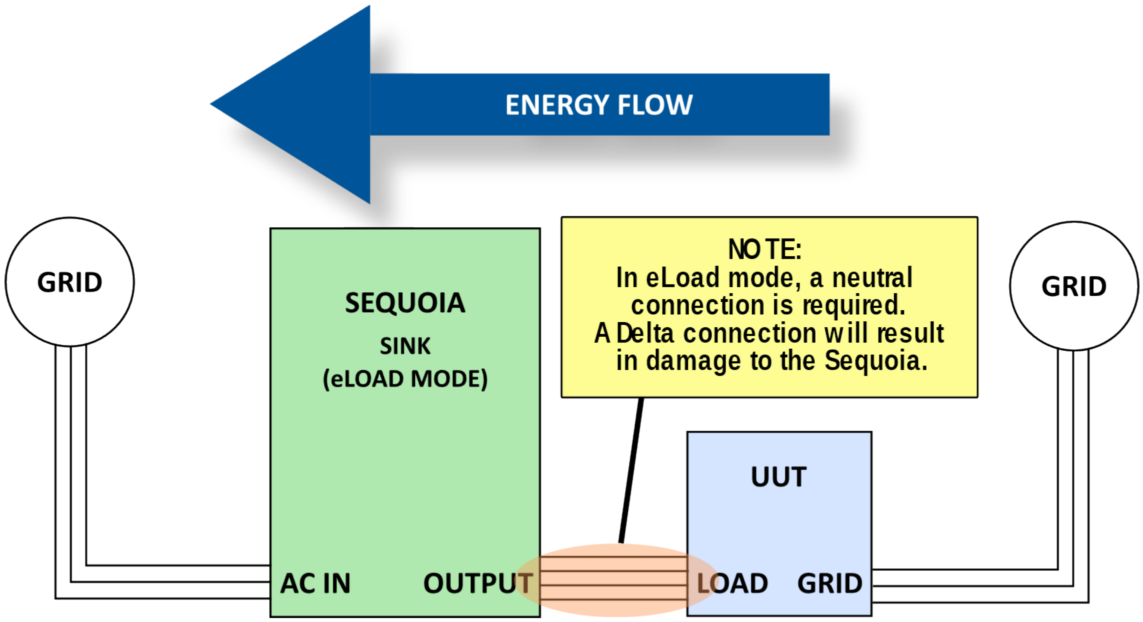

Figure 2-3: Energy flow in electronic load operating mode

2.2 Output Electrical Characteristics – All operating modes

The following output characteristics are common for Source mode, SINK-Grid simulator mode, and SINK-Electronic Load Mode.

Applicable for all Models	
Output phase	SQ15: Single Phase only. SQ22 – 45: Single and Three Phase control by internal hardware. SQ90: Single and Three Phase; Single Phase is external connection only. Neutral Floating for all models. Coupling DC for all models (except for -XVC Option Range).
AC Output Voltage, Full Scale	Low-Range: 0 to 166 Vrms High-Range: 0 to 333 Vrms
DC Output Voltage, Full Scale	Low-Range: 0 to 220 VDC High-Range: 0 to 440 VDC
AC+DC Output Voltage, Full-Scale	AC: Low: 0 - 166 V, High: 0 - 333 V DC Offset: Low: 0 - 150 V, High: 0 - 220 V
Output Float Voltage	471 V(PK), maximum from either output terminal to chassis.
Maximum RMS Output Current	Maximum rating of RMS current for all Sequoia / Tahoe models is given in Section 2.6 and 2.7 for three phase and Section 2.8 and Section 2.9 for single phase. Current, maximum amps indicated per phase is available between 10 and 72 % of voltage range. The maximum ambient temperate for full power operation at full-scale voltage is 35° C. Current derates from less than 10% of voltage range as shown in Section 2.10 and Figure 2-4.
Constant-Power Mode	Operation at higher currents but constant power is possible from 72% of Voltage range (138% of rated current) declining to 100% of rated current at 100 % of voltage range as shown in Section 2.10 and Figure 2-4.

Repetitive Peak Current	SQ0022/TA0022 and SQ0090/TA0090 up to 6; SQ0030/TA0030 up to 4.5; SQ0015/TA0015 and SQ0045/TA0045 up to 3 times FS rms current. Maximum Peak Value reflects absolute peak current protection level. This level may not be reached under all load conditions. Depending on load conditions, peak current may max out at lower levels due to amplifier output impedance. A repetitive peak current limit function is provided which will generate a fault and shut off the power supply if the peak current drawn by the load exceeds the maximum level. During this time, the amplifier will limit the peak current to a level slightly above the maximum level, but it is not allowable to run in this mode indefinitely. This should provide sufficient time to ride through any startup/inrush load conditions. A repetitive peak current limit integrator function will reduce the Repetitive Peak Current level to 100% of rated current level in approximately 100 milliseconds. If ALC Mode is off, power supply output will not shut off.
Frequency Resolution	0.01 Hz from 16.00 to 81.91 Hz 0.1 Hz from 82.0 to 819.1 Hz [(1)] 1 Hz from 820 to 905 Hz [(1)] 1.5 Hz from 905 Hz to 1500 Hz [(1)] With LKM/LKS option, 1 Hz from 16 Hz to 905 Hz [(1)]
Frequency Programming Accuracy	Standard models: ± (0.01 % of actual). FC option: ±0.25% of actual.
Phase Range:	0.0 to 360.0° (Phase B/C relative to phase A)
Phase Resolution:	0.1°
Phase Programming Accuracy:	16 Hz - 100 Hz: < 1.5° > 100 Hz - 500 Hz: < 2° > 500 Hz: < 4° [(1)] > 905 Hz: < 6° [(1)]
[(1)] SINK-Grid simulator mode, and SINK-Electronic Load mode operates only up to 550 Hz.	

2.3 Output Electrical Characteristics- Source Mode

Applicable for all Models	
Working modes	AC, DC, and AC+DC
Voltage Resolution	100 mV, AC, DC, and AC+DC mode
Voltage Stability, Typical	0.25% to 0.04% over 8-hour period at constant line, load and temperature with sense lead connected.
Voltage Programming Accuracy	± (0.2% full-scale) for DC and AC - 16 Hz to 1500 Hz, add ±0.1% FS for AC+DC mode; From 5% V range to 100% of V range, RMS bandwidth < 10 kHz.
Voltage Distortion (Resistive full load)	< 0.5 %, 16 - 66 Hz < 1.00 %, > 66 - 500 Hz < 1.5 %, > 500 Hz - 905 Hz < 2.5%, > 905 Hz
Voltage Load regulation	0.25 % FS, DC - 100 Hz 0.5 % FS, > 100 Hz

Applicable for all Models	
Voltage Line Regulation	0.1% for 10% input line change
Voltage slew rate, typical	< 0.5 V/micro sec
DC Offset Voltage, Typical	< ±20 mVDC
Output Noise	Low V Range: < 2 Vrms High V Range: < 3 Vrms XVC Options: ≤ 6 Vrms Bandwidth 20 kHz to 1 MHz for AC output.

Output Coupling	DC coupled for 166 V/ 333 V range. On optional XVC Voltage range output, which is AC coupled; only AC mode is supported.
Load Power Factor	0 to unity at full output current
Current limit Accuracy	± (0.3% of actual + 0.5% of 125 A) for DC & AC, 16 Hz to 1500 Hz; add ±0.1% of 125 A for AC+DC mode – up to 45 kVA for Sequoia/ Tahoe Models. ± (0.3% of actual + 0.5% FS) for DC & AC, 16 Hz to 1500 Hz; add ±0.1% FS for AC+DC mode – greater than 45 kVA for Sequoia/ Tahoe Models. Valid from 10% FS to 100% FS. Full Scale is the highest value of current based on the range and mode. Refer to Section 2.6 and 2.7 for three phase and Section 2.8 and Section 2.9 for single phase.
Frequency Range	Standard: 16 Hz - 550 Hz (for XVC option range: 45 Hz – 550 Hz) HF option: 16 Hz – 905 Hz (for XVC option range: 45 Hz – 905 Hz) EHF option: 905 Hz – 1500 Hz (for XVC option range: 45 Hz – 1500 Hz)
Ext. Sync Mode (not available with FC option)	
Input:	Isolated TTL input for external frequency control, Requires 5 V at 5 mA for logic high.
Accuracy:	Ext. Sync to phase A with fixed Ext. Sync Frequency input: 16 Hz - 100 Hz: < 2° > 100 Hz - 500 Hz: < 3° > 500 Hz: < 4° > 905 Hz: < 6°

2.4 Output Electrical Characteristics- AC/DC SINK -Grid simulator mode

The following output characteristics are applicable only for SEQUOIA model. All specifications in Source operating mode apply to SINK-Grid simulator mode except for the following.

Applicable for All Models	
Working modes	AC, DC Mode
Output current Range	Full current can be returned to SEQUOIA if voltage does not exceed maximum voltage limit setting for selected range.
Output power Range	Full power can be returned to SEQUOIA if current does not exceed maximum current limit setting for selected range.
Frequency Range	16 Hz – 550 Hz
Voltage Resolution	100 mV for AC and DC mode

Voltage Programming Accuracy	± (0.2% FS) for DC and AC - 16 Hz to 550 Hz; From 5% V range to 100% of V range, RMS bandwidth < 10 kHz.
Voltage Distortion	< 1 %, 16 - 66 Hz < 2 %, > 66 - 550 Hz

2.5 Output Electrical Characteristics- AC/DC SINK - Electronic Load mode

The following output characteristics are applicable only for SEQUOIA model.

Applicable for all Models	
Working modes	AC, DC Mode
Current Range	As shown in Sections 2.6, 2.7, 2.8 and 2.9
Current Resolution	0.1% FS
Current Programming Accuracy	± (0.3% of actual + 0.5% of 125 A) for DC & AC, 16 Hz to 550 Hz. ± (0.3% of actual + 0.5% FS) for DC & AC, 16 Hz to 550 Hz. Valid from 10% FS to 100% FS. Full Scale is the highest value of current based on the range and mode. Refer to Section 2.6 and 2.7 for three phase and Section 2.8 and Section 2.9 for single phase.
Current Slew Rate, Typical	< 1ms for 10% to 90% FS at a step transient.
Current distortion	< 1 %, 16 - 100 Hz < 2 %, > 100 - 300 Hz < 4 %, > 300 Hz
Frequency Range	16 Hz - 550 Hz
Phase shift Range	0 to 90.0° (lead/lag) (Between output phase voltage and current)
Phase shift Accuracy	< 2°, 16 Hz - 100 Hz < 3° at > 100 Hz - 300 Hz: < 4°, > 300 Hz
Phase shift Resolution	0.1°
Power resolution	10 W / 10 VAR / 10 VA
Real Power programming accuracy (1) (2)	±1%FS, < 100 Hz ±2%FS, > 100 Hz
Reactive Power programming accuracy (1) (2)	±1%, 16 - 100 Hz ±2.5%, > 100 - 300 Hz ±4%, > 300 Hz

Applicable for all Models	
Resistance range per phase (Applicable to AC mode and DC mode)	Refer to section 2.11 for the details. At a given operating voltage Minimum and Maximum resistance is determined as follows: *Minimum resistance = Operating UUT Voltage / (Maximum RMS current at the operating voltage)* Refer to Table 2-1: Resistance range for different models- Three Phase -AC , Table 2-2: Resistance range for different models- Three Phase DC , Table 2-5: Resistance range for different models- Single Phase -AC mode, and Table 2-6: Resistance range for different models - Single Phase - DC mode to find the maximum RMS current allowed for given operating UUT voltage. *Maximum resistance = Operating UUT Voltage / (0.8% of rated current)*
Inductance range per Phase (Only Applicable to AC mode)	Refer to section 2.11 for the details. At a given operating voltage Minimum and Maximum inductance is determined as follows: *Minimum Inductance = Operating UUT Voltage / (Maximum RMS current at the operating voltage * 2 *Pi* Maximum Frequency)* Table 2-3: Inductance range for different models- Three Phase Mode, and Table 2-7: Inductance range for different models - Single Phase AC-Mode to find the maximum RMS current allowed for given operating UUT voltage. *Maximum Inductance = Operating UUT Voltage / 0.8% of rated current* 2 * Pi* Minimum Frequency)*
Capacitance range per Phase (Only Applicable to AC mode)	Refer to section 2.11 for the details. At a given operating voltage Minimum and Maximum capacitance is determined as follows *Maximum Capacitance = (Maximum RMS current at the operating voltage) / (Operating UUT voltage * 2 *Pi* Minimum Frequency)* Table 2-4: Capacitance range for different models- Three Phase mode And Table 2-8: Capacitance range for different models- Single Phase AC-Mode to find the maximum RMS current allowed for given operating UUT voltage. *Minimum Capacitance = (0.8% of rated current) / (Operating UUT voltage * 2* **Pi* Maximum Frequency)*
Resistance Resolution	0.001 ohm up to 1 ohm 0.01 ohm >1 ohm to 10 ohm 0.1 ohm from >10 ohm to 1000 ohm 1 ohm from >1000 ohm
Inductance Resolution	0.001 mH up to 1 mH 0.01 mH >1 mH to 10 mH 0.1 mH from >10 mH to 1000 mH 1 mH from >1000 mH
Capacitance Resolution	1 uF up to 1000 uF 10 uF > 1000 uF

Applicable for all Models
(1) For Models up to 45 kVA, specifications are valid only if the programmed value of active & reactive power is greater than: 10% of 15 kW & ±10% of 15 kVAR.
(2) For Models greater than 45 kVA, specifications are valid only if the programmed value of active & reactive power is greater than 10% FS for active power and ±10% FS for reactive power.

2.6 Output Power and current ratings – Three Phase AC Mode

The following output characteristics are common for Source mode for all models. For the SEQUOIA models, SINK-Grid simulator mode, and SINK- Electronic Load modes.

Model	No of chassis	Output Power (kVA) AC mode	Output Current, Rated (Per Phase) AC mode (1)	
			Low – 166 V, RMS (A)	High – 333 V, RMS (A)
SQ0022/TA0022	1	22.5	45.1 at 166 V 62.5 at 120 V (2)	22.5 at 333 V 31.2 at 240 V (2)
SQ0030/TA0030	1	30	60.2 at 166 V 83.3 at 120 V (2)	30 at 333 V 41.6 at 240 V (2)
SQ0045/TA0045	1	45	90.3 at 166 V 125 at 120 V (2)	45 at 333 V 62.5 at 240 V (2)
SQ0090/TA0090	2 x SQ0045 2 x TA0045 or 1 x SQ0090 1 x TA0090	90	180.7 at 166 V 250 at 120 V (2)	90 at 333 V 125 at 240 V (2)
SQ0135/TA0135	3 x SQ0045 3 x TA0045	135	271 at 166 V 375 at 120 V (2)	135.1 at 333 V 187.5 at 240 V (2)
SQ0180/TA0180	2 x SQ0090 2 x TA0090	180	361.4 at 166 V 500 at 120 V (2)	180.1 at 333 V 250 at 240 V (2)
SQ0270/TA0270	3 x SQ0090 3 x TA0090	270	542.1 at 166 V 750 at 120 V (2)	270.2 at 333 V 375 at 240 V (2)
SQ0360/TA0360	4 x SQ0090 4 x TA0090	360	722.8 at 166V 1000 at 120 V (2)	360.3 at 333 V 500 at 240 V (2)
SQ0450/TA0450	5 x SQ0090 5 x TA0090	450	903.6 at 166V 1250 at 120 V (2)	450.4 at 333V 625 at 240 V (2)
SQ0540/TA0540	6 x SQ0090 6 x TA0090	540	1084.3 at 166V 1500 at 120 V (2)	540.5 at 333V 750 at 240 V (2)

(1) Refer to Constant Power Characteristics in Section 2.10, Sequoia/ Tahoe provides 138% of the rated current.

(2) Output Current Full-Scale values.

2.7 Output Power and Current Ratings – Three Phase DC and AC+DC Mode

The following output characteristics are common for Source mode for all models. For the SEQUOIA models, SINK-Grid simulator mode, and SINK- Electronic Load modes.

Model	No of chassis	Output Power (kW) DC & AC+DC modes	Output Power (kVA) AC mode	AC + DC mode Output Current, Rated (Per Phase) AC (A) (1)		DC mode Output Current, Rated (Per Phase) DC (A) (1)	
				Low – 166 V	High – 333 V	Low – 220 V	High – 440 V
SQ0022 / TA0022	1	15	22.5	30.1 at 166 V 41.6 at 120 V (2)	22.5 at 333 V 31.2 at 240 V (2)	22.7 at 220 V 31.4 at 159 V (2)	17 at 440 V 23.6 at 317 V (2)
SQ0030 / TA0030	1	20	30	40.1 at 166 V 55.5 at 120 V (2)	30 at 333 V 41.6 at 240 V (2)	30.3 at 220 V 41.9 at 159 V (2)	22.7 at 440 V 31.5 at 317 V (2)
SQ0045 / TA0045	1	30	45	60.2 at 166 V 83.3 at 120 V (2)	45 at 333 V 62.5 at 240 V (2)	45.4 at 220 V 62.8 at 159 V (2)	34 at 440 V 47.3 at 317 V (2)
SQ0090 / TA0090	2 x SQ0045 2 x TA0045 1 x SQ0090 1 x TA0090	60	90	120.4 at 166 V 166.7 at 120 V (2)	90 at 333 V 125 at 240 V (2)	90.9 at 220 V 125.7 at 159 V (2)	68.1 at 440 V 94.6 at 317 V (2)
SQ0135 / TA0135	3 x SQ0045 3 x TA0045	90	135	180.7 at 166V 250 at 120 V (2)	135.1 at 333 V 187.5 at 240 V (2)	136.3 at 220 V 188.6 at 159 V (2)	102.2 at 440 V 141.9 at 317 V (2)
SQ0180 / TA0180	2 x SQ0090 2 x TA0090	120	180	240.9 at 166 V 333.3 at 120 V (2)	180.1 at 333 V 250 at 240 V (2)	181.8 at 220 V 251.5 at 159 V (2)	136.4 at 440 V 189.2 at 317 V (2)
SQ0270 / TA0270	3 x SQ0090 3 x TA0090	180	270	361.4 at 166 V 500 at 120 V (2)	270.2 at 333 V 375 at 240 V (2)	272.7 at 220 V 377.3 at 159 V (2)	204.5 at 440 V 283.9 at 317 V (2)
SQ0360 / TA0360	4 x SQ0090 4 x TA0090	240	360	481.9 at 166 V 666.6 at 120 V (2)	360.3 at 333 V 500 at 240V (2)	363.6 at 220 V 503.1 at 159V (2)	272.7 at 440 V 378.5 at 317 V (2)
SQ0450 / TA0450	5 x SQ0090 5 x TA0090	300	450	602.4 at 166V 833.3 at 120 V (2)	450.4 at 333 V 625 at 240 V (2)	454.5 at 220V 628.9 at 159V (2)	340.9 at 440 V 473.1 at 317 V (2)
SQ0540 / TA0540	6 x SQ0090 6 x TA0090	360	540	722.8 at 166 V 1000 at 120 V (2)	540.5 at 333 V 750 at 240 V (2)	545.4 at 220V 754.7 at 159 V (2)	409 at 440 V 567.8 at 317 V (2)

(1) Refer to Constant Power Characteristics in Section, 2.10, Sequoia/ Tahoe provides 138% of the rated current.
(2) Output Current Full-Scale values.

2.8 Output Power and current ratings – Single Phase AC Mode

The following output characteristics are common for Source mode for all models. For the SEQUOIA and TAHOE models, SINK-Grid simulator mode, and SINK- Electronic Load modes.

Model	No of chassis	Output Power (kVA) AC mode	Output Current, Rated (per Phase Mode) AC mode (1)	
			Low – 166 V RMS(A)	High – 333 V RMS(A)
SQ0015/TA0015	1	15	90.3 at 166 V 125 at 120 V (2)	45 at 333 V 62.5 at 240V (2)
SQ0022/TA0022	1	22.5	135.5 at 166 V 187.5 at 120 V (2)	67.5 at 333 V 93.7 at 240 V (2)
SQ0030/TA0030	1	30	180.7 at 166 V 250 at 120 V (2)	90 at 333 V 125 at 240 V (2)
SQ0045/TA0045	1	45	271 at 166 V 375 at 120 V (2)	135.1 at 333 V 187.5 at 240 V (2)
SQ0090/TA0090	2 x SQ0045 2 x TA0045 1 x SQ0090 1 x TA0090	90	542.1 at 166 V 750 at 120 V (2)	270.2 at 333 V 375 at 240 V (2)
SQ0135/TA0135	3 x SQ0045 3 x TA0045	135	813.2 at 166 V 1125 at 120 V (2)	405.4 at 333 V 562.5 at 240 V (2)
SQ0180/TA0180	2 x SQ0090	180	1084.3 at 166 V 1500 at 120 V (2)	540.5 at 333 V 750 at 240 V (2)
SQ0270/TA0270	3 x SQ0090 3 x TA0090	270	1626.5 at 166 V 2250 at 120 V (2)	810.8 at 333 V 1125 at 240 V (2)
SQ0360/TA0360	4 x SQ0090 4 x TA0090	360	2168.6 at 166 V 3000 at 120 V (2)	1081 at 333 V 1500 at 240V (2)
SQ0450/TA0450	5 x SQ0090 5 x TA0090	450	2710.8 at 166 V 3750 at 120 V (2)	1351.3 at 333 V 1875 at 240 V (2)
SQ0540/TA0540	6 x SQ0090 6 x TA0090	540	3253 at 166 V 4500 at 120 V (2)	1621.6 at 333 V 2250 at 240 V (2)

(1) Refer to Constant Power Characteristics in Section 2.10, Sequoia/ Tahoe provides 138% of the rated current.

(2) Output Current Full-Scale values.

2.9 Output Power and Current Ratings - Single Phase DC and AC+DC Mode

Model	No of chassis	Output Power (kVA) DC & AC+DC modes		AC+DC mode, Output Current, Rated (Per Phase) RMS (A) (1)		DC mode Output Current, Rated (Per Phase) DC (A) (1)	
		Low – 166 V	High – 333 V	Low – 166 V	High – 333 V	Low – 220 V	High – 440 V
SQ0015/ TA0015	1	10	15	60.2 at 166 V 83.3 at 120V (2)	45 at 333 V 62.5 at 240V (2)	45.4 at 220 V 62.8 at 159 V (2)	34 at 440 V 47.3 at 317 V (2)
SQ0022/ TA0022	1	15	22.5	90.3 at 166 V 125 at 120 V (2)	67.5 at 333 V 93.7 at 240 V (2)	68.1 at 220 V 94.3 at 159 V (2)	51.1 at 440 V 70.9 at 317 V (2)
SQ0030/ TA0030	1	30	30	120.4 at 166 V 166.6 at 120 V (2)	90 at 333 V 125 at 240 V (2)	90.9 at 220 V 125.7 at 159 V (2)	68.1 at 440 V 94.6 at 317 V (2)
SQ0045/ TA0045	1	30	45	180.7 at 166 V 250 at 120 V (2)	135.1 at 333 V 187.5 at 240 V (2)	136.3 at 220 V 188.6 at 159 V (2)	102.2 at 440 V 141.9 at 317 V (2)
SQ0090/ TA0090	2 x SQ0045 2 x TA0045 1 x SQ0090 1 x TA0090	60	90	361.4 at 166V 500 at 120 V (2)	270.2 at 333 V 375 at 240 V (2)	272.7 at 220 V 377.3 at 159 V (2)	204.5 at 440 V 283.9 at 317 V (2)
SQ0135/ TA0135	3 x SQ0045 3 x TA0045	90	135	542.1 at 166V 750 at 120 V (2)	405.4 at 333 V 562.5 at 240 V (2)	409 at 220V 566 at 159V (2)	306.8 at 440 V 425.8 at 317 V (2)
SQ0180/ TA0180	2 x SQ0090 2 x TA0090	120	180	722.8 at 166 V 1000 at 120 V (2)	540.5 at 333 V 750 at 240 V (2)	545.4 at 220 V 754.7 at 159 V (2)	409 at 440 V 567.8 at 317 V (2)
SQ0270/ TA0270	3 x SQ0090 3 x TA0090	180	270	1084.3 at 166 V 1500 at 120 V (2)	810.8 at 333 V 1125 at 240 V (2)	818.1 at 220 V 1132 at 159 V (2)	613.6 at 440 V 851.7 at 317 V (2)
SQ0360/ TA0360	4 x SQ0090 4 x TA0090	240	360	1445.7 at 166 V 2000 at 120 V (2)	1081 at 333 V 1500 at 240 V (2)	1090.9 at 220 V 1509.4 at 159 V (2)	818.1 at 440 V 1135.6 at 317 V (2)
SQ0450/ TA0450	5 x SQ0090 5 x TA0090	300	450	1807.2 at 166 V 2500 at 120 V (2)	1351.3 at 333 V 1875 at 240 V (2)	1363.6 at 220 V 1886.7 at 159 V (2)	1022.7 at 440 V 1419.5 at 317 V (2)
SQ0540/ TA0540	6 x SQ0090 6 x TA0090	360	540	2168.6 at 166 V 3000 at 120 V (2)	1621.6 at 333 V 2250 at 240 V (2)	1636.3 at 220 V 2264.1 at 159 V (2)	1227.2 at 440 V 1703.4 at 317 V (2)

(1) Refer to Constant Power Characteristics in Section 2.10, Sequoia/ Tahoe provides 138% of the rated current.

(2) Output Current Full-Scale values.

2.10 Output Current limit characteristics – Constant Power Mode

The unit operates at 138% of the rated current from 10% to 72% of the voltage range. From 72% to 100% of the voltage range, the current decreases according to a constant power curve. These output current limit characteristics apply to both Source and Sink operating modes, Refer to Figure 2-4.

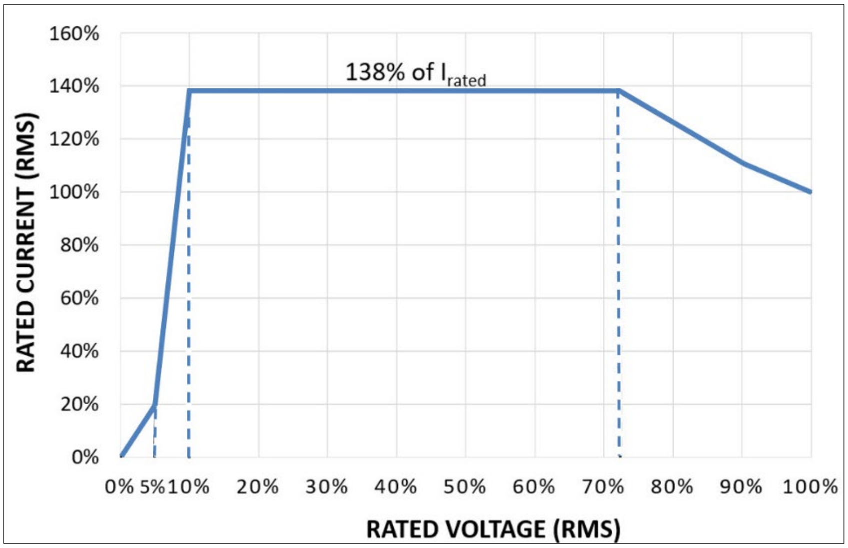

Figure 2-4: Output current limit characteristics - Constant Power Mode

2.11 SINK- Electronic Load mode – RLC programming ranges- 3 Phase

The following output characteristics are applicable only for SEQUOIA model.

Model	Resistance Range (per phase)- AC Mode			
	Minimum Resistance (Milli Ohms)		Maximum Resistance (Ohms)	
	166 V	333 V	166 V	333 V
SQ0022	921	3701	460	1850
SQ0030	690	2776	344	1387
SQ0045	460	1851	229	925
SQ0090	230	926	114	462
SQ0135	154	617	76	308
SQ0180	115	463	57	231
SQ0270	77	309	38	154
SQ0360	58	232	28	115
SQ0450	46	185	22	92
SQ0540	39	155	19	77

Table 2-1: Resistance range for different models- Three Phase -AC mode

Model	Resistance Range (per phase)- DC Mode			
	Minimum Resistance (Milli Ohms)		Maximum Resistance (Ohms)	
	220 V	440 V	220 V	440 V
SQ0022	2423	6471	1211	3235
SQ0030	1816	4846	907	2422
SQ0045	1212	3236	605	1617
SQ0090	606	1616	302	807
SQ0135	404	1077	201	538
SQ0180	303	808	151	403
SQ0270	202	538	100	268
SQ0360	152	404	75	201
SQ0450	122	323	60	161
SQ0540	101	270	50	134

Table 2-2: Resistance range for different models- Three Phase DC mode

Model	Inductance Range (per phase) – AC mode			
	Minimum Inductance (uH)		Maximum Inductance (mH)	
	166 V	333 V	166 V	333 V
SQ0022	294	1179	1464	5888
SQ0030	220	884	1094	4414
SQ0045	147	590	728	2944
SQ0090	74	295	362	1470
SQ0135	50	197	241	980
SQ0180	37	148	181	735
SQ0270	25	99	120	490
SQ0360	19	74	89	366
SQ0450	15	59	70	292
SQ0540	13	50	60	245

Table 2-3: Inductance range for different models- Three Phase Mode

Model	Capacitance Range (per phase)- 3 Phase - AC mode			
	Minimum Capacitance (uF)		Maximum Capacitance (uF)	
	166 V	333 V	166 V	333 V
SQ0022	1	1	3456	860
SQ0030	1	1	4613	1146
SQ0045	2	1	6919	1719
SQ0090	3	1	13839	3437
SQ0135	5	2	20669	5158
SQ0180	6	2	27679	6874
SQ0270	9	3	41338	10301
SQ0360	12	3	54881	13720
SQ0450	15	4	69197	17205
SQ0540	17	5	81617	20536

Table 2-4: Capacitance range for different models- Three Phase mode

2.12 SINK- Electronic Load Mode – RLC programming ranges- Single phase

The following output characteristics are applicable only for SEQUOIA model.

Model	Resistance Range (per phase)-Single Phase - AC Mode			
	Minimum Resistance (Milli Ohms)		Maximum Resistance (Ohms)	
	166 V	333 V	166 V	333 V
SQ0015	460	1851	229	925
SQ0022	307	1234	153	616
SQ0030	230	926	114	462
SQ0045	154	617	76	308
SQ0090	77	309	38	154
SQ0135	52	206	25	102
SQ0180	39	155	19	77
SQ0270	26	103	12	51
SQ0360	20	78	9	38
SQ0450	16	62	7	30
SQ0540	13	52	6	25

Table 2-5: Resistance range for different models- Single Phase -AC mode

Model	Resistance Range (per phase)-Single Phase - DC Mode			
	Minimum Resistance (Milli Ohms)		Maximum Resistance (Ohms)	
	220 V	440 V	220 V	440 V
SQ0015	1212	3236	605	1617
SQ0022	808	2153	403	1076
SQ0030	606	1616	302	807
SQ0045	404	1077	201	538
SQ0090	202	538	100	268
SQ0135	135	359	67	179
SQ0180	101	269	50	134
SQ0270	68	180	33	89
SQ0360	51	135	25	67
SQ0450	41	108	20	53
SQ0540	34	90	16	44

Table 2-6: Resistance range for different models - Single Phase - DC mode

Model	Inductance Range (per phase)-Single Phase - AC Mode			
	Minimum Inductance (uH)		Maximum Inductance (mH)	
	166 V	333 V	166 V	333 V
SQ0015	147	590	728	2944
SQ0022	98	393	487	1960
SQ0030	74	295	362	1470
SQ0045	50	197	241	980
SQ0090	25	99	120	490
SQ0135	17	66	79	324
SQ0180	13	50	60	245
SQ0270	9	33	38	162
SQ0360	7	25	28	120
SQ0450	6	20	22	95
SQ0540	5	17	19	79

Table 2-7: Inductance range for different models - Single Phase AC-Mode

Model	Capacitance Range (per phase)- AC mode			
	Minimum Capacitance (uF)		Maximum Capacitance (uF)	
	166 V	333 V	166 V	333 V
SQ0015	2	1	6919	1719
SQ0022	3	1	10368	2579
SQ0030	3	1	13839	3437
SQ0045	5	2	20669	5158
SQ0090	9	3	41338	10301
SQ0135	13	4	61213	15451
SQ0180	17	5	81617	20536
SQ0270	27	7	122426	30903
SQ0360	36	9	159154	40808
SQ0450	46	11	198943	51340
SQ0540	54	13	244853	61213

Table 2-8: Capacitance range for different models- Single Phase AC-Mode

2.13 AC Input Specifications

Model	Line VA	Line current	Inrush current
SQ0015 / TA0015	18 kVA	58 ARMS at 187 V_{LL} 52 ARMS at 207 V_{LL} 30 ARMS at 360 V_{LL} 25 ARMS at 432 V_{LL}	77 Apk at 208 V_{LL} 73 Apk at 230 V_{LL} 44 Apk at 400 V_{LL} 37 Apk at 480 V_{LL}
SQ0022 / TA0022	26 kVA	89 ARMS at 187 V_{LL} 79 ARMS at 207 V_{LL} 49 ARMS at 342 V_{LL} 46 ARMS at 360 V_{LL} 38 ARMS at 432 V_{LL}	153 Apk at 208 V_{LL} 146 Apk at 230 V_{LL} 94 Apk at 342 V_{LL} 87 Apk at 400 V_{LL} 73 Apk at 480 V_{LL}
SQ003 / TA0030	37 kVA	116 ARMS at 187 V_{LL} 105 ARMS at 207 V_{LL} 64 ARMS at 342 V_{LL} 60 ARMS at 360 V_{LL} 50 ARMS at 432 V_{LL}	230 Apk at 208 V_{LL} 220 Apk at 230 V_{LL} 140 Apk at 342 V_{LL} 132 Apk at 400 V_{LL} 110 Apk at 480 V_{LL}
SQ0045 / TA0045	53 kVA	175 ARMS at 187 V_{LL} 157 ARMS at 207 V_{LL} 95 ARMS at 342 V_{LL} 90 ARMS at 360 V_{LL} 75 ARMS at 432 V_{LL}	230 Apk at 208 V_{LL} 220 Apk at 230 V_{LL} 140 Apk at 342 V_{LL} 132 Apk at 400 V_{LL} 110 Apk at 480 V_{LL}
SQ0090 / TA0090	112 kVA	350 ARMS at 187 V_{LL} 314 ARMS at 207 V_{LL} 189 ARMS at 342 V_{LL} 180 ARMS at 360 V_{LL} 150 ARMS at 432 V_{LL} **Note: 208 VAC and 230 VAC inputs are not available on the single cabinet SQ0090 and TA0090 but is available on the 2 x SQ0045 and 2 x TA0045 systems** If it is 2 x SQ0045/TA0045 then Each chassis requires its own AC service. Total Line currents are 2 x SQ0045/TA0045	460 Apk at 208 V_{LL} 440Apk at 230 V_{LL} 280Apk at 342 V_{LL} 264Apk at 400 V_{LL} 220Apk at 480 V_{LL} **Note: 208 VAC and 230 VAC inputs are not available on the single cabinet SQ0090 and TA0090 but is available on the 2 x SQ0045 and 2 x TA0045 systems** If it is 2 x SQ0045/TA0045 then Each chassis requires its own AC service. Total Line currents are 2 x SQ0045/TA0045
SQ0135 / TA0135	159 kVA	Each SQ0045 chassis requires its own AC service. Total Line currents are 3 x SQ0045/TA0045	Each SQ0045 chassis requires its own AC service. Total peak currents are 3 x SQ0045/TA0045
SQ0180 / TA0180	224 kVA	Each SQ0090 chassis requires its own AC service. Total Line currents are 2 x SQ0090/TA0090	Each SQ0090 chassis requires its own AC service. Total peak currents are 2 x SQ0090/TA0090

SQ0270 / TA0270	336 kVA	Each SQ0090 chassis requires its own AC service. Total Line currents are 3 x SQ0090/TA0090	Each SQ0090 chassis requires its own AC service. Total peak currents are 3 x SQ0090/TA0090
SQ0360 / TA0360	448 kVA	Each SQ0090 chassis requires its own AC service. Total Line currents are 4 x SQ0090/TA0090	Each SQ0090 chassis requires its own AC service. Total peak currents are 4 x SQ0090/TA0090
SQ0450 / TA0450	560 kVA	Each SQ0090 chassis requires its own AC service. Total Line currents are 5 x SQ0090/TA0090	Each SQ0090 chassis requires its own AC service. Total peak currents are 5 x SQ0090/TA0090
SQ0540 / TA0540	672 kVA	Each SQ0090 chassis requires its own AC service. Total Line currents are 6 x SQ0090/TA0090	Each SQ0090 chassis requires its own AC service. Total peak currents are 6 x SQ0090/TA0090

All Models	
Line Voltage: (3 phase, 3 wire + ground (PE) SQ0015 / TA0015 up to SQ0045 / TA0045	208 V_{LL} ±10% 230 V_{LL} ±10% 380 V_{LL} ±10% [1] 400 V_{LL} ±10% 480 VLL ±10%
Line Voltage: (3 phase, 3 wire + ground (PE) SQ0090 / TA0090	380 V_{LL} ±10% 400 V_{LL} ±10% 480 V_{LL} ±10%
Line Frequency:	47-63 Hz
Efficiency:	SQ0015/TA0015 – 89% [2] SQ0022/TA0022 – 84% [2] SQ0030/TA0030 – 86% [2] SQ0045/TA0045 – 88% [2] SQ0090/TA0090 – 85% [2]
Power Factor:	SQ0015/TA0015 – 0.97 [3] SQ0022/TA0022 – 0.85 [3] SQ0030/TA0030 – 0.91 [3] SQ0045/TA0045 – 0.94 [3] SQ0090/TA0090 – 0.95 [3]
Hold-Up Time:	> 10 ms
Isolation Voltage:	2200 VAC input to output 1350 VAC input to chassis
(1) Not available on SQ0015 *(2) Typical measurement; depending on line and load conditions.* *(3) Measured at full power*	

2.14 AC Output Measurements

Measurement specifications apply to SQ0015 & TA0015 in single-phase mode and SQ0022 & TA0022 / SQ0030 & TA0030 / SQ0045 & TA0045 / SQ0090 & TA0090 in three-phase mode. Refer to the notes for details on other models and configurations.

Parameter	Range	Accuracy (±)	Resolution
Frequency	16.00 - 1500 Hz	0.01% + 0.01 Hz ±0.25 % for the FC option	0.01 to 81.91 Hz 0.1 to 500 Hz 1 Hz to 905 Hz 1.5 Hz above 905 Hz
RMS Voltage	0 - 333 Volts	± (0.1% of actual + 0.2% FS) for 16 Hz to 1500 Hz Valid from 5% FS. with sense leads connected.	0.01 volt
RMS Current **SQ0015 & TA0015** **SQ0045 & TA0045**	0 - 125 Amps	± (0.3% of actual + 0.5% FS) for 16 Hz to 1500 Hz Valid from 10% FS to 100% FS.	0.1 Amp
RMS Current **SQ0022 & TA0022**	0 - 62.5 Amps		
RMS Current **SQ0030 & TA0030**	0 - 83 Amps		
RMS Current **SQ0090 & TA0090**	0 - 250 Amps		
Peak Current **SQ0015 & TA0015** **SQ0022 & TA0022** **SQ0030 & TA0030** **SQ0045 & TA0045**	0 - 375 Amps	2% FS, < 100 Hz 4% FS, > 100 Hz	0.1 Amp
Peak Current **SQ0090 & TA0090**	0 - 750 Amps		
VA Power **SQ0015 & TA0015** **SQ0022 & TA0022** **SQ0030 & TA0030** **SQ0045 & TA0045**	0 - 15 kVA	1%FS, < 100 Hz 2.5%FS, > 100 - 300 Hz 4%FS, > 300 Hz	10 VA
VA Power **SQ0090 & TA0090**	0 - 30 kVA		
Real Power **SQ0015 & TA0015** **SQ0022 & TA0022** **SQ0030 & TA0030** **SQ0045 & TA0045**	0 - 15 kW	1%FS, < 100 Hz 2%FS, > 100 Hz	10 W

Real Power **SQ0090 & TA0090**	0 - 30 kW		
Reactive Power **SQ0015 & TA0015** **SQ0022 & TA0022** **SQ0030 & TA0030** **SQ0045 & TA0045**	0 - 15 kVAR	1%FS, < 100 Hz 2.5%FS, > 100 - 300 Hz 4%FS, > 300 Hz	10 VAR
Reactive Power **SQ0090 & TA0090**	0 - 30 kVAR		
Power Factor **(>0.2 kVA)**	0.00 - 1.00	0.01, < 100 Hz 0.02, > 100 - 905 Hz 0.03, 905 - 1500 Hz	0.01

Note: *For current and power measurements, specifications apply from 5% to 100% of measurement range.*

Current and Power range, and accuracy specifications are times three for all models operated in single phase mode.

For the multi chassis models the current and power range accuracy specifications are to be multiplied by No of chassis.

Note: *Power factor accuracy applies for PF > 0.5 and VA > 50 % of max.*

2.15 Harmonics Measurements

Measurement specifications apply to SQ0015 & TA0015 in single-phase mode and SQ0022 & TA0022 / SQ0030 & TA0030 / SQ0045 & TA0045/ SQ0090 & TA0090 in three-phase mode. Refer to the notes for details on other models and configurations.

Parameter	Range	Accuracy (±)	Resolution
Frequency fundamental	16.00 - 1500 Hz	0.03% + 0.03 Hz ±0.25 % for the FC option	0.01 Hz
Frequency harmonics	32.00 Hz – 16 kHz	0.03% + 0.03 Hz	0.01 Hz
Phase	0.0 - 360.0°	2° typ.	0.5°
Voltage	Fundamental	0.1% FS	0.01 V
	Harmonics 2 - 50	0.1% + 0.1%/kHz	0.01 V
Current	Fundamental	0.5%FS, < 100 Hz 1.0%FS, > 100 Hz	0.1 A
	Harmonics 2 - 50	1% + 0.5%/kHz FS	0.1 A

Note: *For current and power measurements, specifications apply from 5% to 100% of measurement range.*

Current and Power range, and accuracy specifications are times three for all models operated in single phase mode.

For the multi chassis models the current and power range accuracy specifications are to be multiplied by No of chassis.

2.16 DC Output Measurements

Measurement specifications apply to SQ0015 & TA0015 in single-phase mode and SQ0022 & TA0022 / SQ0030 & TA0030 / SQ0045 & TA0045/ SQ0090 & TA0090 in DC mode. See notes for other models and configurations.

Parameter	Range	Accuracy (±)	Resolution
Voltage	0 - 440 VDC	± (0.1% of actual + 0.2% FS). add ±0.1% FS for AC+DC mode; Valid from >5% FS. with sense leads connected.	0.1 Volt
Current **SQ0015 & TA0015** **SQ0022 & TA0022** **SQ0030 & TA0030** **SQ0045 & TA0045**	0 - 100 ADC	± (0.3% of actual + 0.5% FS) for DC. Valid from 10% FS to 100% FS.	0.01 Amp
Current **SQ0090 & TA0090**	0 - 200 ADC		
Power **SQ0015 & TA0015** **SQ0022 & TA0022** **SQ0030 & TA0030** **SQ0045 & TA0045**	0 - 15 kW per output	±1% FS	10 W
Power **SQ0090 & TA0090**	0 - 30 kW per output		
Note: *For current and power measurements, specifications apply from 5% to 100% of measurement range. Current and Power range, and accuracy specifications are times three for all models in single phase mode. For the multi chassis models the current and power range accuracy specifications are to be multiplied by No of chassis.*			

2.17 Operational Characteristics

Operational characteristics common for all three operation modes: Source mode (all models), and for SEQUOIA models only, SINK-Grid Simulator mode and SINK-Electronic Load Mode.	
Parameter	**Characteristic**
Parallel Operation	Multi-chassis configurations are formed with up to six units in parallel using one Leader unit and up to five units operating as follower units. Maximum power that can be obtained by paralleling is limited to 540 kVA. Setup of the multi-chassis configuration is automatically accomplished when the chassis are interconnected with the interface cables, and require no user setup, except to wire the inputs and outputs.
Output Relays	Isolation and range relays are provided internally to automatically configure the outputs, turn the output ON/OFF, and disconnect the load from the output amplifier when in the off state.
1-Phase and 3-Phase mode selection	Switches between 1 and 3 phase outputs for SQ0022 - SQ0045. External connection needed for SQ0090 single-phase output.
Non-Volatile Memory	16 complete instrument setups and transient lists, 100 events per list.
Waveform Management	Sequoia / Tahoe series employs independent arbitrary waveform generators for each phase; this allows the user to create custom waveforms. In addition, three standard waveforms sine, square and clipped are always available.
Fault Identification	On-board diagnostics identify when an assembly has experienced a fault.
Emergency Stop	Push button is installed on the front panel of the Sequoia / Tahoe system. When pushed in, the main AC contactor is opened disconnecting the AC input power to the input transformer. Note that the controller (and front panel display) will still be powered up, but no power is available to the amplifiers and there will be no output power either. The controller runs off the LV supply, which must be turned off with the front panel unit ON/OFF switch.
Watt Hour Measurement	Displays the energy, kWh, consumed by the load, and the true power in kW. The Start and Stop function determine the interval during which energy is calculated. The Clear function resets the accumulated energy value.
Calibration	Calibration interval is 1 year; calibration is firmware-based through the digital interface or Virtual Panels.

Operational characteristics specific to Source mode (SEQUOIA and TAHOE models)	
Current Limit Modes	Two selectable modes of operation: a) Constant Voltage/ Constant Current mode, voltage folds back with automatic recovery. b) Constant Voltage/ Current limit (Relays open).
Automatic Level Control (ALC)	User-selectable ALC operation enables a digitally implemented feedback control loop to precisely regulate the RMS value of the output voltage. Turn off programmable output impedance to use ALC.

Transient Generator	Output is controlled to produce transient events with 500 µs programming resolution: Voltage: drop, step, sag, surge, sweep. Frequency: step, sag, surge, sweep. Voltage and Frequency: step, sweep.
External Drive	Supported up to 905Hz. 0-7.00 Vrms aux input.
Programmable Output Impedance	The TA0015 & SQ0015 / TA0022 & SQ0022 / TA0030 & SQ0030/ TA0045 & SQ0045/ TA0090 & SQ0090 offers programmable output impedance in three-phase mode of operation. This allows the user to simulate line impedance conditions by programming resistive and inductive elements of the AC source's output impedance. Output impedance option is not supported during Multi chassis and single-phase mode operation. Turn off ALC to use programmable output impedance. This feature supports only in source mode. Range: 20 – 200 mOhm Resolution: 10 mOhm Accuracy: 10 % FS

Operational characteristics specific to SINK- Grid Simulator mode (only for SEQUOIA model)	
Protection Characteristics	The absolute value of the current exceeds the regenerative programmable current limit setpoint, the output voltage of the SEQUOIA will be increased gradually to reduce the amount of current being fed back. Note that there is no other way for the SEQUOIA to limit the current as the current is not generated by the SEQUOIA itself but rather by the load (inverter). Consequently, normal current limit operation does not apply in this mode of operation. The voltage will continue to be raised until the user set over voltage trip point is reached.
Automatic Level Control (ALC)	User-selectable ALC operation enables a digitally implemented feedback control loop to precisely regulate the RMS value of the output voltage.
Transient Generator	Output is controlled to produce transient events with 500 µs programming resolution: Voltage: drop, step, sag, surge, sweep; Frequency: step, sag, surge, sweep; Voltage and Frequency: step, sweep.

Operational characteristics specific to SINK- Electronic Load Mode (only for SEQUOIA models)	
Protection Characteristics	Users are allowed to set maximum UUT voltage and the SEQUOIA would trip on reaching the overvoltage setpoint. In this operating mode SEQUOIA do not have any control on the voltage applied by the UUT, only current drawn from the UUT is being controlled by SEQUOIA, at any point time of time user should ensure the Maximum UUT voltage does not exceed the maximum range specified of the SEQUOIA.
Automatic Level Control (ALC)	User-selectable ALC operation enables a digitally implemented feedback control loop to precisely regulate the RMS value of the output current.
Transient Generator- SINK- Electronic Load	Output is controlled to produce transient events with 500 µs programming resolution: Current: drop, step, sag, surge, sweep.

Mode	
RLC Programming- SINK- Electronic Load mode	Users can program Resistance, Inductance and Capacitance as load as per the range specified for each output model. In this mode SEQUOIA programs the RMS current with appropriate phase angle to the output as per the programmed RLC values.
Non-Linear Current Programming - SINK- Electronic Load mode	Using current waveform programming feature, a nonlinear current example, six pulse rectified current waveform can be programmed to the SEQUOIA output. The highest peak current programmed is as defined by output repetitive peak current rating.

2.18 Additional AC only Output Range Hardware options

Output Voltage Range Options – Only AC mode supported	
XVC, option	Adds 444/555/666/721 VAC only output range. SINK-Electronic load operating mode is only supported in 444 VAC, 555 VAC, and 666 VAC.

2.19 Additional Hardware options

ES (Emergency Stop with Key), option	This is a key lock push button feature installed on the front panel of the SEQUOIA system. When pushed in, the main AC contactor is opened disconnecting the AC input power to the input transformer. Note that the controller (and front panel display) will still be powered up, but no power is available to the amplifiers and there will be no output power either. The controller runs off the LV supply, which must be turned off with the front panel unit ON/OFF switch.
413, Option	IEC 61000-4-13 harmonics and Inter-harmonics EMC test hardware and software.
CTSHL	Sequoia or Tahoe Series can be used as AC power source for the CTSHL compliance to meet the requirements of IEC 61000-3-2, IEC 61000-3-3, IEC 610003-11, IEC 61000-3-12, IEC 61000-4-7, and IEC 61000-4-15.

2.20 Hardware options

0 A - Air Filter, option	Adds dust filters to the front panel air inlet
2 C - Chill Door, option [1]	The Chilled door option is a rack cooling system available only for SQ/TA 0090 configurations. The chilled door assembly removes heat generated by the power supply instruments and cools the air before returning it through the exhaust into the room. Units with the chilled door option also include air filters installed on the front panels. (This option requires additional installation procedures after delivery.) **Cooling option:** The door cooling system is an active heat exchanger mounted on the rear panel of each AC power rack. It pulls room air into the cabinet through the front panels, where the air absorbs heat from the power supply and is then directed to the door chiller. The heat is transferred to the coolant inside the heat exchanger and sent to the chilled water source. The door then releases cool air back into the room at a set temperature. By removing heat directly at its source, the system ensures that all heat from the power supplies is removed before leaving the cabinet. The system continuously monitors various environmental factors to adjust to conditions inside the power rack. It operates above the ambient dew point, preventing condensation near sensitive internal equipment. Refer Figure 3-7 for the overall Dimension of SQ/TA 0090 with Chill door option Figure 3-8 for the location of air inlet, air outlet and rare view of chill door assembly. **Note:** Refer to the outline drawing section 3.4 to view the drawings of SQ/TA 0090 with Chill Door Assembly. **Dimension of SQ/TA 0090 with Chill door option:** Height: 76.2 in (1935.4 mm) Weight: 33 in (838.2 mm) Depth: 56 in (1422.4 mm) **Weight of a Chill Door Option:** Chilled Door Weight: 450 lbs. Frame Weight: 75 lbs. Total Added Weight: 525 lbs. **Chill Door Specifications:** Fluid type: 100% Water or Glycol % Design Fluid Flow: 0-20 GPM Max Fluid Flow:23 GPM Estimated Total Fluid Pressure Drop: 0-15 PSID Design Fluid inlet Temp: 65°F Design Fluid outlet Temp: 75-85°F Design Cooling Capacity: 5-75 kW Available Air flow: 3500-7500 CFM **Electrical Power Requirement Specifications:** Power: 208-230 V/1/60 Hz Full Load Amps (FLA): 7 Amps Minimum Circuit Ampacity (MCA): 10 Amps Maximum Overcurrent Protection (MOP): 15 Amps
Note 1: *Specifications are based on average load conditions. Capacity and performance will vary based on flow, water temps, and fluid type.* *(1) Available only for SQ/TA 0090 configurations.*	

2.21 SINK option

The following output characteristics are applicable only for SEQUOIA model.

SINK-Grid Simulator, option	In Grid Simulator Mode SEQUOIA regulates the output voltage to the user set value and works as the grid to UUT. SEQUOIA serves as the grid and sinks the current generated by UUT. This allows the user to test current source type UUT such as Photo Voltaic Solar inverter or any grid tied inverter. Users can change the grid parameters such as voltage, frequency, and phase as per the requirement. The energy received from the UUT is fed back to the grid instead of dissipating as heat.
SINK- electronic load, option	In Electronic Load Mode SEQUOIA regulates the RMS current set by the user and operates as the load. Current programming, power programming, and RLC programming are supported in the Electronic Load Mode. The energy received from the UUT is fed back to the grid instead of dissipating as heat.

2.22 Frequency Options

HF, option	High frequency option: Output frequency range of 16 Hz to 905 Hz. **Note:** With HF option installed, during SINK mode (Grid simulator and electronic load frequency is restricted to 550 Hz.
FC, option	High frequency and reduced frequency control options are combined. In this option the frequency range is 16 Hz to 905 Hz. With the FC option installed, accuracy reduces to ±0.25%. With FC option installed external waveform programming signal feature is disabled.
EHF, option	Extended high frequency option adds selectable range to achieve 1500 Hz output in source mode. **Note:** With EHF option installed, frequency is restricted to 550 Hz during SINK mode (Grid simulator and electronic load).

2.23 Clock and Lock Mode Option

LKM, option (Clock and Lock Mode)	Clock and Lock interface option for Leader unit. Multi-phase configurations are formed with up to three units using the Clock and Lock signal interface. One-unit acts as the Leader and provides the reference signals to the other Follower units. **Note:** The frequency of operation is restricted to 1500 Hz if the power supply is configured to operate in LKM mode. LKM mode is not supported in SINK- Grid simulator and Electronic Load Modes.
LKS, option (Clock and Lock Mode)	Clock and Lock interface option for follower unit. Multi-phase configurations are formed with up to three units using the Clock and Lock signal interface. One-unit acts as the Leader and provides the reference signals to the other Follower units. **Note:** The frequency of operation is restricted to 1500 Hz if the power supply is configured to operate in LKS mode. LKS mode is not supported in SINK- Grid simulator and Electronic Load Mode.

2.24 Analog/Digital Signal Characteristics

Function	Characteristics
External Analog Programming of Output Voltage Waveform	Signal input for output voltage waveform programming by external analog reference. Signal ranges: 0-7.07 Vrms for zero to full-scale RMS output voltage, with AC input waveform at 16 Hz to 550 Hz. Programming accuracy, ±2% FS output. individual inputs provided for each output phase; input impedance, 40 kΩ, typical; safety isolation SELV-rated, referenced to chassis. **Note:** External Analog waveform programming function is not supported in SINK- Electronic Load Mode.
External Analog Programming of Output Voltage Amplitude – Source and SINK-Grid Simulator	Signal input for output voltage amplitude programming of waveform that is set by internal controller reference. Signal ranges: 0-10 VDC for zero to full-scale RMS of internally programmed output voltage; Programming accuracy, ±2% FS output. individual inputs provided for each output phase; input impedance, 40 kΩ, typical. Safety isolation SELV-rated, referenced to chassis.
External Analog Programming of Output Current Amplitude – SINK-electronic load Mode	Signal input for output current amplitude programming of waveform that is set by internal controller reference. Signal ranges: 0-10 VDC for zero to full-scale RMS of internally programmed output current; programming accuracy, ±2% FS output. individual inputs provided for each output phase; input impedance, 40 kΩ, typical; safety isolation SELV-rated, referenced to chassis.

Function	Characteristics
External Analog Modulation of Output Voltage	Signal input for output voltage modulation of waveform set by internal controller reference; 0-5 Vrms signal range for 0-10% output voltage amplitude modulation. Programming accuracy, ±2% FS output. individual inputs provided for each output phase; input impedance, 40 kΩ, typical; safety isolation SELV-rated, referenced to chassis. **Note:** External Analog waveform modulation function is not supported in SINK- Electronic Load Mode.
Trigger Output	Signal output with dual function: user selectable as either function trigger or list trigger. Function trigger provides a pulse for any programmable change in output voltage or frequency; list trigger provides a pulse if programmed as part of list transients. Pulse logic level, user-selectable as active-high or active-low; pulse duration, 550 µs; rear panel BNC connector; safety isolation SELV-rated, referenced to chassis.
Isolated Output Voltage Monitor Outputs	Signal outputs for each output phase for monitoring the waveform of the command signal of the output amplifier. 0-7.07 Vrms signal range for zero to full-scale output voltage. Individual outputs provided for each output phase, safety isolation SELV-rated, referenced to chassis.
Isolated Output Current Monitor Outputs	Signal outputs for each output phase for monitoring the waveform of the command signal of the output amplifier. 0-7.07 Vrms signal range for zero to full-scale output current. Individual outputs provided for each output phase, safety isolation SELV-rated, referenced to chassis.
Trigger Input	Signal input for external trigger for execution of programmed value; logic level, TTL-compatible. Signal return common to signals, Trigger input, Synchronization Clock and Remote Inhibit. Safety isolation SELV-rated.
Synchronization Signal (SYNC) Input	Signal input for external square wave clock to control the output frequency and phase of the waveform generated by the internal generator. Logic level, TTL-compatible. Signals return common to signals, Trigger input, Synchronization Clock and Remote Inhibit; safety isolation SELV-rated. **Note:** Not available with FC option and not available with LKM and LKS option. **Note:** SYNC input is not supported in SINK- electronic load operating mode.
Output Status	Monitors state of the output relay. Isolated TTL output. High if output relay is closed, low if output relay is open.
Remote Inhibit Input	Signal input to turn the output ON/OFF. Logic level, TTL-compatible; user-selectable as active-high or active-low. Signal return common to signals, Trigger input, Synchronization Clock and Remote Inhibit; safety isolation SELV-rated.

Function	Characteristics
Summary Fault Output	Signal output indicates that a fault condition is present; solid-state, normally closed ac/dc switch. Logic level, active-low (open-circuit when fault is not present). Switch ratings: 50 V, maximum peak voltage; 0.1 A, maximum current; 2.5 Ω, maximum resistance; 1 µA, maximum off-state leakage current. Isolated from all other signals; safety isolation SELV-rated.
LKM (Option)	Signal outputs for Leader Clock and Logic signals used in synchronizing two or more AC sources; logic level, TTL-compatible. Rear panel BNC connectors for each signal. Safety isolation SELV-rated, referenced to chassis. **Note:** SYNC input is not supported in SINK- electronic load operating mode
LKS (Option)	Signal inputs for Auxiliary Clock and Logic signals used in synchronizing two or more AC sources; logic level, TTL-compatible. Rear panel BNC connectors for each signal. Safety isolation SELV-rated, referenced to chassis. **Note:** SYNC input is not supported in SINK- Electronic Load operating mode.

2.25 Remote Control Digital Interface Characteristics

Interface	Characteristic
LAN	Ethernet 10BASE-T and 100BASE-T over twisted-pair cables compliant with IEEE 802.3; Connector: 8P8C modular jack.
USB	Serial interface compliant to USB 2.0. Connector: Type-B receptacle.
RS-232C	Serial interface compliant to RS-232C. Protocol: data bits, 7 with parity and 8 without parity; stop bits, 2; baud rate, 9600 to 115200; handshake, CTS and RTS. Connector: Subminiature-D, 9-contact receptacle.
IEEE-488 (Option)	Parallel interface complies with IEEE-488.1, IEEE-488.2, and the SCPI-99 command specification; command execution response time, 10 ms, typical. Connector: IEEE-488.1 compliant.
Firmware Upgrade	Firmware can be upgraded through LAN, USB or RS-232 interfaces. Upgrade through IEEE-488 is not supported.

2.26 Front Panel Controls/Indicators

Controls/Indicators
Touch-Panel, TFT color LCD display with menu-based control. Display Size: 5" diagonal. Rotary encoder for menu navigation and parameter adjustment and entry, with integrated selection switch. Input switch: turns unit ON/OFF, located on the top left corner of the front panel. disconnects the low voltage bias supply of the SEQUOIA /TAHOE. OUTPUT switch: turns output of the unit ON/OFF. OUTPUT LED: integrated into the OUTPUT switch; indicates that the output of the unit has been turned on. CC LED: indicates that the unit is in constant-current mode and the output current is being regulated. CV LED: indicates that the unit is in constant-voltage mode and the output voltage is being regulated. HI RNG LED: indicates that the high-voltage output range has been selected. FAULT LED: indicates that an internal fault has been detected, and the output has been shut down. REM LED: Indicates that the unit is under control of the remote digital interface. LXI LED: LXI status annunciation. EMERGENCY STOP: Removes power from amplifiers and opens output relays.

Panel LED Indicators
Front side sheet metal panel is illuminated with LEDs indicating the operating status of the Sequoia / Tahoe as described below: READY OUTPUT OFF Status: Panel is illuminated with Green LEDs. OUTPUT ON/OFF Status: Panel is illuminated with Blue LEDs. FAULT Status: Panel is illuminated with Red LEDs.

2.27 Rear Panel Connectors

Connector	Description
AC Input	Cable entry and strain relief for AC input wiring. Remove rear panel covers for making connection.
Safety-Ground	Earth stud is provided in the chassis. Remove rear panel covers for making connection.
AC/DC Output – Three Phase output	Cable entry and strain relief for AC/DC output wiring for 3 phases and neutral. To remove rear panel covers for making connection.
AC/DC Output – Single Phase output	Cable entry and strain relief for AC/DC output Single phase wiring. To remove rear panel covers for making connection.
Functional-Ground	Earth stud is provided in the chassis. Remove rear panel covers for making connection.
AC/DC Output Remote Sense	Single row four pole terminal block is located on the rear panel for external voltage sense.
External Interface-I	Control analog and monitor signals for each output phase for user remote control. (Includes external voltage signals for output programming, output voltage monitors and output current monitors.) safety isolation: SELV-rated; connector: high-density, 15-contact, female

Connector	Description
	Subminiature-D.
External Interface-II	Control analog and digital signals for each output phase for user remote control. (Includes external voltage signals for output modulation of voltage, SYNC, Remote inhibit, Summary fault output, Output ON/OFF status.) safety isolation: SELV-rated; connector: high-density, 15-contact, female Subminiature-D.
System interface, Follower	Control signal interface on Follower unit coming from Leader unit (or previous Follower unit) for multi-chassis operation; connector, high-density, 37-contact, female D-Type.
System interface, Leader	Control signal interface on Leader unit (or previous Follower unit) going to Follower unit for multi-chassis operation; connector: high-density, 37-contact, male D-Type.
System relay Interface	Single row six pole terminal block is located on the rear panel for remote-control of Leader / Follower configurations and Emergency Stop.
Trigger Output	Signal output with dual function, either function trigger or list trigger; safety isolation SELV- rated Connector: BNC
Trigger Input	Signal input for external trigger for execution of programmed value; Logic level, TTL-compatible; safety isolation SELV-rated. Connector: BNC
Clock and Lock (LKM and LKS options)	Signal control interfaces for synchronization of multiple units; signal outputs on leader unit, and signal inputs on auxiliary units; safety isolation SELV-rated; connectors: individual BNC.
LAN Interface	Ethernet 10BASE-T and 100BASE-T; safety isolation SELV-rated, referenced to chassis. Connector: 8P8C modular jack.
RS-232 Interface	Serial interface to RS-232C; safety isolation SELV-rated, referenced to chassis. Connector: Subminiature-D, 9-contact receptacle.
USB Interface	Serial interface to USB 2.0; safety isolation SELV-rated, referenced to chassis. Connector: Type-B.
IEEE-488 Interface	Parallel interface to IEEE-488.1, IEEE-488.2, and SCPI-99; safety isolation SELV-rated, referenced to chassis; connector: IEEE-488.1 compliant.

2.28 Protection Function Characteristics

Function	Characteristic
Input Over current	In-line fast acting fuses. Check fuse rating in Service and Maintenance section. Ratings will depend on AC input configuration settings. Circuit breaker for LV supply.
Input Over voltage	Automatic shutdown.
Input Over voltage Transients	Surge protection to withstand EN50082-1 (IEC 801-4, 5) levels.
Output Over current	Adjustable level constant current mode with programmable setpoint.
Output Short Circuit	Peak and RMS current limit.
Over temperature	Automatic shutdown.

2.29 Environmental Specifications

Parameter	Specification
Operating Temperature	0° to +40° C. (Except in Constant Power mode). +32° to +104° F.
Storage Temperature	-40° to +85 °C. -40° to +185° F.
Altitude	< 2000 meters
Relative Humidity	0-95 % RAH, non-condensing maximum for temperatures up to 31°C decreasing linearly to 50% at 40°C.
Vibration	Designed to meet ISTA 1H transportation levels.
Shock	Designed to meet ISTA 1H transportation levels.
Transportation integrity	ISTA Test Procedure 1H

2.30 Regulatory Agency Compliance

Parameter	Specification
EMC	CE marked for EMC Directive 2014/30/EU per EN 61326-1:2013 Class A for Emissions and Industrial Immunity levels as required.
Safety	CE marked for LVD compliance 2014/35/EU to EN 61010-1, Edition 3.1
CE Mark LVD Categories	Installation Overvoltage Category: II; Pollution Degree: 2; indoor use only.
RoHS	CE marked for compliance with RoHS3 EU Directive 2015/863/EU for Restriction of Hazardous Substances in Electrical and Electronic Equipment.

2.31 Mechanical Specifications

Note: Refer to the outline drawing section 3.4 to view the drawings of SQ/TA 0022, 0030, 0045, SQ/TA 0090, SQ/TA 0090 with Chill Door Assembly, and SQ/TA 0015.

Parameter	Specification
Dimensions SQ0015 & TA0015	Height: 29.70" 754.4 mm Width: 26.14" 664 mm Depth: 30.14" 765.6 mm
Dimensions SQ0022 & TA0022, SQ0030 & TA0030, SQ0045 & TA0045	Height: 45.5" 1155.7 mm Width: 29.0" 736.6 mm Depth: 34.7" 881.4 mm
Dimensions SQ0090 & TA0090	Height: 73.7" 1872 mm Width: 33" 838.2 mm Depth: 44.2" 1122.7 mm
Dimensions (2) SQ0090 & TA0090 with chilled door option	Height: 76.2" 1935.4 mm Width: 33" 838.2 mm Depth: 56" 1422.4 mm
Unit Weight SQ0015 & TA0015	600 lbs. (272 kg)
Unit Weight SQ0022 & TA0022, SQ0030 & TA0030, SQ0045 & TA0045	1016 lbs. (461 kg)

Parameter	Specification
Unit Weight **SQ0090 & TA0090**	2500 lbs. (1133 kg)
Total Weight of Chilled door assembly[2]	Chilled Door Weight: 450 lbs. (204.1 kg) Frame Weight: 75 lbs. (34 kg) Total Added Weight: 525 lbs. (238.1 kg)
Shipping Weight **SQ0015 & TA0015**	700 lbs. (317.5 kg)
Shipping Weight **SQ0022 & TA0022, SQ0030 & TA0030, SQ0045 & TA0045**	1378 lbs. (625 kg)
Shipping Weight **SQ0090 & TA0090**	2862lbs. (1298 kg)
Material	Steel chassis with aluminum panels and covers.
Finish	Light textured painted external surfaces. Black Semi Glossy finish
Acoustic Noise **SQ0015 & TA0015**	45 dBA maximum at 0% to 50% load, 55 dBA maximum greater than 50% load to 100% load. Measured at one meter.
Acoustic Noise **SQ0022 & TA0022,** **SQ0030 & TA0030,** **SQ0045 & TA0045,** **SQ0090 & TA0090**	65 dBA maximum at 0% to 50% load, 75 dBA maximum greater than 50% load to 100% load. Measured at one meter.
Cooling	Fan cooled with air intake on the front and exhaust to the rear. Fans: SQ0015 / TA0015 – 2 x 225 CFM SQ0022 / TA0022 up to SQ0045 / TA0045 – 6 x 225 CFM SQ0090 / TA0090 – 12-14[1] x 225 CFM Air displacement 22 cubic feet per second (ft^3/s) max.
Internal Construction	Modular sub-assemblies

[1] *Additional cooling is required for XVC options.*

[2] *For more information refer to section 2.20 Hardware Options.*

2.32 Firmware/Software Options

Option [1]	Description
AVSTD, (MC)	Avionics Electrical Power Quality Test Software Package includes 160 (RTCA/DO160 E/F/G), 704 (MIL-STD 704 A/B/C/D/E/F), ABD (Airbus ADB100.1.8 D/E), A350 (Airbus ADB100.1.8.1 B/C).
AVALL, (MC)	Avionics Electrical Power Quality Test Software Package; includes AVSTD, B787 (Avionics Electrical Power Quality Test Software; Boeing 787B3-0147 A/B/C) AMD (Avionics Electrical Power Quality Test Software; Airbus AMD24 C)
MIL1399, (MC)	Interface Standard for Shipboard Systems Electric Power, Alternating Current. MIL-STD 1399-300B Shipboard Power Test
MIL1399+ AVSTD, (MC)	Interface Standard for Shipboard Systems Electric Power, Alternating Current Avionics Electrical Power Quality Test Software Package. includes 160 (RTCA/DO160 E/F/G), 704 (MIL-STD 704 A/B/C/D/E/F), ABD (Airbus ADB100.1.8 D/E), A350 (Airbus ADB100.1.8.1 B/C).
MIL1399+ AVALL, (MC)	Interface Standard for Shipboard Systems Electric Power, Alternating Current Avionics Electrical Power Quality Test Software Package; includes AVSTD, B787 (Avionics Electrical Power Quality Test Software; Boeing 787B3-0147 A/B/C) AMD (Avionics Electrical Power Quality Test Software; Airbus AMD24 C).
MC	Options are installed in all chassis of a multi-chassis (MC) configuration.
(1) For Avionics options, reference the Avionics Software Manual (P/N 4994-971) for test details. All options require the use of the provided Virtual Panels, graphical user interface Windows application software GUI; refer to AMETEK PPD website, www.programmablepower.com, to download the latest version.	

2.33 XVC444 Option Specifications

The XVC option provides an AC only output range of 0 to 444 VAC L-N. Common specifications for all models are given in Table 2-9. Current ratings for different power models for 3-phase and 1-phase mode are in Table 2-10 and Table 2-11 respectively. In XVC444 option range, all operating modes are supported. Output current limit characteristics are shown in Figure 2-5.

All Models	
Working mode	AC Mode
AC Output phase Voltage	0 – 444 V
Voltage Resolution	0.1 V
Voltage Programming Accuracy	± 0.25% FS / ±1.5 VAC rms
Output Coupling	AC coupled
Frequency range	with Standard option: 45 Hz – 500 Hz with HF option: 45 Hz – 900 Hz (see also HF option specification.) [1]
(1) Operating in 444 V range at 500 Hz to 900 Hz is available on SQ0090/TA0090 only.	

Table 2-9: Common Output electrical specifications for XVC444V option

Model	No of chassis	Output Power (kVA)	AC mode Output Current, Rated (1) (Per Phase)	
		AC mode	RMS (A)	Peak (A)
SQ0022/TA0022	1 x SQ0022 / 1 x TA0022	22.5	17	51
SQ0030/TA0030	1 x SQ0030 / 1 x TA0030	30	22	66
SQ0045/TA0045	1 x SQ0045 / 1 x TA0045	45	34	102
SQ0090/TA0090	2 x SQ0045 2 x TA0045 1 x SQ0090 1 x TA0090	90	68	204
SQ0135/TA0135	3 x SQ0045 3 x TA0045	135	101	303
SQ0180/TA0180	2 x SQ0090 2 x TA0090	180	135	405
SQ0270/TA0270	3 x SQ0090 3 x TA0090	270	203	609
SQ0360/TA0360	4 x SQ0090 4 x TA0090	360	270	810
SQ0450/TA0450	5 x SQ0090 5 x TA0090	450	338	1014
SQ0540/TA0540	6 x SQ0090 6 x TA0090	540	405	1215

(1) Operation at higher currents from 10% to 72% of voltage range (138% of rated current). Constant power is possible from 72% of voltage range declining to 100% of rated current at 100% of voltage range.

Table 2-10: Phase output Current and Power specifications for XVC444 option -Three phase.

Model	No of chassis	Output Power (kVA)	AC mode Output Current, Full-Scale (Per Phase)	
		AC mode	RMS (A)	Peak (A)
SQ0015/TA0015	1 x SQ0015 / 1 x TA0015	15	34	102
SQ0022/TA0022	1 x SQ0022 / 1 x TA0022	22.5	51	153
SQ0030/TA0030	1 x SQ0030 / 1 x TA0030	30	66	198
SQ0045/TA0045	1 x SQ0045 / 1 x TA0045	45	102	306
SQ0090/TA0090	2 x SQ0045 2 x TA0045 1 x SQ0090 1 x TA0090	90	204	612
SQ0135/TA0135	3 x SQ0045 3 x TA0045	135	303	909
SQ0180/TA0180	2 x SQ0090 2 x TA0090	180	405	1215
SQ0270/TA0270	3 x SQ0090 3 x TA0090	270	609	1827
SQ0360/TA0360	4 x SQ0090 4 x TA0090	360	810	2430
SQ0450/TA0450	5 x SQ0090 5 x TA0090	450	1014	3042
SQ0540/TA0540	6 x SQ0090 6 x TA0090	540	1215	3645

Table 2-11: Phase output Current and Power specifications for XVC444 option – Single phase

2.34 XVC555 Option Specifications

The XVC option provides an AC only output range of 0 to 555 VAC L-N. Common specifications for all models are given in Table 2-12. Current ratings for different power models for 3-phase and 1-phase mode are in Table 2-13 and Table 2-15 respectively. In XVC555 option range, all operating modes are supported. Output current limit characteristics are shown in Figure 2-5.

All Models	
Working mode	AC Mode
AC Output phase Voltage	0 – 555 V
Voltage Resolution	0.1 V

Voltage Programming Accuracy	± 0.25% FS / ±1.5 VAC rms
Output Coupling	AC coupled
Frequency range	with Standard option: 45 Hz – 500 Hz not supported in HF option.

Table 2-12: Common Output electrical specifications for XVC555 option

Model	**No of chassis**	**Output Power (kVA)**	**AC mode Output Current, Rated [(1)] (Per Phase)**	
		AC mode	**RMS (A)**	**Peak (A)**
SQ0090/TA0090	1 x SQ0090 1 x TA0090	90	54	162
SQ0180/TA0180	2 x SQ0090 2 x TA0090	180	108	324
SQ0270/TA0270	3 x SQ0090 3 x TA0090	270	162	486
SQ0360/TA0360	4 x SQ0090 4 x TA0090	360	216	648
SQ0450/TA0450	5 x SQ0090 5 x TA0090	450	270	810
SQ0540/TA0540	6 x SQ0090 6 x TA0090	540	324	972

(1) Operation at higher currents from 10% to 72% of voltage range (138% of rated current).
Constant power is possible from 72% of voltage range declining to 100% of rated current at 100% of voltage range.

Table 2-13: Phase output Current and Power specifications for XVC555 option-Three phase.

Model	No of chassis	Output Power (kVA)	AC mode Output Current, Full-Scale (Per Phase)	
		AC mode	RMS (A)	Peak (A)
SQ0090/TA0090	1 x SQ0090 1 x TA0090	90	162	486
SQ0180/TA0180	2 x SQ0090 2 x TA0090	180	324	972
SQ0270/TA0270	3 x SQ0090 3 x TA0090	270	486	1458
SQ0360/TA0360	4 x SQ0090 4 x TA0090	360	648	1944
SQ0450/TA0450	5 x SQ0090 5 x TA0090	450	810	2430
SQ0540/TA0540	5 x SQ0090 5 x TA0090	540	972	2916

Table 2-14: Phase output Current and Power Specifications for XVC555 option-Single phase

2.35 XVC666 Option Specifications

The XVC option provides an AC only output range of 0 to 666 VAC L-N. Common specifications for all models are given in Table 2-15. Current ratings for different power models for 3-phase and 1-phase mode are in Table 2-16 and Table 2-17 respectively. In XVC666 option range, all operating modes are supported. Output current limit characteristics are shown in Figure 2-5.

All Models	
Working mode	AC Mode
AC Output phase Voltage	0 – 666 V
Voltage Resolution	0.1 V
Voltage Programming Accuracy	± 0.25% FS / ±1.5 VAC rms
Output Coupling	AC coupled
Frequency range	With the Standard option: 45 Hz – 500 Hz, not supported in the HF option.

Table 2-15: Common Output electrical specifications for XVC666 option

Model	No of chassis	Output Power (kVA)	AC mode Output Current, Rated [(1)] (Per Phase)	
		AC mode	RMS (A)	Peak (A)
SQ0022/TA0022	1 x SQ0022 / 1 x TA0022	22.5	11.2	33.6
SQ0030/TA0030	1 x SQ0030 / 1 x TA0030	30	15	45
SQ0045/TA0045	1 x SQ0045 / 1 x TA0045	45	22.5	67.5
SQ0090/TA0090	2 x SQ0045 2 x TA0045 1 x SQ0090 1 x TA0090	90	45	135
SQ0180/TA0180	2 x SQ0090 2 x TA0090	180	90	270
SQ0270/TA0270	3 x SQ0090 3 x TA0090	270	135	405
SQ0360/TA0360	4 x SQ0090 4 x TA0090	360	180	540
SQ0450/TA0450	5 x SQ0090 5 x TA0090	450	225	675
SQ0540/TA0540	5 x SQ0090 5 x TA0090	540	270	810

[(1)] Operation at higher currents from 10% to 72% of voltage range (138% of rated current). Constant power is possible from 72% of voltage range declining to 100% of rated current at 100% of voltage range.

Table 2-16: Phase output Current and Power specifications for XVC666 option-Three phase.

Model	No of chassis	Output Power (kVA)	AC mode Output Current, Full-Scale (Per Phase)	
		AC mode	RMS (A)	Peak (A)
SQ0022/TA0022	1 x SQ0022 / 1 x TA0022	22.5	33.78	101.34
SQ0030/TA0030	1 x SQ0030 / 1 x TA0030	30	45	135

SQ0045/TA0045	1 x SQ0045 / 1 x TA0045	45	67.5	202.5
SQ0090/TA0090	2 x SQ0045 2 x TA0045 1 x SQ0090 1 x TA0090	90	135	405
SQ0180/TA0180	2 x SQ0090 2 x TA0090	180	270	810
SQ0270/TA0270	3 x SQ0090 3 x TA0090	270	405	1215
SQ0360/TA0360	4 x SQ0090 4 x TA0090	360	540	1620
SQ0450/TA0450	5 x SQ0090 5 x TA0090	450	675	2025
SQ0540/TA0540	6 x SQ0090 6 x TA0090	540	810	2430

Table 2-17: Phase output Current and Power specifications for XVC666 option-Single phase

2.36 XVC721 Option Specifications

The XVC option provides an AC only output range of 0 to 721 VAC L-N. Common specifications for all models are given in Table 2-18. Current ratings for different power models for 3-phase and 1-phase mode are in Table 2-19 and Table 2-20 respectively. In XVC721 option range, only Source and SINK-grid simulator operating modes are supported. For Electronic-load mode, contact the manufacturer for more details. Output current limit characteristics are shown in Figure 2-5.

All Models	
Working mode	AC Mode
AC Output phase Voltage	0 – 721 V
Voltage Resolution	0.1 V
Voltage Programming Accuracy	± 0.25% FS / ±1.5 VAC rms
Output Coupling	AC coupled
Frequency Range	With Standard option: 45 Hz – 500 Hz.

Table 2-18: Common Output electrical specifications for XVC721 option

Model	No of chassis	Output Power (kVA)	AC mode Output Current, Rated (1) (Per Phase)	
		AC mode	RMS (A)	Peak (A)
SQ0090/TA0090	1 x SQ0090 1 x TA0090	90	41.6	124.7
SQ0180/TA0180	2 x SQ0090 2 x TA0090	180	83.1	249.4
SQ0270/TA0270	3 x SQ0090 3 x TA0090	270	124.7	374.1
SQ0360/TA0360	4 x SQ0090 4 x TA0090	360	166.3	498.8
SQ0450/TA0450	5 x SQ0090 5 x TA0090	450	207.8	623.5
SQ0540/TA0540	6 x SQ0090 6 x TA0090	540	249.4	748.2

(1) Operation at higher currents from 10% to 72% of voltage range (138% of rated current). Constant power is possible from 72% of voltage range declining to 100% of rated current at 100% of voltage range.

Table 2-19: Phase output Current and Power specifications for XVC721 option -Three Phase

Model	No of chassis	Output Power (kVA)	AC mode Output Current, Full-Scale (Per Phase)	
		AC mode	RMS (A)	Peak (A)
SQ0090/TA0090	1 x SQ0090 1 x TA0090	90	124.8	374.1
SQ0180/TA0180	2 x SQ0090 2 x TA0090	180	249.6	748.2
SQ0270/TA0270	3 x SQ0090 3 x TA0090	270	374.4	1122.3
SQ0360/TA0360	4 x SQ0090 4 x TA0090	360	499.3	1496.4
SQ0450/TA0450	5 x SQ0090 5 x TA0090	450	624.1	1870.5
SQ0540/TA0540	6 x SQ0090 6 x TA0090	540	748.9	2241.6

Table 2-20: Phase output Current and Power specifications for XVC721 option- Single phase

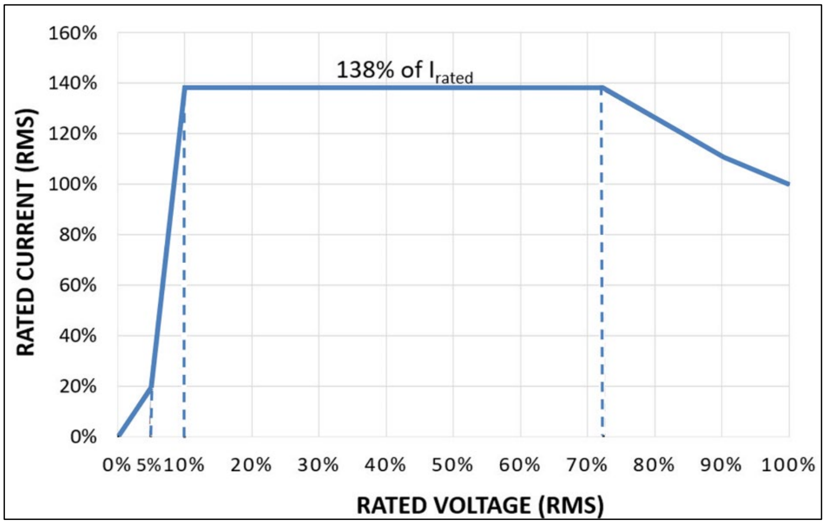

Figure 2-5: Output current limit characteristics -XVC option

2.37 HF Option Specifications

The HF option extends the maximum available output frequency from 550 Hz to 905 Hz. Some restrictions are in effect at this increased output frequency level. All other specifications of the Sequoia / Tahoe system remain unchanged if this option is installed except as noted in the table below. In SINK operating modes (Grid simulator and Electronic Load modes frequency is restricted to 550 Hz.

Parameter		Specification
Frequency	Range	-HF option: 16 Hz - 905 Hz
	Resolution	0.01 Hz < from 16.00 to 81.92 Hz 0.1 Hz > from 82.0 to 819.2 Hz 1 Hz > from 820 to 905 Hz
	Accuracy	±0.01 % 0.25 % for the FC option
Phase	Accuracy	16 - 100 Hz: < 1.5° 100 - 500 Hz: < 2° 500 – 819 Hz: < 4° 819 – 905 Hz: < 5°
Voltage	High Voltage Range	Maximum voltage at 905 Hz is 319 Vrms. Maximum frequency at 333 Vrms is 875 Hz See Figure 2-6.
	Low Voltage Range	Maximum voltage at 905 Hz is 159 Vrms. Maximum frequency at 166 Vrms is 875 Hz, See Figure 2-6.
	XVC444 Voltage Range	Maximum voltage at 905 Hz is 425.3 Vrms. Maximum frequency at 444 Vrms is 875 Hz, See Figure 2-6.
Note: *If the voltage or frequency settings shown here are exceeded for any length of time (> 1 sec), the SEQUOIA/TAHOE may shut down generating an over temperature fault to protect itself.*		

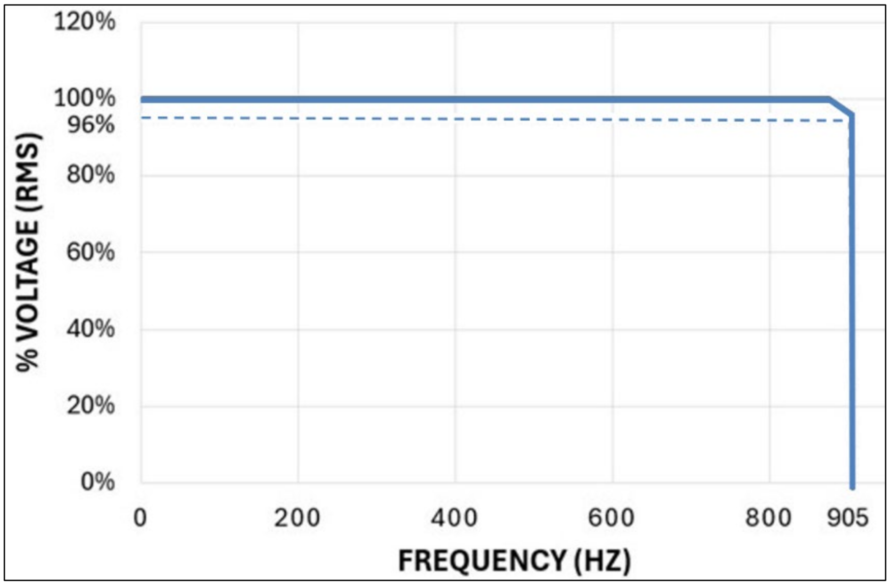

Figure 2-6: Output voltage limit characteristics -HF option

2.38 EHF Option Specifications

The EHF option extends the maximum available output frequency from 905 Hz to 1500 Hz. Some restrictions are in effect at this increased output frequency level. All other specifications of the SEQUOIA/TAHOE system remain unchanged if this option is installed except as noted in the table below. In SINK operating modes (Grid simulator and Electronic Load Mode), frequency is restricted to 550 Hz. In XVC options, frequency is restricted to 500 Hz.

Parameter		Specification
Frequency	**Range**	EHF option: 16 Hz - 1500 Hz
	Resolution	0.01 Hz from 16.00 to 81.92 Hz 0.1 Hz from 82.0 to 819.2 Hz 1 Hz from 820 to 905 Hz 1.5 Hz from 905 to 1500 Hz
	Accuracy	0.01 % 0.25 % for the FC option
Phase	**Accuracy**	16 - 100 Hz: < 1.5° 100 - 500 Hz: < 2° 500 – 819 Hz: < 4° 819 – 905 Hz: < 5° 905 - 1500 Hz: < 6°
Voltage	**High Voltage Range**	Maximum voltage at 1500 Hz is 319 Vrms. Maximum frequency at 333 Vrms is 1450 Hz, refer to Figure 2-7.

	Low Voltage Range	Maximum voltage at 1500 Hz is 159 Vrms. Maximum frequency at 166 Vrms is 1450 Hz, See Figure 2-7.
***Note**: If the voltage or frequency settings shown here are exceeded for any length of time (> 1 sec), the SEQUOIA/TAHOE may shut down generating an over temperature fault to protect itself.*		

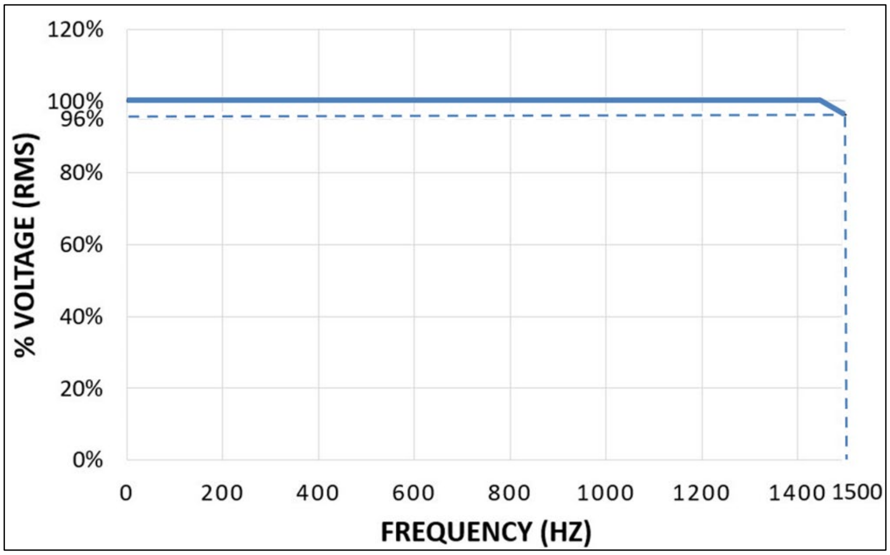

Figure 2-7: Output voltage limit characteristics – EHF option

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3. UNPACKING AND INSTALLATION

3.1 Unpacking

Check the unit for shipping damage as soon as you receive it. If you find any damage, contact the carrier. Do not send the instrument back to the factory without approval. Do not discard the packing container until you have checked for damage. If possible, keep the shipping container (wooden crate) in case the system needs to be returned to the factory for repair or upgrades.

CAUTION!

The power source weighs approximately:

600 lbs. / 272 kg for the SQ0015 / TA0015 model.

1016 lbs. / 461 kg for SQ0022/30/45 and TA0022/30/45 models.

2500 lbs. / 1133 kg for the SQ0090 / TA0090 model.

Obtain adequate help when moving the unit. Make sure the location (floor) in which the Sequoia / Tahoe Series unit(s) will be installed can support the weight of the unit(s).

CAUTION!

Selecting the Chill Door option for the SQ0090/TA0090 unit adds a total weight of 525 lbs. (450 lbs. for the door and 75 lbs. for the frame). Handle with care during installation.

3.1.1 Contents of Shipment

Depending on the model, configuration, and options selected for your Sequoia / Tahoe Series power source, the minimum items included in the shipment are:

1. Sequoia / Tahoe Series User Manual (P/N M447352-01)
2. Sequoia Series Programming Manual (P/N M447353-01)
3. Tahoe Series Programming Manual (P/N M447354-01)

Note: If any of these items are missing, contact AMETEK Customer Service Department at 858-458-0223 (local) or 1-800-733-5427 (toll free).

3.2 Power Requirements

The Sequoia / Tahoe Series Power Source has been designed to operate from a three-phase, three wire (Wye or Delta) AC input line. A protective earth connection is required as well (PE).

Available three-phase input model (Needs to be selected at the time of order) are:

- 208 V_{LL} ±10% (**Note:** Not available on 90kVA single cabinet chassis).
- 230 V_{LL} ±10% (**Note:** Not available on 90kVA single cabinet chassis).
- 380 V_{LL} ±10%
- 400 V_{LL} ±10%
- 480 V_{LL} ±10%

Figure 3-1: The Sequoia / Tahoe Power Sources

CAUTION!

Do not connect 400 V or 480 V into a unit set for 208 V or 230 V unit, the result will be a severely damaged unit. Always check the input rating on the model number tag before connecting AC input power. Consult factory if input settings must be changed.

3.3 Mechanical Installation

The Sequoia/Tahoe Series are self-contained power sources designed to be used as standalone units on a solid surface. They are fan-cooled, with air drawn in from the front and exhausted at the rear. Each unit must have a 12" clearance at the rear and a 6" clearance on both the left and right sides to ensure proper airflow. It is important to consider the overall airflow and internal heat buildup to prevent self-heating and overheating issues.

3.4 Outline Drawings

Figure 3-2, Figure 3-3 and Figure 3-4, show the protective covers for External Sense connector and AC/DC input and output, respectively. Figure 3-5, Figure 3-6 and Figure 3-9 show the outline drawings and overall dimensions for installing standalone model. Figure 3-22 shows the locations of the rear panel connectors.

3.4.1 Rear Panel Protective Covers

Protective covers are provided for the rear panel AC input, AC/DC output, and Output Sense connectors. The covers are attached to standoffs for the Sense connector and to threaded inserts for the input and output connectors. (Figure 3-2, Figure 3-3 and Figure 3-4) using #6-32 x ¼" thread length with a maximum tightening torque of 1.1 Nm (10 lb.-in).

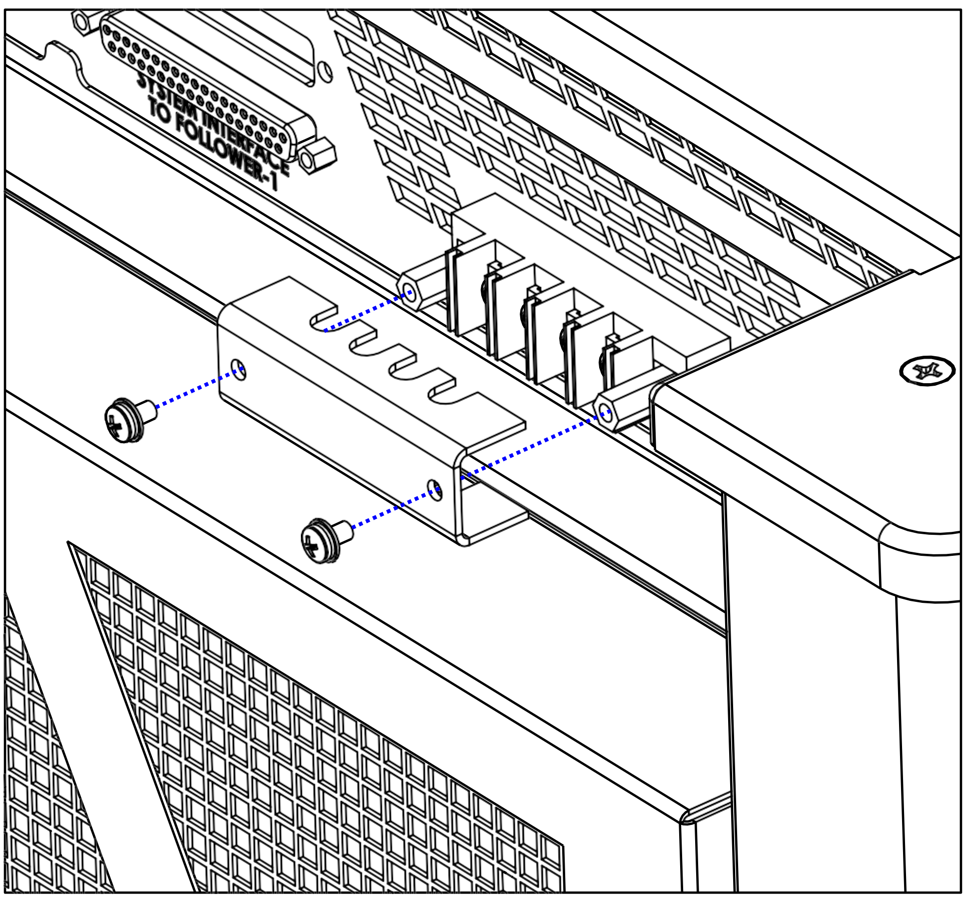


Figure 3-2: Rear Panel Output Sense Protective Cover Installation

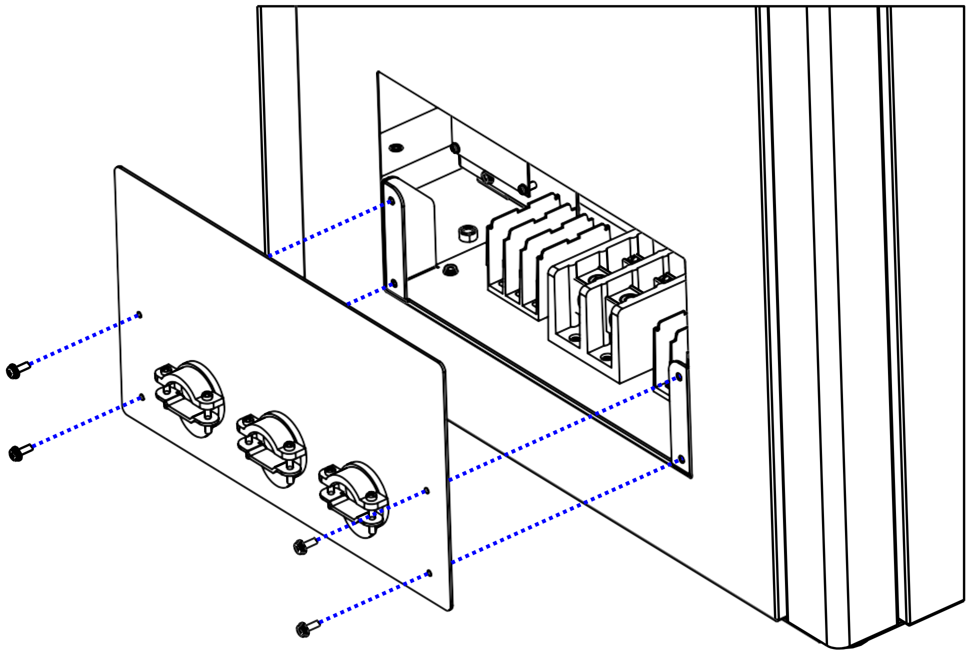


Figure 3-3: Rear Panel Input/Output Protective Cover Installation –For SQ/TA 0022, 0030, 0045 Output Power Models

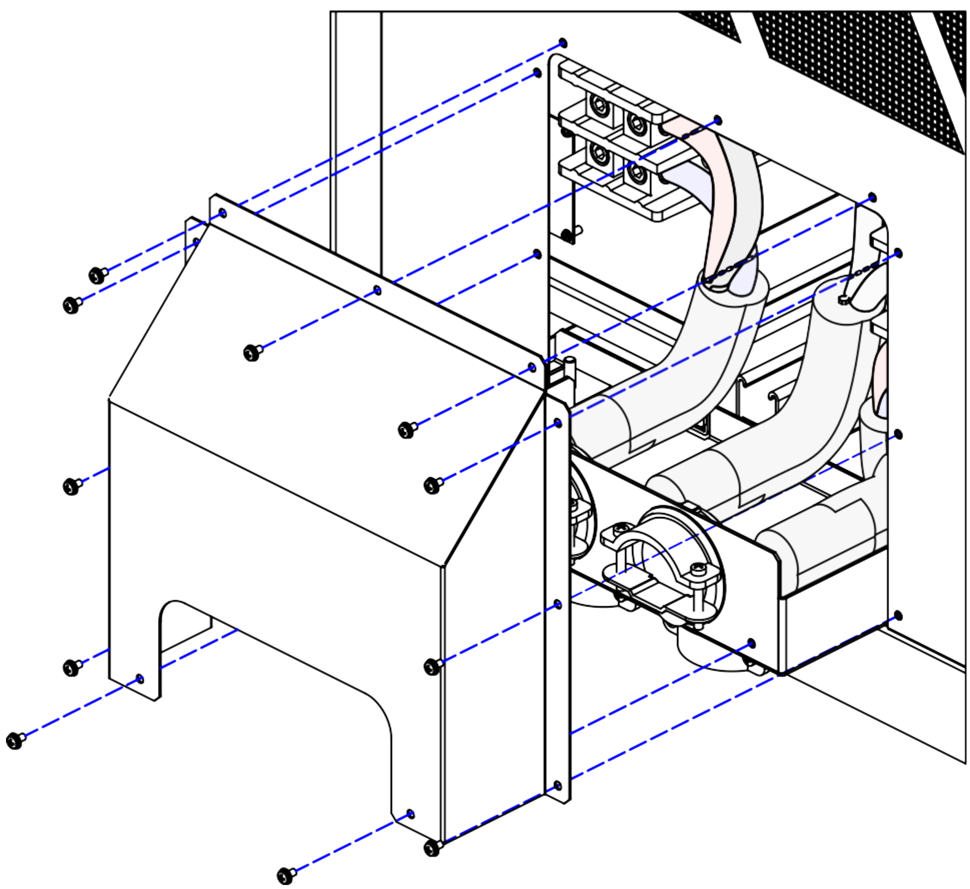


Figure 3-4: Rear Panel Input/Output Protective Cover Installation – SQ/TA 0090

3.4.2 Overall Dimensions for Installation

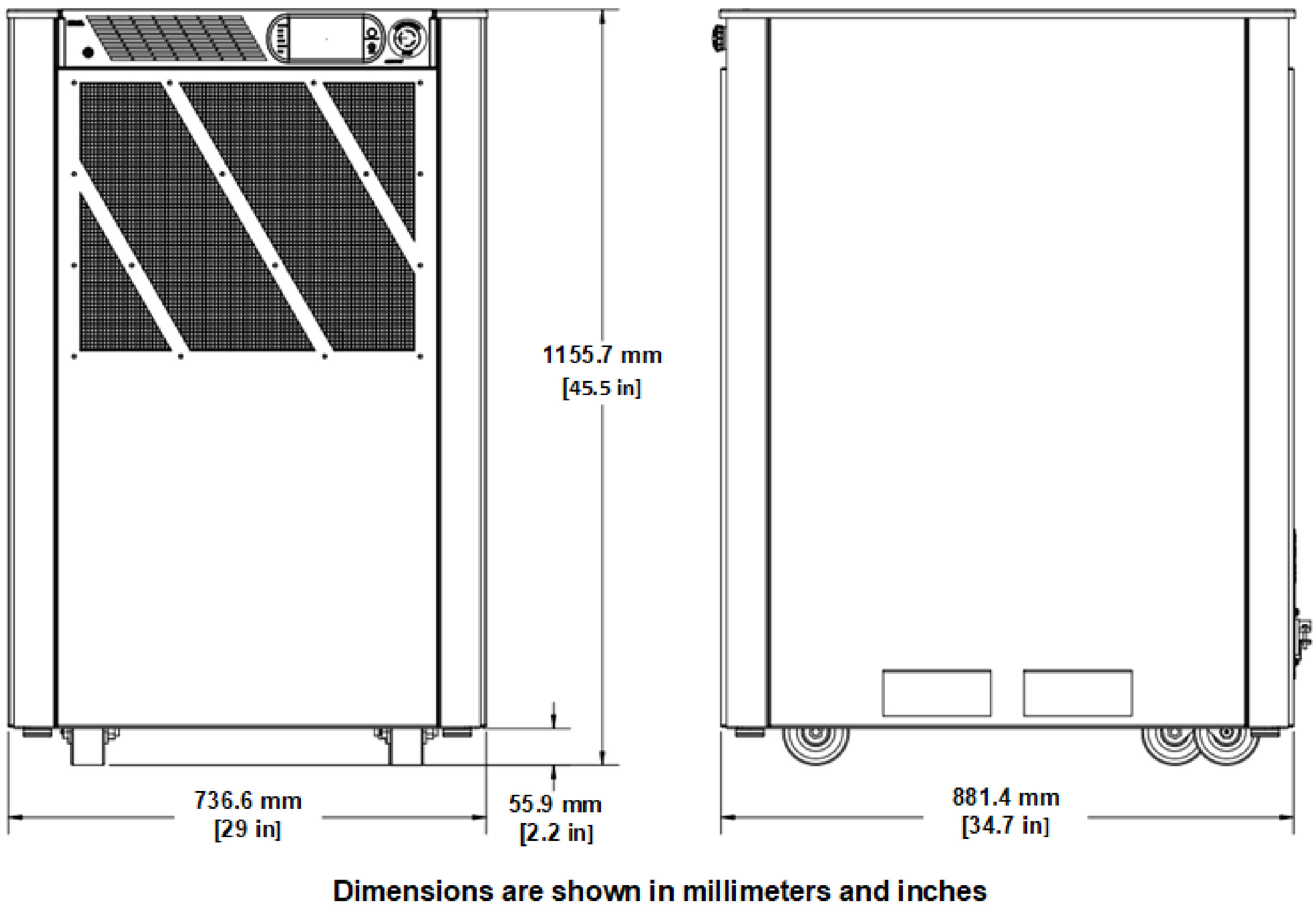


Figure 3-5: Overall Dimension Drawing of Standalone Model – For SQ/TA 0022, 0030, 0045 Output Power Models

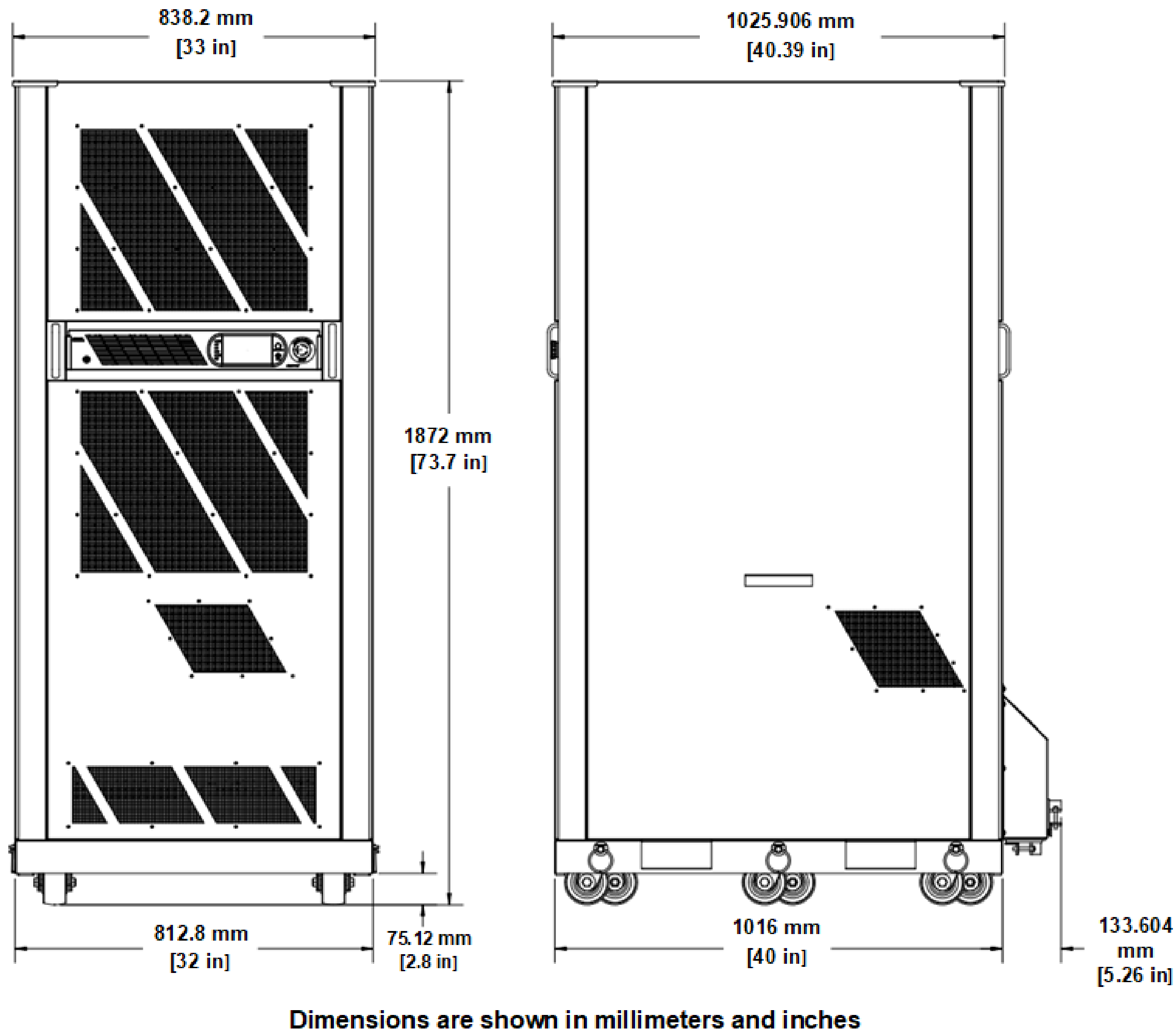


Figure 3-6: Overall Dimension Drawing of Standalone Model – SQ/TA 0090

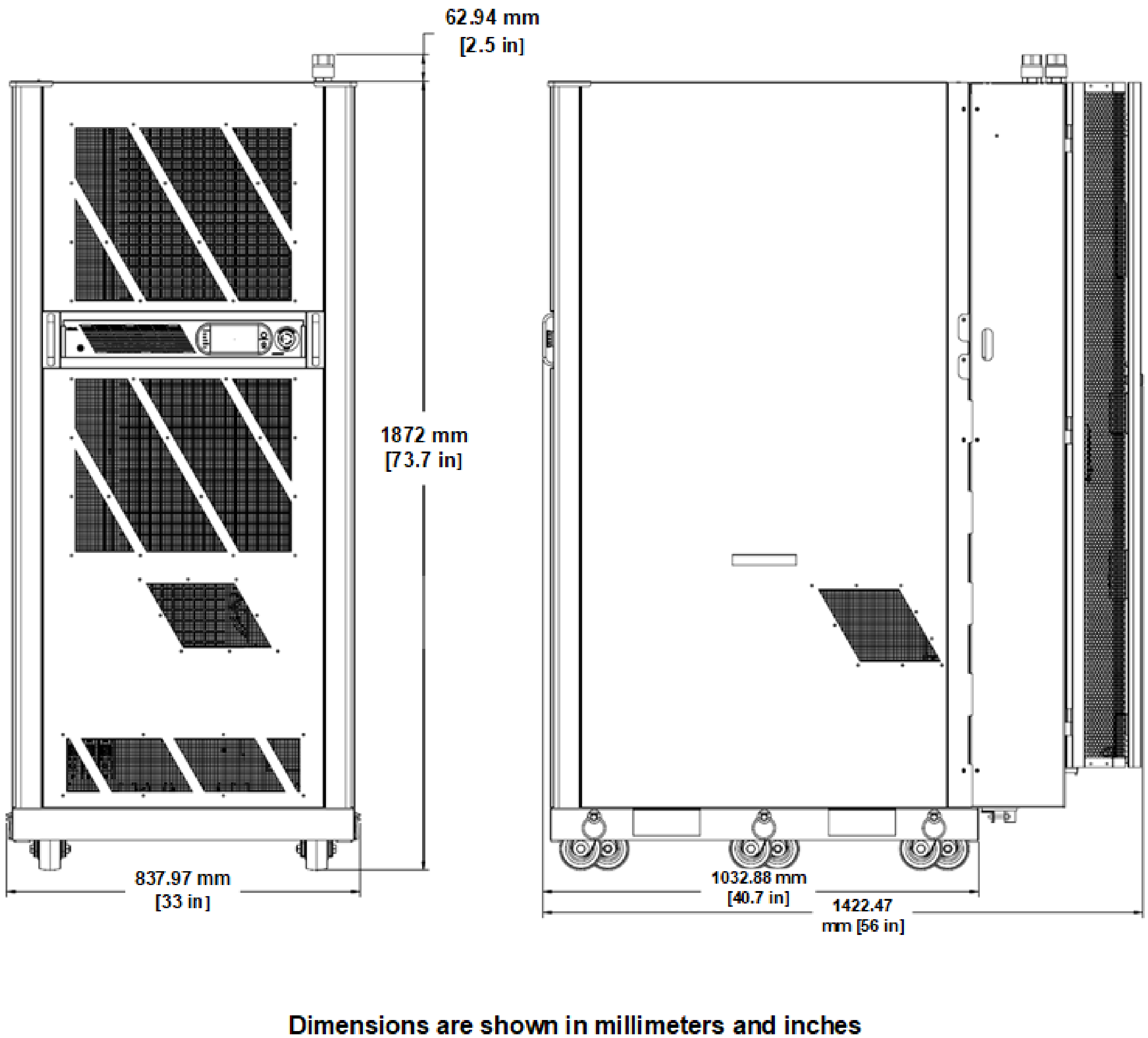


Figure 3-7: Overall Dimension Drawing of Standalone Model – SQ/TA 0090 with Chill door option

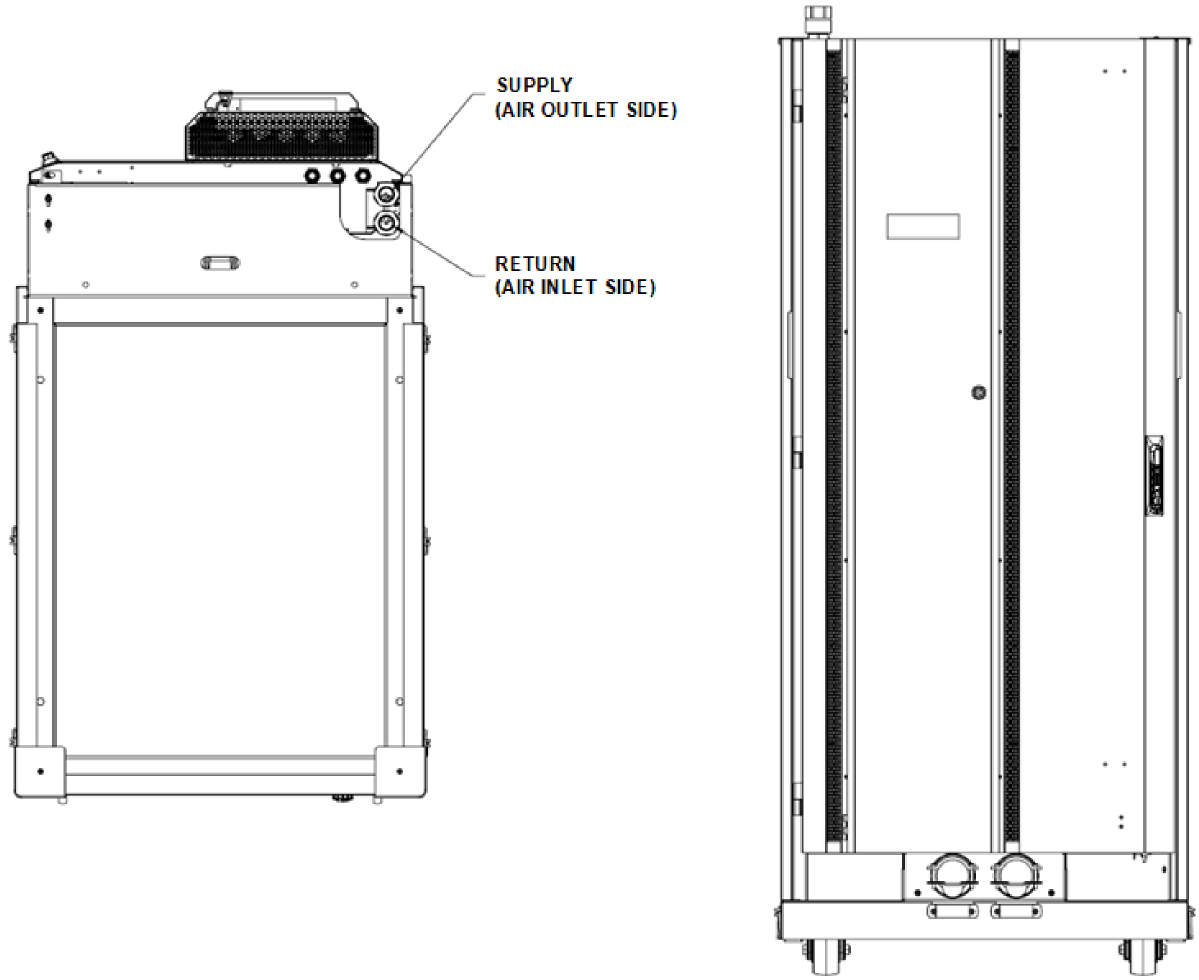


Figure 3-8: Air Inlet and Air Outlet Location and Rare view Drawings for SQ/TA 0090 with Chill Door Assembly model

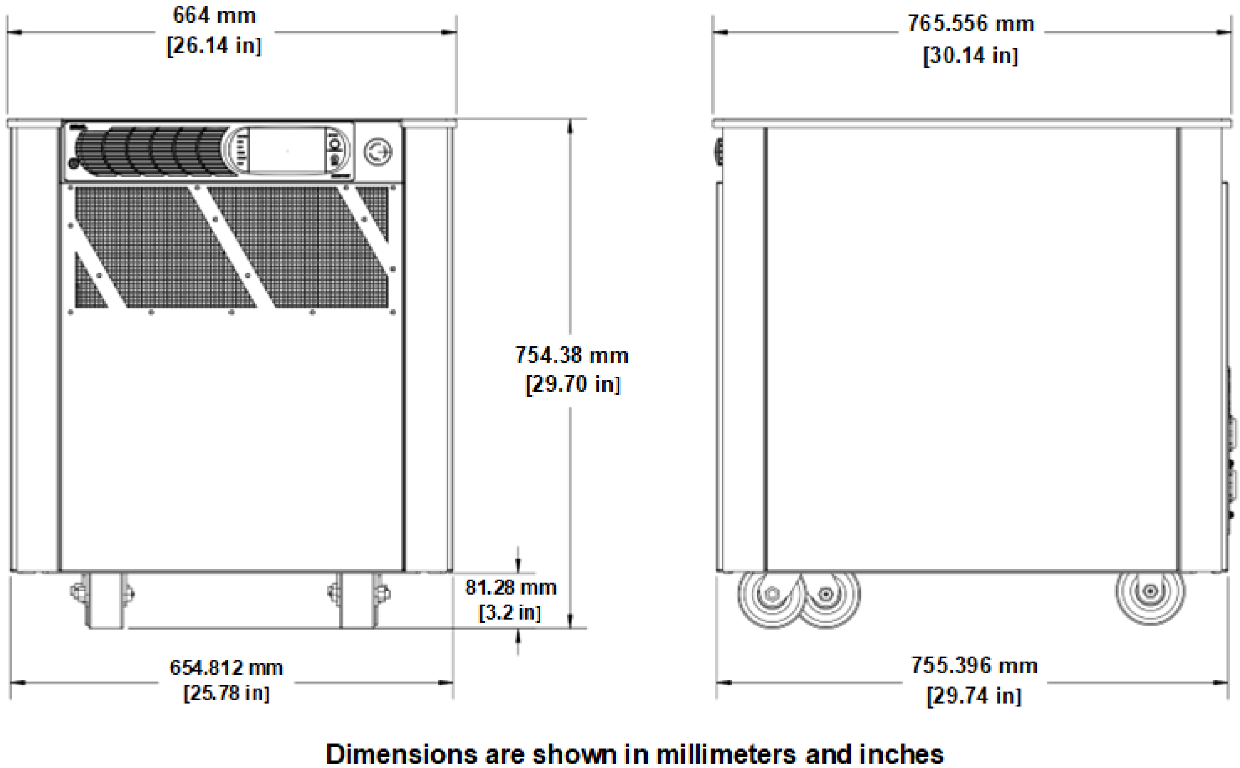


Figure 3-9: Overall Dimension Drawing of Standalone Model – SQ/TA 0015

3.5 AC Input Connections and Wiring

A three-phase Delta or Wye AC input voltage with sufficient amperage is required to power the Sequoia/Tahoe Series. Refer to the AC input specifications for the maximum AC current per phase. The front panel POWER switch of the power supply does not disconnect the AC input line from the unit. Ensure that an appropriately rated safety device, with a rating 25% higher than the maximum input line current specified in section 2.13, is included in the installation. This device must provide isolation from the AC input when opened. It should be located near the unit, within the operator's reach, and clearly labeled as the disconnection device. The protective device can be a three-phase circuit breaker or a similar branch circuit protection device with disconnect capability, such as a fused disconnect.

3.5.1 AC Input Overcurrent Protection

The Sequoia/Tahoe Series power supply has internal fuses at the AC input for fault protection. These fuses are not accessible to the user and provide fault isolation in case of failure of internal components or wiring. An appropriate overcurrent protection device must be installed externally within the system to protect the external wiring and interconnects.

CAUTION!

AC input connections should be routed through a properly sized and rated three-phase CIRCUIT PROTECTION device. This will protect building wiring and other circuits from damage or shutdown in case of a system problem. It will also facilitate removing AC input power to the system in case of service or reconfiguration requirements.

CAUTION!

AC input wiring and connections must comply with local electrical safety codes. Always consult a qualified electrician before installing any Sequoia/Tahoe system.

The input terminal block is located on the lower end of the rear of the Sequoia / Tahoe 22.5kVA to 45kVA chassis and for Sequoia / Tahoe 90 kVA chassis the input terminal block is located on the lower left end. To access the input terminal block, the protective rear cover needs to be removed first. Refer to Figure 3-3 and Figure 3-4.

CAUTION!

Always disconnect the input power completely before removing any protective cover. Allow the internal capacitors to fully discharge for at least 15 minutes before removing any cover

Figure 3-10 and Figure 3-11 shows the rear panel view of the connector and ground stud for models having an AC input with 3-wire plus ground. Table 3-1 shows the functions and connector pinout, and Table 3-2 the connector type.

A 3-phase, 3-wire input is connected to ∅A, ∅B and ∅C and a safety ground connection must always be made to the utility earth protection-ground using the rear panel safety-ground stud located adjacent to the AC input connector.

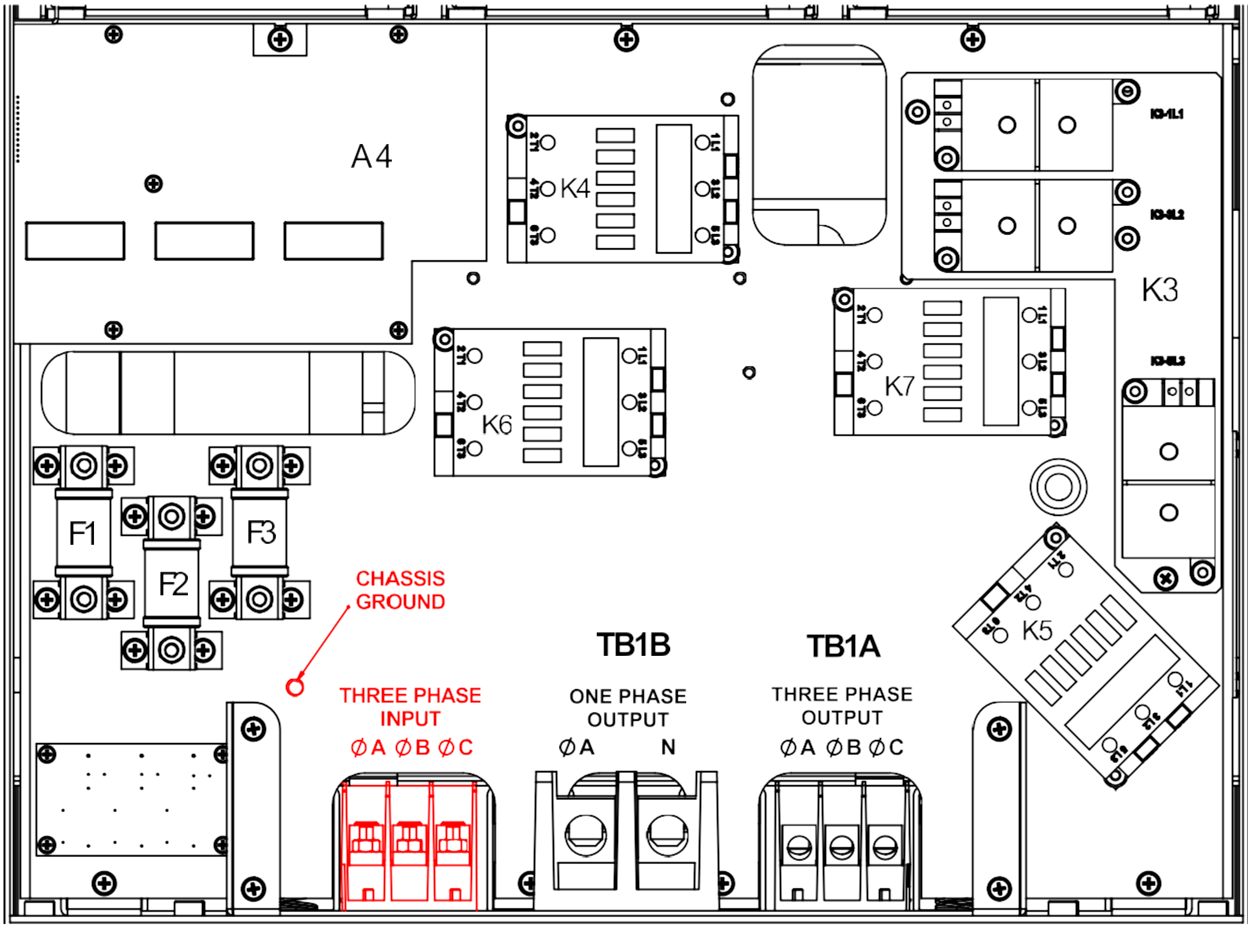


Figure 3-10: Location of AC Input Block and Chassis Ground Connection – For SQ/TA 0022, 0030, 0045 Output Power Models

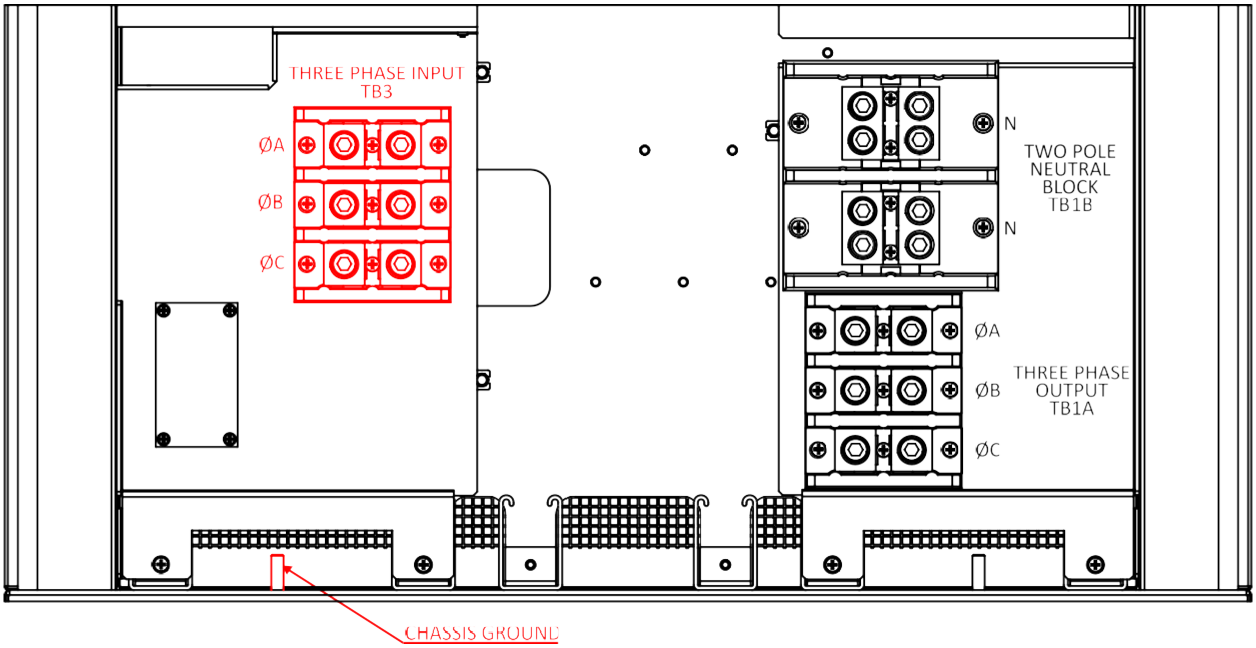


Figure 3-11: Location of AC Input Block and Chassis Ground Connection – SQ/TA 0090

Name	Type	Range	Function
AC INPUT L1	**AC Input**	- 208 V_{LL} ±10% - 230 V_{LL} ±10% - 380 V_{LL} ±10% - 400 V_{LL} ±10% - 480 V_{LL} ±10% 3-Phase, Line-Line	Line-1 input from utility AC mains
AC INPUT L2	**AC Input**	- 208 V_{LL} ±10% - 230 V_{LL} ±10% - 380 V_{LL} ±10% - 400 V_{LL} ±10% - 480 V_{LL} ±10% 3-Phase, Line-Line	Line-2 input from utility AC mains
AC INPUT L3	**AC Input**	- 208 V_{LL} ±10% - 230 V_{LL} ±10% - 380 V_{LL} ±10% - 400 V_{LL} ±10% - 480 V_{LL} ±10% 3-Phase, Line-Line	Line-3 input from utility AC mains
GND	**Safety Ground**	N/A	Safety-Ground connection from utility earth protection-ground

Table 3-1: AC Input Connector Pinout and Safety-Ground, for 3-Wire plus Ground Input Connector

Connector	Type, and Data
AC Input	Manufacturer name: MARATHON SPECIAL PRODUCTS Manufacturer part number: 1323574. Tightening torque: 4 Nm (35.4 lb.-in). Wire Cross Section: 2.5 mm^2, min (14 AWG) to 6 mm^2, max (10 AWG). Wire stripping length and lug would depend upon the size of wire used.
Safety-Ground	Stud name: FHS-0420-14. Stud type: thread specification of ANSI B1.1, 2A with a length of 22 mm. Manufacturer name for nut: MCMASTER-CARR. Manufacturer part number for nut: 91240A029. Nut tightening torque: 7.57 Nm (67 lb.-in), max.

Table 3-2: AC Input Connector Type – For SQ/TA 0022, 0030, 0045 Output Power Models

Connector	Type, and Data
AC Input	Manufacturer name: MARATHON SPECIAL PRODUCTS. Manufacturer part number: 1433126. Tightening torque: 0.7 Nm, min (6 lb.-in) to 1.13 Nm, max (10 lb.-in); Wire cross section: 2.5 mm^2, min (14 AWG) to 70 mm^2, max (2/0 AWG); Wire stripping length and lug would depend upon the size of wire used.
Safety-Ground	Stud name: FH-0518-16. Stud type: thread specification of ANSI B1.1, 2A with a length of 25 mm. Manufacturer name for nut: MCMASTER-CARR. Manufacturer part number for nut: 93580A568. Nut tightening torque: 14.68 Nm (130 lb.-in), max.

Table 3-3: AC Input Connector Type – For SQ0090/TA0090 Output Power Models

No AC input wiring is included with the Sequoia/Tahoe Series. The end-user or installer must provide it. The input wiring should be routed through the wire access opening at the rear bottom of the chassis (Refer to Figure 3-3 and Figure 3-4). A wire channel is provided to guide the input wiring to the connections that need to be made.

WARNING!

The Sequoia/Tahoe Series power source has internal fuses for fault protection, which are not accessible to the user. These fuses isolate faults in case of failure of internal components or wiring. An appropriate overcurrent protection device must be installed externally within the system to protect the external wiring and interconnects. The input connection wiring gauge (size) must be selected based on the maximum input current rating to ensure user safety and prevent damage to the power source, regardless of the actual output load.

WARNING!

The front panel POWER switch of the Sequoia/Tahoe Series power source does not disconnect the AC input line from the unit. Ensure that an appropriately rated safety disconnect device is included in the installation to isolate the AC input when opened. This device can be a switch or circuit breaker, and must be positioned near the unit, within the operator's reach, and clearly labeled as the disconnection device.

WARNING!

To meet product safety requirements, the EARTH GROUND must be connected to the chassis of the AC power system using the ground stud located directly below the AC input fuse block. A Green/Yellow ground wire should be used.

CAUTION!

Do not use the Neutral connection of a 3-phase Wye AC power system as a substitute for a true earth ground connection. AC power system neutral cannot be used as the protective earth ground.

The AC mains source must have a current rating equal to or greater than the input fuses and the input wiring must be sized to satisfy the applicable electrical codes. The rear cover must be re-installed prior to use and the strain relief provisions located at the rear bottom of the unit must be used to maintain protection against hazardous conditions.

WARNING!

For Delta input wiring connections, do not use an AC neutral conductor to ground the Sequoia/Tahoe chassis. Use a separate protective earth-ground connection only.

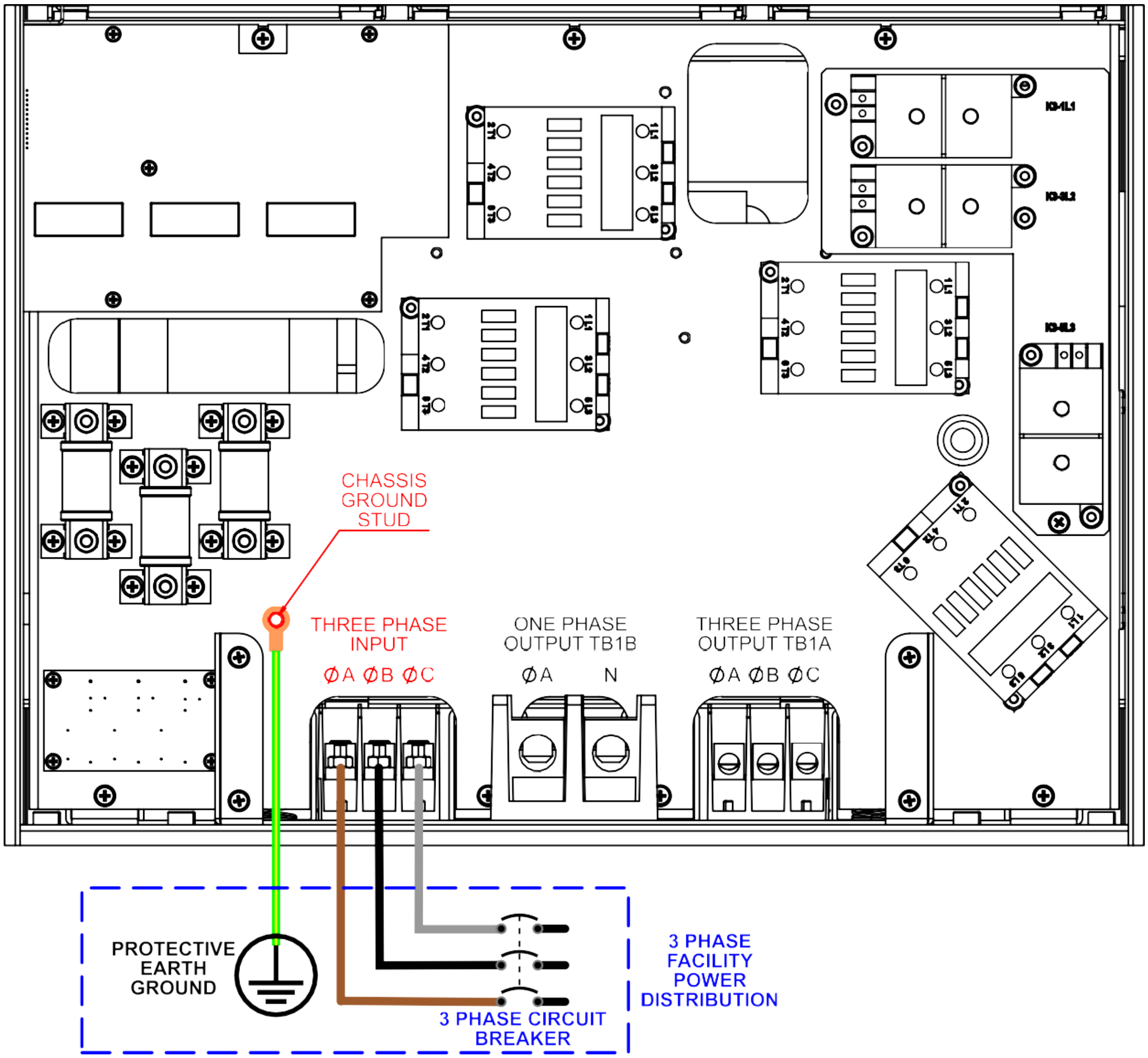


Figure 3-12: AC Input Connection Diagram – For SQ/TA 0022, 0030, 0045 Output Power Models

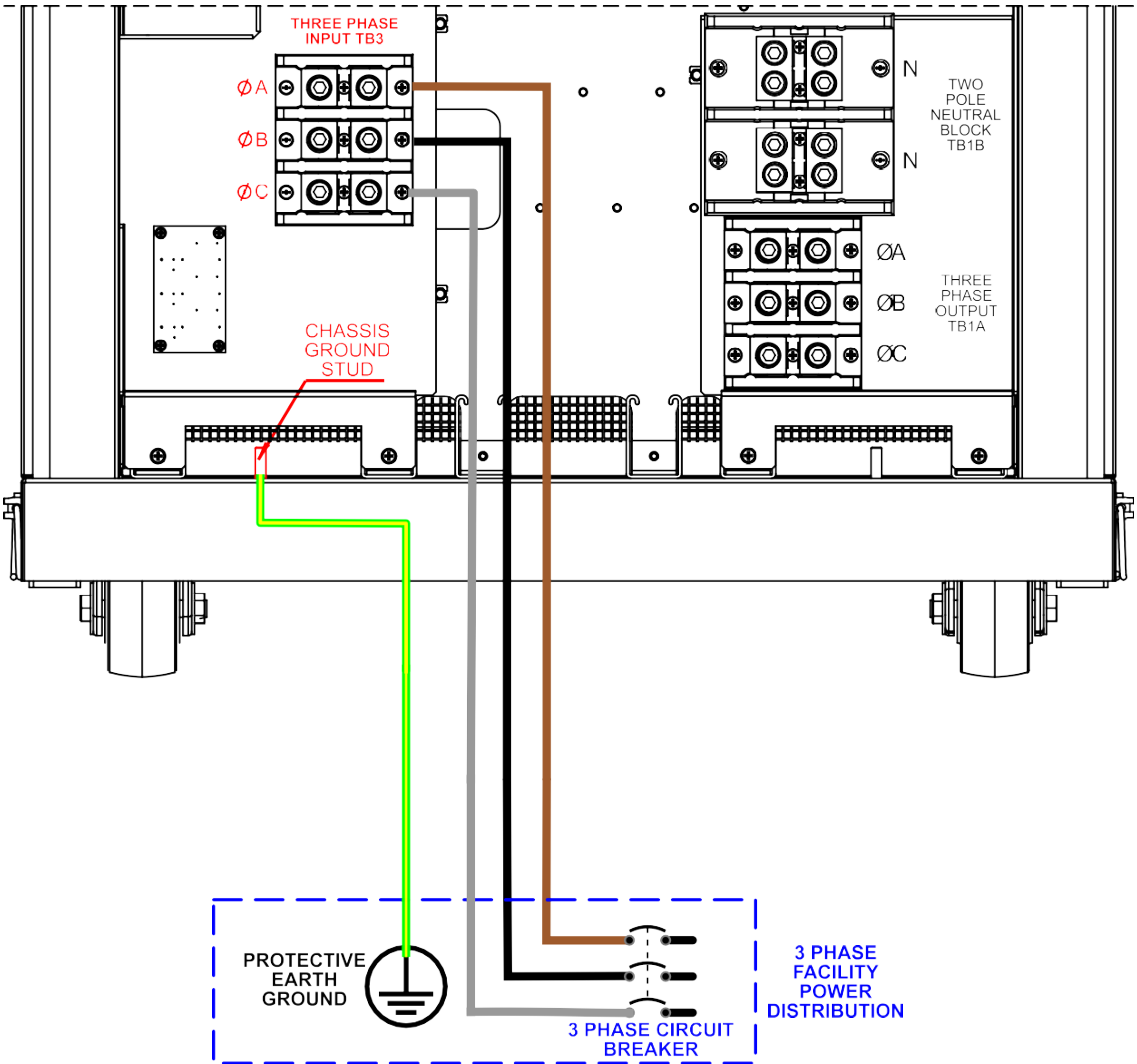


Figure 3-13: AC Input Connection Diagram – SQ/TA 0090

The input power cables, and protective circuit breaker must be rated to handle the input current and voltage of the power source and must comply with local electrical codes. Consult a qualified electrician before installation. Table 3-4 shows the minimum recommended wire size of the cables that may be used per Sequoia / Tahoe Series cabinet based on temperature and refer to Table 3-5 for wire resistance and voltage drop. Note that the wires must be sized to handle the maximum current that may occur under low-line conditions. Local electrical codes may require specific wire types and sizes. These ratings should also be considered when selecting a circuit breaker or equivalent disconnect device.

Cable lengths must not exceed twenty-five (25) feet. For lengths greater than 25 feet, calculate the voltage drop from the following formula:

2 X DISTANCE X CABLE RESISTANCE PER FT. X CURRENT = VOLT DROP

Size	Temperature Rating of Copper Conductor		
AWG	60°C	75°C	90°C
	Types: TW, UF	Types: RHW, THHW, THW, THWN, XHHW, USE, ZW	Types: TBS SA, SIS, FEP, FEPB, MI, RHH, THHN, THHW, XHH, XHHW
	Current Rating, A(RMS)		
18	–	–	14
16	–	–	18
14	15	20	25
12	20	25	30
10	30	35	40
8	40	50	55
6	55	65	75
4	70	85	95
3	85	100	115
2	95	115	130
1	110	130	145
0	125	150	170
00	145	175	195
000	165	200	225
0000	195	230	260

Table 3-4: Suggested Input Wiring Sizes for each Sequoia / Tahoe Cabinet

Size, AWG	A(RMS), (90°C wire)	Ohms/100 Ft, (One Way)	Voltage Drop/100 Ft, (Column 2 x Column 3)
18	14	0.639	8.95
16	18	0.402	7.24
14	25	0.253	6.33
12	30	0.159	4.77
10	40	0.100	4.00
8	55	0.063	3.47
6	75	0.040	3.00
4	95	0.025	2.38
3	115	0.020	2.30
2	130	0.016	2.08
1	145	0.012	1.74

0	170	0.0098	1.67
00	195	0.0078	1.52
000	225	0.0062	1.40
0000	260	0.0049	1.27

Table 3-5: Wire Resistance and Voltage Drop

CAUTION!

Capacitors in the power source may retain a hazardous electrical charge even after the power source has been disconnected from the mains supply. Allow the capacitors to discharge to a safe voltage before touching any exposed pins of the mains supply connectors. Power modules require at least 15 minutes to discharge to safe levels before they can be removed.

3.6 AC ON/OFF Push Button

It is important to understand the function of the ON/OFF Push Button on the bottom-left side of the front panel of the Sequoia/Tahoe Series unit. This button controls the LV Power supply, which provides DC bias power to the entire system. However, pressing the ON/OFF Push Button does not disconnect the AC input line from the unit. The AC input power is routed through a set of three AC line fuses (F1, F2 and F3) located in the lower left bottom of the chassis. These fuses protect the three amplifiers and the AC input transformer from excessive input currents. The AC input power is connected to the input transformer through a large three-pole contactor.

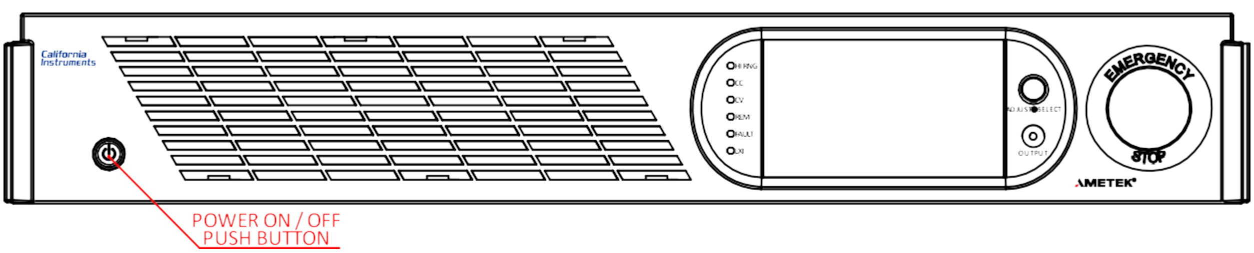


Figure 3-14: Power ON/OFF Push Button

CAUTION!

The AC input fuses can only be checked if the unit is fully de-energized and disconnected from any AC power input.

CAUTION!

If a failure occurs in any part of the Sequoia/Tahoe system, AC input power must be removed immediately and should not be restored until the system has been inspected by a qualified service technician. Always turn off the ON/OFF Push Button before re-applying AC input power.

CAUTION!

Under no circumstances should AC input power be applied if one or more of the AC input line fuses have failed and opened.

3.7 Output Connections

3.7.1 Output Wiring

The output terminal blocks, TB1A and TB1B, are located at the rear of the unit (Refer to Figure 3-16 for details). Three-phase output line connections are made to terminal block TB1A, with the phase outputs labeled A, B, and C. The neutral connection (if needed) can be made on terminal block TB1B for SQ0022/TA0022 to SQ0045/TA0045 models, while for the SQ0090/TA0090 model, TB1B is a two-pole neutral block for the neutral connection only.

For Sequoia/Tahoe models with single-phase capability, the single-phase A output connection is available on TB1B for SQ0022/TA0022 to SQ0045/TA0045 models. For the SQ0090/TA0090 models, the single-phase connection must be made externally to the cabinet by connecting the A, B, and C outputs from TB1A to a larger single terminal block.

Note that the neutral for both single-phase and three-phase modes is always located on TB1B for SQ0022/TA0022 to SQ0045/TA0045 models. The neutral connection is required for single-phase output mode and may be used for the Equipment Under Test in all three-phase output modes if needed.

WARNING!

In **Electronic load** three-phase mode of operation, **a Neutral connection is mandatory**. Neutral from the output of UUT (Unit Under Test) must be connected to the output neutral of the Sequoia. **Damage to the Sequoia will result if the Neutral is open.** If a 4 pole disconnect is used, ensure that the SEQUOIA's output is off before opening the disconnect.

In Grid Simulator three-phase mode of operation, a Neutral connection is optional.

The external sense inputs allow the power system output voltages to be monitored directly at the load and must be connected to the EXT SENSE (External Sense connector) when external sense is programmed. The external sense input does not need to be connected when internal sense is programmed. The external sense wires should be connected to the EXT SENSE connector on the rear panel and should be routed using a twisted shielded cable.

Refer to Figure 3-22 for the location of EXT sense and Figure 3-15 for External sense connector.

CAUTION!

For External Sense connection, a shielded cable MUST be used with the shield connected to chassis ground at the Ext. Sense connector.

External sense is recommended if the output wiring from the cabinets to the common output terminal block is not of equal length.

Figure 3-15: External sense Connector

CAUTION!

The output of the power source is isolated from the input line and floating with respect to chassis ground. If needed, either side (HI or LO) may be grounded.

If the UUT (Unit Under Test) changes frequently, consider using an external quick disconnect system to avoid powering down the UUT and removing the rear covers. This can be implemented with a panel-mounted socket (1-phase or 3-phase) of appropriate current and voltage rating (not supplied with the Sequoia/Tahoe Series).

The output power cables must be sufficiently sized to ensure that the total voltage drop does not exceed 1% of the rated output voltage between the power source and the load.

Table 3-6 shows the minimum recommended wire size of the cables that may be used per Sequoia / Tahoe Series cabinet based on temperature and refer to Table 3-7 for wire resistance and voltage drop.

Note that the wires must be sized to handle the maximum available current, which may vary depending on the voltage range and phase mode of the Sequoia/Tahoe models. If the unit has multiple output voltage ranges, size the wires for the lowest available voltage range, as the currents will be highest in that range.

Cable lengths must not exceed twenty-five (25) feet. For lengths greater than 25 feet, calculate the voltage drop from the following formula:

2 X DISTANCE X CABLE RESISTANCE PER FT. X CURRENT = VOLT DROP

Size	Temperature Rating of Copper Conductor		
AWG	60°C	75°C	90°C
	Types: TW, UF	Types: RHW, THHW, THW, THWN, XHHW, USE, ZW	Types: TBS SA, SIS, FEP, FEPB, MI, RHH, THHN, THHW, XHH, XHHW
	Current Rating, A(RMS)		
18	–	–	14
16	–	–	18
14	15	20	25
12	20	25	30
10	30	35	40
8	40	50	55
6	55	65	75
4	70	85	95
3	85	100	115
2	95	115	130
1	110	130	145
0	125	150	170
00	145	175	195
000	165	200	225
0000	195	230	260

Table 3-6: Suggested Output Wiring Sizes for each Sequoia / Tahoe Cabinet

Size, AWG	A(RMS), (90°C wire)	Ohms/100 Ft, (One Way)	Voltage Drop/100 Ft, (Column 2 x Column 3)
18	14	0.639	8.95
16	18	0.402	7.24
14	25	0.253	6.33
12	30	0.159	4.77
10	40	0.100	4.00
8	55	0.063	3.47
6	75	0.040	3.00
4	95	0.025	2.38
3	115	0.020	2.30
2	130	0.016	2.08
1	145	0.012	1.74
0	170	0.0098	1.67
00	195	0.0078	1.52
000	225	0.0062	1.40

0000	260	0.0049	1.27

Table 3-7: Wire Resistance and Voltage Drop

CAUTION!

When the unit is operating in DC mode, all three-phase output return current will flow through the neutral wire in TB1B. Therefore, use appropriately sized wire gauges to handle the return current.

3.7.2 Output Terminal Blocks

The Sequoia/Tahoe 22.5kVA to 45kVA Series models have two output terminal blocks, TB1A and TB1B. When operating in single-phase mode, only terminal block TB1B will be used. The terminal blocks are located at the lower end of the rear panel, which must be removed to access them.

CAUTION!

REMOVE ALL INPUT POWER TO THE UUT BEFORE REMOVING THE REAR PANEL.

WARNING!

Do not use the output terminal block for both single-phase and three-phase connections simultaneously. For safety, ensure all single-phase connections are disconnected when operating in three-phase mode, and vice versa.

Terminal block TB1B always provides the output neutral connection, regardless of the phase mode (1 or 3- phase output mode).

For the Sequoia / Tahoe 22.5kVA to 45kVA models, in single-phase mode, phase A output is provided through ∅A of TB1B.

In three-phase mode, phase A, B, and C outputs are provided through terminals ∅A, ∅B and ∅C of TB1A, respectively.

Connector	Terminal	Mode	Output
TB1A	∅A	3 Phase	Phase A
	∅B	3 Phase	Phase B
	∅C	3 Phase	Phase C
TB1B	∅A	1 Phase	Phase A
	N	1 and 3 Phase	Neutral

Table 3-8: Output Terminal connections – for SQ/TA 0022, 0030, 0045

The Sequoia/Tahoe 90kVA Series models have a single three-phase output terminal block, TB1A, as no single-phase terminal block is provided with the 90kVA series models. To establish a single-phase connection, the user must connect the A, B, and C outputs from TB1A to a larger single terminal block, which should be connected externally to the SQ0090/TA0090 cabinet (refer to Table 3-16).

The chassis will use only one output terminal block when operating in single-phase mode. The terminal blocks are located at the lower end of the rear panel, which must be removed to access them. Terminal block TB1B only provides the output neutral connection.

In three-phase mode, phase A, B, and C outputs are provided through terminals ∅A, ∅B and ∅C of TB1A, respectively.

Connector	Terminal	Mode	Output
TB1A	∅A	3 Phase	Phase A
	∅B	3 Phase	Phase B
	∅C	3 Phase	Phase C
TB1B	N	1 and 3 Phase	Neutral
	N	1 and 3 Phase	Neutral

Table 3-9: Output Terminal connections – for SQ/TA 0090

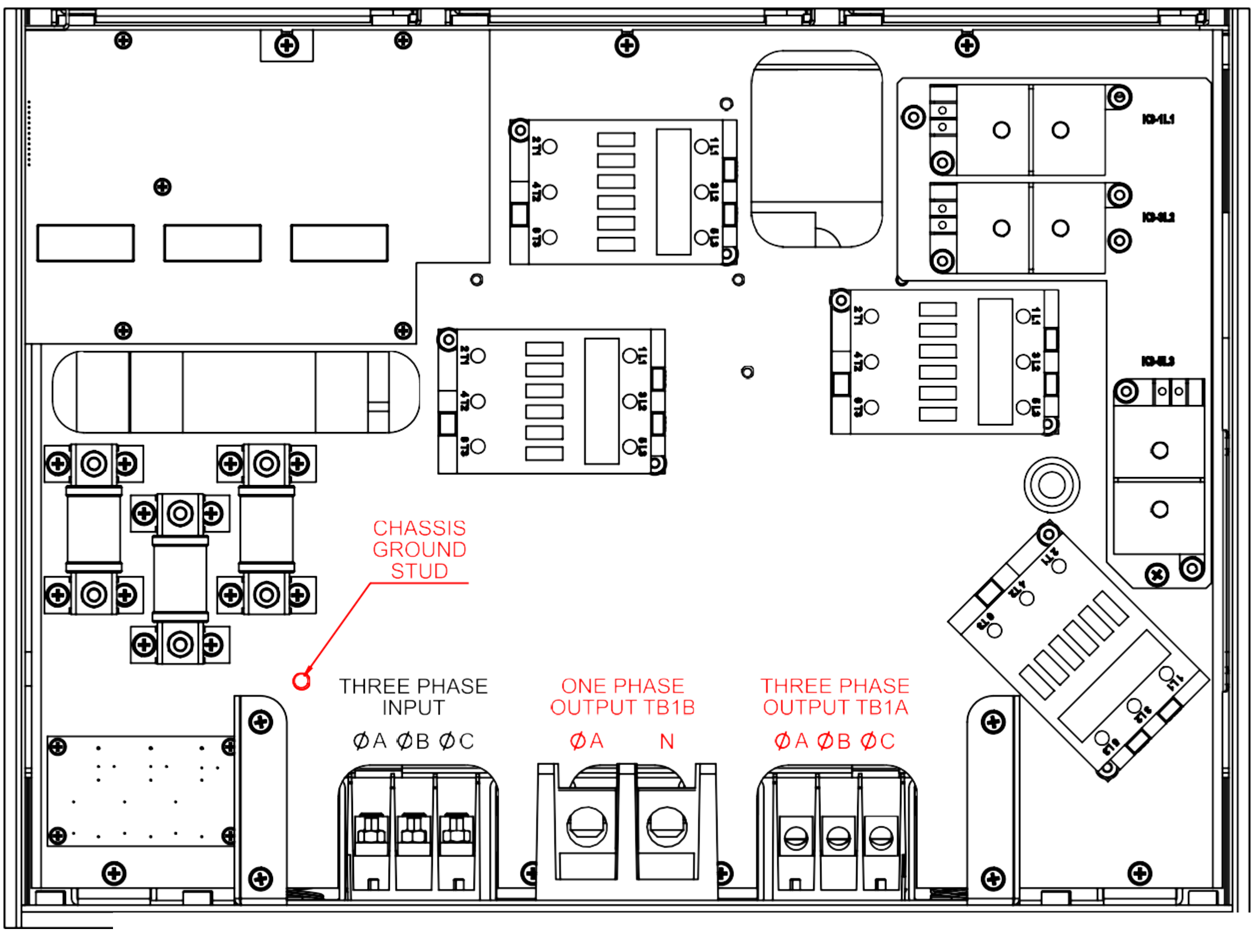


Figure 3-16: Location of Output Terminals – For SQ/TA 0022, 0030, 0045 Output Power Models

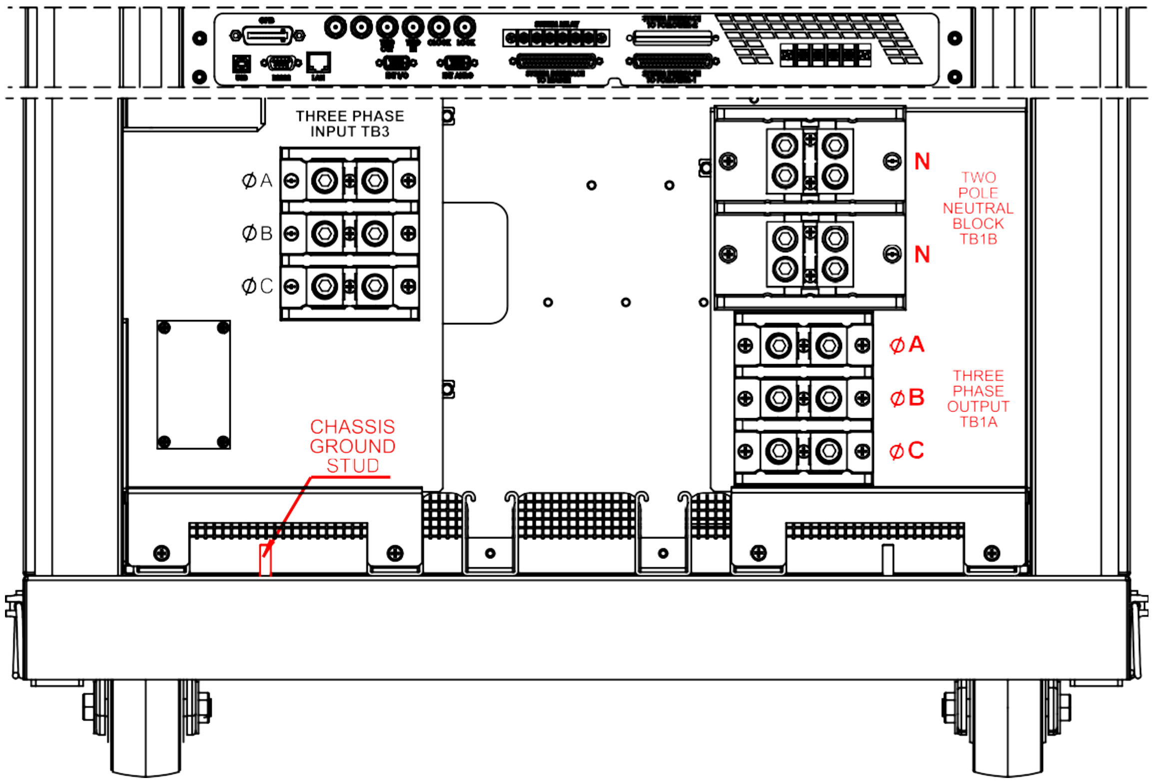


Figure 3-17: AC Output Connector Locations SQ/TA 0090

Refer to Figure 3-16 for a view of the connector, Table 3-10 for the pinout and functions, and Table 3-11 for the connector type for three phase output terminal block.

Name	Type	Range	Function
Phase-A LINE	Output	0-166/333 VAC. 0 V to ±220/440 VDC	Connection of AC/DC output Phase-A
Phase-B LINE	Output	0-166/333 VAC. 0 V to ±220/440 VDC	Connection of AC/DC output Phase-B
Phase-C LINE	Output	0-166/333 VAC. 0 V to ±220/440 VDC	Connection of AC/DC output Phase-C

Table 3-10: AC/DC Three Phase Output Connector Pinout

Connector	Type and Data
AC/DC Output	Manufacturer name: MARATHON; Manufacturer part number: 1423570. Wire stripping length: 17 mm (11/6"); lug size: 10 AWG. Tightening torque: 4 Nm (35.4 lb.-in). Wire cross section: 2.5 mm², min (14 AWG) to 6 mm², max (10 AWG).

Table 3-11: AC/DC Three-Phase Output Connector Type – for SQ0022

Refer to Figure 3-14 for a view of AC Output Connector Locations for SQ/TA 0090, Table 3-10 for AC/DC Three Phase Output Connector Pinout, and Table 3-12: AC/DC Three phase – SQ0090 for the connector type for three phase output terminal block.

Connector	Type and Data
AC/DC Output	Manufacturer Name: MARATHON Manufacturer part number: 1433126 Wire stripping length: 27 mm (1/6") Tightening torque: 3.4 Nm (30 lb.-in). Wire cross section: 16 mm^2, min (6 AWG) to 18.25 mm^2, max (5.5 AWG).

Table 3-12: AC/DC Three phase – SQ0090

Refer to Figure 3-16 for a view of the connector, Table 3-13 for the pinout and functions, and Table 3-14 for the connector type for single phase output terminal block.

Name	Type	Range	Function
Phase-A LINE	Output	0-166/333 VAC. 0 V to ±220/440 VDC	Connection of AC/DC output Phase-A
Neutral	Output	NA	Neutral output

Table 3-13: AC/DC Single Phase Output Connector Pinout – SQ22

Connector	Type
AC/DC Output	Manufacturer Name: MARATHON SPECIAL PRODUCTS. Manufacturer part number: 1432553. Wire stripping Length: 27 mm (1/6"); lug size: 4 AWG tightening torque: 3.4 Nm (30 lb.-in). Wire cross section: 16 mm^2, min (6 AWG) to 25 mm^2, max (4 AWG).

Table 3-14: AC/DC Single Phase Output Connector Type – SQ22

Refer to Figure 3-16 for a view of the connector, Table 3-13 for the pinout and functions, and Table 3-14 for the connector type for Two Pole Neutral terminal block.

Name	Type	Range	Function
Neutral	Output	NA	Neutral output
Neutral	Output	NA	Neutral output

Table 3-15: Two Pole Neutral Terminal Connector Pinout – for SQ90

Connector	Type and Data
AC/DC Output	Manufacturer Name: MARATHON SPECIAL PRODUCTS. Manufacturer part number: 1452129. Wire stripping length: 27 mm (1 / 6”); Tightening torque: 3.4 – 4.5 Nm (30 - 40 lb.-in); Wire cross section: 16 mm^2, min (6 AWG) to 18.25 mm^2, max (5.5 AWG).

Table 3-16: Two Pole Neutral Terminal Connector Type – SQ090

If two or more Sequoia/Tahoe chassis are used to form a single power system, the outputs of all chassis must be combined (paralleled by phase). This can be done directly at the UUT (Unit Under Test) if convenient. Multi-chassis systems include two blocks: a 2-position block and a 3-position block. These blocks allow up to four wires to be combined into one larger wire gauge.

The outputs of the Sequoia/Tahoe chassis are connected to one side of these blocks (Phase A, B, and C into the 3-position terminal and the neutral into the 2-position terminal).

The UUT can then be connected to the other side. Note that the wire size to the UUT should be selected to accommodate the combined current from multiple phases (double or triple current per phase).

CAUTION!

Note that even if the UUT (Unit Under Test) has a three-phase delta input, the output neutrals of the Sequoia/Tahoe chassis must be connected for the system to function correctly.

3.7.3 Single Phase mode Output Wiring Diagram

Figure 3-18 and Figure 3-19 shows the required output connections for a single-phase mode output configuration (rear-view perspective). Refer to section 3.7.4 for the three-phase mode.

Always disconnect all input power feeding this chassis before removing the rear panel cover that provides access to the input and output terminal connections.

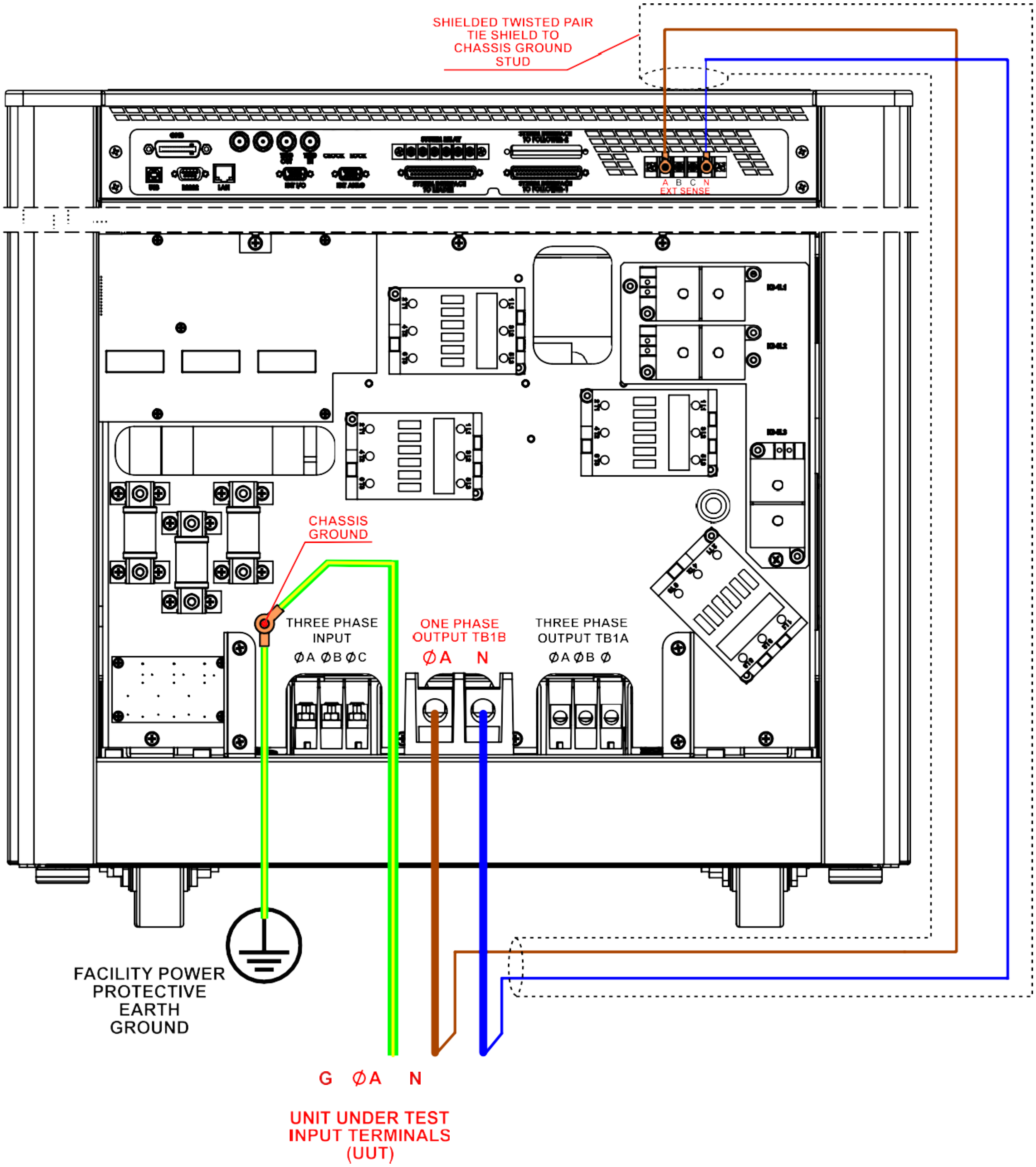


Figure 3-18: Single Phase Output Wiring – For SQ/TA 0022, 0030, 0045 Output Power Models

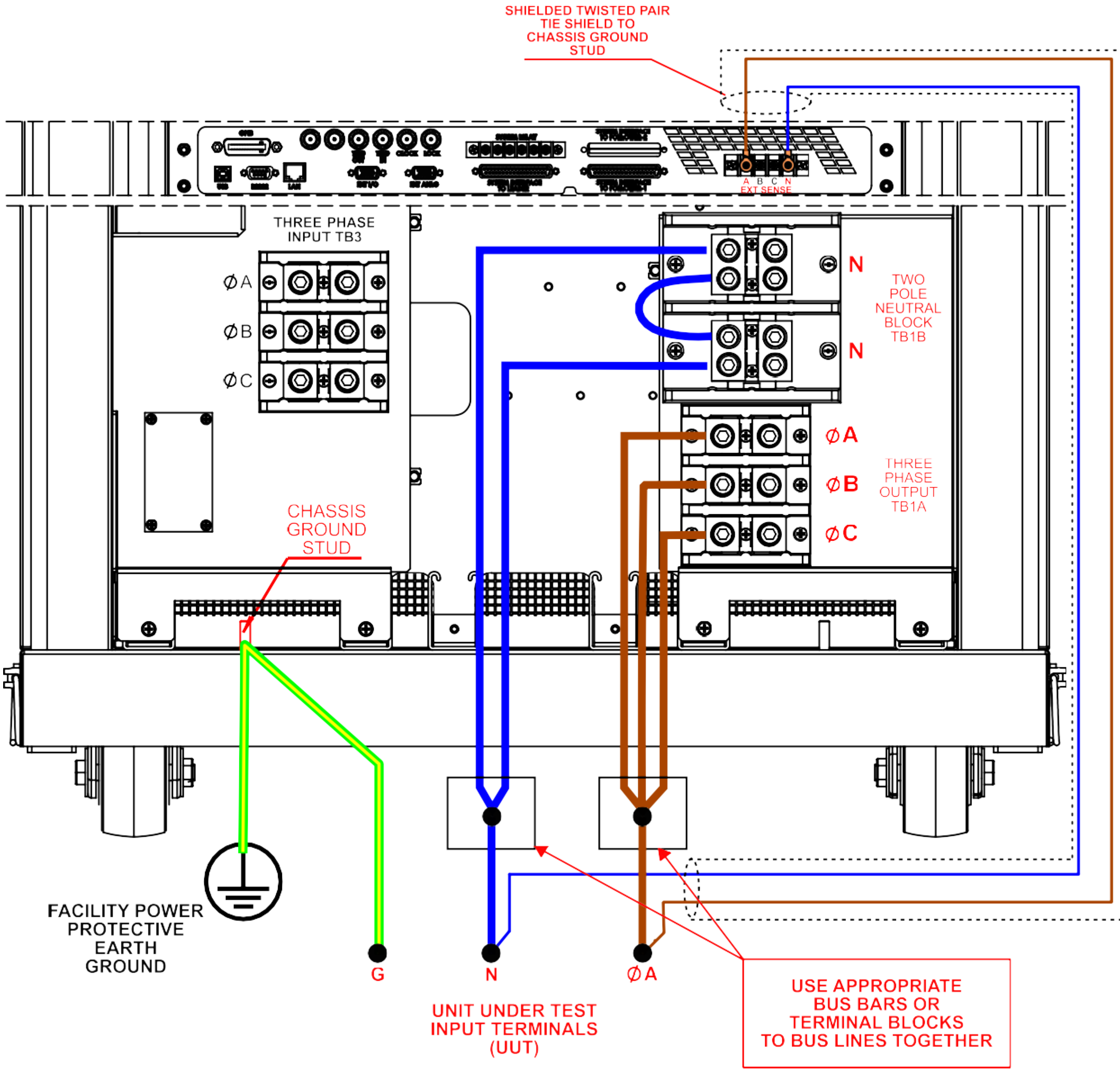


Figure 3-19: Single Phase Output Wiring – SQ/TA 0090

3.7.4 Three Phase mode Output Wiring Diagram

The Figure 3-20 and Figure 3-21 shows the required output connections for a three-phase mode output configuration (rear-view perspective). Refer to section 3.7.3 for the single-phase mode.

Always disconnect all input power feeding this chassis before removing the rear panel cover that provides access to the input and output terminal connections.

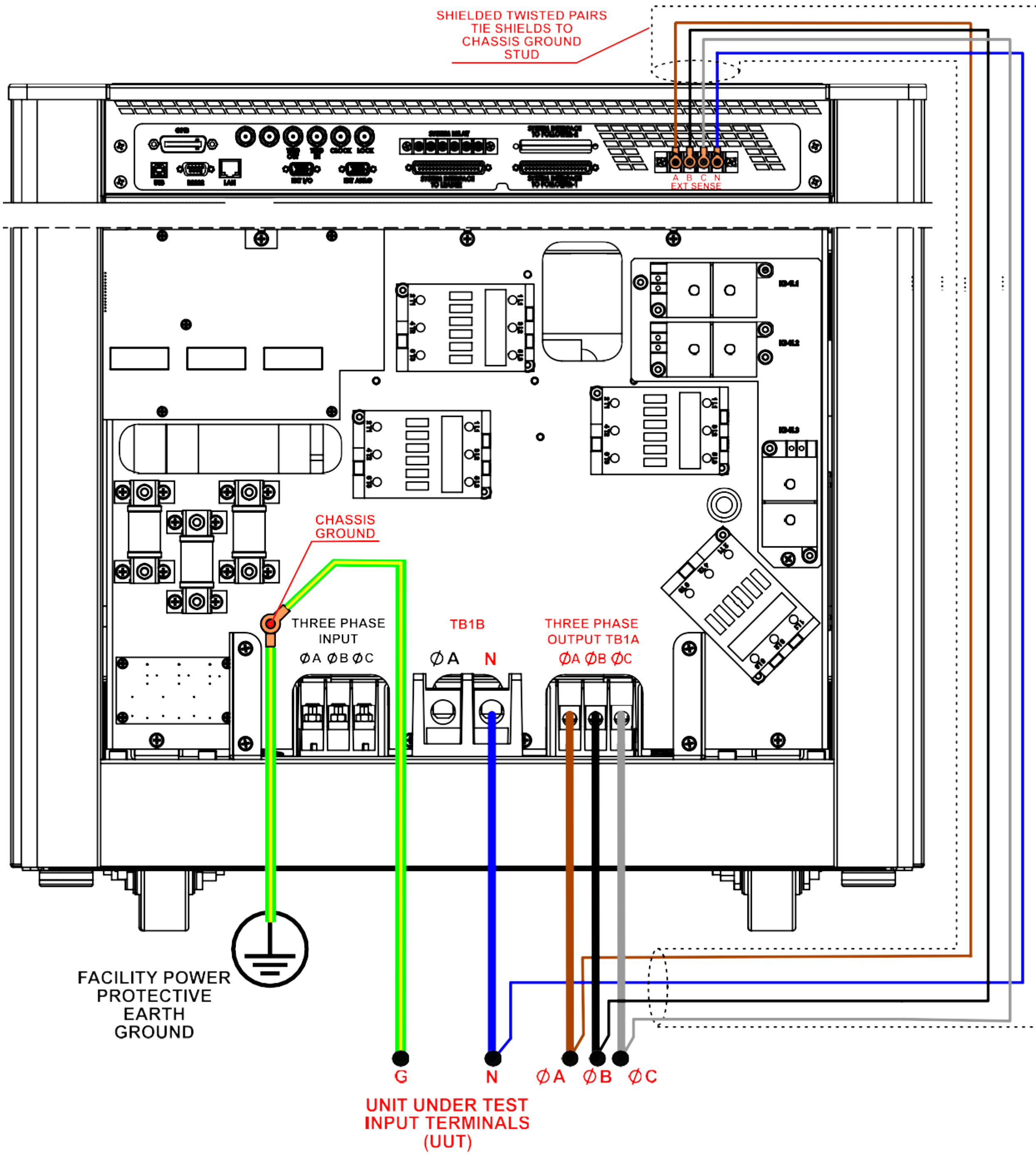


Figure 3-20: Three Phase Output Wiring – For SQ/TA 0022, 0030, 0045 Output Power Models

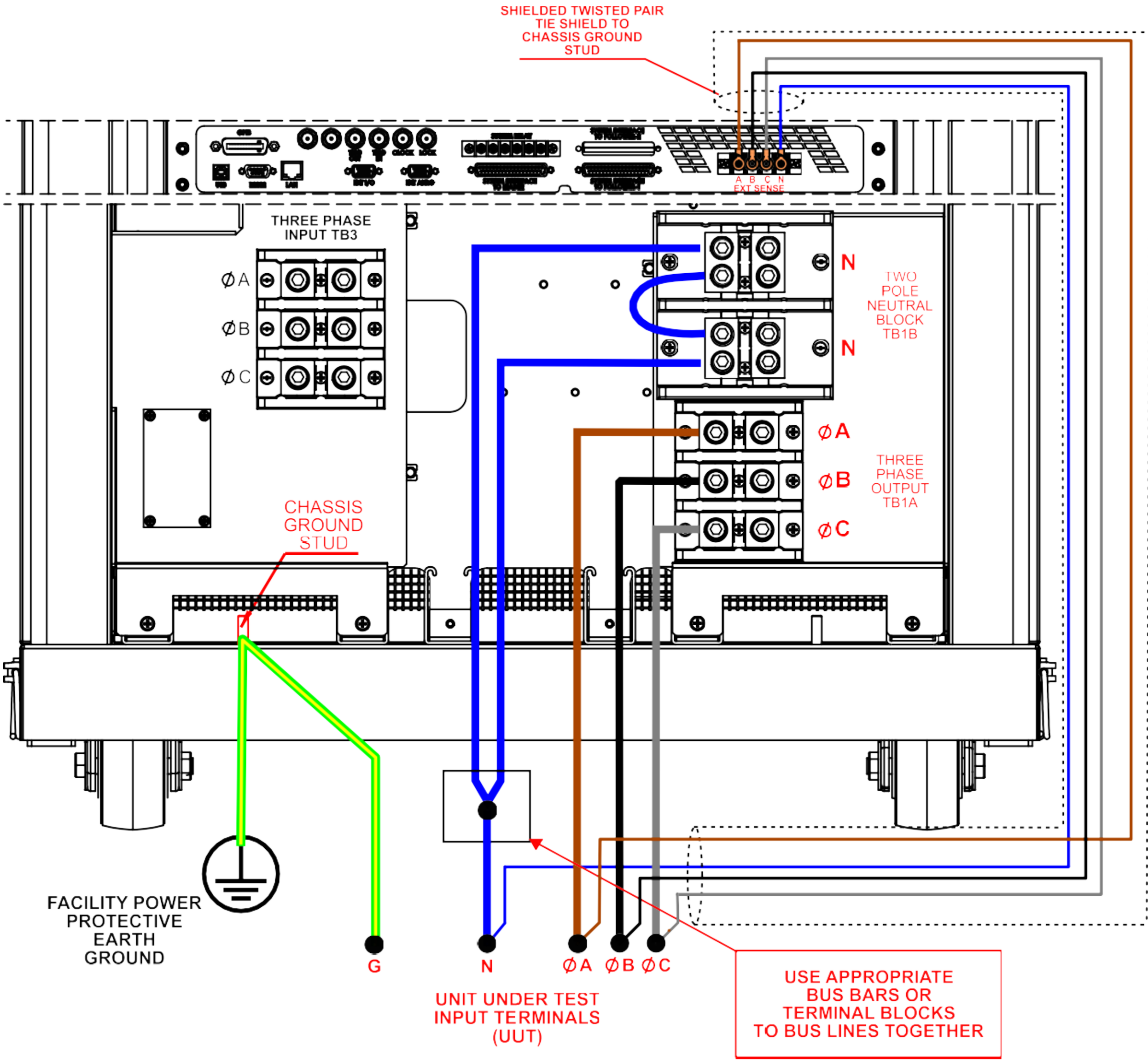


Figure 3-21: Three Phase Output Wiring– SQ/TA 0090

WARNING!

In **Electronic load** three-phase mode of operation, **A Neutral connection is mandatory**. Neutral from the output of UUT must be connected to the output neutral of the Sequoia. **Damage to the Sequoia will result if the Neutral is open.**

3.8 Connectors - Rear Panel

Interface connectors are located along the top rear covers. These connectors are in a recessed area to protect them from shipment damage, refer to Figure 3-22.

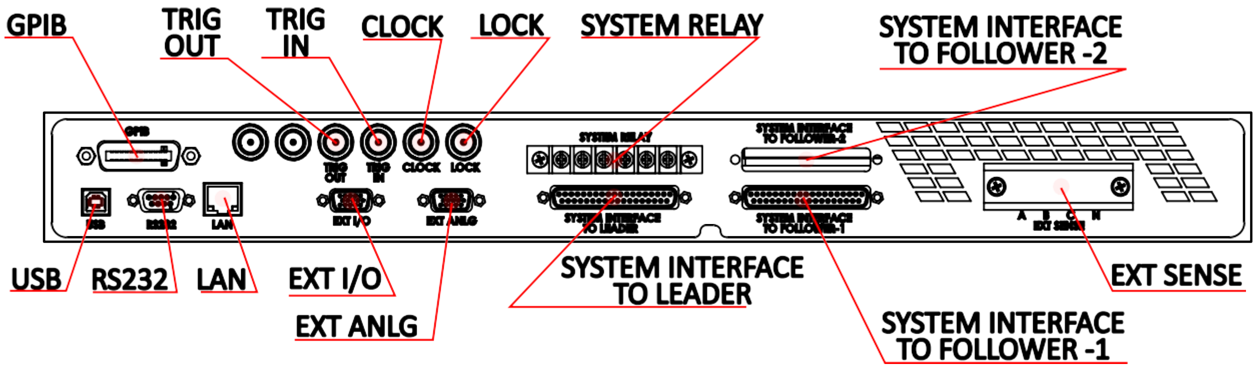


Figure 3-22: Rear Panel Connectors

3.8.1 System Interface

WARNING!

The system interface connectors are for use with California Instruments supplied cables, and only between California Instruments equipment.

A set of two identical System Interface connectors are located on the rear panel of each Sequoia / Tahoe unit chassis. The system interface can be used to connect the multiple Sequoia / Tahoe power sources in a Leader/Follower configuration.

The Leader connector and Follower connector are used to connect Follower/Auxiliary power sources to the Leader power source for operation in parallel, multi-chassis systems; refer to Figure 3-23 for the view of connectors, with Table 3-17 and Table 3-18 for descriptions. The Leader/Follower interface signals are dedicated to the control of the parallel-group operation and are not to be utilized by the user.

The power source that is to be the Leader will have the System Interface cable plugged into its connector labeled SYSTEM INTERFACE TO FOLLOWER - 1. The other end of the System Interface cable will plug into the connector labeled SYSTEM INTERFACE TO LEADER in the first Follower power source comprising the system. Additional Follower power sources would be chained together with System Interface cables connecting the Follower connector of one unit to the Leader connector of the next unit in the chain. Refer to Figure 3-31 for an example of a parallel system.

Figure 3-23: External Leader/Follower System Interface Connectors

Connector	Type
Leader	High-density, 37-socket, receptacle (female) Subminiature-D.
Follower	High-density, 37-socket, receptacle (female) Subminiature-D.

Table 3-17: External Leader/Follower System Interface Connector Type

Function	Characteristics
Leader Interface	Control signal interface on Leader unit (or other Follower units if more than two units comprise the multi-phase / parallel group) going to Follower unit for multi-chassis parallel operation.
Follower Interface	Control signal interface on Follower unit coming from Leader unit (or other Follower units if more than two units comprise the multi-phase / parallel group) for multi-chassis parallel operation.

Table 3-18: External Leader/Follower System Interface Characteristics

3.8.2 BNC Connectors

The functions of each BNC connector are called out on the rear panel decal. Table 3-19 shows the connections from left to right when standing at the rear of the Sequoia / Tahoe cabinet.

BNC	Description
1	Trigger Output (TTL output); Refer to Table 3-20.
2	Trigger IN (TTL input); Refer to Table 3-20.
3	Clock (TTL output on Leader / TTL input on Auxiliary); Refer to Table 3-20.
4	Lock (TTL output on Leader / TTL input on Auxiliary); Refer to Table 3-20.

Table 3-19: BNC Connectors

Name	Description
Trigger Output	Signal output with dual function: user selectable as either function trigger or list trigger. Function trigger provides a pulse for any programmable change in output voltage or frequency; list trigger provides a pulse if programmed as part of list transients. Pulse logic level, user-selectable as active-high or active-low; pulse duration, 400 µs. Rear panel BNC connector: safety isolation SELV-rated, referenced to chassis.
Trigger Input	Signal input for external trigger for execution of programmed value; logic level, TTL-compatible. Signal return common to signals, Trigger input, Synchronization Clock and Remote Inhibit. Safety isolation SELV-rated.

LKM (Option)	Signal outputs for Leader Clock and Logic signals used to synchronize two or more AC sources. Logic level, TTL-compatible. Rear panel BNC connector. Safety isolation SELV-rated, referenced to chassis. **Note**: SYNC input is not supported in SINK-Electronic load operating mode.
LKS (Option)	Signal inputs for Auxiliary Clock and Logic signals used in synchronizing two or more AC sources. Logic level, TTL-compatible; Rear panel BNC connector. Safety isolation SELV-rated, referenced to chassis. **Note**: SYNC input is not supported in SINK-Electronic load operating mode.

Table 3-20: Trigger Output Function

3.8.3 External I/O Control Signal Connector

The External Input/Output connector, EXT IN/OUT, is located on the rear panel. Figure 3-24 shows the rear panel view of the connector, Table 3-21 lists the connector type. Table 3-22 shows the functions and Table 3-23 shows the connector pinout.

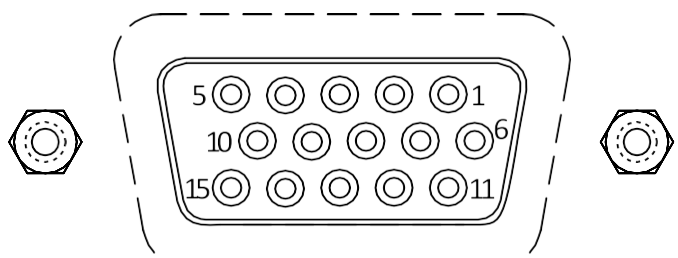


Figure 3-24: External Input/Output Control Connector

Connector	Type
External Input/Output Control	High-density, 15-socket, receptacle (female) Subminiature-D.

Table 3-21: External Input/Output Control Connector Type

Function	Characteristics
External Analog Modulation of Output Voltage	Signal input for output voltage modulation of waveform set by internal controller reference; 0-5 Vrms signal range for 0-10% FS output voltage amplitude modulation; programming accuracy, ±2% FS output. Individual inputs provided for each output phase; input impedance, 40 kΩ, typical; safety isolation SELV-rated, referenced to chassis. **Note**: External Analog waveform modulation function is not supported in SINK-Electronic Load Mode.

Trigger Input	Signal input for external trigger for execution of programmed value; logic level, TTL-compatible. Signal return common to signals, Trigger input, Synchronization Clock and Remote Inhibit. Safety isolation SELV-rated.
Synchronization Signal (SYNC) Input	Signal input for external square wave clock to control the output frequency and phase of the waveform generated by the internal generator. Logic level, TTL-compatible. Signal return is common to signals, Trigger input, Synchronization Clock and Remote Inhibit; safety isolation SELV-rated. **Note**: Not available with FC option and not available with LKM and LKS option. **Note**: SYNC input is not supported in SINK-Electronic load operating mode.
Output Status	Monitors state of the output relay. Isolated TTL output. High if output relay is closed, low if output relay is open.
Remote Inhibit Input	Signal input to turn the output ON/OFF. Logic level, TTL-compatible; user-selectable as active-high or active-low. Signal return common to signals, Trigger input, Synchronization Clock, and Remote Inhibit; safety isolation SELV-rated.
Summary Fault Output	Signal output indicates that a fault condition is present; solid-state, normally closed ac/dc switch. Logic level, active-low (open-circuit when the fault is not present). Switch ratings: 50 V, maximum peak voltage; 0.1 A, maximum current; 2.5 Ω, maximum resistance; 1 µA, maximum off-state leakage current; isolated from all other signals; safety isolation SELV-rated.

Table 3-22: External Input/Output Control Functions

Pin #	Name	Type	Range	Function
1	**ISO_COM**	Return	Return	Isolated signal return terminal for signals from Pin-2 to Pin-15. / Common Ground
2	**SYNC_HIGH**	Digital Input	0-5 VDC	Isolated signal for synchronization of the output to a logic-high signal transition; paired with Pin-3.
3	**SYNC_LOW**	Return	Return	Isolated signal return for synchronization of the output; paired with Pin-2.
4	**INHIBIT**	Digital Input	0-5 VDC	Isolated inhibit signal to turn the output off/on and open/close the output relay; signal return on Pin-1.
5	**TRIGGER**	Digital Input	0-5 VDC	Isolated trigger signal; signal return on Pin-1.
6	**SUMMARY FAULT**	Switch Output	±12 VDC	Isolated Summary Fault (DFI) signal; paired with Pin-7; refer to Table 3-22.
7	**SUMMARY FAULT RETURN**	Return	Return	Signal return for Summary Fault; paired with Pin-6.
8	**N/C**	N/C	N/C	N/C
9	**N/C**	N/C	N/C	N/C
10	**ISO_COM**	Return	Return	Common Ground
11	**OUTPUT STATUS**	Digital Output	0 VDC or 5 VDC	Isolated TTL output; High if the output relay is closed, low if the output relay is open.
12	**MODULATION REFERENCE - A**	Analog Input	0-5 V (RMS)	External modulation signal input terminal for Phase-A.
13	**MODULATION REFERENCE - B**	Analog Input	0-5 V (RMS)	External modulation signal input terminal for Phase-B.
14	**MODULATION REFERENCE - C**	Analog Input	0-5 V (RMS)	External modulation signal input terminal for Phase-C.
15	**ISO_COM**	Return	Return	Common ground

Table 3-23: External Input/ Output Control Connector Pinout

3.8.4 External Analog Control Signal Connector

The External Analog connector, EXT ANLG, is located on the rear panel. The Figure 3-25 shows the rear panel view of the connector, Table 3-24 lists the connector type. Table 3-25 shows the functions and Table 3-26 shows the Analog Interface Connector.

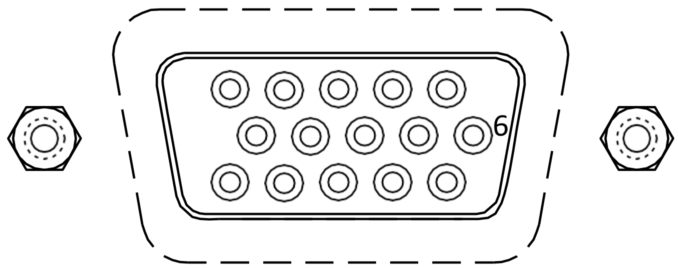


Figure 3-25: External Analog Control Connector

Connector	Type
External Analog Control	High-density, 15-socket, receptacle (female) Subminiature-D.

Table 3-24: External Analog Control Connector Type

Function	Characteristics
External Analog Programming of Output Voltage Waveform	Signal input for output voltage waveform programming by external analog reference. Signal ranges: 0-7.07 Vrms for zero to full-scale RMS output voltage, with AC input waveform at 16Hz to 550Hz. Programming accuracy, ±2% FS output. Individual inputs provided for each output phase; input impedance, 40 kΩ, typical; safety isolation SELV-rated, referenced to chassis. **Note**: External Analog waveform programming function is not supported in SINK- Electronic Load Mode.
External Analog Programming of Output Voltage Amplitude – Source and SINK-Grid Simulator	Signal input for output voltage amplitude programming of waveform that is set by internal controller reference. Signal ranges: 0-10 VDC for zero to full-scale RMS of internally programmed output voltage; programming accuracy, ±2% FS output. individual inputs provided for each output phase; input impedance, 40 kΩ, typical. Safety isolation SELV-rated, referenced to chassis.
External Analog Programming of Output Current Amplitude – SINK-Electronic Load Mode	Signal input for output current amplitude programming of waveform that is set by internal controller reference. Signal ranges: 0-10 VDC for zero to full-scale RMS of internally programmed output current; Programming accuracy, ±2% FS output. Individual inputs provided for each output phase; input impedance, 40 kΩ, typical. Safety isolation SELV-rated, referenced to chassis.

Isolated Output Voltage Monitor Outputs	Signal outputs for each output phase for monitoring the waveform of the command signal of the output amplifier. 0-7.07 Vrms signal range for zero to full-scale output voltage.
Isolated Output Current Monitor Outputs	Signal outputs for each output phase for monitoring the waveform of the command signal of the output amplifier. 0-7.07 Vrms signal range for zero to full-scale output voltage.

Table 3-25: External Analog Control Functions

Pin #	Name	Type	Range	Function
1	**External Reference Signal – Phase A**	Analog Input	0-7.07 Vrms or 0 – 10 VDC	Analog programming signal input terminal for user- selectable external waveform programming or amplitude control (RPV) for Phase-A.
2	**External Reference Signal – Phase B**	Analog Input	0-7.07 Vrms or 0 – 10 VDC	Analog programming signal input terminal for user- selectable external waveform programming or amplitude control (RPV) for Phase-B.
3	**External Reference Signal – Phase C**	Analog Input	0-7.07 Vrms or 0 – 10 VDC	Analog programming signal input terminal for user- selectable external waveform programming or amplitude control (RPV) for Phase-C.
4	**ISO_COM**	Return	Return	Common Ground: Pins 4, 9, and 14 are internally connected.
5	**N/C**	N/C	N/C	N/C
6	**Output Current Monitor -Phase A**	Analog Output	0-7.07 Vrms	Signal outputs for output phase A for monitoring the waveform of the command signal of the output amplifier.
7	**Output Current Monitor - Phase B**	Analog Output	0-7.07 Vrms	Signal outputs for output phase B for monitoring the waveform of the command signal of the output amplifier.
8	**Output Current Monitor -Phase C**	Analog Output	0-7.07 Vrms	Signal outputs for output phase C for monitoring the waveform of the command signal of the output amplifier.
9	**ISO_COM**	Return	Return	Common Ground: Pins 4, 9, and 14 are internally connected.
10	**N/C**	N/C	N/C	N/C
11	**Output Voltage Monitor -Phase A**	Analog Output	0-7.07 Vrms	Signal outputs for output phase A for monitoring the waveform of the command signal of the output amplifier.
12	**Output Voltage Monitor -Phase B**	Analog Output	0-7.07 Vrms	Signal outputs for output phase B for monitoring the waveform of the command signal of the output amplifier.
13	**Output Voltage Monitor -Phase C**	Analog Output	0-7.07 Vrms	Signal outputs for output phase C for monitoring the waveform of the command signal of the output amplifier.
14	**ISO_COM**	Return	Return	Common Ground: Pins 4, 9, and 14 are internally connected.
15	**N/C**	N/C	N/C	N/C

Table 3-26: Analog Interface Connector

3.8.5 System Relay

A single row six pole terminal block (Figure 3-26) is located on the rear panel for remote control of Leader/Auxiliary configurations and Emergency Stop.

FOLLOWER and FCOM are used to remotely control the system's configuration for Leader or Follower operation. When 24 VDC is applied to FOLLOWER and FCOM, the system is set to FOLLOWER mode. When 24 VDC is removed, the system switches to LEADER mode.

ESTOP and ECOM are used to remote control the Emergency shut off switch. This connection is required to create an OR-ed operation of more than one Emergency Stop switch. When 24 VDC is applied, the unit’s output is Enabled (ON). When 24 VDC is removed, the unit’s output is disabled (OFF). Note that ESTOP connection is required for each individual chassis. ESTOP results in disabling voltage directly to the amplifiers.

Pin	Name	Description
1	FOLLOWER	24 VDC is applied to set the unit to either Leader unit or Follower mode. Connection is made to Leader Chassis only.
2	FCOM	Follower Common
3	ESTOP	24 VDC Enables unit’s Output and 0 VDC Disables the unit’s Output.
4	ECOM	ESTOP Common
5	AUX1	Reserved
6	AUX2	Reserved

Table 3-27: Leader Select and Emergency Stop Switch

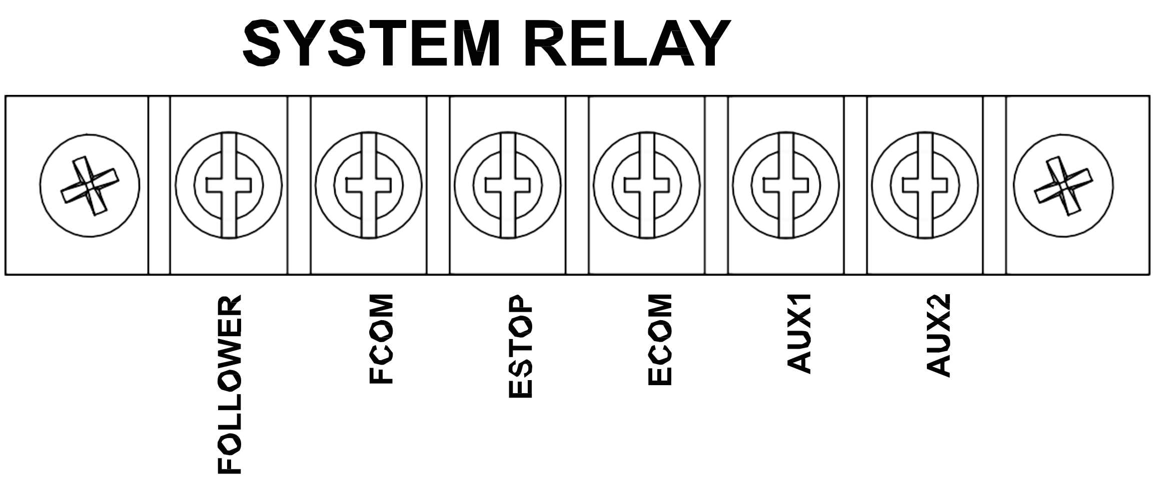


Figure 3-26: FOLLOWER and ESTOP interconnect at the rear panel.

3.8.6 Multiple Chassis System Configurations

The Sequoia / Tahoe power source has the capability to be configured in multi-chassis groups with multiple- phase outputs using the optional Clock/Lock signal interface. The sources are individually programmed for output voltage/current, while the Clock/Lock interface ensures frequency and phase synchronization between units.

The power source can be configured in parallel, multiple-chassis groups to extend the total output power. The outputs of the individual units must be connected in parallel, and a Leader/Follower System interface cable must interconnect them. The control interface of the units is automatically configured when the Leader/Follower System interface cable is connected, so no setting changes by the user are required.

3.8.6.1 Multi-Phase System

The connections to set up a multi-phase group of units requires the output lines, PHASE-A, PHASE-B, PHASE-C, and RTN to be connected independently from each output of a unit to the load. If the remote sense is used, each unit must have it connected to the phase of the load at the point where precise regulation of the output voltage is desired.

The units must have the Clock/Lock options installed, with the Leader unit having the LKM option and the Auxiliary units having the LKS option. The Clock/Lock connectors of the Leader unit provide output signals: CLOCK to set the frequency, and LOCK to set the phase. The Clock/Lock connectors of the Auxiliary units are inputs to accept the control signals from the Leader unit. The Clock and Lock interfaces are signal buses, so the Clock connectors of all units must be connected, and the Lock connectors must be connected. Programming, readback, and control are done through the individual units. Also, the Auxiliary units must have their phase programmed in reference to the Leader unit. Refer to Figure 3-32 for an example configuration.

The clock source and configuration must be set for multi-phase operation through the remote digital interface using SCPI commands or the front panel display. Set up through the front panel is as follows:

- In the CONFIGURATION, PONS CLOCK CONFIG display menu, the Leader unit must have the configuration set to Leader (the AC input must be cycled off/on for a change in a PONS setting to take effect); refer to Section 5.7.7.
- In the CONFIGURATION, PONS CLOCK CONFIG display menu, the Auxiliary units must have the configuration set to Auxiliary (the AC input must be cycled off/on for a change in a PONS setting to take effect); refer to Section 5.7.7.
- In the CONFIGURATION, CLOCK MODE display menu, the Auxiliary units must have the clock source set to External; refer to Section 5.7.7.

3.8.6.2 Parallel System

The connections to set up a parallel group of units require the output lines PHASE-A, PHASE-B, PHASE-C, and RTN to be connected from each unit to an external terminal block. If the remote sense is used, only the Leader unit has it connected to the load at the point where precise regulation of the output voltage is desired; the follower unit does not have remote sense connected. The Leader/Follower System Interface cable is connected from the Leader unit connector, LEADER, to the Follower unit connector, FOLLOWER. Refer to Figure 3-29 and Figure 3-30 for an example configuration.

The aggregate output power of the parallel group would be the sum of the individual ratings of the Sequoia / Tahoe models connected in parallel. The maximum aggregate power allowed by paralleling the power sources is limited to 540 kVA.

The Leader/Follower interface is automatically configured so that the current reported by the Leader unit is the sum of all units within the group. The display of a Follower unit is disabled, and shows the message, “SOURCE IN FOLLOWER MODE No access to the user”.

When operating in parallel, the Follower unit should be powered on first. Wait for front panel of the Follower unit to display “SOURCE IN AUXILIARY MODE No access to the user” before powering on the Leader unit, refer to Figure 3-27. The order should be reversed when powering off the system. Leader unit should be powered off first followed by Follower units.

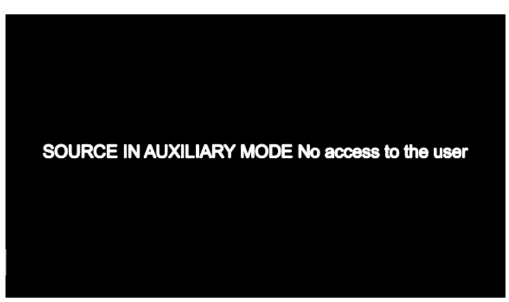


Figure 3-27: Front panel of the Follower unit

Note: After powering up, if the Follower power source is turned off, an error message, "Follower Down, ensure all are powered up," will appear on the Leader source. If power is restored to the Follower source, the message will clear, and normal operation will continue. If the Leader/Follower System Interface cable is disconnected from the Follower source while the source is off, the error message will clear, but the Leader source will not have the correct configuration. The Leader source must have its AC power toggled from Off to On to restore the correct configuration.

WARNING!

In **Electronic load** three-phase mode of operation, **A Neutral connection is mandatory**. Neutral from the output of UUT must be connected to the output neutral of the Sequoia. **Damage to the Sequoia will result if the Neutral is open.**

E-STOP Configuration for Parallel Mode Operation:

Connect the ESTOP system cable (AMETEK P/N 5441323-01R/02R), consists of two twisted wires, to the system relay terminal block between parallel systems, as shown in the diagram refer to Figure 3-28, when F/G units are connected in the Leader/Follower configuration. Connect the ESTOP wire from the Leader to the ESTOP of the Follower. Connect the ECOM wire from the Leader to the ECOM of the Follower. For more than two units, the ESTOP system cable needs to be daisy chained.

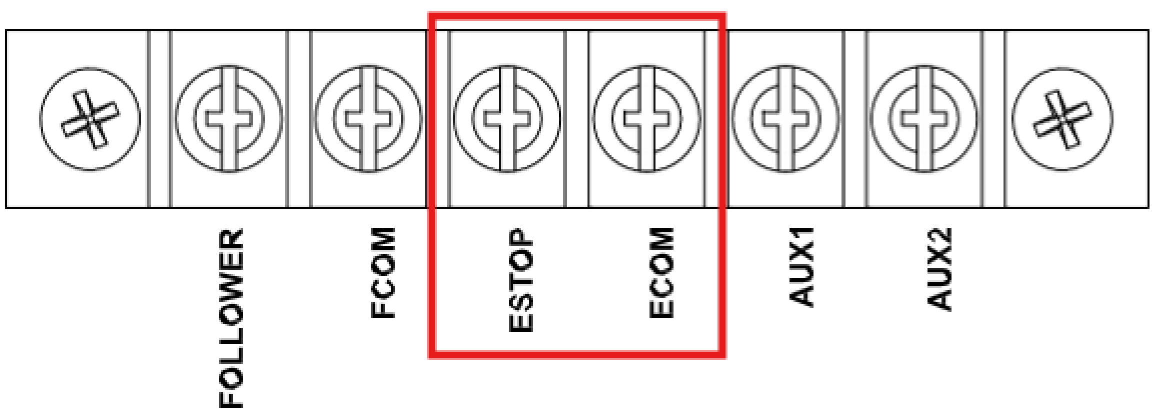


Figure 3-28: ESTOP Configuration for Parallel Mode Operation

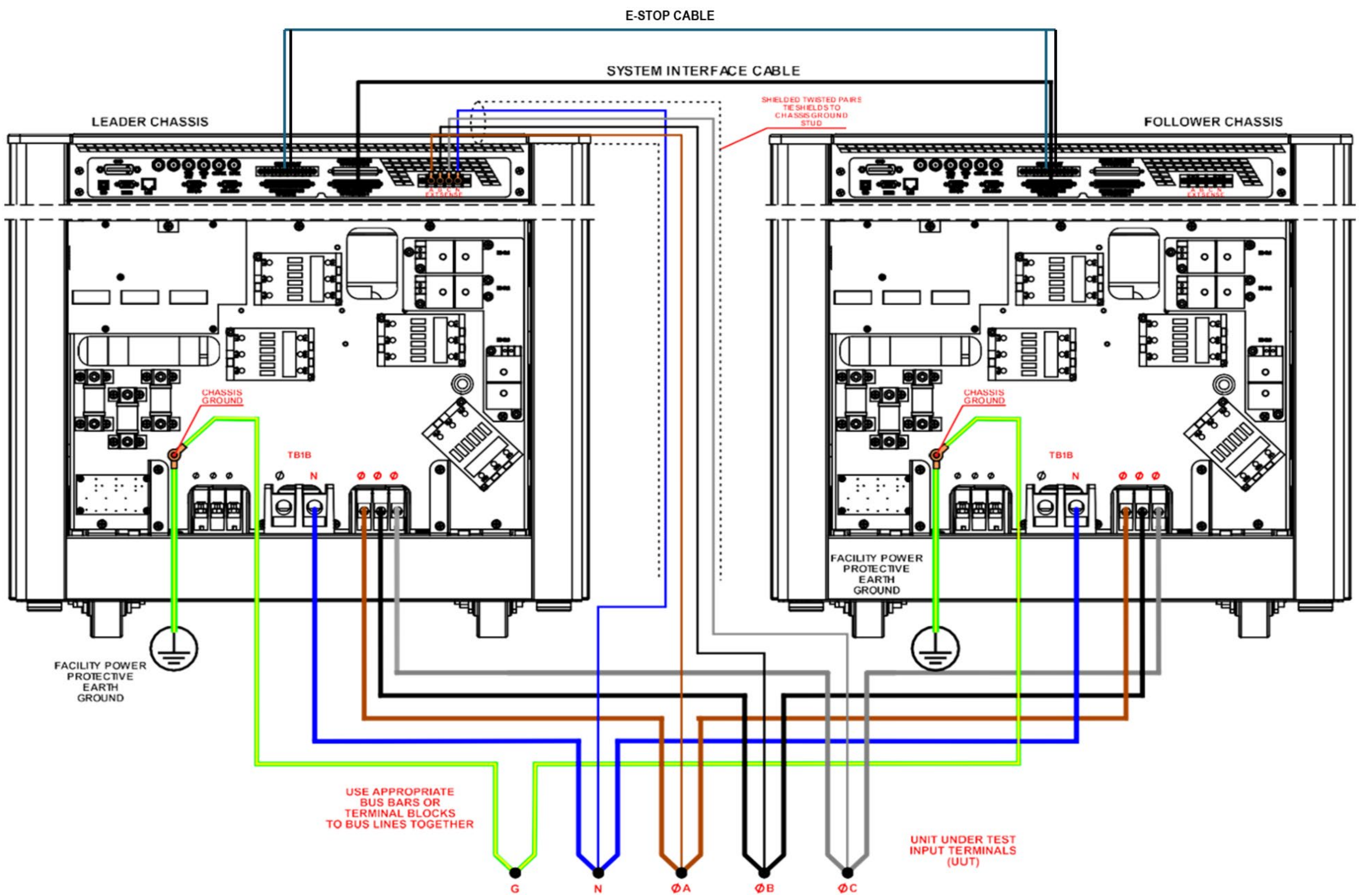


Figure 3-29: Connections for 3-Phase Parallel Group Between Two Chassis – For SQ/TA 0022, 0030, 0045 Output Power Models

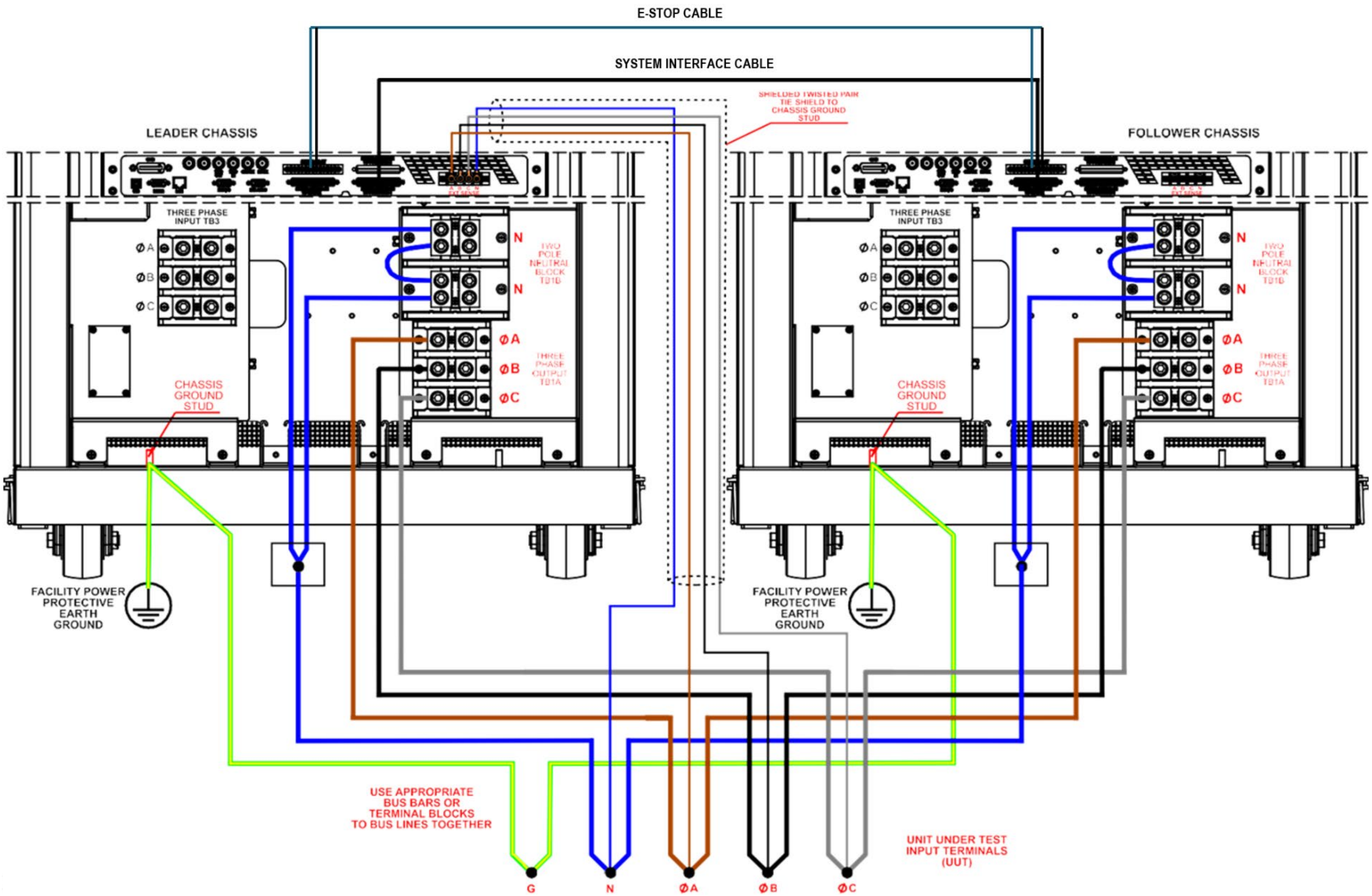


Figure 3-30: Connections for 3-Phase Parallel Group Between Two Chassis – SQ/TA 0090

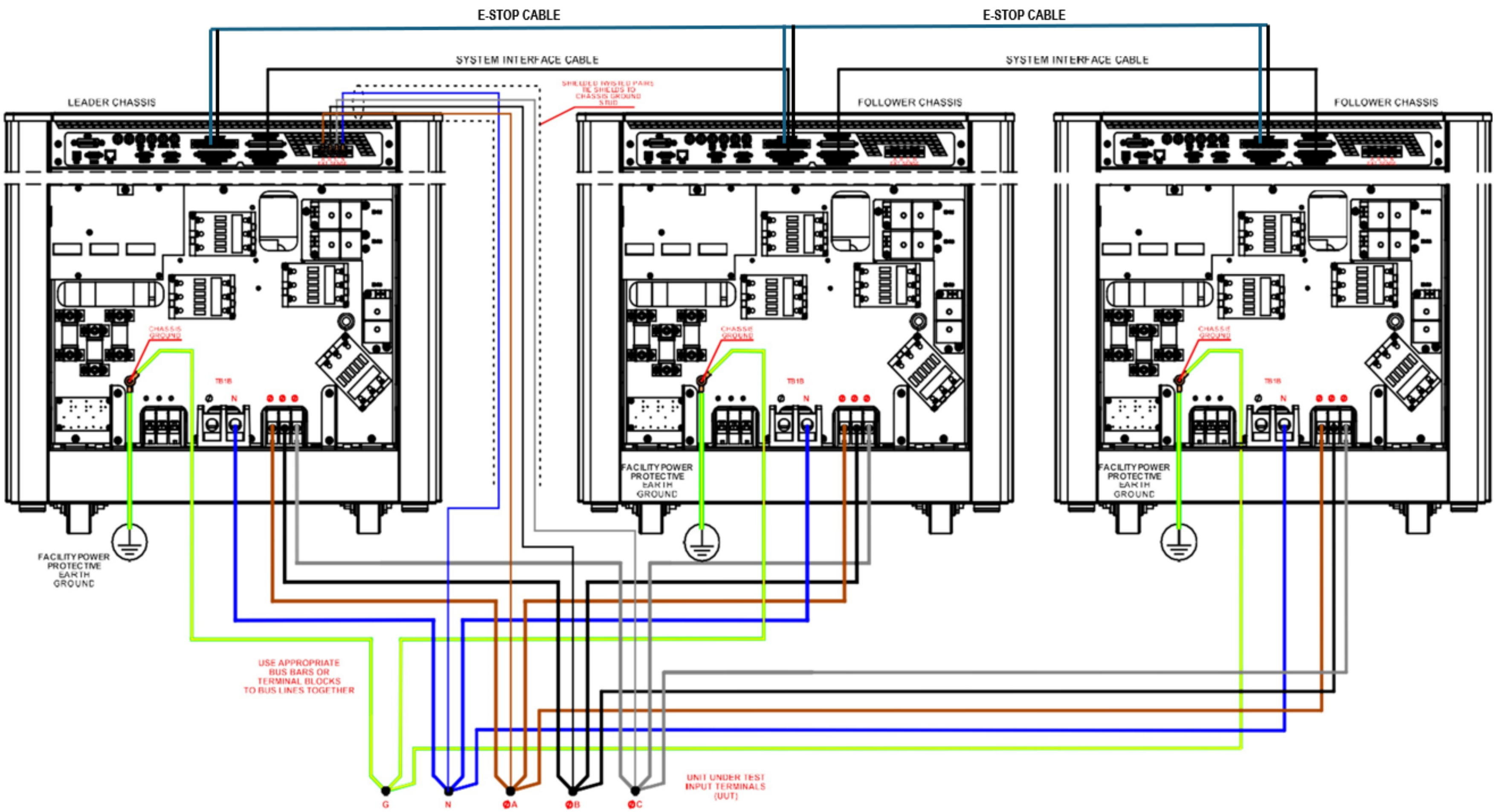


Figure 3-31: Connections for 3-Phase Parallel Group Between Three Chassis – For SQ/TA 0022, 0030, 0045 Output Power Models

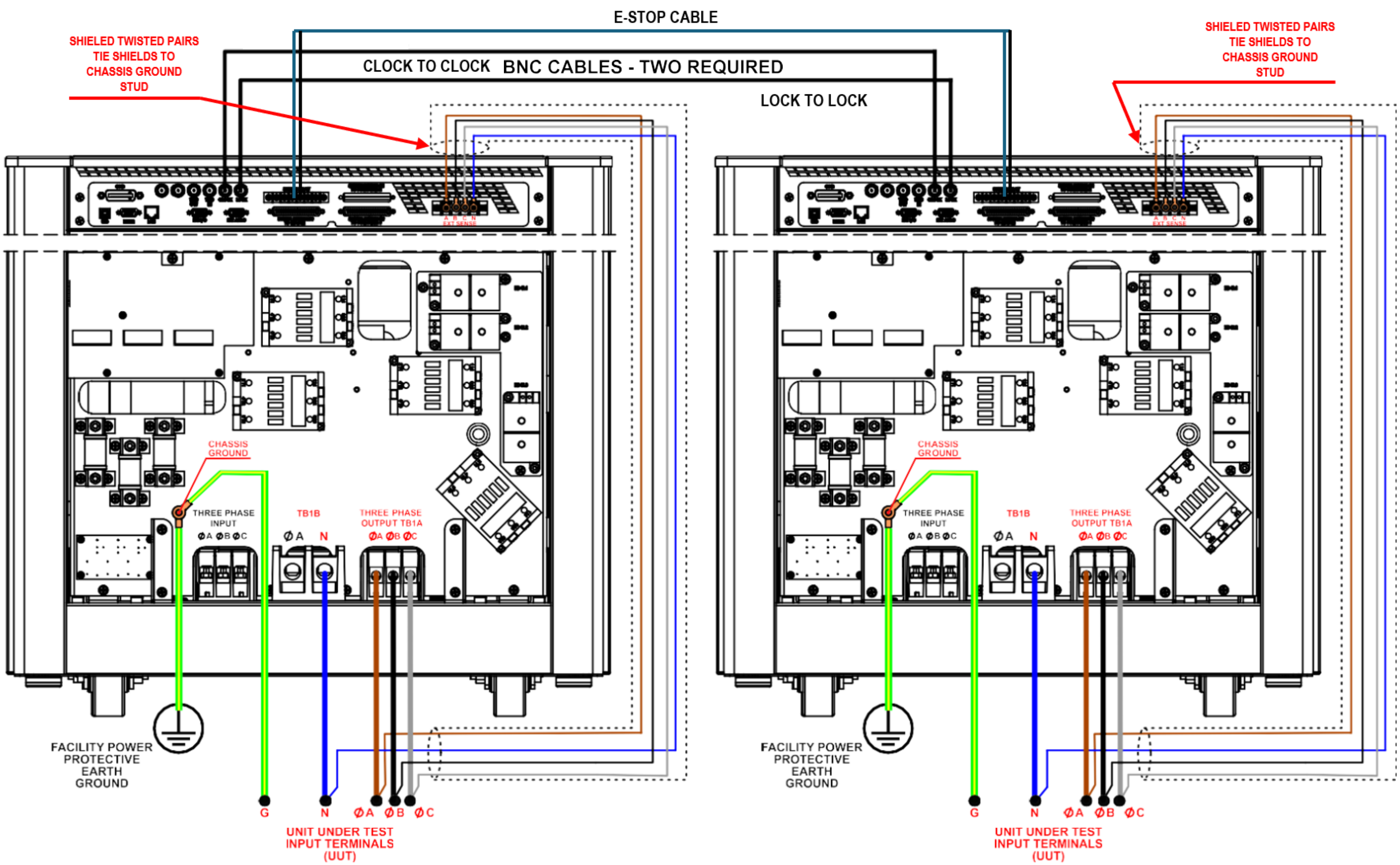


Figure 3-32: Connections for 3-Phase Leader/Auxiliary Multi-Phase Group – For SQ/TA 0022, 0030, 0045 Output Power Models

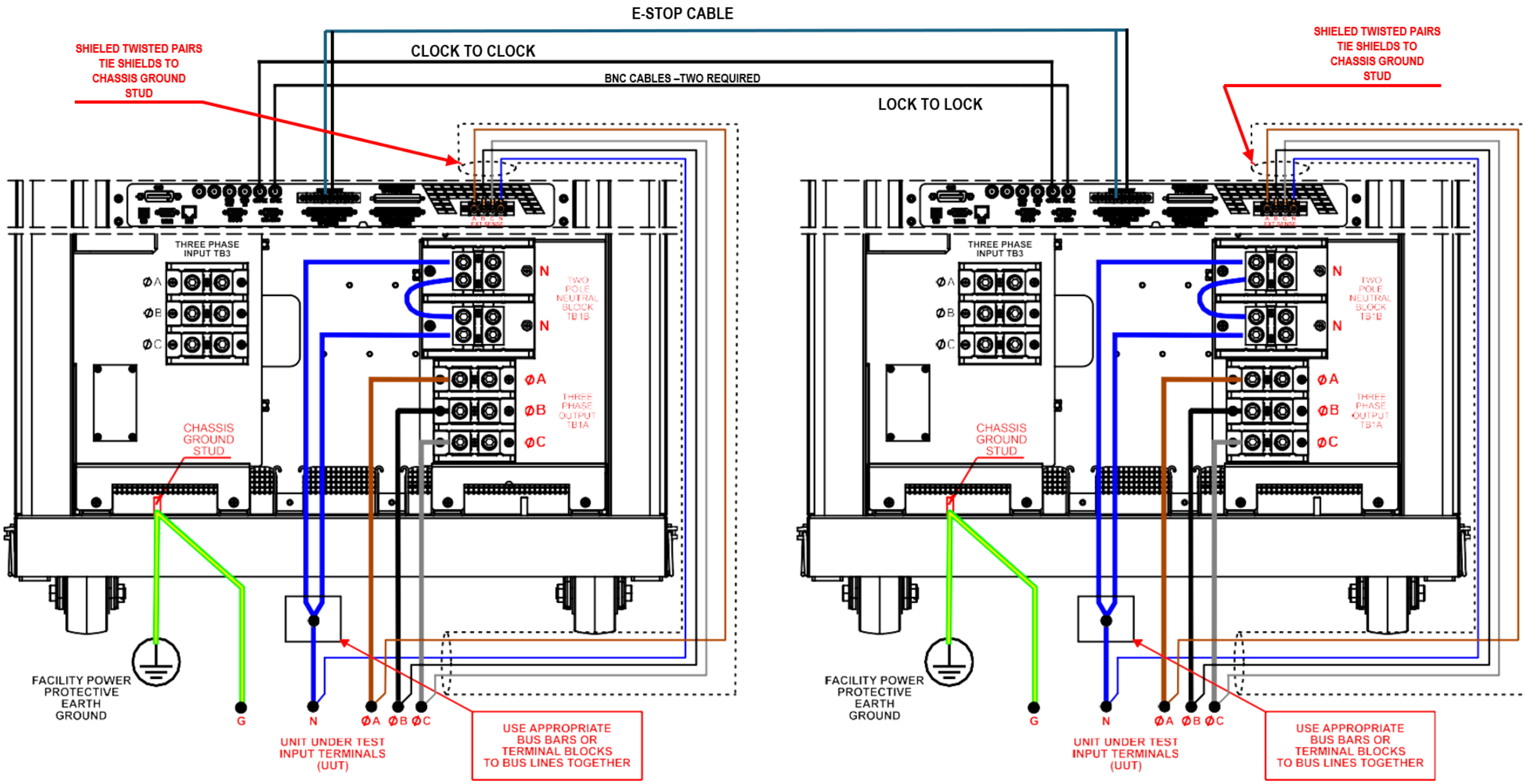


Figure 3-33: Connections for 3-Phase Leader/Auxiliary Multi-Phase Group – SQ/TA 0090

3.8.7 External Sense Connector

External Sense Connector allows the unit to regulate the output voltage accurate within 600 mV when the unit is programmed to EXTERNAL sense and its sense connection is connected at the load termination end' For single phase outputs, refer to Figure 3-18 for 22.5 to 45kVA models or Figure 3-19 for 90kVA models. For three phase outputs, refer to Figure 3-20 for 22.5 to 45kVA models or Figure 3-21 for 90kVA models. There will be no significant current flowing through the sensing terminals. The connection from the load end can be neglected when sense connection is selected as INTERNAL. The unit will regulate the output voltage up to 7 Vrms without any fault when the sense connection is absent, and sense is selected as EXTERNAL.

The Sense can be selected either through the front panel, refer to Section 5.8.7, or using the SCPI command refer to the Programming Manual (M447353-01 for SEQUOIA Series and M447354-01 for TAHOE Series power supplies).

Pin	Description
1	Phase A sense
2	Phase B sense
3	Phase C sense
4	Neutral sense

Table 3-28: External Sense Connector

3.8.8 RS-232C Serial Interface

RS-232C is a serial communication standard used to connect the Sequoia Series power supply to other equipment, enabling data transfer and remote control, refer to Figure 3-34, Table 3-29 for connector type and Table 3-30 for pin descriptions. The power source functions as Data Circuit-terminating Equipment (DCE). The cable connecting to the Data Terminal Equipment (DTE) should be straight-through (one-to-one contact connections). For EMC considerations a ferrite core can be added to the cable AMETEK P/N: 991-642-28, Manufacturer P/N: CS28B0642.

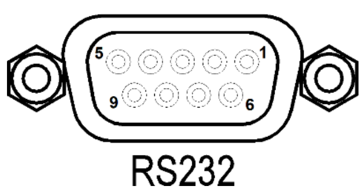


Figure 3-34: RS-232C Interface Connector

Connector	Type
RS-232C Interface	9-contact receptacle (female) Subminiature-D.

Table 3-29: RS-232C Interface Connector Type

Pin #	Name	DCE Signal	Direction
1	N/C	N/A	N/A
2	TxD	Transmit Data	Output
3	RxD	Receive Data	Input
4	N/C	N/A	N/A
5	Common	N/A	N/A
6	N/C	N/A	N/A
7	RTS	Request to Send	Input
8	CTS	Clear to Send	Output
9	N/C	N/A	N/A

Table 3-30: RS-232C Interface Connector Pinout

3.8.9 USB interface

USB remote control interface is made through a Series-B device connector located on the rear panel; refer to Figure 3-35 for view of connector, Table 3-31 for the connector type and Table 3-32 for pin descriptions. A standard USB cable between the Asterion Series power source and a computer should be used. For EMC considerations a ferrite core can be added to the cable AMETEK P/N: 991-642-28, Manufacturer P/N: CS28B0642.

CAUTION!

Connecting the power source to the computer controller through a USB hub is not recommended. The USB connection should be direct between the two devices.

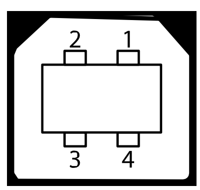


Figure 3-35: USB Type – B Interface Connector

Connector	Type
USB Interface	USB series-B type Connector

Table 3-31: USB Interface Connector Type

Pin #	Name	Description
1	N/C	No Connection
2	D-	Data -
3	D+	Data +
4	GND	Ground

Table 3-32: USB Interface Connector Pinout

3.8.10 LAN interface

A LAN connector (Ethernet 10BaseT/100BaseT) is located on the rear panel for remote control; refer to Figure 3-36 for view of connector, Table 3-33 for connector type and Table 3-34 for pin descriptions. A standard modular cable with an 8P8C modular plug should be used between the power source and a network hub. For a direct connection to a computer LAN card, a crossover cable with an 8P8C modular plug is required. The MAC Address (Media Access Control) of the Ethernet port is printed on a label on the chassis of the power source. For EMC considerations a ferrite core can be added to the cable AMETEK P/N: 991-642-28, Manufacturer P/N: CS28B0642.

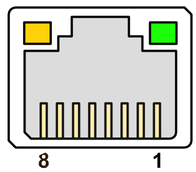


Figure 3-36: LAN Interface 8P8C Modular Connector

Connector	Type
LAN Interface	Standard RJ45 connector

Table 3-33: LAN Interface Connector Type

Pin #	Ethernet Signal	EIA/TIA 568A	EIA/TIA 568B Crossover
1	Transmit/Receive Data 0 +	White with green stripe	White with an orange stripe
2	Transmit/Receive Data 0 -	Green with a white stripe or solid green	Orange with a white stripe or solid orange
3	Transmit/Receive Data 1 +	White with an orange stripe	White with a green stripe
4	Transmit/Receive Data 2 +	Blue with a white stripe or solid blue	Blue with a white stripe or solid blue
5	Transmit/Receive Data 2 -	White with blue stripe	White with blue stripe
6	Transmit/Receive Data 1 -	Orange with a white stripe or solid orange	Green with a white stripe or solid green
7	Transmit/Receive Data 3 +	White with a brown stripe or solid brown	White with a brown stripe or solid brown
8	Transmit/Receive Data 3 -	Brown with a white stripe or solid brown	Brown with a white stripe or solid brown

Table 3-34: LAN Interface 8P8C Modular Connector Pinout

3.8.11 GPIB interface (Optional)

A GPIB connector is located on the rear panel for remote control; refer to Figure 3-37 for rear view of connector, Table 3-35 for connector type and Table 3-36 for pin descriptions.

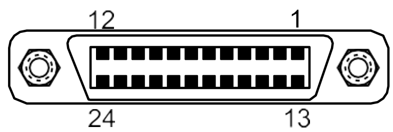


Figure 3-37: GPIB interface Connector

Connector	Type
GPIB Interface	PCB D-Sub Connectors, Receptacle, Cable-to-Board, 24 Position TE Connectivity P/N: 5554923-1

Table 3-35: GPIB Interface Connector Type

Pin #	GPIB Signal	Description
1	**DIO1**	Data Input/ Output bit
2	**DIO2**	Data Input/ Output bit
3	**DIO3**	Data Input/ Output bit
4	**DIO4**	Data Input/ Output bit
5	**EOI**	End- Or- Identity
6	**DAV**	Data Valid
7	**NRFD**	Not Ready for Data
8	**NDAC**	Not Data Accepted
9	**IFC**	Interface Clear
10	**SRQ**	Service Request
11	**ATN**	Attention
12	**SHIELD**	Tied to Digital Ground
13	**DIO5**	Data Input/ Output bit
14	**DIO6**	Data Input/ Output bit
15	**DIO7**	Data Input/ Output bit
16	**DIO8**	Data Input/ Output bit
17	**REN**	Remote Enable
18	**GND**	Digital Ground
19	**GND**	Digital Ground
20	**GND**	Digital Ground
21	**GND**	Digital Ground
22	**GND**	Digital Ground
23	**GND**	Digital Ground
24	**GND**	Digital Ground

Table 3-36: GPIB Interface Connector Pinout

3.9 Clock and Lock Connectors (Optional)

The connectors for the Clock signal, CLOCK, and Lock signal, LOCK, are BNC-type located on the rear panel; refer to Figure 3-38 for view of connectors and Table 3-37 for descriptions. These connectors are only available with the LKM or LKS options. These options are used to synchronize and control the phase shift of the output voltage of Auxiliary power sources in relation to the output of the Leader power source.

In E-load mode, when LKS is used as the leader, change the PONS Clock Config setting to 'Standalone' in the configuration screen of the front panel. If the LKS unit is to be operated as a stand-alone unit or connected as a leader in parallel operation, an external voltage of 5 VDC and a current of 0.75 A must be applied to the Lock signal located on the rear panel to sync the unit. Refer to Figure 3-39 shows the location of the Lock connector on the rear panel and its connection to the external DC power supply.

The frequency of the Auxiliary power sources is determined by the frequency of the Leader source through the CLOCK signal; the phase is determined by the LOCK signal.

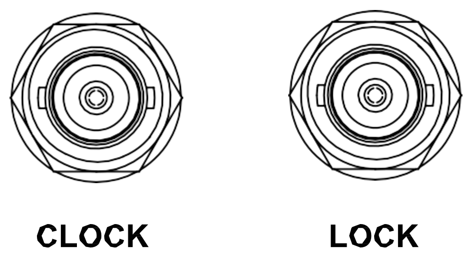


Figure 3-38: External Clock/Lock Interface Connectors (Option)

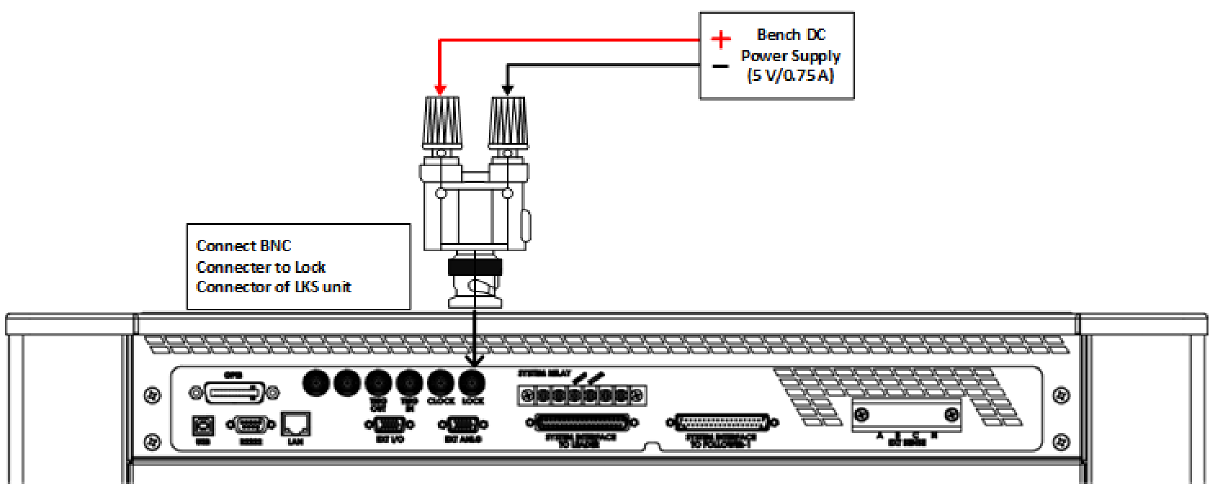


Figure 3-39: Location of the Lock Connector on the Sequoia/Tahoe Rear Panel and Its Connection to the External DC Power Supply

Function	Characteristics
LKM (Option)	Signal outputs in Leader unit for Clock and Lock that are used to synchronize two or more sources; CLOCK sets the frequency, while LOCK sets the phase; logic level, TTL-compatible; individual rear panel BNC connectors for each signal; safety isolation SELV-rated, referenced to chassis.
LKS (Option)	Signal inputs in Auxiliary units for Clock and Lock that are used to synchronize two or more sources; CLOCK sets the frequency, while LOCK sets the phase; logic level, TTL-compatible; individual rear panel BNC connectors for each signal; safety isolation SELV-rated, referenced to chassis.

Table 3-37: External Clock/Lock Interface Characteristics (Option) Basic Initial Functional Test

CAUTION!

Work carefully when performing these tests; hazardous voltages are present on the input and output during this test.

Refer to Figure 3-40 for the required functional test set up. Proceed as follows to perform a basic function check of the power system:

1. Verify the correct AC line input rating on the nameplate of the Sequoia / Tahoe unit(s) and make sure the correct three-phase line voltage is wired to the input of the chassis before applying input power.
2. Connect a suitable resistive or other type load to the output of Sequoia / Tahoe unit. The load resistance value will depend on the voltage range you plan to check. Make sure the power resistor has sufficient power dissipation capability - up to 15 kW for full load test on one phase of SQ0045-3 or up to 30kW for full load test on one phase of an SQ0090. For three phase configurations, this test can be performed on one phase at a time if needed.
3. Connect an oscilloscope and DMM / voltmeter to the AC source output. Set both for AC mode.
4. If the correct voltage is present, turn on the Sequoia / Tahoe unit(s) by closing the ON/OFF Push Button on the front panel. For multi-chassis setup, turn on the auxiliary/follower unit first and wait for them to cycle on, then turn on the leader unit.
5. If the Sequoia / Tahoe unit has more than one available output voltage range, go to the Configuration –Range menu screen and select the desired voltage range. The output mode can be set from the Configuration – Mode menu screen. Select AC mode.
6. Set the output voltage to 0 volt and close the output relay with the OUTPUT ON/OFF button. There should be little or no output although the DMM may show a noise level, especially if the DMM is in auto ranging mode.
7. Select the VOLTAGE field in the Dashboard screen or through Output Program – Voltage and either use the numerical keypad to program a small voltage (20 VAC) or slew the voltage up slowly with the rotary encoder. Observe the DMM reading. The reading should track the programmed voltage.
8. Also monitor the scope. The output should be a sinusoidal voltage waveform.
9. If the output tracks, increase the voltage till you reach 80 % of the voltage range or more. Check the output voltage reading and waveform.
10. Select the MEASUREMENT menu screen. The output voltage, current, and power will be displayed. For three-phase configurations, go to the Configuration – Phase Number menu and select "three-phase." This will display the voltage, current, and power for all three phases. If all phases are loaded equally, the same current and power will be displayed for all three phases, unless the voltages are

programmed differently. If only one phase is loaded, current and power will be displayed only for the loaded phase.

In the unlikely event the power source does not pass the functional test, refer to the calibration procedure in the manual.

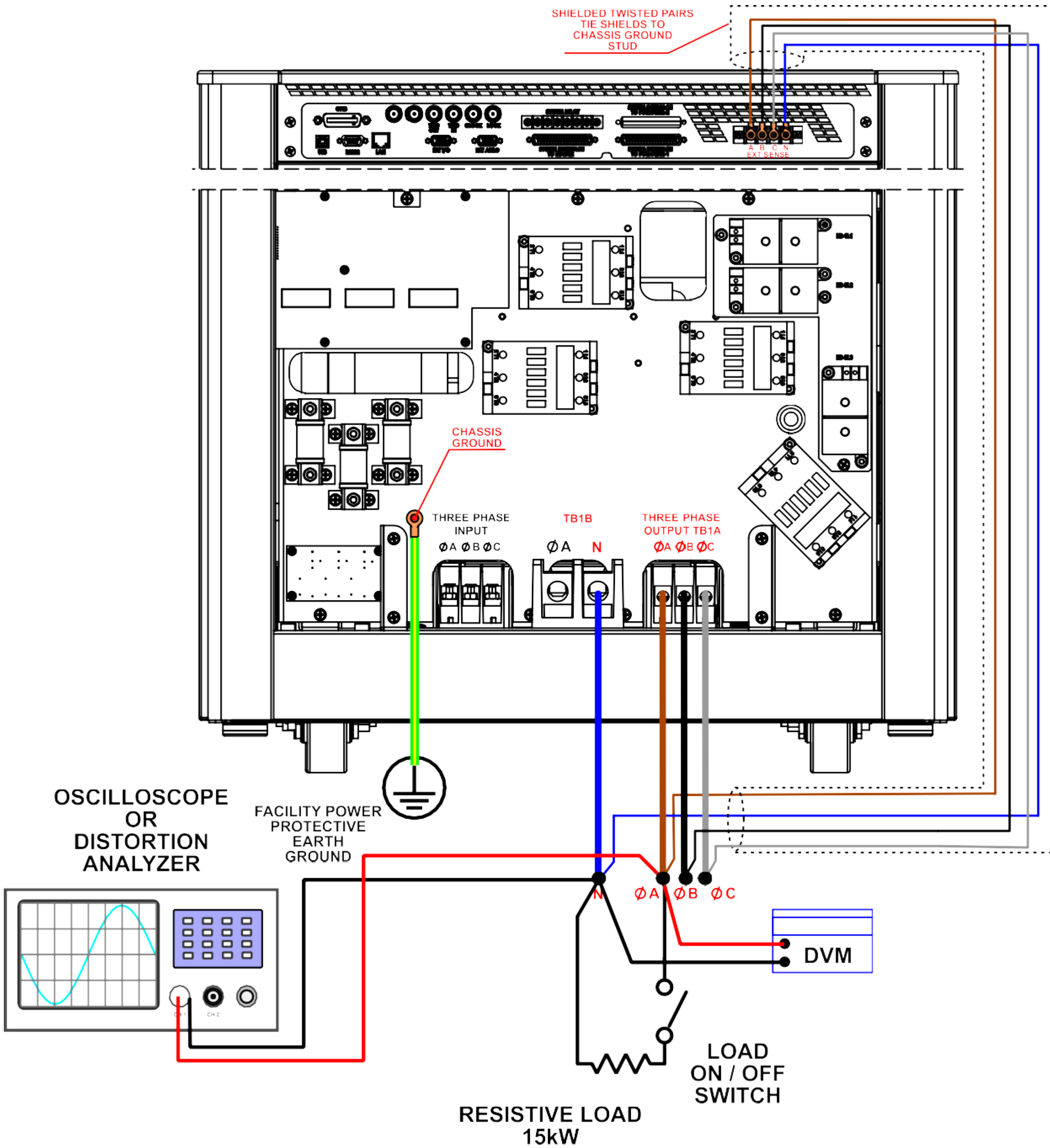


Figure 3-40: Functional Test Setup

4. OPERATION

The Sequoia/Tahoe Series power supply offers extensive functionality and programmability through the front panel, remote digital interface, and remote analog/digital control interface. The front panel features a graphical touchscreen display with a menu-driven interface for easy operation and quick access to advanced functions. The remote interfaces offer expanded control capabilities and full access to the power supply's features. The following sections explain the available operating modes for Sequoia/Tahoe Source, as well as the remote I/O and analog interfaces.

4.1 Operating Modes

4.1.1 Source Mode

In the Source mode, Sequoia / Tahoe acts as a power source and energy flows from the facility AC input to the Unit Under Test (UUT) as shown in Figure 4-1. In this operating mode, the user can program output voltage with the following possible regulation settings. The default operating mode is source mode.

Constant Voltage/ Constant Current: Output voltage is regulated as per the user-set value; on reaching the current limit, the power supply regulates at the programmed current limit.

Constant Voltage/ Current Limit: Output voltage is regulated as per the user-set value; on reaching the current limit, the power supply output voltage is programmed to zero.

Sequoia / Tahoe units when operating in source mode, will generate an error message if more than 20% of available power (per phase) is regenerated by the load. The AC source will shut off if the negative power reaches 30% of the available power.

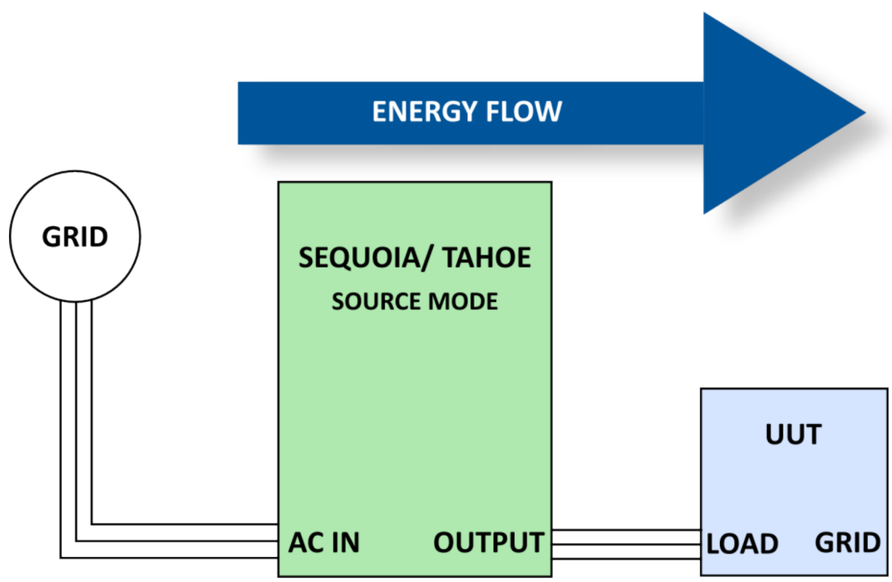


Figure 4-1: Source Mode

4.1.2 Basic Output Programming

For basic operation, the power source requires the selection of the output phase number (1-Phase or 3-Phase), output phase sequence, output voltage mode (AC, DC, or AC+DC), voltage range (Low-Range or High-Range), the mode of operation (CV/CC or CV/CL modes), and adjustment of the output parameters (voltage, current, frequency, phase, and DC offset). This can be accomplished through the front panel display by navigating to the appropriate menu, entering the desired values, and enabling the output; alternately, the remote digital interface can be used with SCPI commands (refer to the Sequoia Series Programming Manual P/N M447353-01 and Tahoe Series Programming Manual P/N M447354-01) or the Sequoia / Tahoe Virtual Panels GUI; refer to AMETEK PPD website, www.programmablepower.com, to download the latest version.

4.1.3 Basic Functional Test (Source Mode)

WARNING!

When performing the functional tests, exercise appropriate care to protect against hazardous voltages that are present on the input and output.

A basic functional test of the power source can be performed with the following steps:

1. Connect an oscilloscope and DVM to the power source AC/DC Output connector. Recommended equipment: oscilloscope, Tektronix TDS 3034C with P5202A high-voltage differential probe; DVM, Keysight 34461A.
2. With the AC mains verified as being off, make the AC input voltage connections to the power source input connector.
3. Turn on the AC mains then turn on the POWER switch on the power source front panel.
4. Verify that the front panel display initializes. After several seconds, the display should show the DASHBOARD Screen Top-Level Menu or the Default screen; refer to Section 5.6 for the description of menus.
5. Switch on the resistive load for each phase that is set to draw 90% FS current at 166 Vrms for the low-range AC output.
6. Using the front panel display or remote digital interface, set the output of each phase for AC mode operation with the following parameters: voltage mode = AC; voltage range = low, 166 V; output voltage = 166 Vrms; frequency = 60 Hz; and current setting = full-scale for the model being tested. Ensure that the Constant-Voltage/Current-Limit mode is selected in the REGULATION menu of the CONFIGURATION Screen Top-Level Menu; refer to Section 5.7.7(Source Mode).
7. Enable the output by tapping the OUTPUT switch. The OUTPUT LED in the switch button will turn on when the output is on.
8. Verify that the output voltage of each phase remains a sine wave within specifications for voltage accuracy.
9. Program the output current to 50% of the full-scale output current and verify that a fault condition is generated with the output turned off, the output voltage set to zero, and the front panel FAULT indicator on.
10. Return the current setpoint to 100% FS and set the output voltage = 166 Vrms.
11. Enable the output with the OUTPUT switch. The OUTPUT LED in the switch button will turn on when the output is on.
12. Verify that the output voltage of each phase returns to its setpoint.
13. Program the power source to the Constant-Voltage/Constant-Current mode through the display using the REGULATION menu of the Configuration Screen Top-Level Menu; refer to Section 5.7.7

(Source Mode).

14. Program the output current to 50% of the full-scale output current and verify that the output voltage of each phase is reduced from the setpoint, while the output current is regulated to its setpoint.
15. Return the current setpoint to 100% FS and verify that the output voltage of each phase returns to its setpoint.
16. Turn off the OUTPUT switch.
17. Switch on the resistive load to each phase that is set to draw 90% FS current at 333 Vrms for the high-range AC output.
18. Repeat Steps 7 through 11, instead set the AC output of each phase for the following: voltage range = high, 333 V; output voltage = 333 Vrms; current setting = full-scale for the model being tested.
19. Repeat Steps 5 through 18 but set the output of each phase for DC mode operation with the voltage set for 220 VDC in the low range and 440 VDC in the high range, and the load for each phase set appropriately for the DC range selected.

4.1.4 Grid Simulator Mode

Note: This mode applies only to the SEQUOIA series. TAHOE series does not support this mode of operation.

The Grid simulator mode enables Sequoia AC Sources to sink current from the unit under test. This mode of operation is particularly useful when testing grid-tied products that feed energy back onto the grid. The ability of the Sequoia to simulate the grid provides unique opportunities to test the UUT for immunity to commonly occurring line anomalies like voltage and/or frequency fluctuations. Typical examples of these types of UUTs are solar and/or wind power inverters.

In this mode of operation, the measured power is negative, indicating energy is being fed back into the Sequoia amplifiers. The current limit mode will behave differently than it does under source mode conditions.

When the absolute value of the current exceeds the regenerative current limit setpoint (current limit is set in the REGENERATIVE CURRENT SETTINGS screen), the output voltage of the Sequoia will be increased gradually to reduce the amount of current being fed back. The voltage will continue to be raised until the user set over-voltage trip point is reached. This trip level can be set in the REGENERATIVE CONTROL SETTINGS screen located under the CONFIGURATION screen. At this point, and after the delay set by the “DELAY F” parameter is reached, the AC frequency will be shifted by the amount set in the dFREQ parameter field. The dFREQ is irrelevant to the DC operation. A consideration in the AC mode is the fact that most AC inverters will shut down when detecting a sudden change in frequency. If the frequency shift (dFREQ) is set to zero, however, the output voltage will be dropped to the under-voltage limit setting (UNDER VOLT) set in the REGENERATIVE CONTROL screen instead of the frequency shift. At this point, the UUT should shut down due to an under-voltage condition. Finally, the output relay is opened after the user set delay expires and the current still exceeds the regenerative current limit set in the REGENERATE CONTROL screen.

In grid simulator mode, Sequoia Series AC sources allow positive power operation also, meaning the user can source from the Sequoia. If the power is positive, then Sequoia will consider the source current limit instead of the regenerative current limit as the regulation parameter.

For the DC mode, the Sequoia must be set to the DC Voltage mode and voltage range that accepts the maximum desired set voltage.

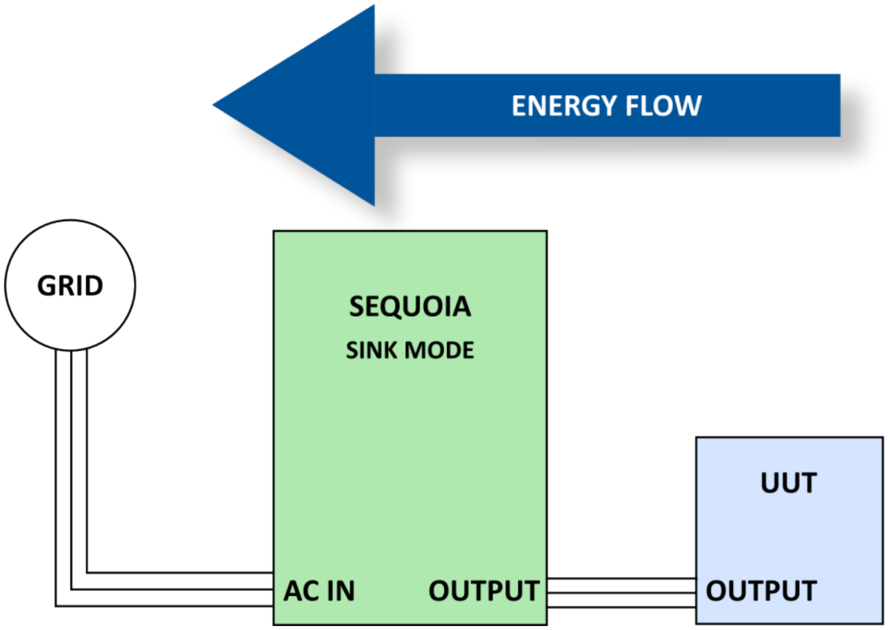


Figure 4-2: Grid Simulator Mode

4.1.4.1 Output Relay control while in Grid Simulator mode

For some PV inverter tests, it may be necessary to 'disconnect' the inverter from the grid (simulated by the power supply). the OUTPUT relay control (Output ON/OFF) will cause the output relay to open without the output voltage being dropped first. It is important to make sure the inverter is in a balanced state with respect to its load so minimal current flows into the Sequoia. If not, the relay of the Sequoia will be hot switched, which should be avoided.

4.1.4.2 Grid Simulator Phase Modes

On Sequoia models operating in three-phase mode, the regulation mechanisms are applied to each phase separately. This means that the parameters can differ for each phase. To set the same values for all three phases, use the individual PHASE button on the front panel to select phases A, B, and C. This will allow you to set the values for all three phases at once.

4.1.4.3 Basic Output Programming

For basic operation, the power supply requires the selection of the output phase number (1-Phase or 3-Phase), output phase sequence, output voltage mode (AC, DC, or AC+DC), voltage range (Low-Range or High-Range), and adjustment of the output parameters (voltage, regenerative current, source current limit, frequency, phase, and DC offset). This can be accomplished through the front panel display by navigating to the appropriate menu, entering the desired values, and enabling the output; alternately, the remote digital interface is used with SCPI commands (refer to the Sequoia Series Programming Manual P/N M447353-01) or the Sequoia Virtual Panels GUI; refer to AMETEK PPD website, www.programmablepower.com, to download the latest version.

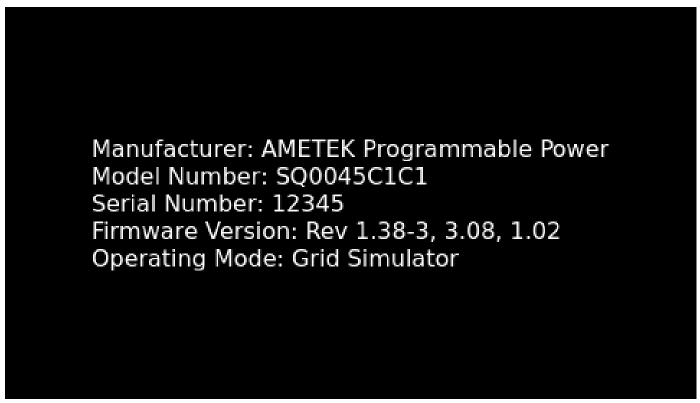
4.1.4.4 Basic Functional Test (Source and Grid Simulator Mode)

WARNING!

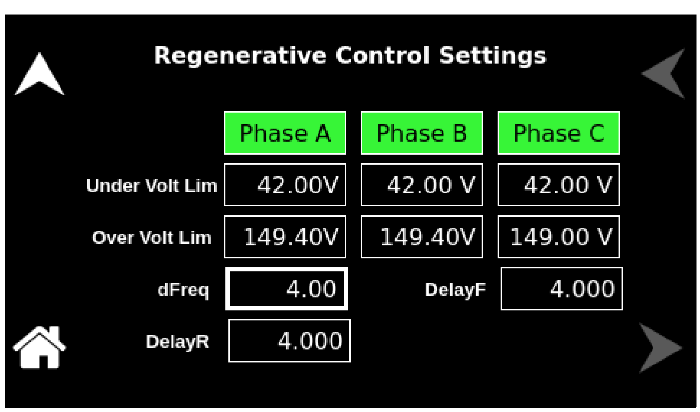
When performing the functional tests, exercise appropriate care to protect against hazardous voltages that are present on the input and output.

A basic functional test of the power source can be performed with the following steps:

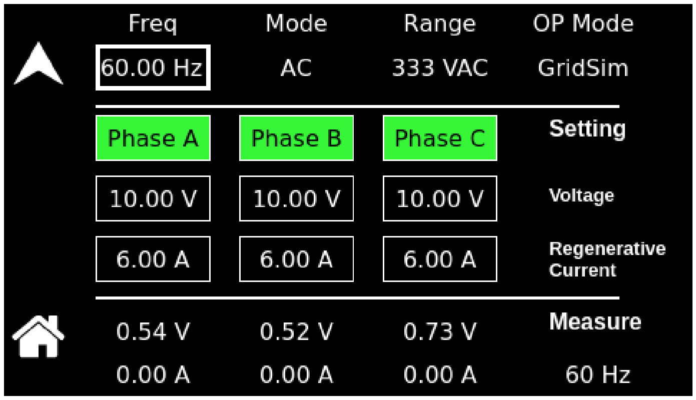
1. Connect an oscilloscope and DVM to the power source AC/DC Output connector. Recommended equipment: oscilloscope, Tektronix TDS 3034C with P5202A high-voltage differential probe; DVM, Keysight 34461A.
2. With the AC mains verified as being off, make the AC input voltage connections to the Sequoia input connector.
3. Connect the output of UUT (PV / grid-tie Inverter) to the output of Sequoia.
4. Turn on the AC mains and then turn on the POWER switch from the Sequoia front panel.



5. Verify the operating mode of the Sequoia is set to Grid Simulator mode from the banner screen of the front panel display during the bootup, refer to the below image.
6. If not, navigate to the operating mode screen and press the SINK-Grid Simulator button.
7. Power cycle the Sequoia and verify the banner screen for the selected mode.
8. After several seconds, the display should show the DASHBOARD Screen Top-Level Menu or the Default screen; refer to Section 5.8 for the description of menus.
9. Set the Sequoia to the required voltage mode and range and navigate to the regenerative control settings screen and program the Under Volt and Over Volt limits, dFreq (Delta Frequency) as per the UUT configuration. Refer to the image below.



10. Program the required output parameters such as output voltage and regenerative current limit from the DASHBOARD screen for the model to be tested.



11. Tapping the OUTPUT switch button would turn on the OUTPUT LED when the output is on.
12. Switch on the Output and operate in the desired condition. (Can Load up to 100% of the rated power)
13. Verify that the front panel power measurement is negative or observe the voltage and current waveforms in the DSO and those will be 180 deg phase shifted. Verify that the front panel power measurement is negative or observe the voltage and current waveforms in the DSO and those will be 180 deg phase shifted.

4.1.5 Electronic Load Mode

Note: This mode applies only to the SEQUOIA series. TAHOE series does not support this mode.

Energy flow is from UUT to facility AC input through SEQUOIA as shown in Figure 4-3.

In Electronic Load Mode, SEQUOIA regulates the RMS current set by the user and works as the load for UUT.

In this operating mode, the user can program the load to be applied to UUT using the following programming types.

- **Current Programming:** The user can program the RMS current, and phase angle (between voltage and current) required as the load for the UUT.
- **Active and Reactive Power programming:** The user can program the Active power, and the Reactive Power required as the load for the UUT.
- **Parallel RLC programming:** The user can program the Resistance, Inductance and Capacitance required as the load for the UUT

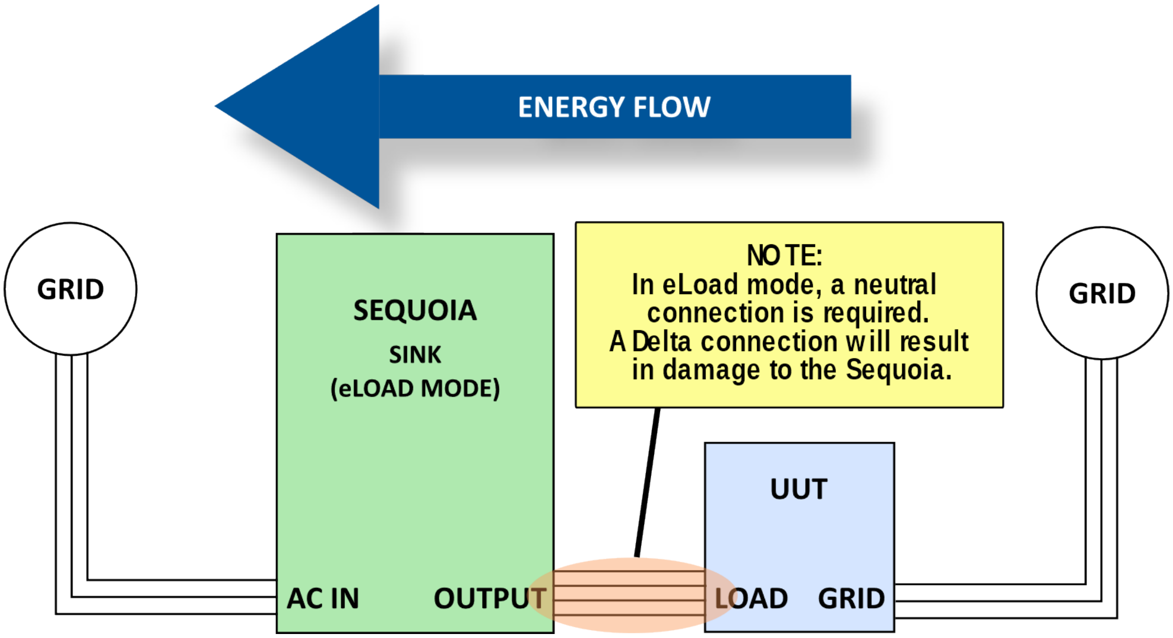
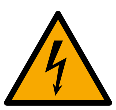


Figure 4-3: Electronic Load Mode



WARNING!

In Electronic load three-phase mode of operation, A Neutral connection is mandatory. Neutral from the output of UUT must be connected to the output neutral of the Sequoia. **Damage to the Sequoia will result if the Neutral is open.**

If a 4 pole disconnect is used, make certain the SEQUOIA has its output off, prior to opening the disconnect.

4.1.5.1 Electronic load Phase Modes

On Sequoia models operating in three-phase mode, the regulation mechanisms are implemented on a phase-by-phase basis. This means that these parameters can be different for each phase. To set all parameters to the same value for all three phases, use the individual PHASE button on the front panel to select the individual phase A, B, and C of the front panel display. This will allow you to set these values for all three phases. To set values by individual phase.

In the three-phase mode of operation, Sequoia requires a STAR-connected source as UUT. Neutral from the output of UUT must be connected to the output neutral of the Sequoia. Refer to the Figure 4-3.

4.1.5.2 Basic Output Programming

For basic operation, the Sequoia requires the selection of the operating mode, output phase number (1-Phase or 3-Phase), output voltage mode (AC or DC), voltage range (Low-Range or High-Range), the configuration of the sync parameters (sync voltage, sync frequency, and sync phase sequence), Synchronization and adjustment of the load parameters based on programming mode selected (Current and phase shift for current programming mode, Active and reactive power for the power programming mode, and R, L, and C for the Parallel RLC Programming mode).

This can be accomplished through the front panel display by navigating to the appropriate menu, entering the desired values, performing the synchronization, and enabling the output; alternately, the remote digital interface is used with SCPI commands.

Refer to the Sequoia Series Programming Manual P/N M447353-01) or the Sequoia Virtual Panels GUI; refer to AMETEK PPD website, www.programmablepower.com, to download the latest version.

4.1.5.3 Basic Functional Test

Steps to be followed:

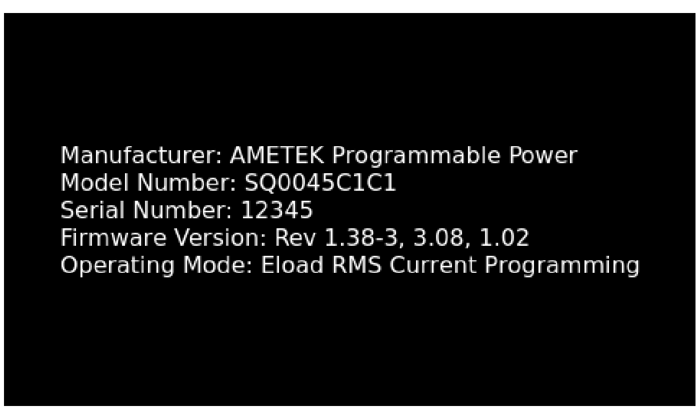
1. Electrical Connection: Connect the UUT output to the SEQUOIA output as shown in Figure 4-3.
2. Select the Operating Mode.
3. Configure the Sync settings and turn on the UUT output.
4. Synchronize Sequoia Output to UUT output using steps given in Section 4.1.5.4
5. Program load parameters for the selected Operating mode.
6. Turn ON the Output of the Sequoia.

4.1.5.4 Synchronization

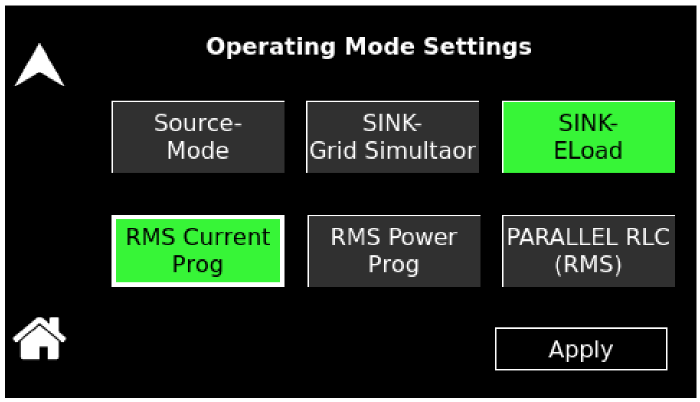
To use the Sequoia in Electronic load operating mode; the voltage, frequency, and phase sequence of Sequoia and UUT must be synchronized for the AC mode of operation and only voltage to be synchronized in the DC mode of operation.

Steps to perform the AC mode Synchronization:

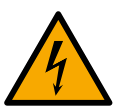
1. Connect UUT output to the output of the Sequoia Series AC Source.
2. Power up the UUT followed by the Sequoia.
3. Verify the operating mode of the Sequoia is set to Electronic Load Mode from the banner screen of the front panel display during the bootup, refer to the below image.



4. If not, navigate to the operating mode screen and press the SINK-Electronic load button.
5. Upon pressing the SINK-Electronic load button, the programming modes will be displayed that are available for the Electronic Load operating mode. Refer to section 5.6.
    - RMS Current Prog (RMS Current Programming Mode)
    - RMS Power Prog (RMS Power Programming Mode)
    - Parallel RLC (RMS) (Parallel RLC Programming Mode)
6. Select the required programming mode to act as a load and apply. Refer to the image below.



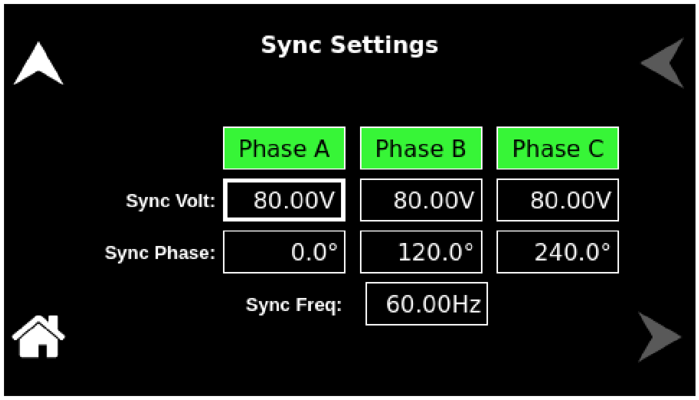
7. Power cycle the Sequoia and verify the banner screen for the selected mode.
8. Set the Sequoia to the required range and enable the output of UUT.
9. Program the sync voltage the same as the output voltage of the UUT, sync voltage tolerance is +/- 10% of the set value.



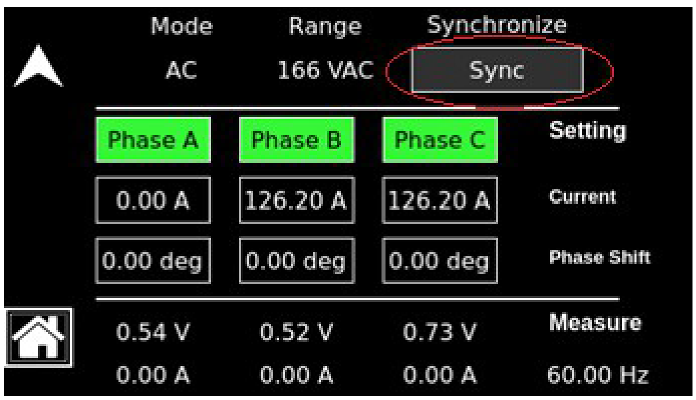
WARNING!

When using the Sequoia Series in the Electronic Load Mode make sure that the UUT voltage range is compatible with the Sequoia Voltage range and operate the Sequoia unit with the appropriate voltage range to protect against hazardous voltages.

10. Program the sync frequency the same as the output frequency of the UUT, sync frequency tolerance is +/- 2 Hz of the set value.
11. To program sync phase sequence value same as the UUT phase sequence, navigate to the phase measurement screen (refer to section 5.6.7, below image) of Sequoia and measure the phase sequence for each Phase.
12. Navigate to the CONFIGURATION MENU screen – SYNC SETTINGS screen and Enter the measured value of each phase as the sync phase sequence value of the Sequoia. refer to the below image.



13. Synchronize the Sequoia with the UUT output by pressing the Sync button from the front panel dashboard screen, refer to the below image.



14. The sync button will be highlighted once the synchronization has happened or else an error message will be displayed with the text “Sync Setting Error”.
15. If an error occurs, verify the programmed sync settings (voltage, frequency, and phase sequence) match with the UUT output values.
16. Set the required Load parameters through the front panel dashboard screen and enable the output of the Sequoia.

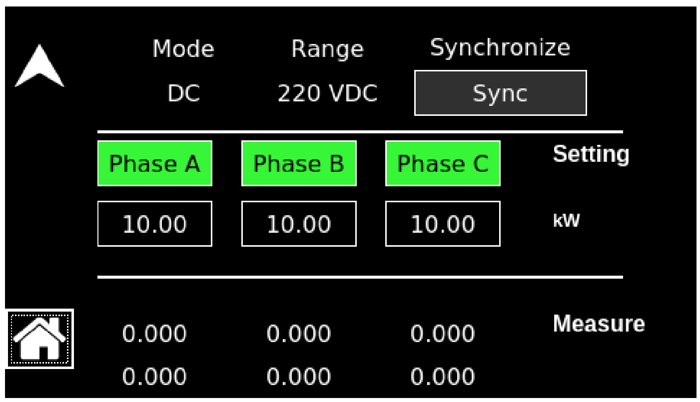
Steps to perform the DC mode Synchronization:

1. Connect UUT to the output of the Sequoia. Power up both units.
2. Set the Sequoia to the required range and enable the output of UUT.
3. Set the Sequoia to the required range and program the sync voltage as the output voltage of the UUT, sync voltage tolerance can be +/- 10% of the set value.

WARNING!

When performing the Sequoia unit in Electronic Load Mode make sure that the UUT voltage range is compatible with the Sequoia Voltage range and operate the Sequoia unit with the appropriate voltage range to protect against hazardous voltages that are present on the input and output.

4. Synchronize the Sequoia with the UUT output by pressing the Sync button from the front panel dashboard screen, refer to the below image.



5. The sync button will be highlighted once the synchronization has happened or else an error message will be displayed with the text "Sync Settings Error" If the error occurs, verify the programmed sync voltage is matching with the output voltage of the UUT.
6. Set the required programming parameters through the front panel dashboard screen and enable the output of the Sequoia.

4.1.5.5 Basic Functional Test of Electronic load – Current Programming Mode

WARNING!

When performing the functional tests, exercise appropriate care to protect against hazardous voltages that are present on the input and output.

A basic functional test of the Sequoia in Electronic Load Mode can be performed with the following steps:

1. Connect a UUT output to the Sequoia output connector.
2. Connect a DVM to the Sequoia output connector. Recommended equipment: DVM, Keysight 34461A.
3. With the AC mains verified as being off, make the AC input voltage connections to the Sequoia unit input connector.

4. Verify that the front panel display initializes. After several seconds, the display should show the DASHBOARD Screen Top-Level Menu or the Default screen; refer to Section 5.7.3 for the description of menus.
5. Switch on the UUT and set voltage 150 Vrms, frequency 60 Hz.
6. Set the sync voltage, sync frequency, and sync phase to the Sequoia and perform synchronization (refer to Section 4.1.5.1).
7. Set the Sequoia current and phase shift from the front panel dashboard screen and enable the output (make sure that UUT current limit is greater than the Sequoia current set value).
8. Measure the output current of each phase using a clamp meter and verify that the output current of each phase remains within specifications for current program accuracy.

4.1.5.6 Basic Functional Test of Electronic load – Power Programming Mode

A basic functional test of the Sequoia in Electronic Load Mode can be performed with the following steps:

1. Connect a UUT output to the Sequoia output connector.
2. Connect a DVM to the Sequoia output connector. Recommended equipment: DVM, Keysight 34461A.
3. With the AC mains verified as being off, make the AC input voltage connections to the Sequoia input connector.
4. Turn on the AC mains and then turn on the POWER switch on the Sequoia front panel.
5. Verify that the front panel display initializes. After several seconds, the display should show the DASHBOARD Screen Top-Level Menu or the Default screen; refer to Section 5.7.3 for the description of menus.
6. Switch on the UUT and set the UUT to provide voltage 150 Vrms, frequency 60 Hz.
7. Set the sync voltage, sync frequency, and sync phase to the Sequoia and perform synchronization (refer to section 4.1.5.1).
8. Set the Sequoia active and reactive power from the front panel dashboard screen and enable the output (make sure that the UUT current limit is sufficient to load the net apparent power set in Sequoia).
9. Measure the output power of each phase using a power meter and verify that the output power of each phase remains within specifications for power program accuracy.

4.1.5.7 Basic Functional Test of Electronic load – Parallel RLC Programming Mode

A basic functional test of the Sequoia in Electronic Load Mode can be performed with the following steps:

1. Connect a UUT output to the Sequoia output connector.
2. Connect a DVM to the Sequoia output connector. Recommended equipment: DVM, Keysight 34461A.
3. With the AC mains verified as being off, make the AC input voltage connections to the Sequoia input connector.
4. Turn on the AC mains and then turn on the POWER switch on the Sequoia front panel.
5. Verify that the front panel display initializes. After several seconds, the display should show the DASHBOARD Screen Top-Level Menu or the Default screen; refer to Section 5.7.3 for the description of menus.
6. Switch on the UUT and set the voltage to 150 Vrms and frequency 60 Hz.

7. Set the sync voltage, sync frequency, and sync phase to the Sequoia unit and perform synchronization (refer to section 4.1.5.1).
8. Make the Inductance and capacitance value to “NC, set the Resistance value through the front panel dashboard screen, and press apply the button refer to the below image:
   R = 150V / 50% of the Rated current
9. Enable the output of the Sequoia and measure the output voltage and current of each phase and calculate the resistance for each phase (make sure that UUT current limit is greater than 50% rated value of the Sequoia).
10. Query the following command for getting the reference current: `CURR?`
11. Verify the reference current is the same as the measured output current or within the current program accuracy limit of each phase.
12. Make the resistance value 0, the capacitance value “NC” and Set the Inductance value through the front panel dashboard screen and apply the button refer above image:

    ZL = V/I

    L = V/(I*2πf)

    L = 150V / (50% of Rated current * 2πf) Inductance value in millihenry unit = L * 1000
13. Enable the output of the Sequoia unit and measure the output voltage and current of each phase (make sure that UUT current limit is greater than 50% rated value of Sequoia).
14. Query the following command for getting the reference current: `CURR?`
15. Verify the reference current is the same as the measured output current or within the current program accuracy limit of each phase.
16. Make the resistance value 0, the Inductance value “NC” and set the capacitance value through the front panel dashboard screen and apply the button refer above image:

    ZC = V/I

    C = I/(Vω)

    C = 50% of Rated current / (150V * 2πf) Capacitance units in microfarads = C * 10^6
17. Query the following command for getting the reference current: `CURR?`
18. Enable the output of the Sequoia and measure the output voltage and current of each phase (make sure that UUT current limit is greater than 50% rated value of Sequoia).
19. Verify the reference current is the same as the measured output current or within the current program accuracy limit.

4.2 External I/O Control Signal Connector

The Sequoia / Tahoe power supply is provided with an External I/O Control Signal 15-pin connector on the rear panel. This section contains the setup and operating configuration of Output ON/OFF Status, External Synchronization, Fault status, Remote inhibit, External Analog Modulation of Output Voltage, and Trigger Functions. Refer to Figure 4-4 for the connector pin-out diagram and Table 4-1 for connector pin-out details.

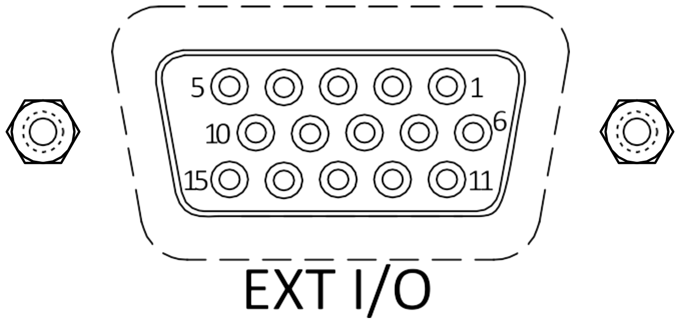


Figure 4-4: External Input/Output Control Connector

Pin #	Name	Type	Range	Function
AWG	ISO_COM	Return	Return	Isolated signal return / Common ground terminal for Pins 4, 5, 11, 12, 13, and 14.
2	SYNC_HIGH	Digital Input	0-5 V	Isolated signal for synchronization of the output to a logic-high signal transition; paired with Pin-3.
3	SYNC_LOW	Return	Return	Isolated signal return for synchronization of the output; paired with Pin-2.
4	/INHIBIT	Digital Input	0 VDC or 5 VDC	Isolated inhibit signal to turn the output off/on and open/close the output relay; signal return on Pin-1.
5	TRIGGER IN	Digital Input	0-5 VDC	Isolated trigger signal; signal return on Pin-1.
6	SUMMARY FAULT	Digital Output	±12 VDC	Isolated Summary Fault signal; paired with Pin-7.
7	SUMMARY FAULT RETURN	Return	Return	Signal return for Summary Fault; paired with Pin-6.
8	N/C	N/C	N/C	N/C
9	N/C	N/C	N/C	N/C
10	ISO_COM	Return	Return	Isolated signal return / Common ground terminal for Pins 4, 5, 11, 12, 13, and 14.
11	OUTPUT STATUS	Digital Output	0 VDC or 5 VDC	Isolated TTL output; High if the output relay is closed, low if the output relay is open.
12	MODULATION REFERENCE - A	Digital Output	0 VDC or 5 VDC	Isolated TTL output; High if the output relay is closed, low if the output relay is open.
13	MODULATION REFERENCE - B	Analog Input	±7.07 V	External modulation signal input terminal for Phase-A.
14	MODULATION REFERENCE - C	Analog Input	±7.07 V	External modulation signal input terminal for Phase-B.
115	ISO_COM	Analog Input	±7.07 V	External modulation signal input terminal for Phase-C.

Table 4-1: External Input/ Output Control Connector Pinout

4.2.1 External Synchronization

An external Synchronization Signal is given to pin-2 (SYNC_HIGH) and pin-3 (SYNC_LOW) present in the External I/O Control Signal 15-pin connector available on the rear panel; refer to Table 4-1 for pinout details. Applying an external square waveform of the range between 0 V to 5 V with desired frequency on SYNC_HIGH and SYNC_LOW pins will allow the user to control the output frequency and phase of the waveform generated by the internal generator; refer to Figure 4-5.

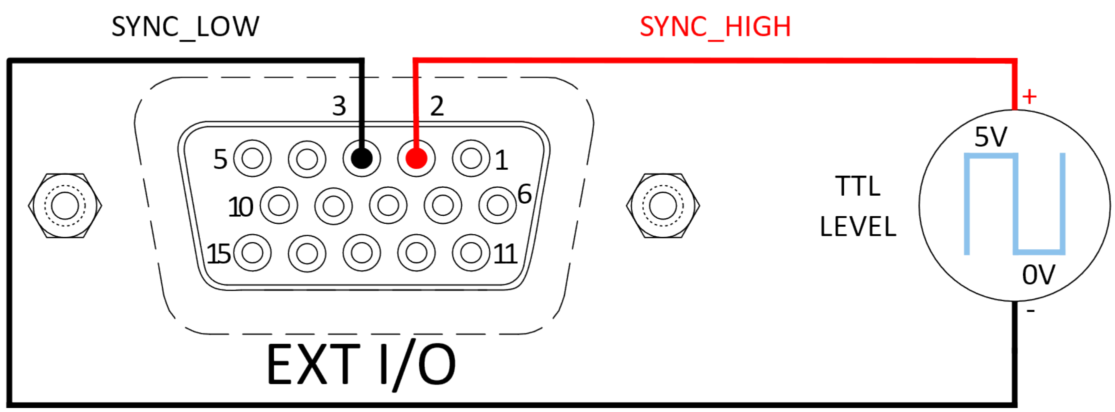


Figure 4-5: Synchronization Signal Pinout Diagram

4.2.2 Remote Inhibit

External I/O Control Signal 15-pin connector is provided with remote inhibit inputs; refer to Table 4-1 for pin-out details. A contact closure (direct shot) or contact open between Inhibit and Return / ISO_COM pins, will allow the output to be enabled/disabled based on the selection between LOGIC-LOW or LOGIC-HIGH; refer to Figure 4-6 for the pinout diagram.

The default logic level for Remote Inhibit is a logic-low or contact closure between /INHIBIT_ISO (Pin-4) and ISO_COM (Pin-1). This will cause the output voltage to be programmed to zero volts and the output relays to open. This logic level can also be selected with the SCPI command, `OUTPUT:RI:LEVEL LOW`.

Alternatively, the logic level can be changed by the user to logic-high using the remote digital interface SCPI command, `OUTPUT:RI:LEVEL HIGH`. A logic-high (5 V) or open-circuit between /INHIBIT_ISO (Pin-4) and ISO_COM (Pin-1) will cause the output voltage to be programmed to zero volts and the output relays to open.

The mode of operation of the Remote Inhibit can be changed using the remote digital interface SCPI command, `OUTP:RI:MODE <mode>`. The following modes can be selected:

LATC(hing) A TTL logic-low (or user-selected logic-high) at the Remote Inhibit input latches the output in the protection shutdown state; this state can only be cleared by the remote digital interface SCPI command, `OUTPut:PROTection:CLEar`.

LIVE The output state follows the state of the Remote Inhibit input. A TTL logic-low (or user-selectable logic-high) at the Remote Inhibit input turns the output off; a TTL logic-high (or user-selectable logic-low) turns the output on. This mode is equivalent to using the Output ON/OFF button on the front panel.

Off The power source ignores the external Remote Inhibit input and allows the user to turn ON/OFF the output irrespective of the logic level (logic-low / logic-high).

The Remote Inhibit output mode state is saved at power-down. The factory default state is LIVE.

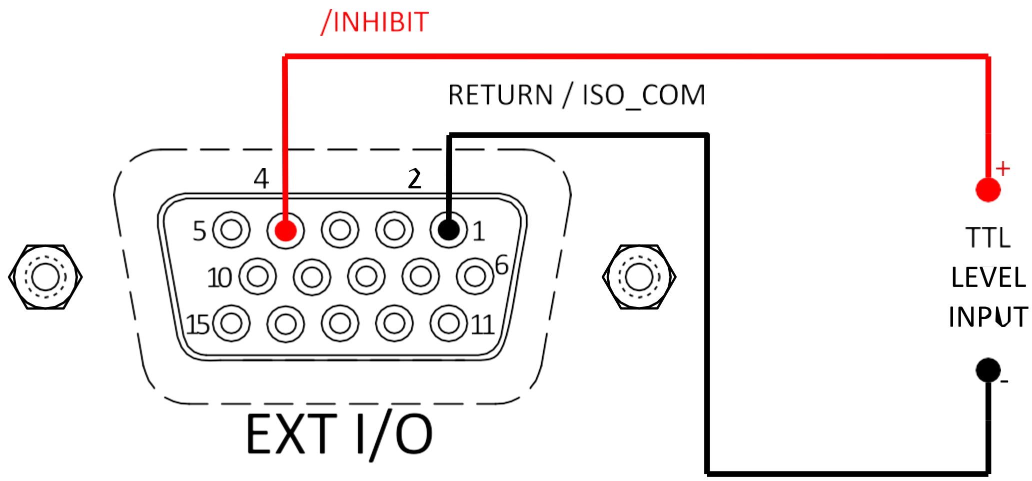


Figure 4-6: Remote Inhibit Pinout Diagram

4.2.3 Trigger IN Function

There are two types of user-selectable Trigger IN functions: Internal and External. This can be selected from the front panel Transients menu. Refer to Section 5.7.6.

An external trigger signal is to be given to the TRIGGER IN (Pin 5) and RETURN / ISO_COM (Pin 1) when Start Source is selected as EXT(ernal) for the execution of programmed values or transient lists right after the START button is pressed which is present in Transients ➔ RUN sub-menu, refer to Figure 4-7.

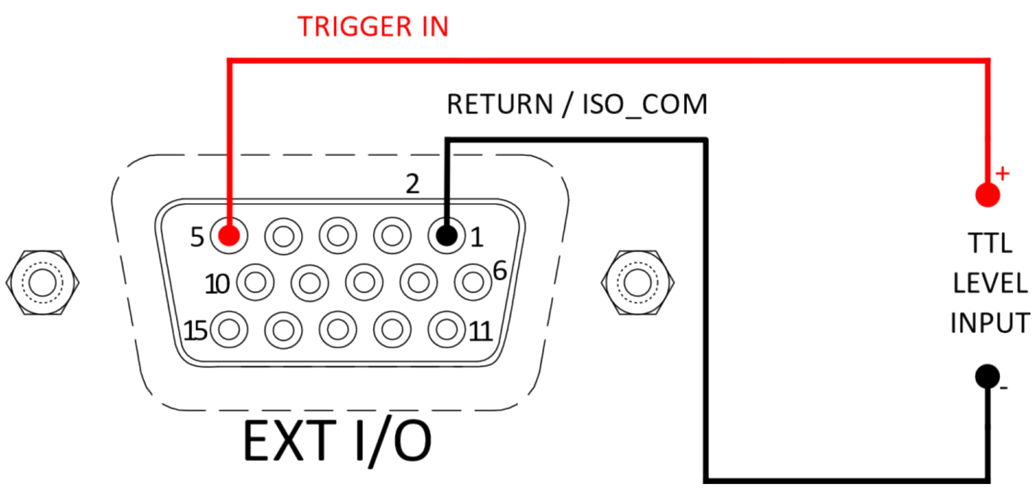


Figure 4-7: Trigger IN Pinout diagram

4.2.4 Summary Fault Signal

The Summary Fault signals, SUMMARY FAULT (Pin-6) and SUMMARY FAULT RETURN (Pin-7) signals provides an indication of abnormal condition occurrence. A summary fault signal with a high state (applied VCC) indicates that there is no fault present, and a Low state (0 V / short) indicates that fault is present, refer to Figure 4-8.

Note: The user must make sure that the resistor should be designed in such a way that the current to the summary fault pin should not exceed 0.1 A.

In the default configuration, the signal reports the summary bit that is the logic-OR of the Questionable Status Register outputs for the following events:

a) HV BUS OV fault: Overvoltage in HVDC BUS

b) Amplifier fault: Inverter Overcurrent Fault

c) Overtemperature fault: Inverter Over temperature

d) Output overvoltage fault

e) Output voltage regulation fault

f) Output current-limit fault.

The functionality of the Summary Fault signal is programmed through SCPI commands to report events as captured in either of the following sources: Questionable Status Register (default setting), Operation Status Register, Standard Event Status Register, or Request Service Summary Bit. Also, the Summary Fault signal operation is enabled and disabled through SCPI commands. Refer to the Sequoia Programming Manual, P/N M447353-01, and Tahoe Series Programming Manual P/N M447354-01 for specific information on the programming options.

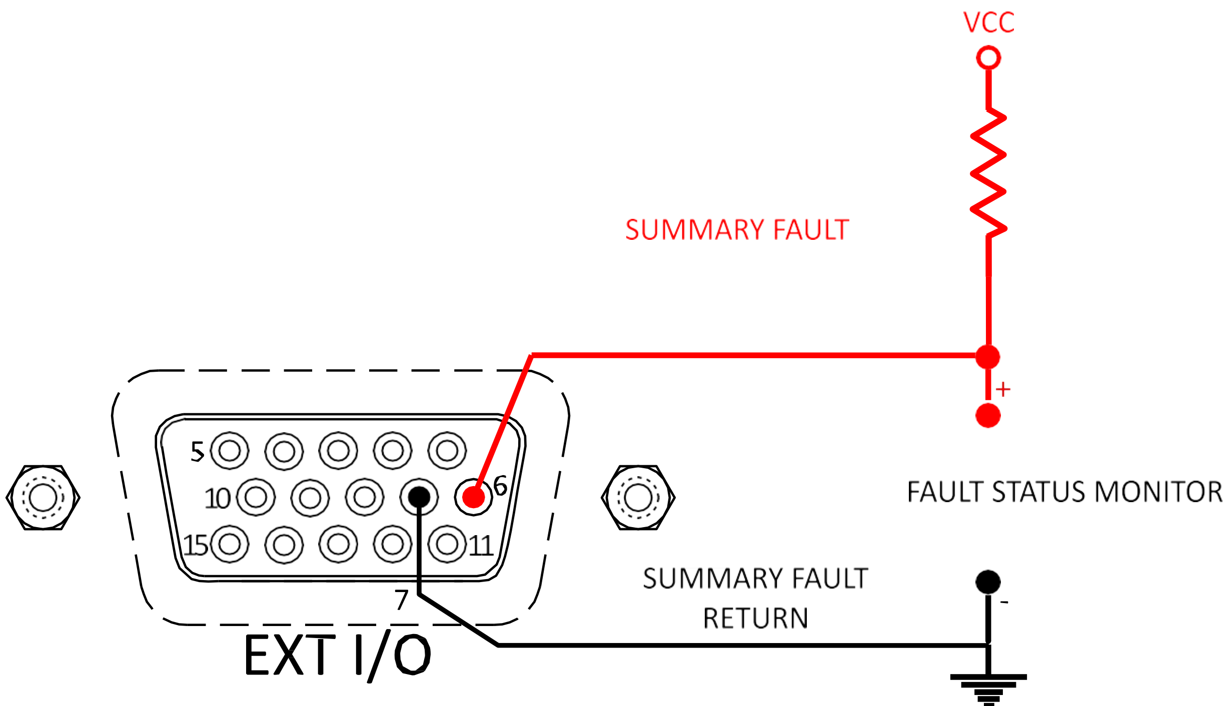


Figure 4-8: Summary Fault Pinout Diagram

4.2.5 Output ON/OFF Status

External I/O Control Signal 15-pin connector is provided with Output ON/OFF Status; refer to Table 4-1 for pin-out details. An output signal with a high state (2 to 5 VDC) indicates that the output of the power supply is enabled, and a Low state (0 V) indicates that the output of the power supply is disabled. The Output status signal can be monitored between Pin-11 (OUTPUT STATUS) and Pin-1 (ISO_COM/ Return); refer to Figure 4-9: Output On/Off Status Pin-out Diagram.

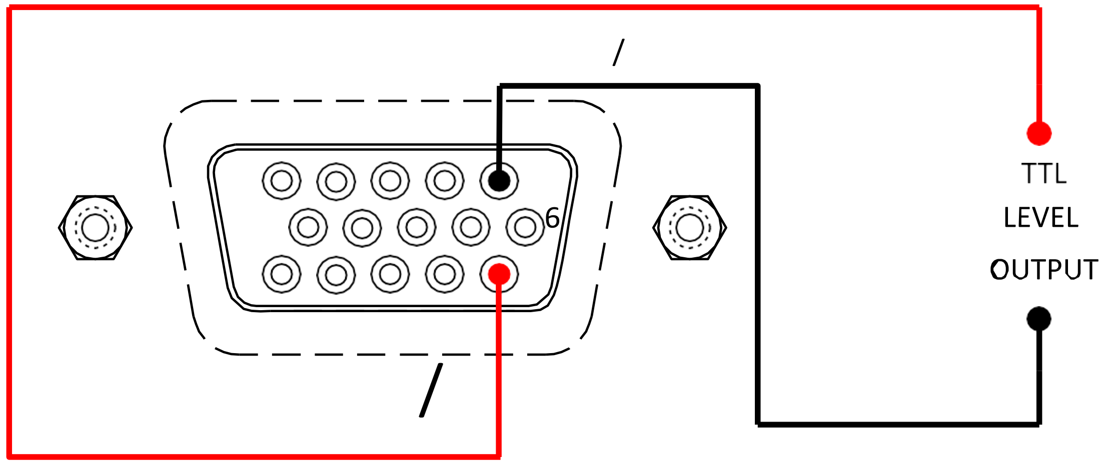


Figure 4-9: Output On/Off Status Pin-out Diagram

4.2.6 External Analog Modulation of Output Voltage (Source and Grid-Simulator MODE)

Note: This function is available in both the SEQUOIA and TAHOE series power supply, and for the SEQUOIA series, this function is applicable only in SOURCE and Grid-Simulator Modes of operation. Also, the external modulation signal is limited to a maximum peak of 485 V so that the signal peak would not go beyond 485 V in the HIGH range and 242.5 V in the LOW range.

Users can program the output voltage amplitude to be modulated based on the AC waveform provided to the External Modulation Reference Signal pins. Applying an external AC Waveform of the range between (0 to 5 Vrms) or (0 to ±7.07 Vpk) to the External I/O Control Signal Connector can provide 0-10% of full-scale output voltage amplitude modulation.

Pin 12 (External Modulating Signal – Phase A) and Pin 10 (Return / ISO_COM) are to be connected to an AC source to vary the output voltage for Phase A, refer to Figure 4-10.

Pin 13 (External Modulating Signal – Phase B) and Pin 10 (Return / ISO_COM) are to be connected to an AC source to vary the output voltage for Phase B, refer to Figure 4-11.

Pin 14 (External Modulating Signal – Phase C) and Pin 10 (Return / ISO_COM) are to be connected to an AC source to vary the output voltage for Phase C, refer to Figure 4-12.

The mentioned above pins are present in the External I/O Control Signal Connector (EXT I/O) available on the rear panel; refer to Figure 4-1 for pin-out details.

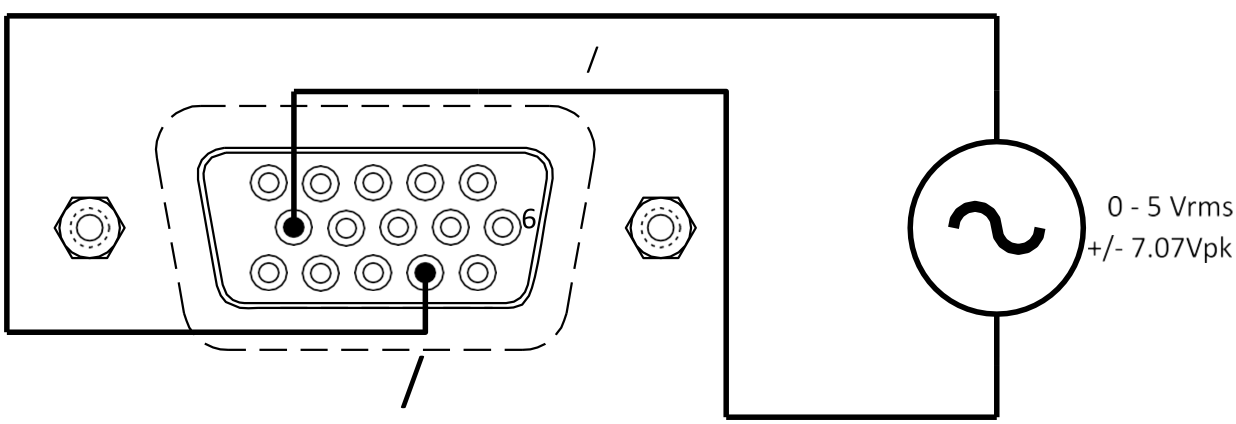


Figure 4-10: Modulation Reference Signal Pinout diagram for Phase A

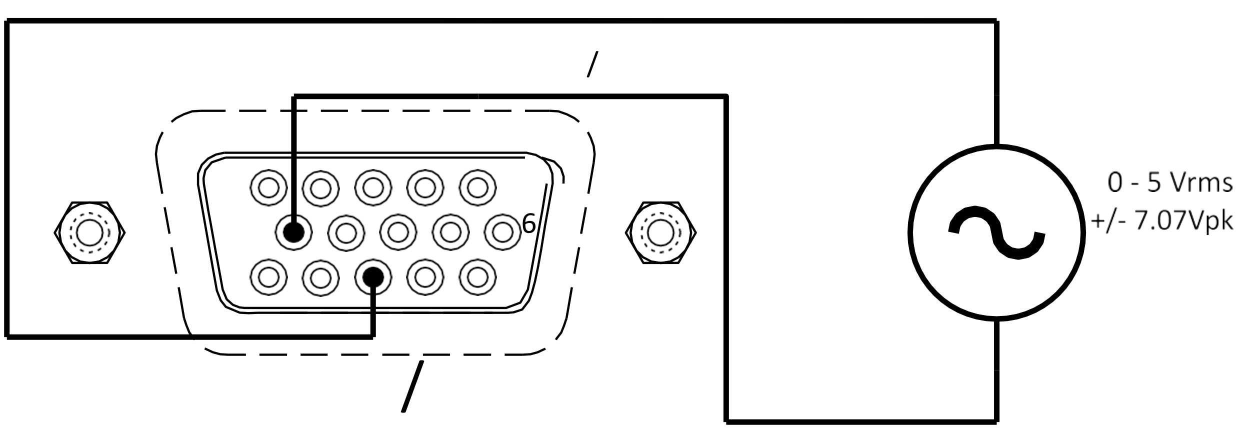


Figure 4-11: Modulation Reference Signal Pinout diagram for Phase B

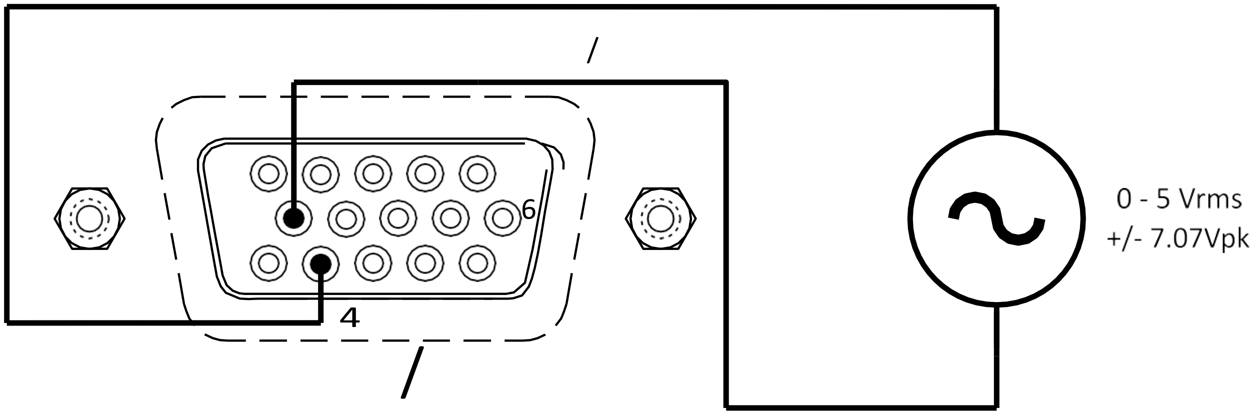


Figure 4-12: Modulation Reference Signal Pinout diagram for Phase C

4.3 External Analog Control Signal Connector

The Sequoia / Tahoe power supply is provided with an External Analog Control Signal 15-pin connector on the rear panel. This section contains the setup and operating configuration of the External Analog Programming of the Output Voltage Waveform, Output Voltage and Current Amplitude, Voltage Monitor, and Current Monitor. Refer to Figure 4-13 for the connector pin-out diagram and Table 4-2 for connector pin-out details.

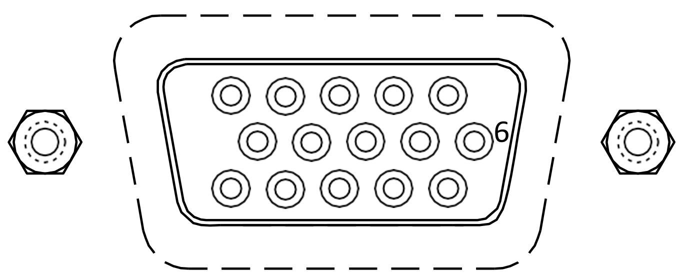


Figure 4-13: External Analog Control Signal Connector

Pin #	Name	Type	Range	Function
1	External Reference Signal – Phase A	Analog Input	±10 V	Analog programming signal input terminal for user-selectable external waveform programming or amplitude control (RPV) for Phase-A.
2	External Reference Signal - Phase B	Analog Input	±10 V	Analog programming signal input terminal for user-selectable external waveform programming or amplitude control (RPV) for Phase-B.
3	External Reference Signal - Phase C	Analog Input	±10 V	Analog programming signal input terminal for user-selectable external waveform programming or amplitude control (RPV) for Phase-C.
4	ISO_COM	Return	Return	Common Ground: Pins 4, 9, and 14 are internally connected.
5	N/C	N/C	N/C	N/C

6	Output Current Monitor - Phase A	Analog Output	±10 V	Signal outputs for output phase A for monitoring the waveform of the command signal of the output amplifier.
7	Output Current Monitor - Phase B	Analog Output	±10 V	Signal outputs for output phase B for monitoring the waveform of the command signal of the output amplifier.
8	Output Current Monitor - Phase C	Analog Output	±10 V	Signal outputs for output phase C for monitoring the waveform of the command signal of the output amplifier.
9	ISO_COM	Return	Return	Common Ground: Pins 4, 9, and 14 are internally connected.
10	N/C	N/C	N/C	N/C
11	Output Voltage Monitor - Phase A	Analog Output	±10 V	Signal outputs for output phase A for monitoring the waveform of the command signal of the output amplifier.
12	Output Voltage Monitor - Phase B	Analog Output	±10 V	Signal outputs for output phase B for monitoring the waveform of the command signal of the output amplifier.
13	Output Voltage Monitor - Phase C	Analog Output	±10 V	Signal outputs for output phase C for monitoring the waveform of the command signal of the output amplifier.
14	ISO_COM	Return	Return	Common Ground: Pins 4, 9, and 14 are internally connected.
15	N/C	N/C	N/C	N/C

Table 4-2: External Analog Control Signal Connector Pinout

4.3.1 External Analog Programming of Output Voltage Waveform (Source and Grid-Simulator Mode)

Note: This function is available in both the SEQUOIA and TAHOE series power supply and for the SEQUOIA series, this function is applicable only in SOURCE and Grid-Simulator Modes of operation.

This is an alternative method where the user can program the output voltage based on the AC waveform provided to the External Reference Signal pins. In this function, the output frequency is limited to 550 Hz for the HF + FC frequency option units. Applying an external AC Waveform of the range between 0 Vrms – 7.07 Vrms to the External Analog Control Signal Connector can provide the output voltage to scale between 0 VAC to 166 VAC when the low range is selected. Similarly, 0 VAC to 333 VAC when the high range is selected.

Pin 1 (Reference Signal – Phase A) and Pin 4 (Return / ISO_COM) are to be connected to an AC source to vary the output voltage for Phase A, refer to Figure 4-14.

Pin 2 (Reference Signal – Phase B) and Pin 4 (Return / ISO_COM) are to be connected to an AC source to vary the output voltage for Phase B, refer to Figure 4-15.

Pin 3 (Reference Signal – Phase C) and Pin 4 (Return / ISO_COM) are to be connected to an AC source to vary the output voltage for Phase C, refer to Figure 4-16.

The above-mentioned pins are present in the External Analog Control Signal Connector (EXT ANLG) available on the rear panel; refer to Table 4-2 for pin-out details.

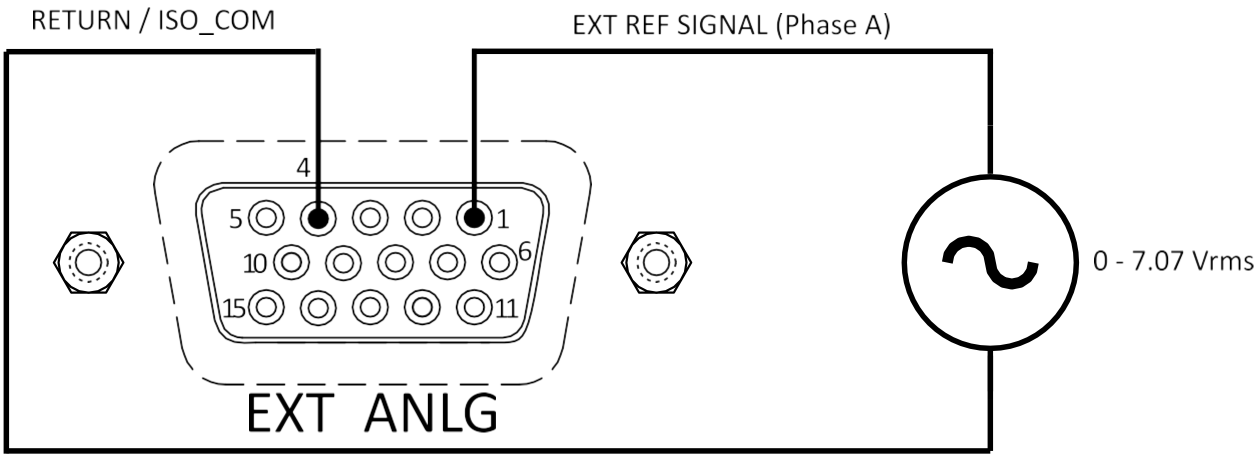


Figure 4-14: External Analog Programming – Reference AC waveform for Phase A

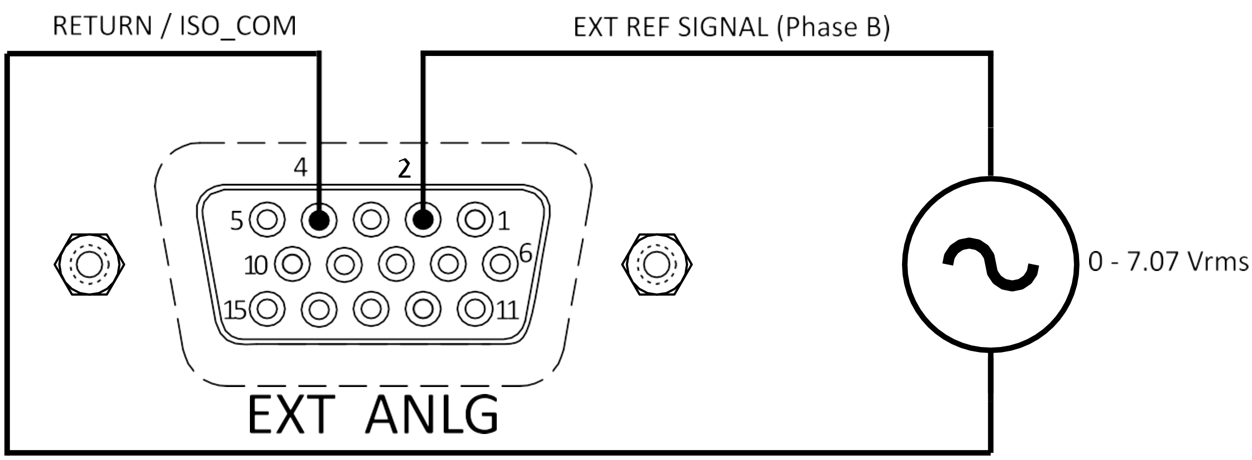


Figure 4-15: External Analog Programming – Reference AC waveform for Phase B

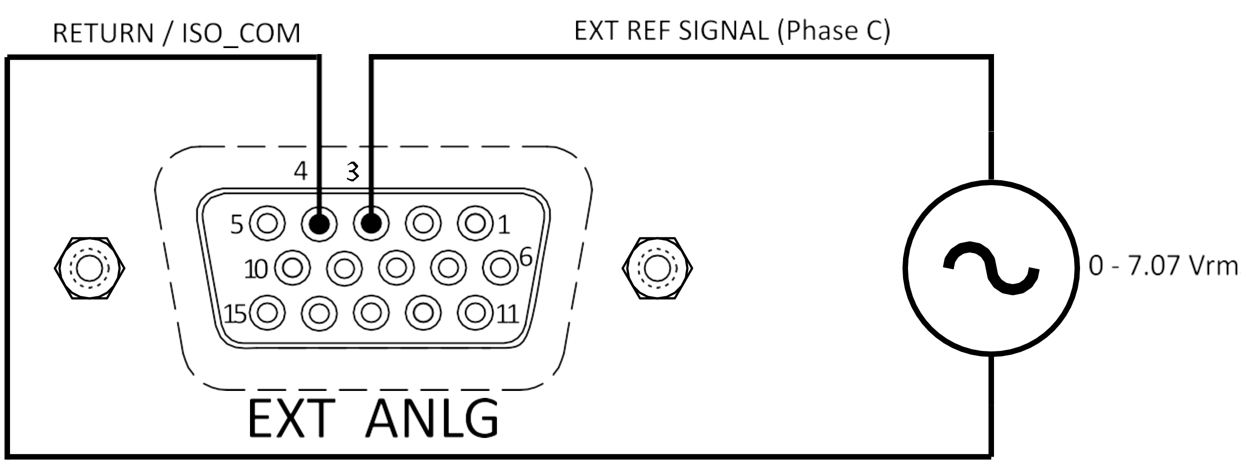


Figure 4-16: External Analog Programming – Reference AC waveform for Phase C

4.3.2 External Analog Programming of Output Voltage Amplitude (Source and Grid-Simulator Mode)

Note: This function is available in both the SEQUOIA and TAHOE series power supply and for the SEQUOIA series, this function is applicable only in SOURCE and Grid-Simulator Modes of operation.

This is an alternative method where the user can program the amplitude of output voltage based on the DC voltage provided to the External Reference Signal pins. Applying an external DC Voltage of the range between 0 VDC to 10 VDC to the External Analog Control Signal Connector can provide the output voltage to scale between 0 VAC to 166 VAC when low-range AC mode is selected and 0 VAC to 333 VAC when high- range AC mode is selected.

Similarly, applying an external DC Voltage of the range between -10 VDC to +10 VDC to the External Analog Control Signal Connector can provide the output voltage to scale between +/- 220 VDC when DC mode low range is selected and +/-440 VDC when DC mode high range is selected.

- Pin 1 (External Reference Signal – Phase A) and Pin 4 (Return / ISO_COM) are to be connected to the DC source to vary the output voltage for Phase A, refer to Figure 4-17.
- Pin 2 (External Reference Signal – Phase B) and Pin 4 (Return / ISO_COM) are to be connected to the DC source to vary the output voltage for Phase B, refer to Figure 4-18.
- Pin 3 (External Reference Signal – Phase C) and Pin 4 (Return / ISO_COM) are to be connected to the DC source to vary the output voltage for Phase C, refer to Figure 4-19.

The above-mentioned pins are present in the External Analog Control Signal Connector (EXT ANLG) available on the rear panel; refer to Table 4-2 for pin-out details.

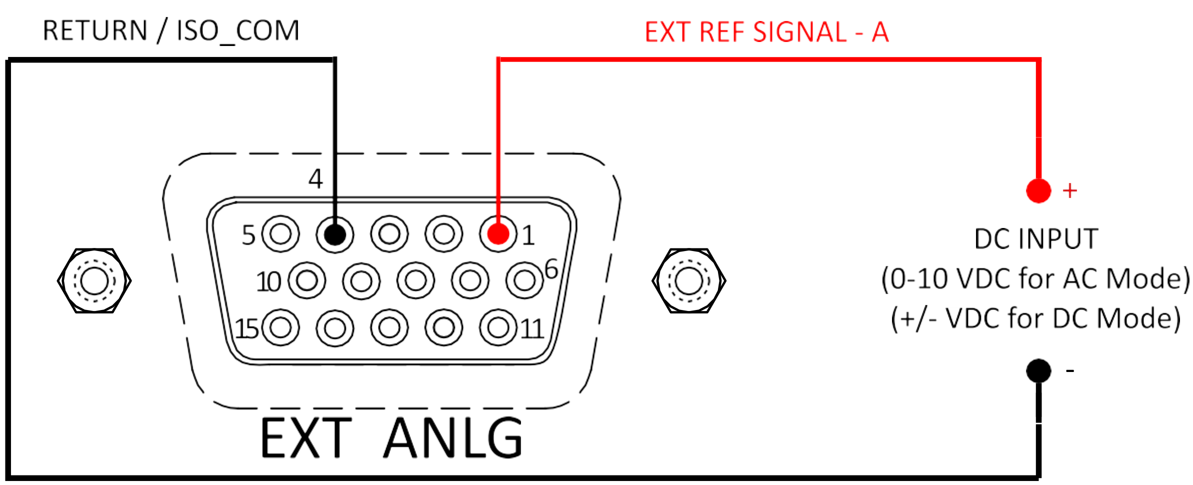


Figure 4-17: External Analog Programming – Reference DC Source for Phase A

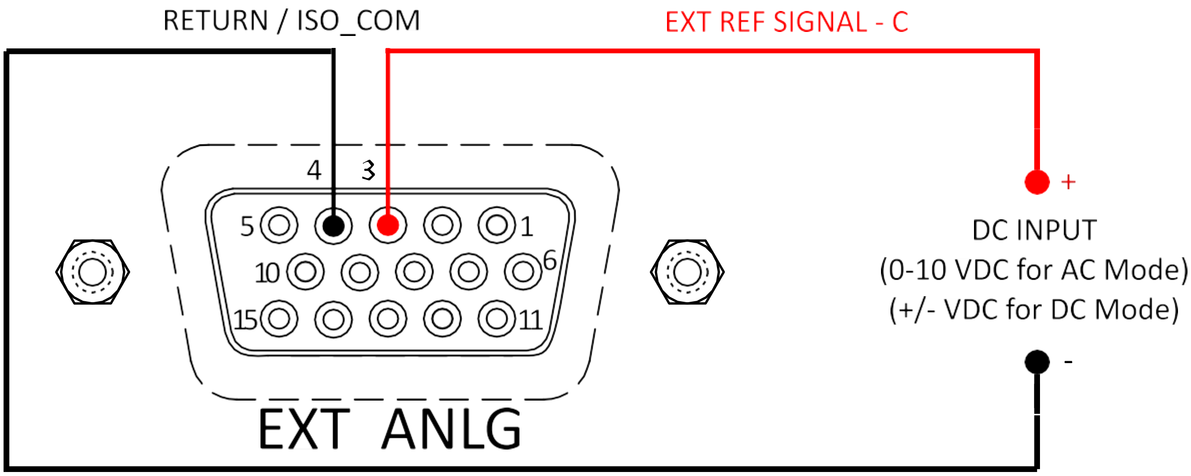


Figure 4-18: External Analog Programming – Reference DC Source for Phase B

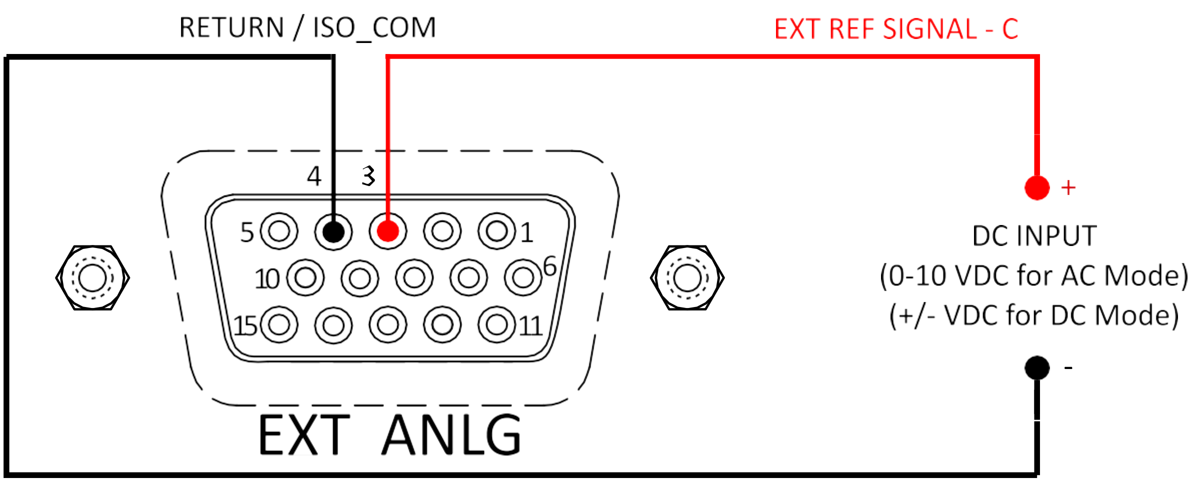


Figure 4-19: External Analog Programming – Reference DC Source for Phase C

4.3.3 External Analog Programming of Output Current Amplitude (Electronic load – Current programming Mode)

Note: This function is available only for Electronic Load – Current Programming Mode for SEQUOIA Series Power Supply and not in TAHOE Series.

This is an alternative method where the user can program the output current based on the DC voltage provided to the External Reference Signal pins. Applying an external DC Voltage of the range between 0 VDC to 10 VDC to the External Analog Control Signal Connector can provide the output current to scale between 0 to full-scale current based on the Range selected for AC Mode.

Similarly, applying an external DC Voltage of the range between -10 VDC to +10 VDC to the External Analog Control Signal Connector can provide the output current to scale between +/- full-scale current based on the Range selected for DC Mode.

Note: When the UUT output voltage is positive, the External DC Voltage must range from 0 to 10 VDC.

When the UUT output voltage is negative, the External DC Voltage must range from 0 to -10 VDC.

- Pin 1 (External Reference Signal – Phase A) and Pin 4 (Return / ISO_COM) are to be connected to the DC source to vary the output voltage for Phase A, refer to Figure 4-17.
- Pin 2 (External Reference Signal – Phase B) and Pin 4 (Return / ISO_COM) are to be connected to the DC source to vary the output voltage for Phase B, refer to Figure 4-18.
- Pin 3 (External Reference Signal – Phase C) and Pin 4 (Return / ISO_COM) are to be connected to the DC source to vary the output voltage for Phase C, refer to Figure 4-19.

The above-mentioned pins are present in the External Analog Control Signal Connector (EXT ANLG) available on the rear panel; refer to Table 4-2 for pin-out details.

4.3.4 Output Voltage Monitor (VMON)

Voltage Monitor provides functionality to monitor the scaled-down output voltage of the unit; refer to Figure 4-13 and Table 4-2 for pin-out details. The scaled-down Output voltage of each phase can be monitored between the VMON terminals of the external analog control signal connector (Pin-11: VMON for Phase A, refer Figure 4-20; Pin-12: VMON for Phase B, refer Figure 4-21; Pin-13: VMON for Phase C, refer Figure 4-22 and Pin-14 (Return / ISO_COM)). Measurement of output voltage from 0 to 100% FS rated corresponds to 0 to ±10 V pk.

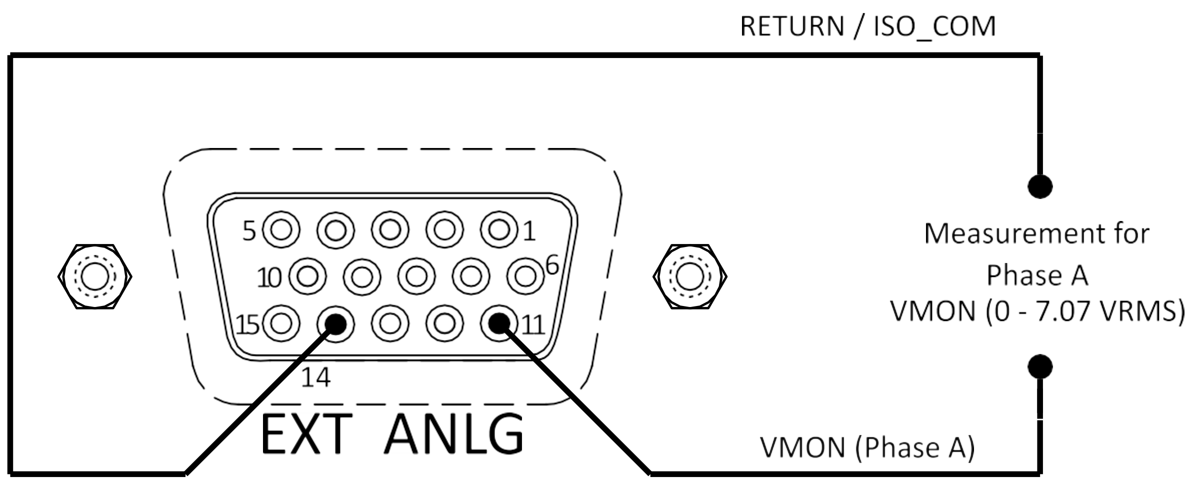


Figure 4-20: Output Voltage Monitor Pinout Diagram for Phase A

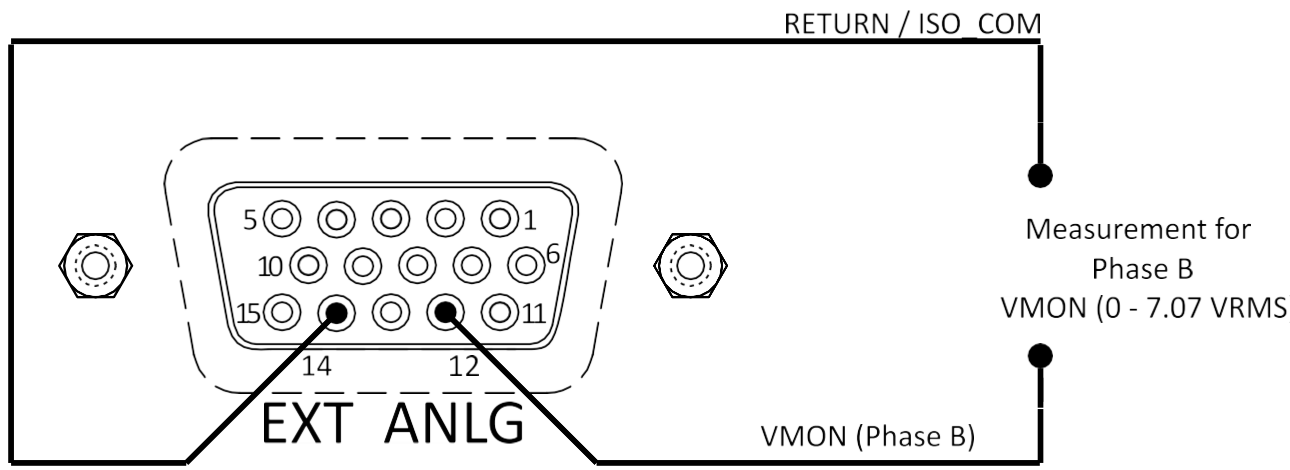


Figure 4-21: Output Voltage Monitor Pinout Diagram for Phase B

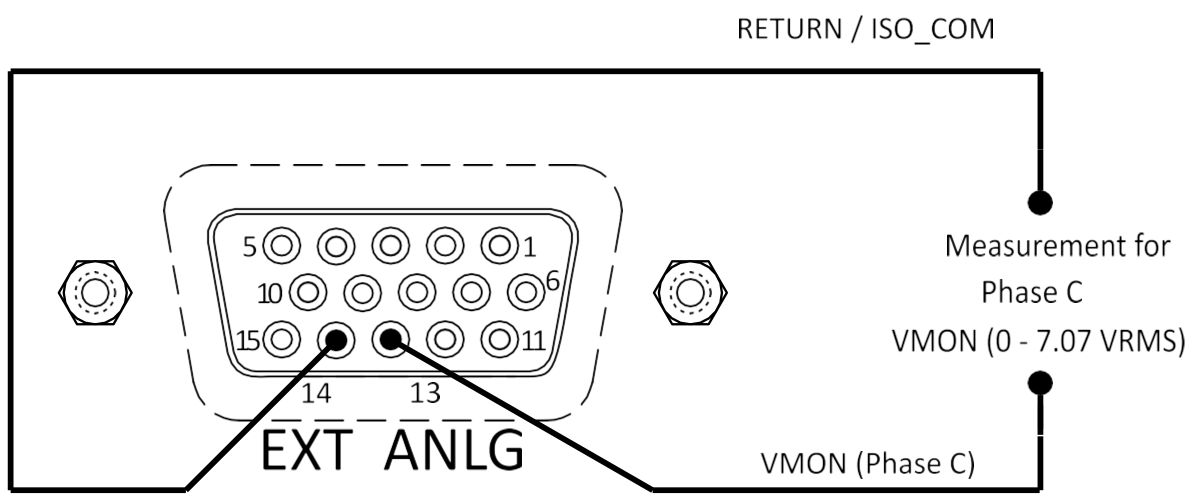


Figure 4-22: Output Voltage Monitor Pinout Diagram for Phase C

4.3.5 Output Current Monitor (IMON)

Current Monitor provides functionality to monitor the scaled-down output current of the unit; refer to Figure 4-13 and Table 4-2 for pin-out details. The scaled-down Output current of each phase can be monitored between the IMON terminals of the external analog control signal connector (Pin-6: IMON for Phase A, Pin-7: IMON for Phase B, and Pin-8: IMON for Phase C) and Pin-9 (Return / ISO_COM). Measurement of output current 0 to 100% FS rated output corresponds to 0 to ±10 Vpk. Refer to Figure 4-23, Figure 4-24 and Figure 4-25.

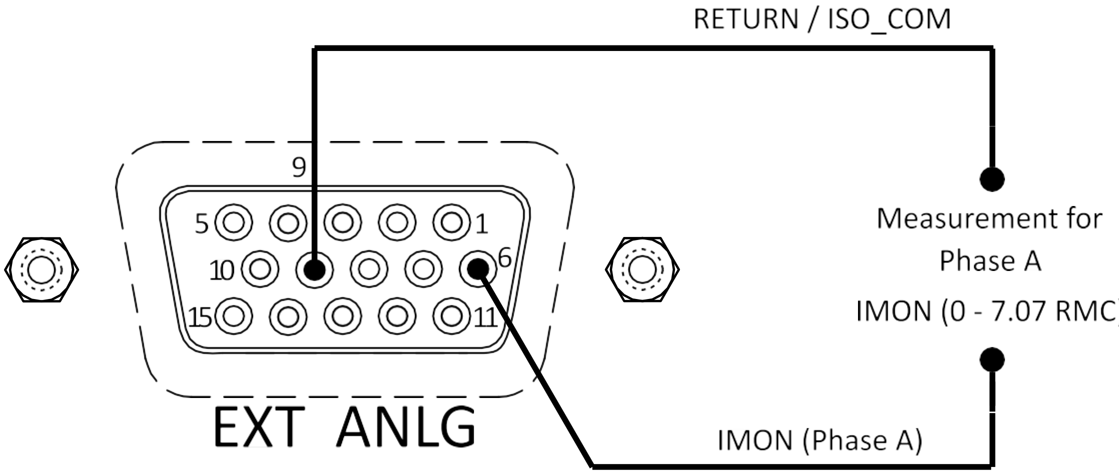


Figure 4-23: Output Current Monitor Pinout Diagram for Phase A

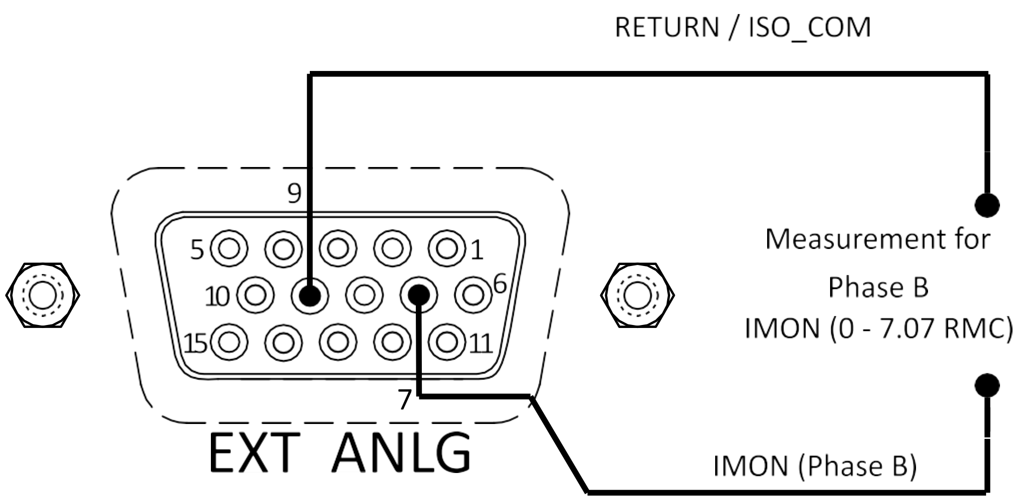


Figure 4-24: Output Current Monitor Pinout Diagram for Phase B

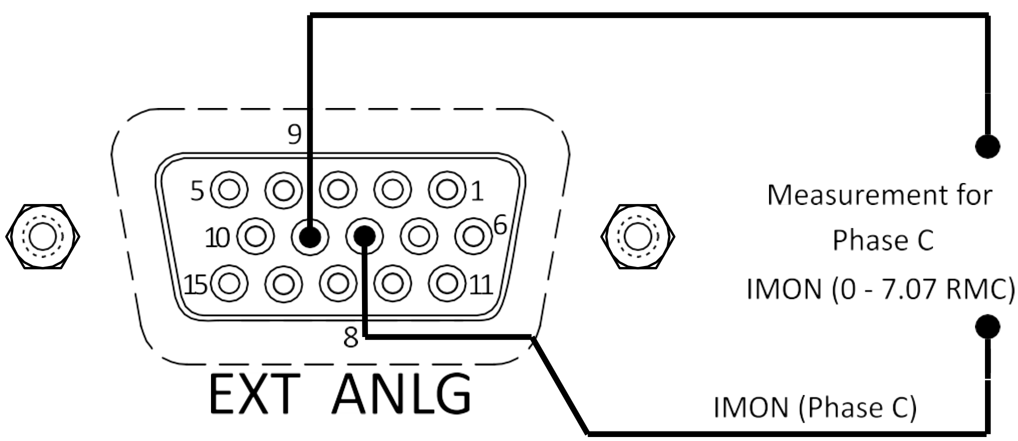


Figure 4-25: Output Current Monitor Pinout Diagram for Phase C

5. FRONT PANEL OPERATION

Figure 5-1 shows a view of the front panel. Refer to Table 5-2 for functional descriptions of the Enhanced front panel.

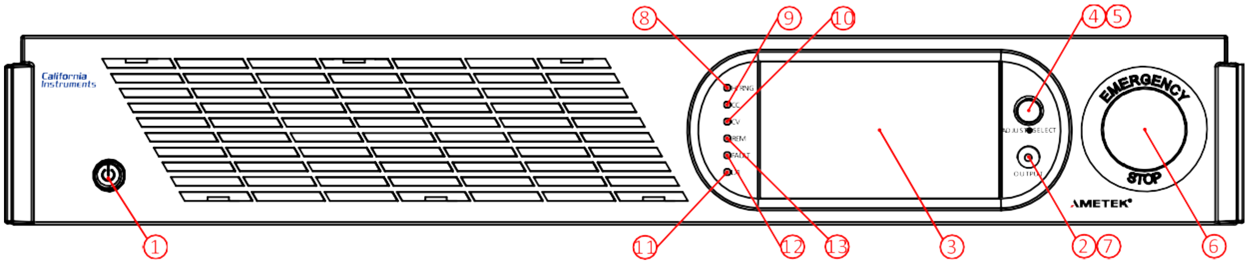


Figure 5-1: Front Panel

5.1 Front Panel Controls and Indicators

Item	Reference	Functional Description
1	ON/OFF(Standby) Switch	A two–position pushbutton switch turns the source on and off. **WARNING!** The OFF position does not remove AC input from internal circuits. Disconnect external AC input before servicing unit.
2	OUTPUT Switch	Momentary switch that toggles the output power ON/OFF, and closes/opens the output isolation relay.
3	Display	TFT color graphics display with backlight and pressure-actuated touchscreen; menu-driven settings and functions.
4	Rotary Encoder	Navigates between and within screens; scrolls through functions and selects numerical values; adjusts output parameters in real-time.
5	Rotary Encoder Switch	Momentary-action push switch that selects functions and enters numerical values. Integral to the Rotary Encoder.
6	EMERGENCY STOP	When pushed in, the main AC contactor is opened, disconnecting the AC input power to the input transformer. Note that the controller and front panel display will still be powered up, but no power is available to the amplifiers and there will be no output power.

LED Mode Indicators Indicates the active mode when illuminated:		
7	OUTPUT	Output is turned on; the indicator is integral to the OUTPUT switch.
8	HI RNG	The output voltage is set to the high range.
9	CC	At least one of the output phases of the power source is presently in Constant-Current mode, and the output current of that output is regulated.

10	**CV**	All output phases of the power source are presently in Constant-Voltage mode, and the output voltage is regulated.
11	**LXI**	LXI status annunciation.
12	**FAULT**	A fault condition has occurred; the output is shut down, the isolation relay is open, and the output voltage is programmed to zero.
13	**REM**	The source is presently controlled by the remote digital interface. If the RS-232C, USB, or LAN interface is used, the REM state can be enabled by the external controller using the SCPI command, `SYST:REM`. If the optional IEEE-488 (GPIB) interface is used, this indicator will be lit whenever the REM line (REM ENABLE) line is asserted by the IEEE-488 controller. Any time the REM LED is lit, the front panel control of the unit is disabled. To regain control through the front panel, the external controller must send the SCPI command, `SYST:LOC`.

Table 5-1: Front Panel Controls and Indicators, Enhanced Models

5.2 Front Panel Display Navigation

The selection of the output characteristics and adjusting the output parameters through the front panel display is accomplished using the DASHBOARD screen (refer to Figure 5-20) or the OUTPUT PROGRAM screen (refer to Figure 5-8). The selection and adjustment of items can be done using either the touch-screen or rotary encoder:

1. Using the touchscreen or rotary encoder, navigate (refer to Section 5.4.1 and Section 5.4.2) to the HOME Screen, and select the OUTPUT PROGRAM screen (refer to Figure 5-8). Within the OUTPUT PROGAM screen, select the parameter, and adjust its value.
2. The DASHBOARD screen provides an alternate means of adjusting the primary parameters, voltage, current, and frequency, in the same menu. It is also located on HOME Screen. It has the additional functionality of real-time adjustment of the parameters as the encoder is rotated (refer to Section 5.4.2).

5.3 Selecting Output Characteristics and Adjusting Parameters

To set up the power source for basic operation with either a sine wave or DC output, perform the following sequence:

Source Mode: (Applicable for Sequoia series and Tahoe series)

1. Navigate to the PHASE NUMBER menu in the CONFIGURATION screen and select the output phase number: either One-Phase or Three-Phase.
2. Navigate to the PHASE menu in the OUTPUT PROGRAM screen, and select the output phase angle: Phase-B and Phase-C relative to Phase-A.
3. Navigate to the MODE menu in the CONFIGURATION screen, and select the output voltage mode: either AC, DC, or AC+DC.
4. Navigate to the RANGE menu in the CONFIGURATION screen and select the output range: either Low-Range or High-Range.
5. Navigate to the REGULATION menu in the CONFIGURATION screen and select the output voltage/Current Regulation: either Constant Voltage/Constant Current or Constant Voltage/Current Limit.
6. Navigate to the VOLTAGE menu in the OUTPUT PROGRAM screen and adjust the output voltage value.
7. If the AC+DC voltage mode had been selected, navigate to the DC OFFSET menu in the CONFIGURATION screen, and adjust the DC component of the output voltage.

8. Navigate to the CURRENT menu in the OUTPUT PROGRAM screen and adjust the output current value.
9. Navigate to the FREQUENCY menu in the OUTPUT PROGRAM screen and adjust the output frequency value.
10. The output is turned on with the front panel OUTPUT switch.

Grid Simulator Mode: (Applicable only for Sequoia series)

1. Navigate to the PHASE NUMBER menu in the CONFIGURATION screen and select the output phase number: either One-Phase or Three-Phase.
2. Navigate to the MODE menu in the CONFIGURATION screen, and select the output voltage mode: either AC, DC, or AC+DC.
3. Navigate to the RANGE menu in the CONFIGURATION screen and select the output range: either Low-Range or High-Range.
4. Navigate to the REGULATION menu in the CONFIGURATION screen and select the output voltage/current regulation: either Constant Voltage/Constant Current or Constant Voltage/Current Limit.
5. Navigate to the VOLTAGE menu in the OUTPUT PROGRAM screen and adjust the output voltage value.
6. If the AC+DC voltage mode had been selected, navigate to the DC OFFSET menu in the CONFIGURATION screen, and adjust the DC component of the output voltage.
7. Navigate to the SOURCE CURRENT menu in the OUTPUT PROGRAM screen and adjust the output Source Current value.
8. Navigate to the REGENERATIVE CURRENT menu in the OUTPUT PROGRAM screen and adjust the Regenerative current value.
9. Navigate to the Regenerative Control Settings menu in the CONFIGURATION screen and adjust the Regenerative Under Volt limit and Over Volt limit value.
10. Navigate to the FREQUENCY menu in the OUTPUT PROGRAM screen and adjust the output frequency value.
11. The output is turned on with the front panel OUTPUT switch.

Electronic Load Mode: Current Programming (Applicable only for the Sequoia series)

1. Navigate to the PHASE NUMBER menu in the CONFIGURATION screen and select the output phase number: either One-Phase or Three-Phase.
2. Navigate to the MODE menu in the CONFIGURATION screen and select the output voltage mode: either AC or DC.
3. Navigate to the RANGE menu in the CONFIGURATION screen and select the output range: either Low-Range or High-Range.
4. Navigate to the SOURCE CURRENT menu in the OUTPUT PROGRAM screen and adjust the source current value.
5. Navigate to the PHASE SHIFT menu in the OUTPUT PROGRAM screen and adjust the Phase Shift value.
6. Navigate to the SYNC Settings menu in the CONFIGURATION screen and adjust the Sync Voltage, Sync Phase, and Sync Frequency values.
7. Navigate to the DASHBOARD screen and press on the SYNC button to start synchronizing between Sequoia and UUT. Once Synchronization is successful, the SYNC button will display

SYNCED with a green color background.

8. The output is turned on with the front panel OUTPUT switch.

Electronic Load Mode: Power Programming (Applicable only for Sequoia series)

1. Navigate to the PHASE NUMBER menu in the CONFIGURATION screen and select the output phase number: either One-Phase or Three-Phase.
2. Navigate to the MODE menu in the CONFIGURATION screen and select the output voltage mode: either AC or DC.
3. Navigate to the RANGE menu in the CONFIGURATION screen and select the output range: either Low-Range or High-Range.
4. Navigate to the ACTIVE POWER menu in the OUTPUT PROGRAM screen and adjust the Active Power value.
5. Navigate to the REACTIVE POWER menu in the OUTPUT PROGRAM screen and adjust the Reactive Power value.
6. Navigate to the SYNC Settings menu in the CONFIGURATION screen and adjust the Sync Voltage, Sync Phase, and Sync Frequency values.
7. Navigate to the DASHBOARD screen and press on the SYNC button to start synchronizing between Sequoia and UUT. Once Synchronization is successful, the SYNC button will display SYNCED with a green color background.
8. The output is turned on with the front panel OUTPUT switch.

Electronic Load Mode: RLC Programming (Applicable only for Sequoia series)

1. Navigate to the PHASE NUMBER menu in the CONFIGURATION screen and select the output phase number: either One-Phase or Three-Phase.
2. Navigate to the MODE menu in the CONFIGURATION screen and select the output voltage mode: either AC or DC.
3. Navigate to the RANGE menu in the CONFIGURATION screen and select the output range: either Low-Range or High-Range.
4. Navigate to the RLC menu in the OUTPUT PROGRAM screen and adjust the Resistance, Inductance, and Capacitance value.
5. Navigate to the SYNC Settings menu in the CONFIGURATION screen and adjust the Sync Voltage, Sync Phase, and Sync Frequency values.
6. Navigate to the DASHBOARD screen and press on the SYNC button to start synchronizing between Sequoia and UUT. Once Synchronization is successful, the SYNC button will display SYNCED with a green color background.
7. The output is turned on with the front panel OUTPUT switch.

5.4 Front Panel Touch-Screen Display

The front panel display of the Sequoia / Tahoe Series power source allows the user to select different menus to configure and operate the unit in Source mode, Grid Simulator, and Electronic Load mode.

The operating modes are explained in detail in separate sections. This section covers the operation of the power supply in Source mode. Below is the Banner screen of the power source displayed during the initial bootup in Source mode.

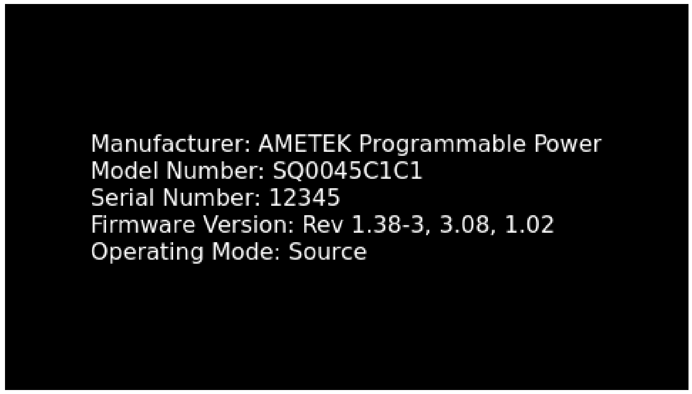


Figure 5-2: Banner Screen

Note: Operating modes can be changed from the Operating mode option. Refer to section 5.6.

Navigating through the various menus is done using the touchscreen display or the rotary encoder. Tapping the display screen or tapping with the encoder on any menu or function that is highlighted (active) will enter that menu or execute that function.

The touchscreen uses resistive, pressure-actuated technology, which detects input position by applying pressure to the screen's surface. You can use a fingertip, fingernail, or stylus pen. To avoid scratching the surface, do not use hard or sharp tips like a ballpoint pen or mechanical pencil.

CAUTION!

Damage or scratching of the touchscreen may occur if excessive pressure is applied to the surface, or if objects with hard/sharp tips are used.

The current cursor position is shown with a selection box that has a highlighted border around the field. Some screens have multiple pages, indicated by the highlighted Arrow icons on the right side. For example, the default HOME Screen can be scrolled through three pages. Tapping an Arrow or selecting it with the rotary encoder and pressing the switch will scroll the screen to the next page. To return to the HOME screens from any other screen, tap the HOME icon. Refer to Figure 5-3.

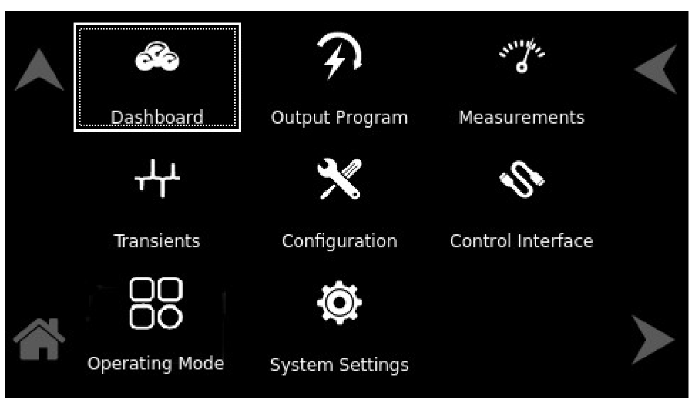


Figure 5-3: HOME Screen

Parameters that are adjustable have selection fields where values can be entered. The parameter selection field that is active has its border highlighted; refer to Figure 5-4, where the Dashboard Menu is shown with the Voltage selection field active.

Tapping the selection-field box, selects that parameter for adjustment, and the screen changes to the numeric keypad that allows value entry; refer to Figure 5-6.

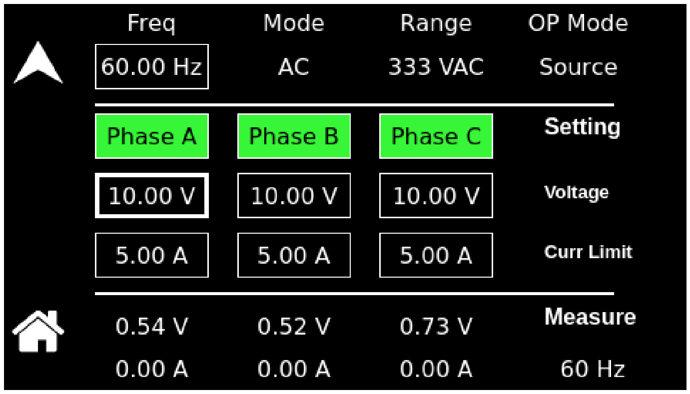


Figure 5-4: DASHBOARD Screen Menu with Voltage Selection-Field Active

When the power source is configured for 3-Phase output, each phase has individual settings. Tapping on a phase button toggles the selection of that phase for inputting values. When a phase is selected, its button is displayed with a green color. When a phase is not selected, its button is displayed with a gray color.

When the unit is configured for 1-Phase output, only Phase-A is displayed in green. When all phases are selected, entry for one phase will make the same changes for the other phases. Refer to Figure 5-5, where only Phase-A has been selected.

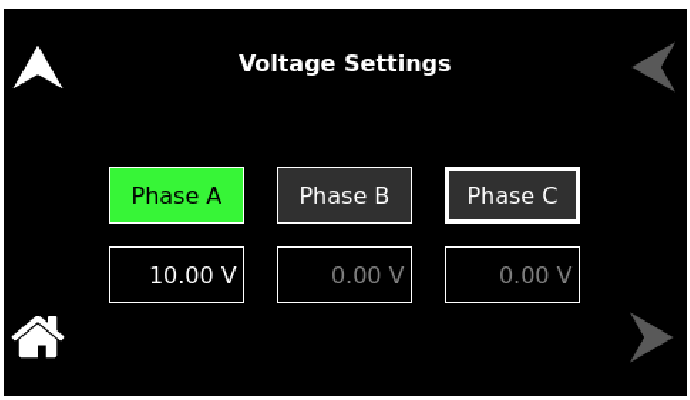


Figure 5-5: Menu with Only Phase-A Selected

5.4.1 Touch-Screen Numeric Keypad

The touch screen has a keypad for entering numeric values; refer to Figure 5-6. After scrolling through menus and highlighting a parameter selection field, tapping the field selects it. The keypad screen will then appear. Tapping the numerical value keys, decimal point key, or polarity key selects them, while the back-arrow key deletes the last entry. To enter a negative value, first enter the number, then the minus sign. The selected values will appear in the upper-left parameter window, and the cursor will move to the next available position. Tapping the OK key confirms the value and applies it.

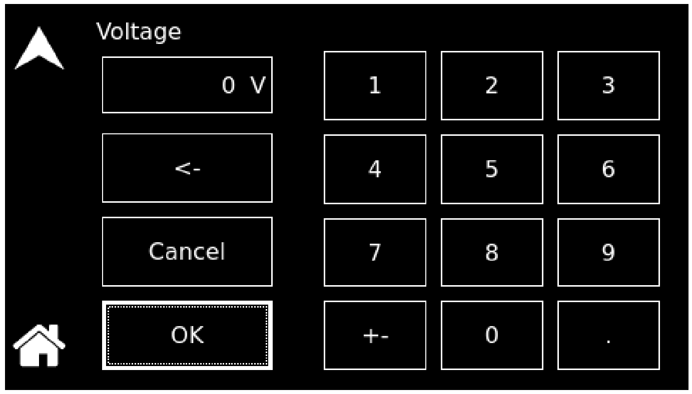


Figure 5-6: Touch-Screen Numeric Keypad

5.4.2 Rotary Encoder

The rotary encoder provides a secondary way to navigate the display. It is used to select functions, change parameter values, and perform setups. It can be used to move between menu screens and between editable items within an individual menu screen.

The rotary encoder is located on the front panel and provides continuous adjustment in the clockwise and counter-clockwise rotation; refer to Figure 5-7. Turning the encoder knob allows sequential scrolling through each menu or function on a screen; the item that is active has its selection field box highlighted. To select a choice, depress the encoder knob to engage the encoder momentary switch.

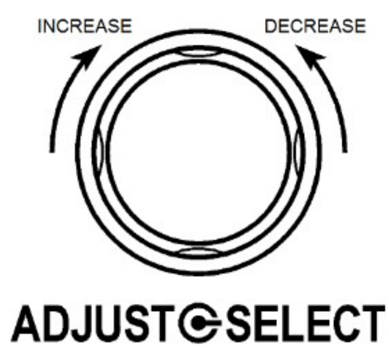


Figure 5-7: Rotary Encoder

The rotary encoder can operate in one of two distinct modes:

MODE	DESCRIPTION
NAVIGATE	The rotary encoder is used to scroll through menu functions and settings. The currently selected item will be outlined in a highlighted selection field. As the encoder is rotated, the highlighted box will move through all selectable items on the screen.
ADJUST/SELECT	After scrolling to a function, pressing the rotary encoder knob selects the function (like tapping on an item). Tapping a selection button will toggle its state (on or off), while tapping on a function or menu will select it and open a screen for further value entry. **NOTE:** Parameter values, such as voltage and current, are adjusted by selecting the parameter (tapping on it) to enable the

selection field (refer to Figure 5-8). If a parameter had been selected whose value can be adjusted, and the encoder switch is depressed, a screen will be displayed with a parameter selection-field highlighted that has a value entry window (refer to Figure 5-74). The rotary encoder can then be used to continuously adjust the parameter value, up and down, as the encoder is rotated. Tap the encoder a second time to enter the value. If the OUTPUT switch is on, the output parameter will change when the encoder is tapped.

The DASHBOARD screen menu has the capability for real-time adjustment of output parameters: the value of the parameters change as the rotary encoder is turned for immediate effect at the output. If the OUTPUT switch is on, the output parameter will change as the encoder is rotated. Refer to the DASHBOARD screen menu in Section 5.7.3, for a description of the parameters that have real-time adjustability.

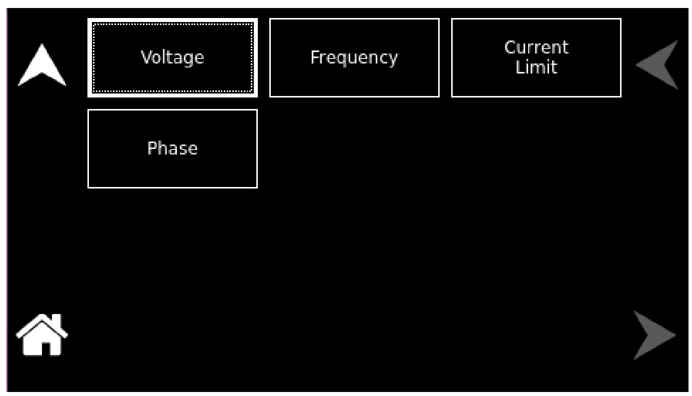
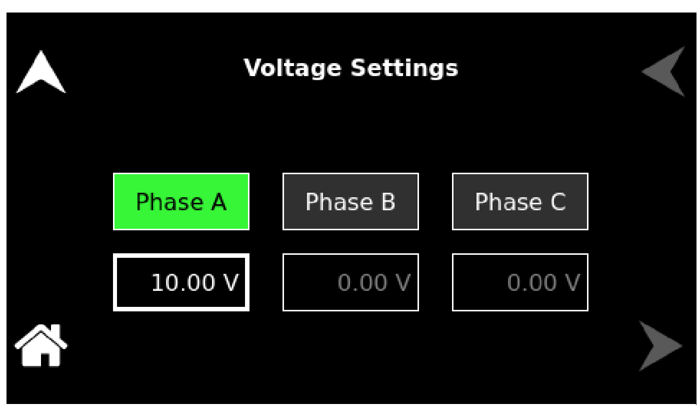
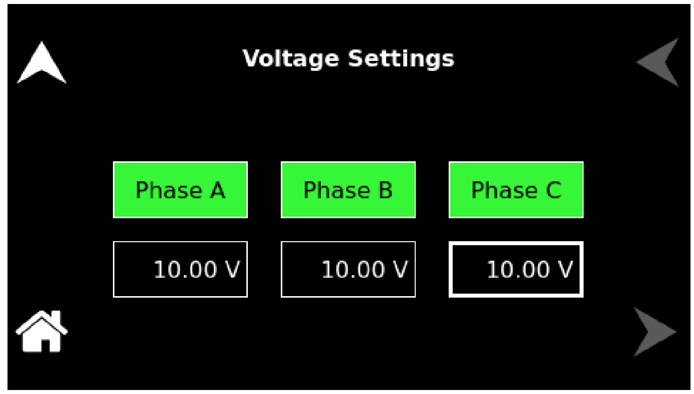


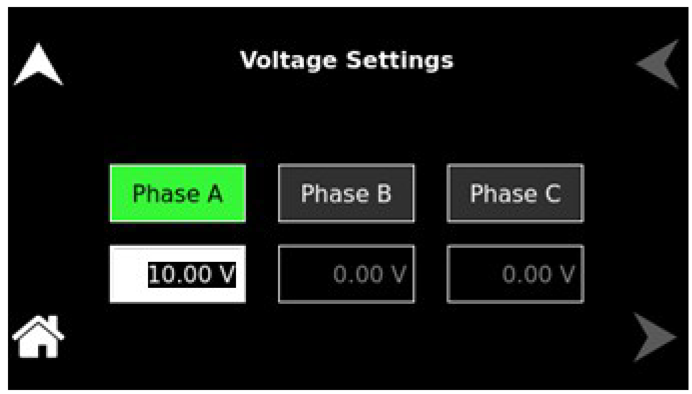
Figure 5-8: Output Program Menu



3-Phase with only Phase-A selected



3-Phase with Phase-A, B, and C selected



3-Phase unit in 1-Phase mode

Figure 5-9: Highlighted Voltage Selection Field with Value Window

The rotary encoder is also used along with the numeric keypad to enter values. After selecting a parameter using the touchscreen, the numeric keypad will be displayed; The rotary encoder can be used to select any of the items of the numeric keypad by scrolling through them and tapping on them with the encoder switch to select them. The active value is identified on the screen with a highlighted field box, and the entered decimal places are shown in the upper-left window. The cursor moves to the next available position as values are entered. After the desired decimal places are entered sequentially, the OK key is tapped to execute the final value and have it taken effect.

5.5 Front Panel Display Top-Level Menu

There are four virtual buttons visible on a screen: UP, LEFT, RIGHT arrows, and HOME icon. Those buttons that are highlighted are active for the screen being displayed. The arrow buttons will scroll to the next page of the menu structure in the direction indicated. The HOME button will return to the previous HOME screen that has the top-level menu from which a sub-menu was entered. The HOME button is no longer functional once a HOME screen is entered.

The following top-level menu choices can be accessed through the touchscreen:

Top-Level Screen Menu	Menu Description
DASHBOARD	Provides setting and measurement of output parameters: voltage, current, frequency, and voltage range. Provides an automatic transition to the Default screen.
OUTPUT PROGRAM	Provides setting of phase number, output mode of operation, individual output parameters, mode of regulation, current limit, and output waveform selection
MEASUREMENTS	Provides measurement of output parameters and harmonic distortion, advanced harmonics analysis, no user settings are available.
TRANSIENTS	Provides setup, running, and saving of output transient lists.
CONFIGURATION	Provides setup of power-on states, operation profiles, parameter limits, selection of clock configuration and mode, and Default screen.
CONTROL INTERFACE	Provides setup of remote analog and digital interfaces, and Remote Inhibit.
OPERATING MODES (Not Applicable for TAHOE Series)	Provides a selection of Operating modes such as source mode, Grid Simulator, and E-Load
SYSTEM SETTINGS	Provides a display of firmware versions, software options that are installed in the unit; hardware parameter limits, selection of language and brightness for the display, and touchscreen calibration.

Table 5-2: HOME Screen Menu Content

5.6 Operating Mode Screen

The top-level menu of the OPERATION MODE screen is shown in Figure 5-10. It can be reached in one of two ways:

1. Tapping OPERATION mode on the HOME Screen of the front panel touchscreen.
2. Scrolling to OPERATION with the encoder and depressing the encoder switch.

The Up-arrow button returns to the previously selected screen menu (e.g., the HOME Screen). The HOME button takes you to the HOME screen, which contains the top-level menu for the current sub-menu. For the PROTECTION screen, the HOME screen is the top-level menu.

NOTE: This feature applies only to the SEQUOIA series. TAHOE series does not support this mode of operation.

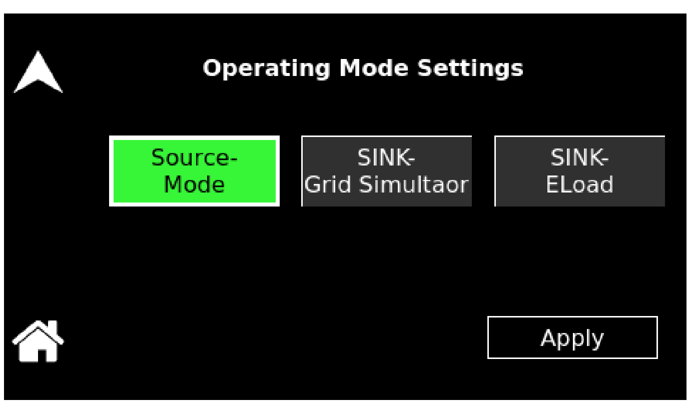


Figure 5-10: Operation Mode Screen

The following sub-menus are available in the PROTECTION menu:

Entry	Description
Source Mode	Sets the power supply in source mode.

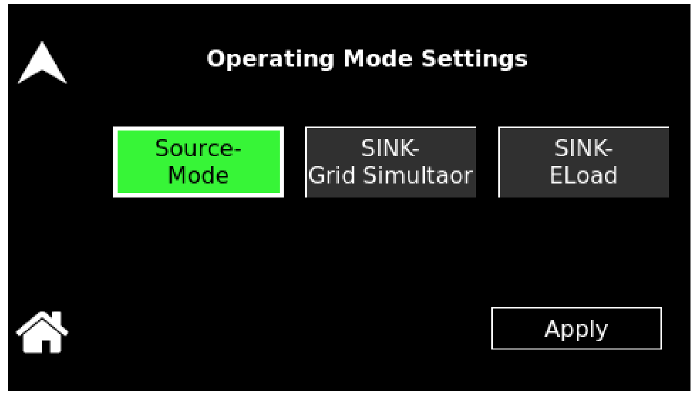


Figure 5-11: Source Mode

SINK-Grid Sim	Sets the power supply in grid simulator mode. In Grid Simulator Mode Sequoia regulates the output voltage to the user-set value and works as the grid to UUT.

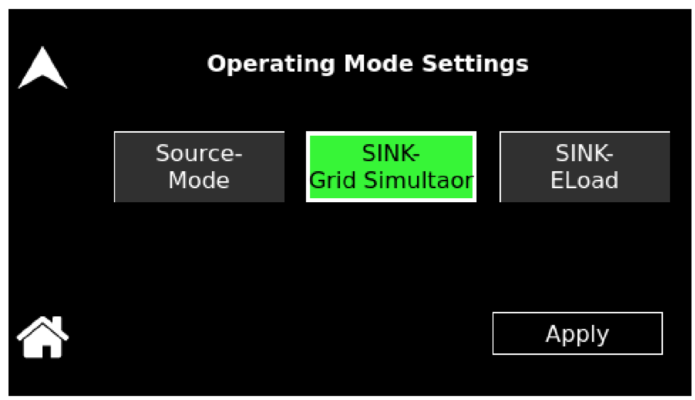


Figure 5-12: Grid Simulator Mode

SINK-Electronic load	Sets the power supply in Electronic Load mode. Electronic Load Mode is further classified into Current Programming mode, Power Programming mode, and RLC programming mode. **RMS Current Programming:** The user can program the RMS current, and phase required as a load for the UUT.

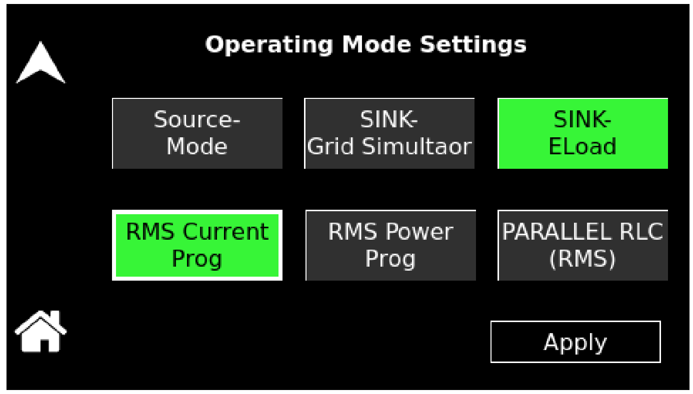


Figure 5-13: Electronic load – Current Programming

RMS Power programming: The user can program the Active power, and the Reactive Power required as a load for the UUT.

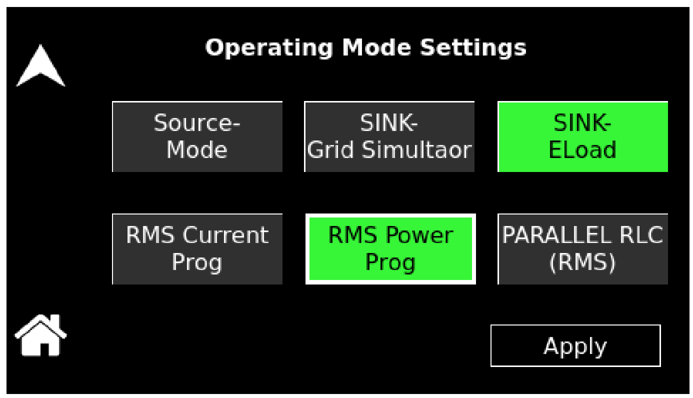


Figure 5-14: Electronic load – Power Programming

Parallel RLC programming: The user can program the Resistance, Inductance and Capacitance required as a load for the UUT.

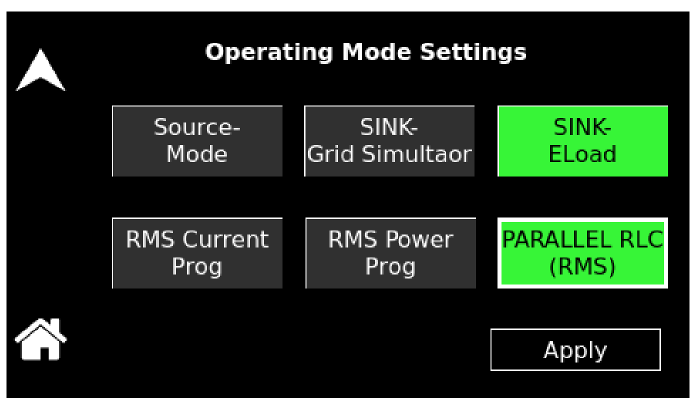


Figure 5-15: Electronic Load Mode – RLC Programming

5.7 Home Screen Top-Level Menu - (Source Mode)

5.7.1 Banner Screen

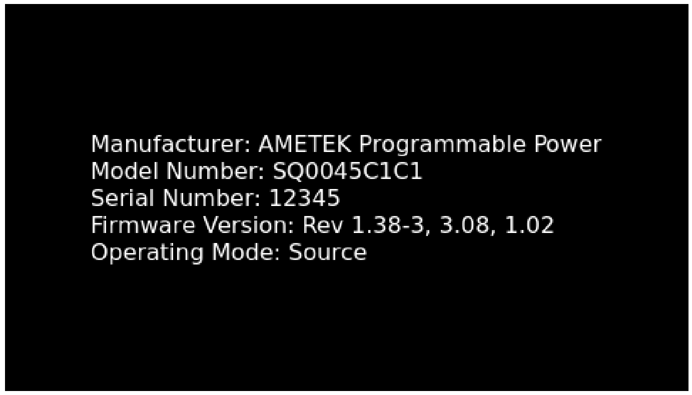


Figure 5-16: Banner Screen for Source Mode – SEQUOIA

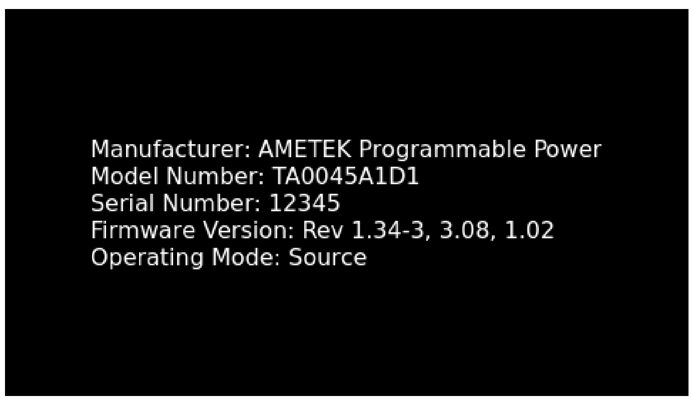


Figure 5-17: Banner Screen – TAHOE Series

5.7.2 HOME Screen

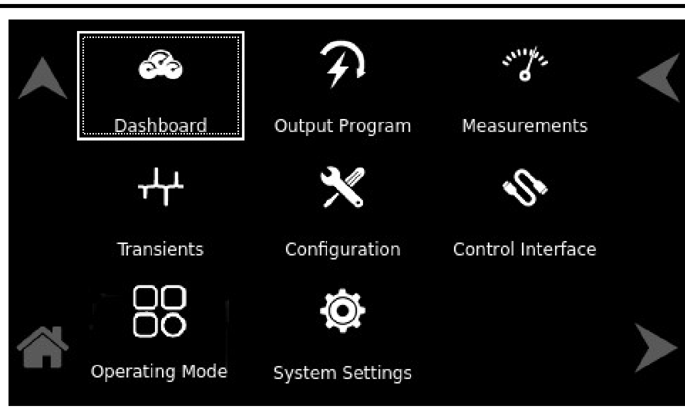


Figure 5-18: HOME Screen for Source Mode – SEQUOIA

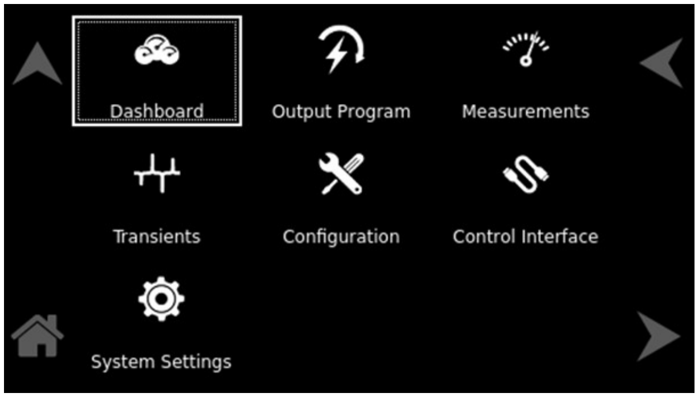


Figure 5-19: HOME Screen – TAHOE Series

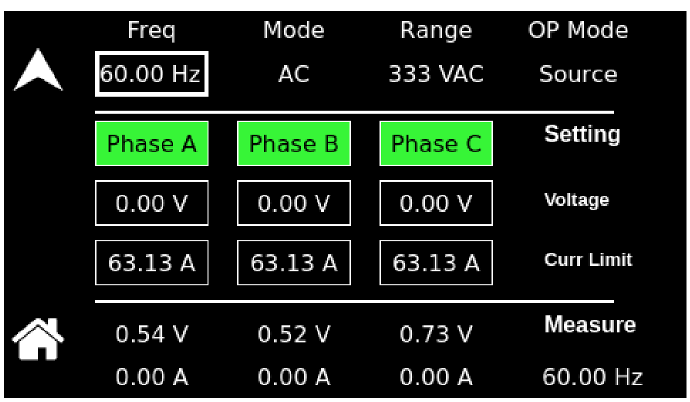
5.7.3 Dashboard Screen Top-Level Menu

The DASHBOARD screen top-level menu is used to change output parameters and simultaneously view output measurements. The most used output parameters are in the DASHBOARD screen menu. The DASHBOARD screen is the default menu that is displayed after powering on.

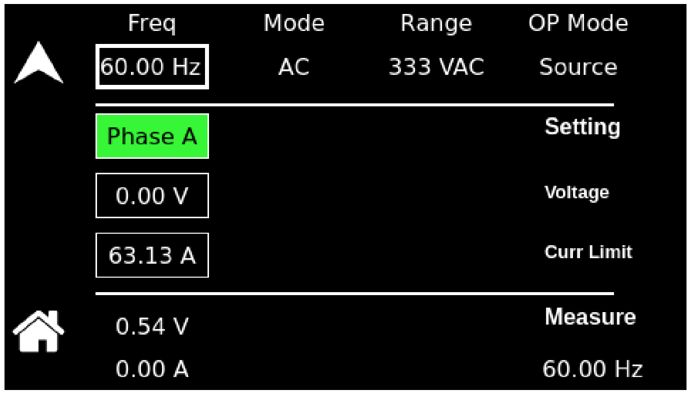
The top-level menu of the DASHBOARD screen is shown for 3 phase and 1 phase modes (Reference Figure Figure 5-20 It can be reached in one of two ways:

1. Tapping DASHBOARD on the HOME Screen of the front panel touchscreen.
2. Scrolling to DASHBOARD with the encoder and depressing the encoder switch.

The Up-arrow button will return to the previously selected screen menu (such as the HOME Screen). The HOME button will return to the HOME screen, which contains the top-level menu for the displayed sub-menu. For the DASHBOARD screen, the top-level menu is the HOME Screen.



3-Phase Mode



1-Phase Mode

Figure 5-20: DASHBOARD Screen Top-Level Menu for Source Mode

The following selections are available in the DASHBOARD screen top-level menu. Functions that accept a numeric value require that the value be within the allowed range, otherwise, an error will be generated, and the value will not be accepted.

When the unit is configured for 3-Phase output, each phase has individual settings. When the unit is configured for 1-Phase output, only Phase-A is displayed. Tapping on a phase button toggles the selection of that phase for inputting values. When a phase is selected, its button is displayed with a green color. When a phase is not selected, its button is displayed with a gray color. When all phases are selected, entry for one phase will make the same changes for the other phases.

Entry	Description Setting
VOLTAGE	Programs the output voltage in RMS value, Vrms, when in AC-mode and DC mode, and the AC component when in (AC+DC) mode. In (AC+DC)-mode, the DC component is programmed using the DC OFFSET sub-menu in the OUTPUT PROGRAM menu. In DC mode, negative values can also be entered. Refer to Section 5.7.4.
CURRENT	Programs the output current in RMS value, A(RMS). Refer to Section 5.7.4.
FREQUENCY	Programs the output frequency in Hz when in AC mode. If the unit is in DC mode, the value for FREQ will be set to DC and cannot be changed until AC mode is selected. When in AC-mode, the frequency can be changed from 16 Hz to 905 Hz (depending on options, for HF option unit 905 Hz and standard unit 550 Hz). Refer to Section 5.7.4.
RANGE	Displays 166 VAC or 333 VAC range for AC-mode and AC+DC -mode (range may vary depending upon the unit's XVC option), and 220 VDC or 440 VDC range for DC-mode operation. The OUTPUT state must be OFF for a change in range to be executed.
MODE	Displays the source mode of operation either AC or DC or AC+DC mode.
OP MODE	Displays the current operating mode.

Measure

VOLTAGE	Displays the true RMS value of the output voltage measured at the voltage sense lines (user selectable to be local or remote). In DC-mode only, the voltage is DC voltage including polarity.
CURRENT	Displays the true RMS value of the output current. In DC mode only, the current is DC including polarity.
FREQUENCY	When in AC-mode or (AC+DC)-mode, the output frequency is measured at the sense lines. When in DC mode, this value always reads “DC”.

5.7.4 Real-Time Parameter Adjustment

The DASHBOARD screen menu provides the capability for output parameter entry that has a real-time, immediate effect on the output. This allows manual adjustment of the output parameters where the tuning of a value is desired. Enabling this function requires tapping on a parameter selection-field box with the encoder switch to select the parameter and display its selection-field highlighted and with a value entry window (refer to Figure 5-21). The rotary encoder can then be used to continuously adjust the parameter value, up and down, as it is rotated. The value change has an immediate effect on the output.

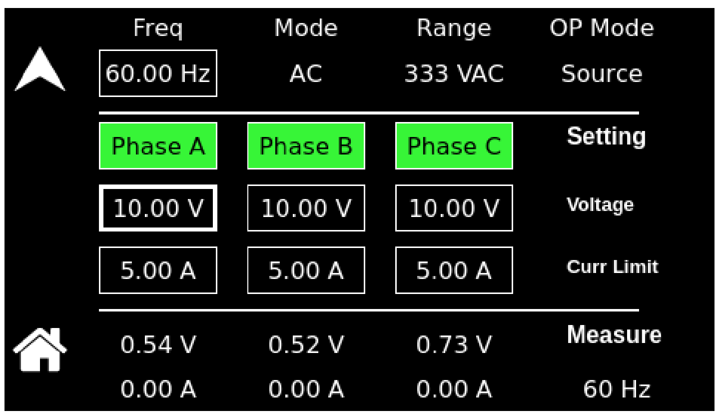


Figure 5-21: Real-Time, Immediate Output Parameter Adjustment

5.7.5 Output Program Screen

The OUTPUT PROGRAM screen provides the setting of output-related items such as individual output parameters, mode of regulation and current limit, output waveform selection, and display of real-time output waveform or harmonics spectrum.

The top-level menus of the OUTPUT PROGRAM screen are shown in Figure 5-22. OUTPUT PROGRAM Screen Top-Level Menu. They can be reached in one of two ways:

1. Tapping the OUTPUT PROGRAM screen on the HOME Screen of the front panel touchscreen.
2. Scrolling to the OUTPUT PROGRAM screen with the encoder and depressing the encoder switch.

The Up-arrow button returns to the previously selected screen menu (e.g., the HOME Screen). The HOME button takes you to the HOME screen, which contains the top-level menu for the current sub-menu. For the OUTPUT PROGRAM screen, the HOME screen is the top-level menu.

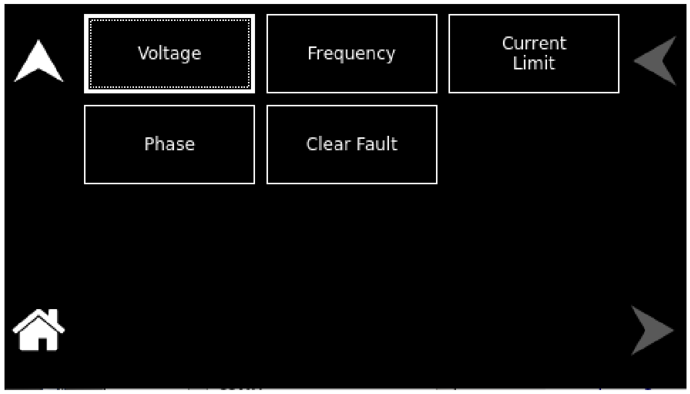


Figure 5-22: OUTPUT PROGRAM Screen Top-Level Menu

The following choices are available in the OUTPUT PROGRAM screen top-level menu. Functions that accept a numeric value require that the value be within the allowed range, otherwise, an error will be generated, and the value will not be accepted.

Entry	Description Settings
VOLTAGE	Programs the output voltage in RMS value, Vrms, when in AC-mode and DC mode, and the AC component when in (AC+DC) -mode. In (AC+DC)-mode, the DC component is set separately using the DC OFFSET selection field (below), or through the Dashboard screen. In DC mode, negative values can also be entered. The default is zero.

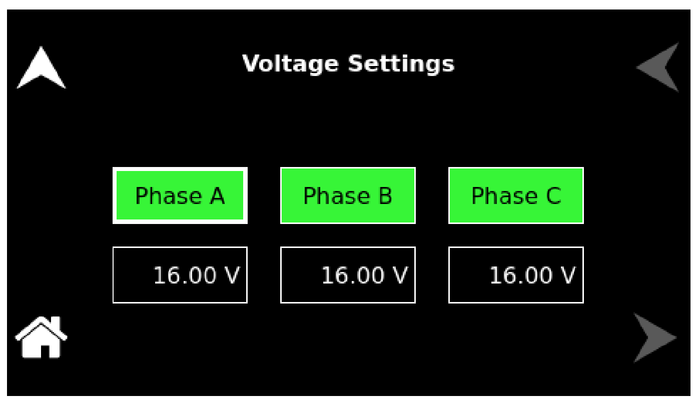


Figure 5-23: Voltage Settings

FREQUENCY	Programs the output frequency in Hz when in AC mode. If the unit is in DC mode, the value for FREQ will be set to DC and cannot be changed until AC mode is selected. When in AC-mode, the frequency can be changed from 16 Hz to 905 Hz (depending on the options). The default is 60 Hz.

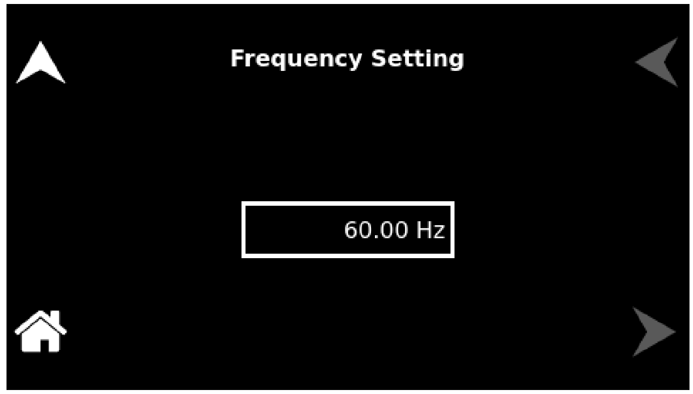


Figure 5-24: Frequency settings

CURRENT LIMIT

Programs the output current in RMS value, A(RMS). The default is full-scale for the model.

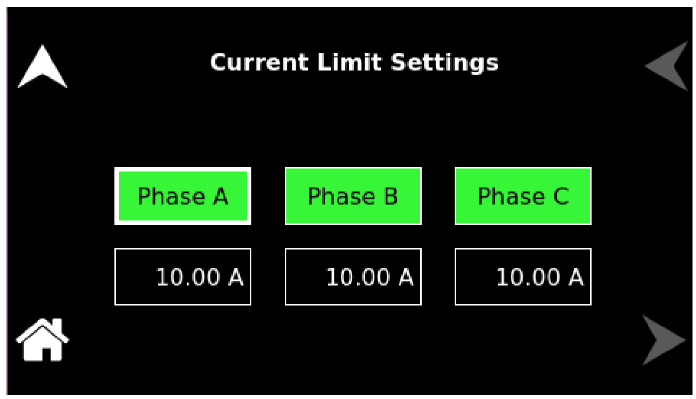


Figure 5-25: Current Limit Settings

PHASE

Programs the phase angle of the output voltage in a standalone unit operating in a 1-Phase configuration; the phase angle would be with respect to the external SYNC signal. In an auxiliary unit (with LKS option) of a multi-phase group, the phase angle would be with respect to Phase-A, while Phase-A would be the reference at 0°. If the clock source is selected to be internal, this parameter has no effect. The default is zero.

In a 3-Phase configuration, the Phase-A phase angle reference is set to default 0° and allows to program the of Phase-B and Phase- C with respect to the Phase-A reference.

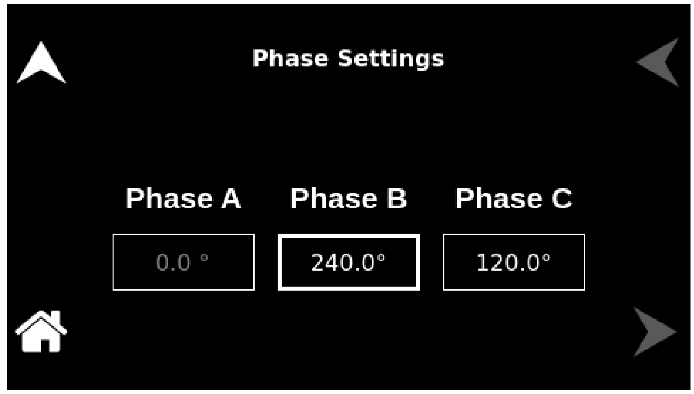


Figure 5-26: Phase Settings

Clear Fault

Programs the unit to clear all the faults. This button will be enabled only when fault bit is high and disabled when fault bit is low.

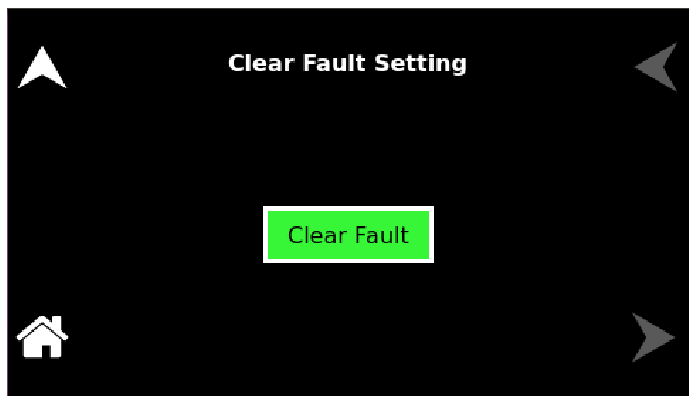


Figure 5-27: Clear Fault Setting

5.7.6 Transients Screen

The Sequoia / Tahoe Series power source provides the capability of generating custom waveforms by programming the output in a sequence of steps in a list of transients. These steps can be comprised of combinations of changes in voltage, frequency, phase angle, waveform, and duration. The list can be created, run, and stored through either the front panel or the remote digital interface using the Sequoia / Tahoe Virtual Panels GUI program or SCPI commands. A library of lists is produced and stored in the memory of the power source for quick recall and utilization through the use of SCPI commands (refer to the Sequoia Series Programming Manual P/N M447353-01 and Tahoe Series Programming Manual P/N M447354-01) or the Sequoia / Tahoe Virtual Panels GUI; refer to AMETEK PPD website, www.programmablepower.com, to download the latest version.

The TRANSIENTS Screen provides access to the transient list data. A transient list of up to 100 data points is possible, represented by 100 transient step numbers from 0 through 99.

The top-level menu of the TRANSIENTS screen is shown in Figure 5-28. It can be reached in one of two ways:

1. Tapping TRANSIENTS on the HOME Screen of the front panel touchscreen.
2. Scrolling to TRANSIENTS with the encoder and depressing the encoder switch.

The Up-arrow button will return to the previously selected screen menu (in this case the HOME Screen). The HOME button will return to the HOME screen that has the top-level menu for the sub-menu being displayed; that is HOME Screen for the TRANSIENTS screen top-level menu.

Figure 5-28: TRANSIENTS Screen Top-Level Menu

The following menus are available in the TRANSIENTS top-level menu: SETTINGS, VIEW, RUN.

The SETTINGS menu allows the selection of how parameter values are entered for time, voltage, and frequency, trigger sources and characteristics, and how a list is executed; refer to Figure 5-29 and Figure 5-30.

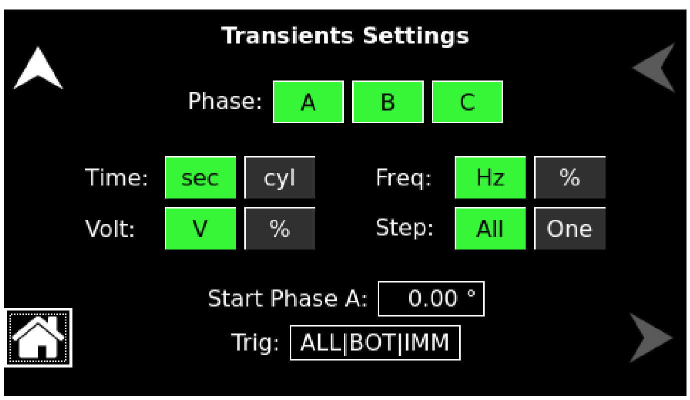


Figure 5-29: Transients Settings in AC and AC+DC Mode

The SETTINGS menu has the following fields:

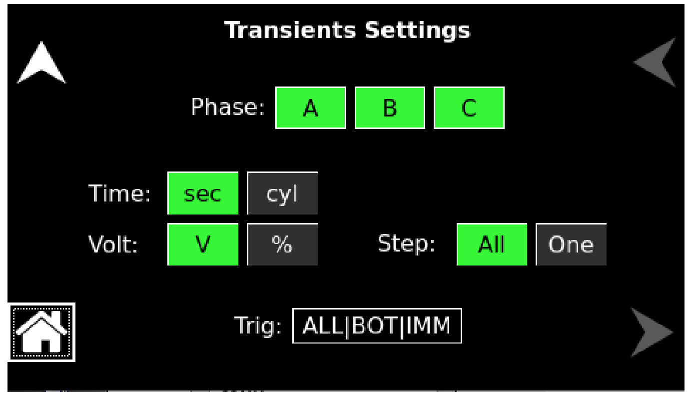


Figure 5-30: Transients Settings in DC Mode

Entry	Description
Phase	Sets the output phase to which the programming of the transients will be applied.
Time	Sets the units for the time of the transient step; the default units are in seconds. Alternatively, the time can be changed to cycles of the output frequency. Note that time durations in seconds may result in rounding errors if the period of the programmed frequency is not an integer number of milliseconds. For example, for 50 Hz output (20 ms period), no rounding errors occur, but for 60 Hz (16.66 ms period) a rounding error would occur when converted. The time duration scale selection affects both the Time and End Delay parameters.
Volt(age)	Sets the units for voltage values; the default units are in Vrms. **V** is the RMS value of the output voltage, while **%** is the percentage of the steady-state setting.
Freq(uency)	Sets the units for frequency values; the default units are in Hz. **Hz** is the value of the output frequency, while **%** is the percentage of the steady-state setting.
Start Phase A	Shows the start phase angle of the voltage transient in degrees. Only one start phase angle per transient sequence is allowed. The start phase angle must be in the first transient event of the list. The start phase angle is not valid for DC transients.
Step	Defines how the step sequence of the transient list is executed; the default is All: **All:** All the steps in the sequence are executed without breaks. **One:** Each step is executed one at a time.

Trig(ger)

The present state of the trigger settings is shown in the TRIG field. Tap on the field to open the TRIGGER sub-menu to change settings; refer to Figure 5-31.

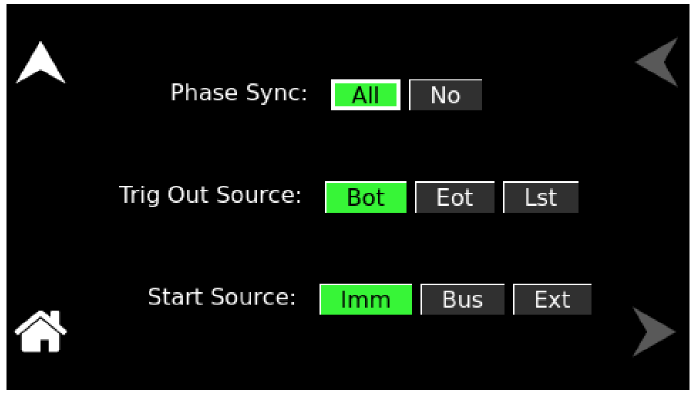


Figure 5-31: SETTINGS Screen, TRIGGER Sub-Menu

The TRIGGER sub-menu has the following fields:

Entry	Description
Phase Sync	***TRIGGER sub-menu:*** Determines when phase synchronization is done; the default phase sync is All: **All**: Synchronization is done at the beginning of the transient list or pulse, for every count. **No**(ne): Synchronization is done once at the beginning of the transient list only for the first count.
Trig Out Source	***TRIGGER sub-menu:*** Selects the source for the trigger output; the default source is BOT: **Bot**: Beginning of transient output. **Eot**: End of transient output. **List**: At each point in the list (that has list-trigger enabled) when that step is reached.
Start Source	***TRIGGER sub-menu:*** Determines the source of the trigger event for the transient; the default source is IMM(ediate): **Imm**(ediate): Triggering occurs as soon as the SCPI command, `INIT`iate, is received. **Bus:** Triggering occurs following the SCPI command, `INIT`iate, after receiving the SCPI command, `*TRG`, or the IEEE-488 Group Execute Trigger (GET) signal from the GPIB interface. **Ext**(ernal): Triggering occurs when an external trigger input is received.

5.7.6.1 LIST Menu

The LIST menu shows the transient list, with sequence numbers that are stored in the transient list buffer Figure 5-32 shows the menu when the buffer is empty.

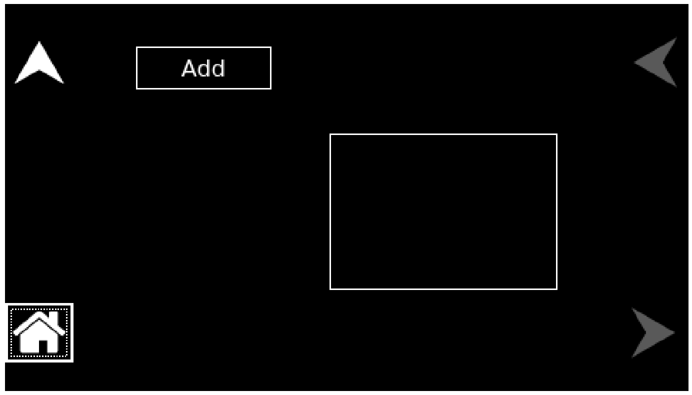


Figure 5-32: Menu, With Empty Buffer

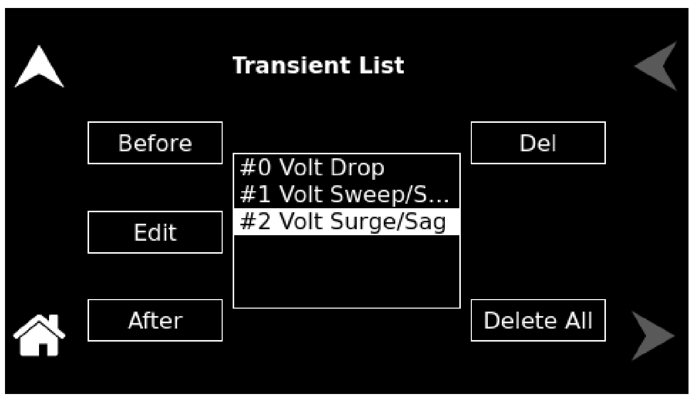


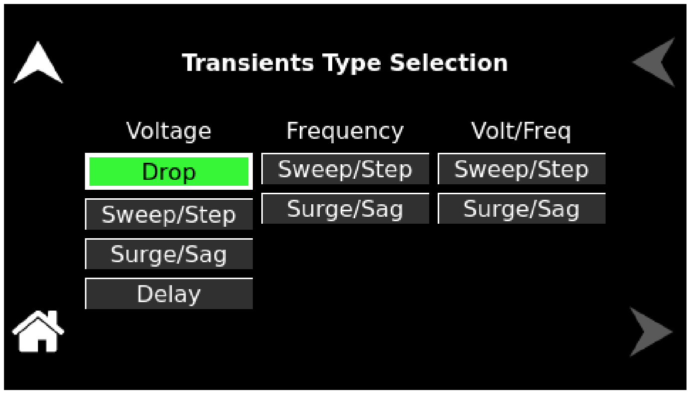
Figure 5-33: LIST Menu, With Transient List Entry

The LIST menu has the following fields:

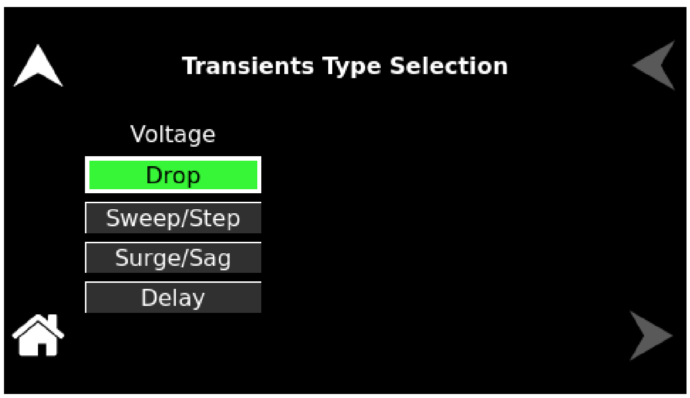
Entry	Description
Add	Allows generating of a new transient list.
Before	Inserts a step before the selected transient step.
Edit	Opens the selected step for editing parameters.
After	Inserts a step after the selected transient step.
Del	Permanently deletes the selected transient step.
Delete All	Clears the transient list buffer.

5.7.6.2 ADD Sub-Menu

The ADD sub-menu is opened when the ADD function is selected on the LIST screen; refer to Figure 5-34. It allows the selection of the type of transient to be added to the sequence.



AC Mode

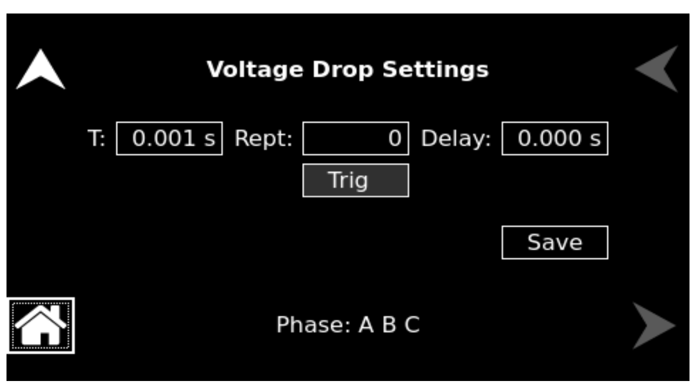


DC Mode

Figure 5-34: LIST Menu, ADD Sub-Menu

The ADD sub-menu has the following fields:

Entry	Description
DROP	Causes the output voltage to go to zero volts for a specified period. As with the step transient, the voltage change is instantaneous. At the end of the drop, the voltage will return to the amplitude at the beginning of the step.



VOLTAGE SWEEP/STEP

VOLTAGE SWEEP causes the output voltage to change from the present value to a specified end value at a specified rate of change, while a VOLTAGE STEP causes an instantaneous change in output voltage. The new value will be held for the specified time duration. The final output voltage value of a sweep and a step transient step should be different than the value at the start of the transient step, or no change in output voltage will occur.

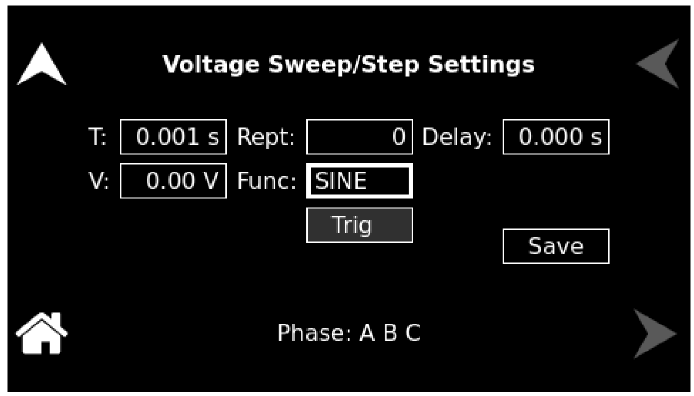


Figure 5-36: Voltage Sweep/Step Settings

VOLTAGE SURGE/SAG

VOLTAGE SURGE and SAG are temporary changes in amplitude. The output voltage will change from its present value to a specified value for a specified duration. Surge is a change to a higher value, while sag is a change to a lower value. After the time duration has expired, the output voltage returns to a specified end value. This value can be the same or different from the value present before the start of the surge or sag.

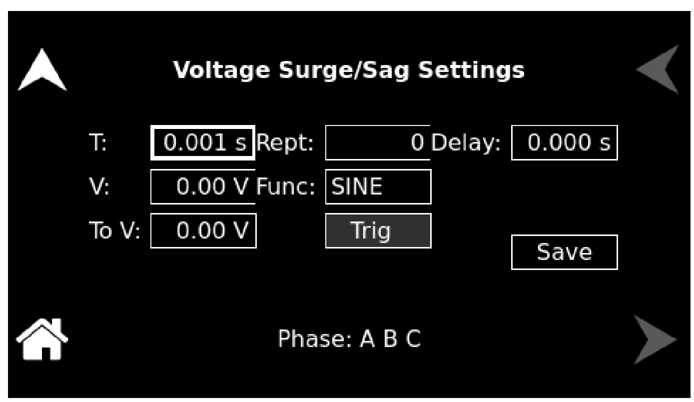


Figure 5-37: Voltage Surge/Sag Settings

FREQUENCY SWEEP/STEP

FREQUENCY SWEEP causes the output frequency to change from the present value to a specified end value at a specified rate of change, while a FREQUENCY STEP is an instantaneous change in output frequency. The new value will be held for the specified time duration. The final output frequency value of a sweep and a step transient step should be different than the value at the start of the transient step, or no change in output frequency will occur.

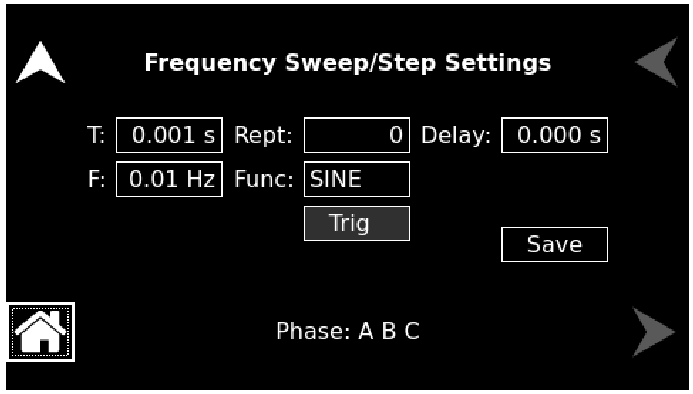


Figure 5-38: Frequency Sweep/Step Settings

FREQUENCY SURGE/SAG

FREQUENCY SURGE and SAG are temporary changes in frequency. The output frequency will change from its present value to a specified value for a specified duration. Surge is a change to a higher value, while sag is a change to a lower value. After the time duration has expired, the output frequency returns to a specified end value. This value can be the same or different from the value present prior to the start of the surge or sag.

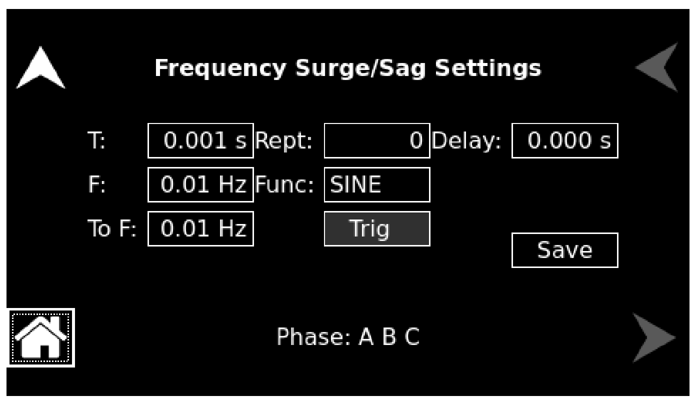


Figure 5-39: Frequency Surge/Sag Settings

VOLT/FREQ SWEEP/STEP

This transient type combines voltage and frequency changes into a single step. The effect is that of changing the output voltage and frequency simultaneously. While this transient is programmed as a single transient step, two list entries are required to store this information. As such, every VOLT/FREQ SWEEP/STEP combined step will consume two list entries at a time.

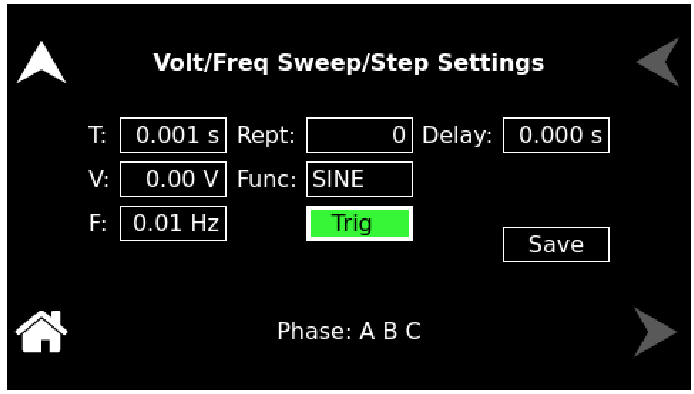


Figure 5-40: Volt/Freq Sweep/Step Settings

VOLT/FREQ SURGE/SAG

This transient type combines voltage and frequency changes into a single step. The effect is that of changing the output voltage and frequency simultaneously. While this transient is programmed as a single transient step, two list entries are required to store this information. As such, every VOLT/FREQ SWEEP/STEP combined step will consume two list entries at a time.

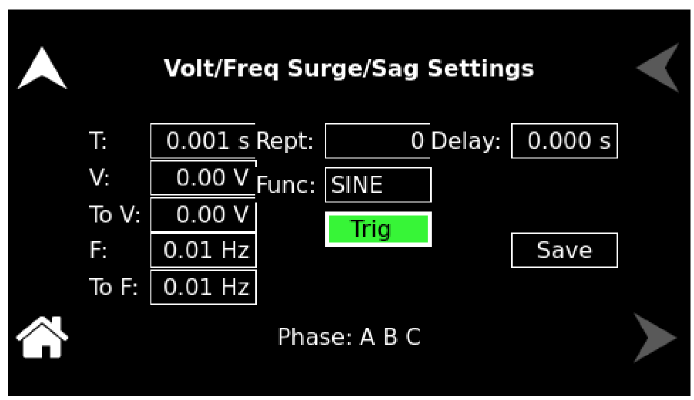


Figure 5-41: Volt/Freq Surge/Sag Settings

DELAY

Sets the time duration, in seconds or cycles that the voltage amplitude and frequency will stay at their existing levels before the next transient event is executed or the transient list is complete.

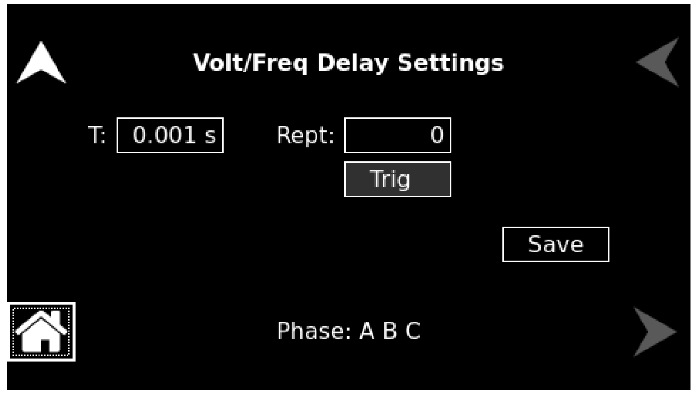


Figure 5-43: Volt/Freq Delay Settings – AC Mode

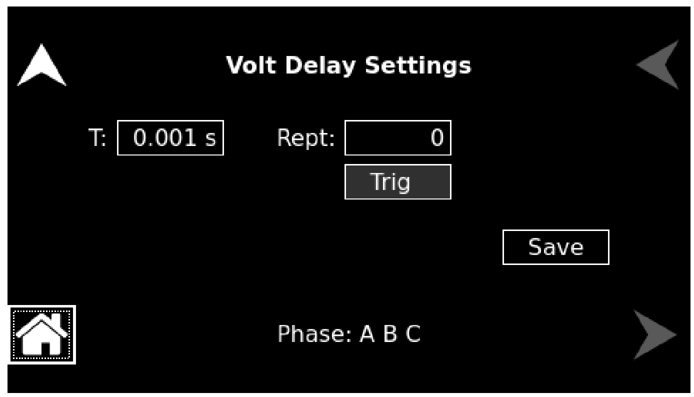


Figure 5-42: Volt/Freq Delay Settings – DC Mode

5.7.6.3 VOLTAGE DROP Sub-Menu

The VOLTAGE DROP menu allows programming the output voltage to zero at the maximum slew rate. After the drop time duration, the voltage returns to the previous level. When the transient definition is complete, tap SAVE to store the transient step settings in non-volatile memory and return to the ADD menu.

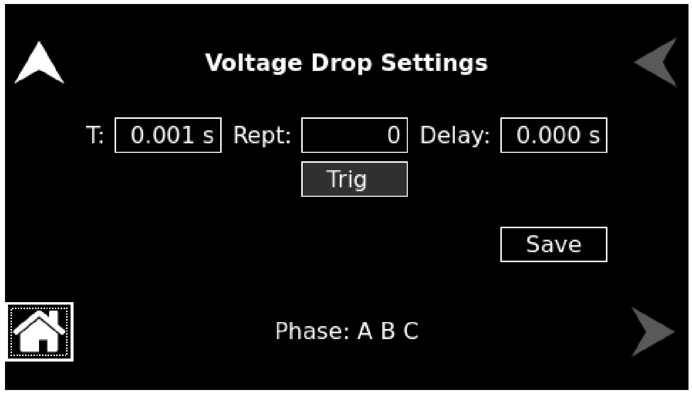


Figure 5-44: LIST Menu, VOLTAGE DROP Sub-Menu

The VOLTAGE DROP sub-menu has the following fields:

Entry	Description
T(ime)	Sets the time, in seconds or cycles, that the output voltage will dwell at zero.
Rep(ea)t	Sets the number of times the sweep/step transient event will be repeated before execution will proceed to the next event or exit the transient list. The number of times the transient event is generated is equal to the value, REPEAT+1. The value should be zero if only one execution of this event in the list is desired.
Trig(ger)	Causes a trigger pulse to be generated for the selected event when LIST is selected for Trig(ger) Out Source in the SETTINGS menu.
Delay	Sets the time duration, in seconds or cycles, that the voltage amplitude will stay at the previous level (before the drop to zero), before the next transient event is executed, or the transient list is completed.
Save	Completes the transient editing. All data fields should be entered before saving. The event number is automatically set based on the selection of either BEFORE or AFTER in the LIST menu and will be a value between 0 and 99. The event number determines the order of execution of the transient events in a multiple-event transient.
Phase	Displays the phases that had been selected in the Settings menu.

5.7.6.4 VOLTAGE SWEEP/STEP Sub-Menu

The VOLTAGE SWEEP/STEP menu allows changing the voltage amplitude during a transient. A voltage sweep is a continual change in amplitude that takes place over a specified period, while during a voltage step, the change occurs at the maximum slew rate. When the transient definition is complete, tap SAVE to store the transient step settings in non-volatile memory and return to the ADD menu.

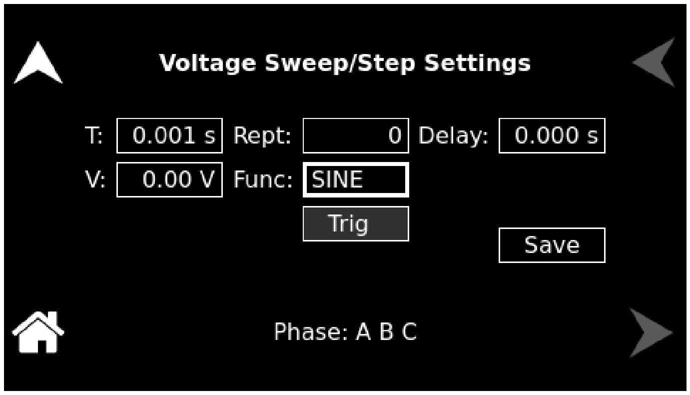


Figure 5-45: LIST Menu, VOLTAGE SWEEP/STEP Sub-Menu

The VOLTAGE SWEEP/STEP sub-menu has the following fields:

Entry	Description
T(ime)	Sets the time, in seconds or cycles, that it will take for the output voltage to reach the level set in the V(olts) field (end voltage). As such, the T(ime) value will define the slew rate of the output voltage for the event. A duration of 0.001 seconds will cause the output voltage to reach the end voltage at the maximum slew rate.
V(olts)	Sets the voltage amplitude, in volts, that will be reached after the sweep or step.
Rep(ea)t	Sets the number of times the sweep/step transient event will be repeated before execution will proceed to the next event or exit the transient list. The number of times the transient event is generated is equal to the value, REPEAT+1. The value should be zero if only one execution of this event in the list is desired.
Func(tion)	Selects the waveform to be used during this section of the transient sequence. Each segment cand use a different waveform from the available user-defined waveforms or the three standard waveforms. The output waveform changes upon entry into each section and remains in effect for the duration of the section. The default waveform is always the SINE (sine wave).
Trig(ger)	Causes a trigger pulse to be generated for the selected event when LIST is selected for Trig(ger) Out Source in the SETTINGS menu.
Delay	Sets the time duration, in seconds or cycles that the voltage amplitude will stay at the level, V(olts), before the next transient event is executed, or the transient list is completed.
Save	Completes the transient editing. All data fields should be entered before saving. The event number is automatically set based on the selection of either BEFORE or AFTER in the LIST menu and will be a value between 0 and 99. The event number determines the order of execution of the transient events in a multiple-event transient.
Phase	Displays the phases that had been selected in the Settings menu.

5.7.6.5 VOLTAGE SURGE/SAG Sub-Menu

The VOLTAGE SURGE/SAG menu allows temporarily changing the voltage amplitude during a transient. The output voltage will change from its present value to a specified value for a specified duration. After this duration has expired, the output voltage returns to a specified end value. When the transient definition is complete, tap SAVE to store the transient step settings in non-volatile memory and return to the ADD menu.

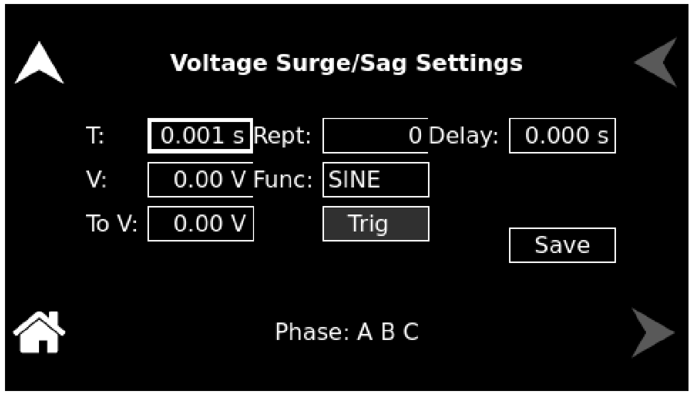


Figure 5-46: LIST Menu, VOLTAGE SURGE/SAG Sub-Menu

The VOLTAGE SURGE/SAG sub-menu has the following fields:

Entry	Description
T(ime)	Sets the time, in seconds or cycles that the output voltage will dwell at the level set in the V(olts) field.
V(olts)	Sets the voltage amplitude, in volts, that will be reached during the surge or sag time duration.
To V(olts)	Sets the output voltage level, in volts, at the end of the transient surge/sag event and after a time specified by T(ime).
Rep(ea)t	Sets the number of times the surge/sag transient event will be repeated before execution will proceed to the next event or exit the transient list. The number of times the transient event is generated is equal to the value, REPEAT+1. The value should be zero if only one execution of this event in the list is desired.
Func(tion)	Selects the waveform to be used during this section of the transient sequence. Each segment can use a different waveform from the available library of user-defined waveforms or the three standard waveforms. The output waveform changes upon entry into each section and remains in effect for the duration of the section. The default waveform is always the SINE (sinewave).
Trig(ger)	Causes a trigger pulse to be generated for the selected event when LIST is selected for Trig(ger) Out Source in the SETTINGS menu.
Delay	Sets the time duration, in seconds or cycles, that the voltage amplitude will stay at the level, To V(olts), before the next transient event is executed, or the transient list is completed.
Save	Completes the transient editing. All data fields should be entered before saving. The event number is automatically set based on the selection of either BEFORE or AFTER in the LIST menu and will be a value between 0 and 99. The event number determines

	the order of execution of the transient events in a multiple-event transient.
Phase	Displays the phases that had been selected in the Settings menu.

5.7.6.6 FREQUENCY SWEEP/STEP Sub-Menu

The FREQUENCY SWEEP/STEP menu allows changing the frequency during a transient. A frequency sweep is a continual change in amplitude that takes place over a specified period, while during a frequency step, the change occurs at the maximum slew rate. When the transient definition is complete, tap SAVE to store the transient step settings in non-volatile memory and return to the ADD menu.

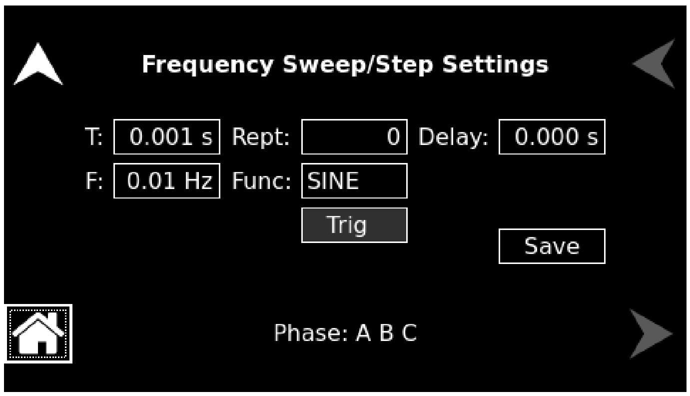


Figure 5-47: LIST Menu, FREQUENCY SWEEP/STEP Sub-Menu

The FREQUENCY SWEEP/STEP sub-menu has the following fields:

Entry	Description
T(ime)	Sets the time, in seconds or cycles, that it will take for the output frequency to reach the level set in the F(requency) field (end voltage). As such, the T(ime) value will define the slew rate of the output frequency for the event. A duration of 0.001 seconds will cause the output frequency to reach the end frequency at the maximum slew rate.
F(requency)	Sets the frequency value, in hertz, that will be reached after the sweep or step.
Rep(ea)t	Sets the number of times the sweep/step transient event will be repeated before execution will proceed to the next event or exit the transient list. The number of times the transient event is generated is equal to the value, REPEAT+1. The value should be zero if only one execution of this event in the list is desired.
Func(tion)	Selects the waveform to be used during this section of the transient sequence. Each segment can use a different waveform from the available library of user-defined waveforms or the three standard waveforms. The output waveform changes upon entry into each section and remains in effect for the duration of the section. The default waveform is always the SINE (sinewave).
Trig(ger)	Causes a trigger pulse to be generated for the selected event when LIST is selected for Trig(ger) Out Source in the SETTINGS menu.

Delay	Sets the time duration, in seconds or cycles, that the frequency will stay at the level, F(requency), before the next transient event is executed, or the transient list is completed.
Save	Completes the transient editing. All data fields should be entered before saving. The event number is automatically set based on the selection of either BEFORE or AFTER in the LIST menu and will be a value between 0 and 99. The event number determines the order of execution of the transient events in a multiple-event transient.
Phase	Displays the phases that had been selected in the Settings menu.

5.7.6.7 FREQUENCY SURGE/SAG Sub-Menu

The FREQUENCY SURGE/SAG menu allows temporarily changing the frequency during a transient. The output frequency will change from its present value to a specified value for a specified duration. After this time duration has expired, the output frequency returns to a specified end value. When the transient definition is complete, tap SAVE to store the transient step settings in non-volatile memory and return to the ADD menu.

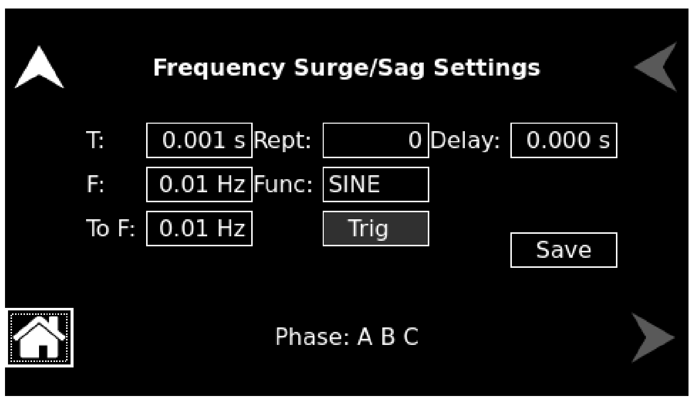


Figure 5-48: LIST Menu, FREQUENCY SURGE/SAG Sub-Menu

The FREQUENCY SURGE/SAG sub-menu has the following fields:

Entry	Description
T(ime)	Sets the time, in seconds or cycles, that the output frequency will dwell at the level set in the F(requency) field.
F(requency)	Sets the frequency, in hertz, that will be reached during the surge or sag time duration.
To F(requency)	Sets the frequency, in hertz, that will be reached at the end of the transient surge/sag event and after a time specified by T(ime).
Rep(ea)t	Sets the number of times the surge/sag transient event will be repeated before execution will proceed to the next event or exit the transient list. The number of times the transient event is generated is equal to the value, REPEAT+1. The value should be zero if only one execution of this event in the list is desired.
Func(tion)	Selects the waveform to be used during this section of the transient sequence. Each segment can use a different waveform from the available library of user-defined waveforms or the three

	standard waveforms. The output waveform changes upon entry into each section and remains in effect for the duration of the section. The default waveform is always the SINE (sinewave).
Trig(ger)	Causes a trigger pulse to be generated for the selected event when LIST is selected for Trig(ger) Out Source in the SETTINGS menu.
Delay	Sets the time duration, in seconds or cycles, that the frequency will stay at the level, To F(requency), before the next transient event is executed, or the transient list is completed.
Save	Completes the transient editing. All data fields should be entered before saving. The event number is automatically set based on the selection of either BEFORE or AFTER in the LIST menu and will be a value between 0 and 99. The event number determines the order of execution of the transient events in a multiple-event transient.
Phase	Displays the phases that had been selected in the Settings menu.

5.7.6.8 VOLT/FREQ SWEEP/STEP Sub-Menu

The VOLT/FREQ SWEEP/STEP menu allows combining voltage and frequency sweep/step changes into a single transient event. The effect is that of changing the output voltage and frequency simultaneously. While this transient is programmed as a single event, two list entries are required to store this information. When the transient definition is complete, tap SAVE to store the transient step settings in non-volatile memory and return to the ADD menu.

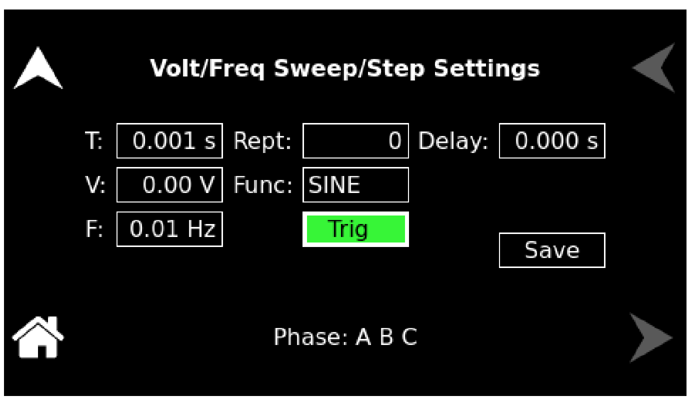


Figure 5-49: LIST Menu, VOLT/FREQ SWEEP/STEP Sub-Menu

The VOLT/FREQ SWEEP/STEP sub-menu has the following fields:

Entry	Description
T(ime)	Sets the time, in seconds or cycles, that it will take for the output frequency to reach F(requency) and the output voltage to reach V(olts). As such, the T(ime) value will define the slew rate of the output frequency and output voltage for the event. A duration of 0.001 seconds will cause the output voltage to reach the end voltage at the maximum slew rate.
V(olts)	Sets the voltage amplitude, in volts, that will be reached after the sweep or step.

F(requency)	Sets the frequency (Hz) that will be reached after the sweep or step.
Rep(ea)t	Sets the number of times the sweep/step transient event will be repeated before execution will proceed to the next event or exit the transient list. The number of times the transient event is generated is equal to the value, REPEAT+1. The value should be zero if only one execution of this event in the list is desired.
Func(tion)	Selects the waveform to be used during this section of the transient sequence. Each segment can use a different waveform from the available library of user-defined waveforms or the three standard waveforms. The output waveform changes upon entry into each section and remains in effect for the duration of the section. The default waveform is always the SINE (sinewave).
Trig(ger)	Causes a trigger pulse to be generated for the selected event when LIST is selected for Trig(ger) Out Source in the SETTINGS menu.
Delay	Sets the time duration, in seconds or cycles, that the voltage amplitude and frequency will stay at the V(olts) and F(requency) levels, before the next transient event is executed, or the transient list is completed.
Save	Completes the transient editing. All data fields should be entered before saving. The event number is automatically set based on the selection of either BEFORE or AFTER in the LIST menu and will be a value between 0 and 99. The event number determines the order of execution of the transient events in a multiple-event transient.
Phase	Displays the phases that had been selected in the Settings menu.

5.7.6.9 VOLT/FREQ SURGE/SAG Sub-Menu

The VOLT/FREQ SURGE/SAG menu allows combining voltage and frequency surge/sag changes into a single transient event. The effect is that of changing the output voltage and frequency simultaneously. While this transient is programmed as a single event, two list entries are required to store this information. When the transient definition is complete, tap SAVE to store the transient step settings in non-volatile memory and return to the ADD menu.

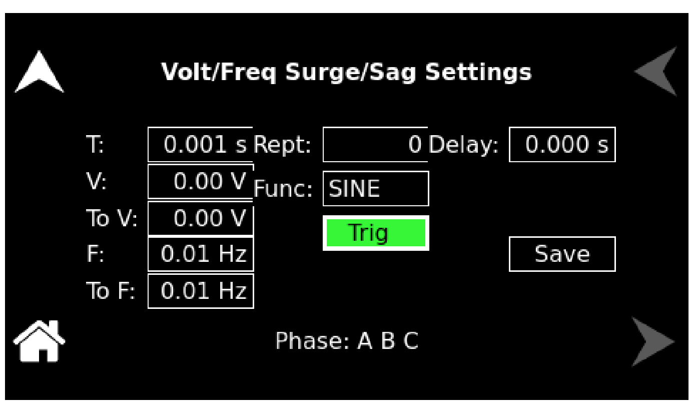


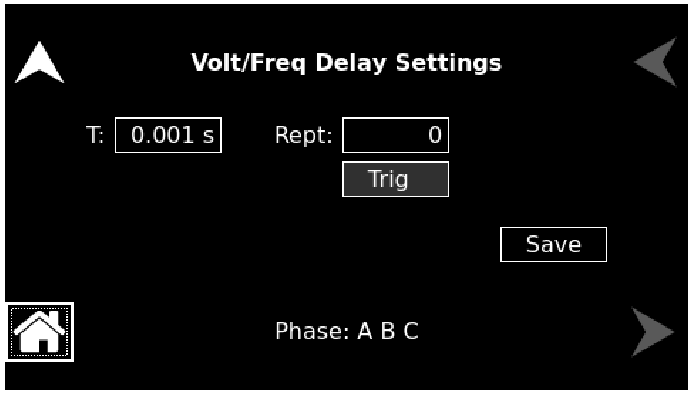
Figure 5-50: LIST Menu, VOLT/FREQ SURGE/SAG Sub-Menu

The VOLT/FREQ SURGE/SAG sub-menu has the following fields:

Entry	Description
T(ime)	Sets the time, in seconds or cycles, that the output frequency will dwell at F(requency) and the output voltage to dwell at V(olts).
V(olts)	Sets the voltage amplitude, in volts, that will be reached during the surge or sag time duration.
To V(olts)	Sets the output voltage amplitude, in volts, at the end of the transient surge/sag event and after a time specified by T(ime).
F(requency)	Sets the frequency, in hertz, that will be reached during the surge or sag time duration.
To F(requency)	Sets the output frequency, in hertz, at the end of the transient surge/sag event and after a time specified by T(ime).
Rep(ea)t	Sets the number of times the surge/sag transient event will be repeated before execution will proceed to the next event or exit the transient list. The number of times the transient event is generated is equal to the value, REPEAT+1. The value should be zero if only one execution of this event in the list is desired.
Func(tion)	Selects the waveform to be used during this section of the transient sequence. Each segment can use a different waveform from the available library of user-defined waveforms or the three standard waveforms. The output waveform changes upon entry into each section and remains in effect for the duration of the section. The default waveform is always the SINE (sinewave).
Trig(ger)	Causes a trigger pulse to be generated for the selected event when LIST is selected for Trig(ger) Out Source in the SETTINGS menu.
Delay	Sets the time duration, in seconds or cycles, that the voltage amplitude and frequency will stay at the levels, To V(olts) and F(requency), before the next transient event is executed, or the transient list is completed.
Save	Completes the transient editing. All data fields should be entered before saving. The event number is automatically set based on the selection of either BEFORE or AFTER in the LIST menu and will be a value between 0 and 99. The event number determines the order of execution of the events in a multiple-event transient.
Phase	Displays the phases that had been selected in the Settings menu.

5.7.6.10 DELAY Sub-Menu

The VOLT/FREQ DELAY menu allows for introducing a delay as a transient event. When the transient definition is complete, tap SAVE to store the transient step settings in non-volatile memory and return to the ADD menu.



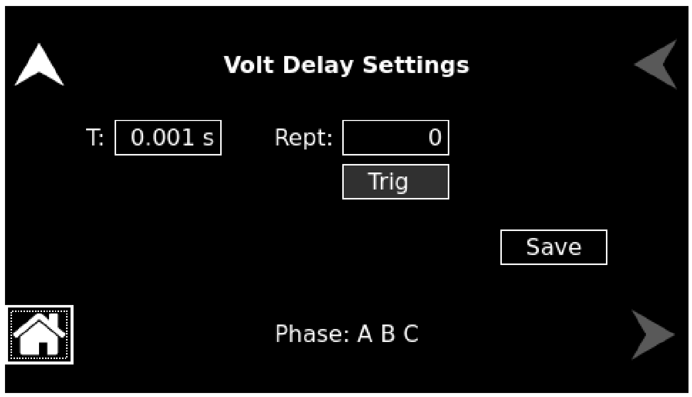


Figure 5-51: LIST Menu, DELAY Sub-Menu

The VOLT/FREQ sub-menu has the following fields:

Entry	Description
T(ime)	Sets the time, in seconds or cycles, that the voltage amplitude and frequency will stay at their existing levels before the next transient event is executed or the transient list is complete.
Rep(ea)t	Sets the number of times the surge/sag transient event will be repeated before execution will proceed to the next event or exit the transient list. The number of times the transient event is generated is equal to the value, REPEAT+1. The value should be zero if only one execution of this event in the list is desired.
Trig(ger)	Causes a trigger pulse to be generated for the selected event when LIST is selected for Trig(ger) Out Source in the SETTINGS menu.
Save	Completes the transient editing. All data fields should be entered before saving. The event number is automatically set based on the selection of either BEFORE or AFTER in the LIST menu and will be a value between 0 and 99. The event number determines the order of execution of the transient events in a multiple-event transient.
Phase	Displays the phases that had been selected in the Settings menu.

5.7.6.11 RUN Menu

The RUN menu is used to control transient execution; It provides two selections, CONTINUOUS and X TIMES, and START/ABORT functions to begin and stop the execution of a list.

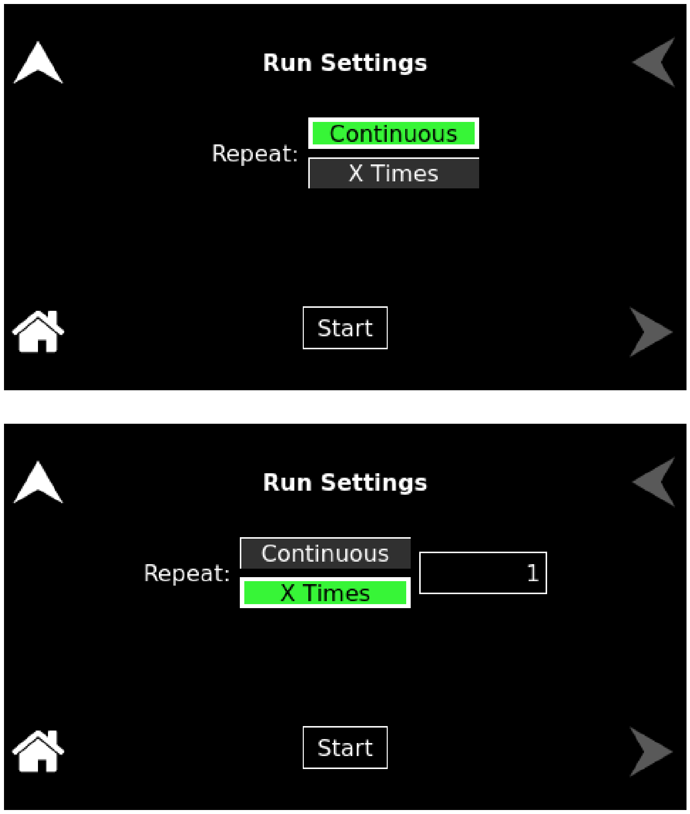


Figure 5-52: RUN Menu

The RUN menu has the following fields:

Entry	Description
Continuous	Causes the transient execution to continue indefinitely. The execution must be stopped manually.
X Times	Determines the number of times a transient list is repeated. The default value is zero, which means the programmed list runs only once. The range for this field is from 0 through 99999. This repeatable function should not be confused with the REPEAT function available for individual events. The event-specific repeat value will cause only that event to be repeated, not the complete list.
Start	Starts a transient execution. The output relay must be closed, or an error message will appear, and the transient will not start.
Abort	Once the START command has been set, the START selection-button will change to an ABORT button, which is used to stop the run and abort the transient list.

5.7.7 Configuration Screen

The CONFIGURATION screen provides a setup of the output mode of operation, power-on states, operation profiles, parameter limits, and selection of clock mode.

The top-level menu of the CONFIGURATION screen is shown in Figure 5-53. It can be reached in one of two ways:

1. Tapping CONFIGURATION on the HOME Screen of the front panel touchscreen.
2. Scrolling to CONFIGURATION with the encoder and depressing the encoder switch.

The Up-arrow button takes you back to the previously selected screen menu (e.g., the HOME Screen). The HOME button returns you to the HOME screen, which contains the top-level menu for the current sub-menu. For the CONFIGURATION screen, the HOME screen is the top-level menu.

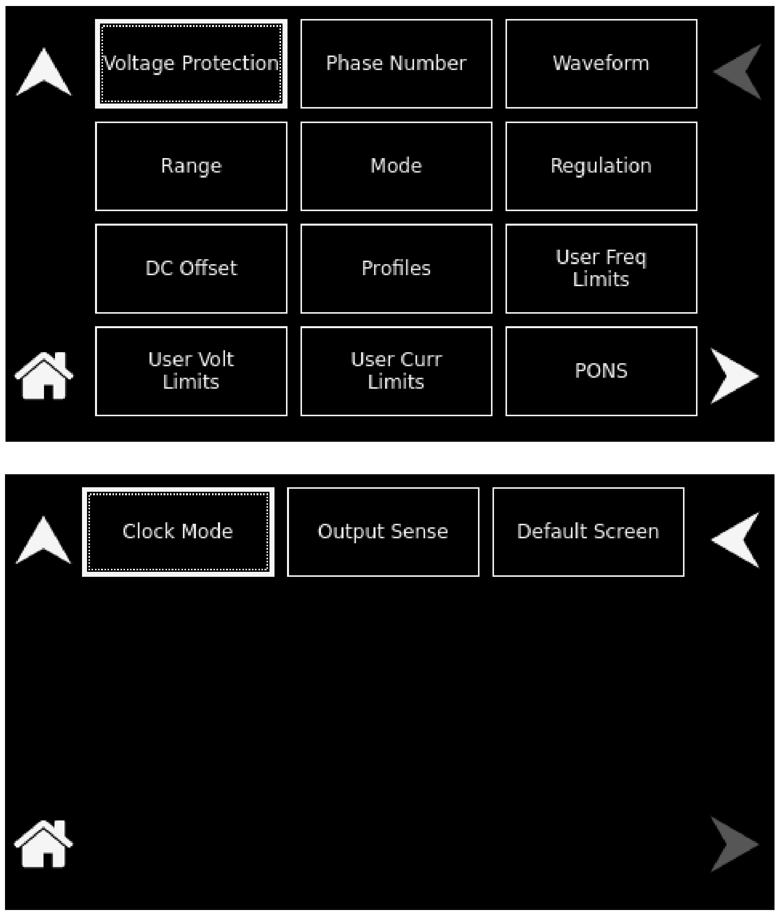


Figure 5-53: CONFIGURATION Screen Top-Level Menu

The following sub-menus are available in the CONFIGURATION menu:

Entry	Description
VOLTAGE PROTECTION	Programs the Voltage Protection threshold for the output voltage of each output phase. Exceeding the OVP threshold will result in the shutdown of the output, with the output isolation relay opened and the output voltage programmed to zero. The maximum OVP setpoint is 115% FS low-range/high- range output voltage: AC- mode and (AC+DC)-mode, 191 V/383 V; DC- mode, 253 V/506 V. The default value is 115% FS.

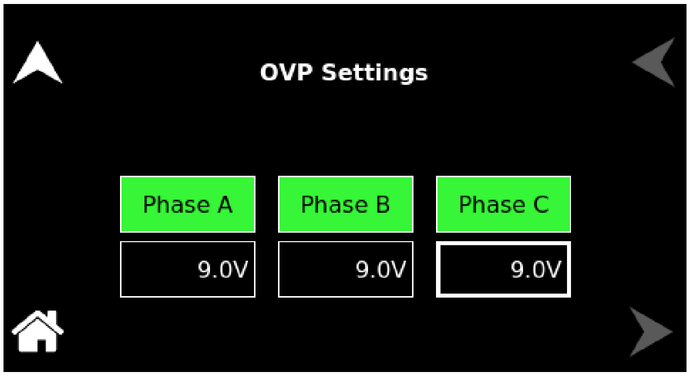


Figure 5-54: Voltage Protection Settings

PHASE NUMBER

Programs the output phase configuration:

One-Phase or Three-Phase. The default is Three-Phase.

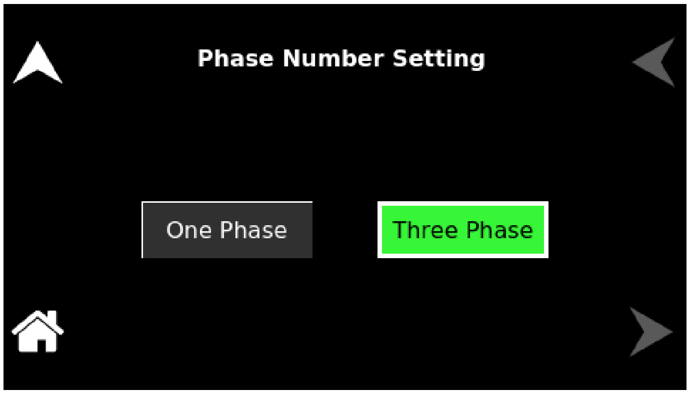


Figure 5-55: Phase Number Settings

WAVEFORM

Selects the waveform for the output voltage: Either standard waveforms for sine wave, square wave, clipped-sine wave; or user-defined waveforms. The default is a sine wave.

The standard waveforms are always available, and do not consume any of the user-defined waveform memory registers; they are always displayed in the waveform list. The clipped-sine waveform has a waveform where the peak amplitude of the positive and negative alternation is clipped (flattened appearance). The level of clipping is dependent on the amount of harmonic distortion present in the output waveform. An additional programmable parameter, CLIP % THD, is available for setting the percentage of total harmonic distortion (THD); the range is 0- 43%.

The user-defined waveforms can be selected from up to fifty waveforms in one of four groups (group 0-3, totaling 200 waveforms) that are active. The waveform group that is active at the power-on of the unit is selected with the SCPI command, `PONSetup:WGRoup <n>`, through the digital interface. For information on generating user-defined waveforms and their selection, refer to the Sequoia Series Programming Manual P/N M447353-01 or Tahoe Series Programming Manual P/N M447354-01 or the Sequoia / Tahoe Virtual Panels GUI; refer to AMETEK PPD website, www.programmablepower.com, to download the latest version.

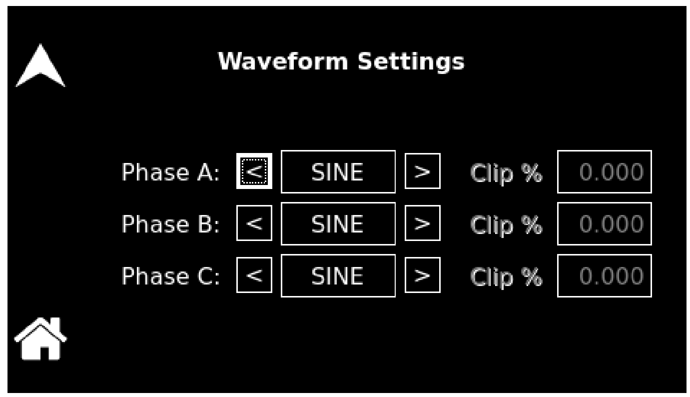


Figure 5-56: Waveform Settings

RANGE

Selects the 166 VAC or 333 VAC range for AC-mode and (AC+DC) -mode, and 220 VDC or 440 VDC range for DC-mode operation. The output must be turned off for a change in range to be executed. The default is low-range, 166 VAC.

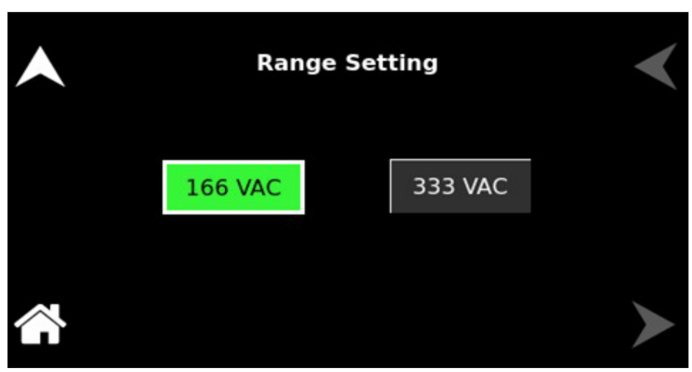


Figure 5-57: Range Settings

MODE SETTING

Selects the mode of operation of output voltage: either AC only, DC only, or AC with a DC offset, AC+DC. This selection also determines the available output voltage ranges: 166/333 Vrms in AC and AC+DC modes, and 220/440 VDC in DC mode. The output must be turned off to change this setting. The default is AC.

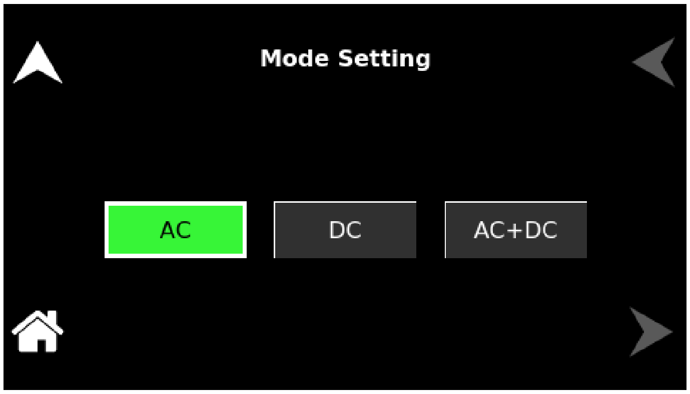


Figure 5-58: Mode Settings

REGULATION

Selects options for regulation of the output voltage: whether ALC is enabled, and what control action will be performed when the load current reaches the current setpoint. The defaults are CV/CL, with a Delay of 0.2 seconds, and ALC on.

Constant-Voltage/Constant-Current (CV/CC): CV/CC mode will regulate the output voltage to the set value until the load current reaches the current setpoint; after the Delay interval, if the current exceeds the setpoint, the output current will be controlled to equal the setpoint. Regulation of the load current is accomplished by reducing the output voltage as needed to satisfy the load. As such, the voltage will be reduced from the set value down to zero, depending on the load requirement. This mode is useful for starting up motor or capacitor loads that may require a high inrush current.

In the constant-voltage mode of operation, the waveform and instantaneous amplitude of the output voltage are regulated to equal the programmed values; if Volt ALC is enabled, the RMS value is also precisely regulated. In the constant-current mode of operation, the RMS value of the output current is regulated to equal the programmed value. However, this is accomplished by controlling the voltage amplitude and waveform, and not directly the current; therefore, the current instantaneous amplitude and waveform and dependent on load characteristics.

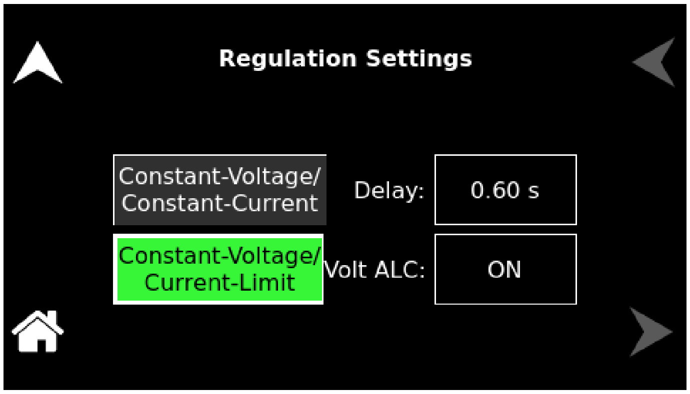


Figure 5-59: Regulation Settings

Constant-Voltage/Current-Limit (CV/CL): CV/CL mode will regulate the output voltage to the set value until the load current reaches the current setpoint; after the Delay interval, if the current equals or exceeds the setpoint, a fault condition will be generated, and the output voltage will be programmed to zero and the isolation relay opened. This effectively turns off the AC source output in case of an overload condition, after the user- programmable trip time-delay.

Delay: Sets the time duration that the output current can equal or exceed the current setpoint before control action is taken. After the delay, if CV/CC mode is selected, the output current will be regulated to its setpoint; if CV/CL mode is selected, an overcurrent fault condition will be generated, and the output will be turned off. The Delay is programmable from 0.1-5 seconds.

Volt ALC: Volt ALC selects whether the automatic loop control, ALC, is enabled. ALC provides improved output regulation and accuracy by regulating the RMS value of the output voltage through the action of a digital regulator that measures the output voltage and controls it to equal the setpoint.

ON: ALC is enabled; regulation is accomplished through the RMS digital regulator; if the RMS digital regulator exceeds its control capability and is unable to maintain regulation, the output will be shut down and a fault condition will be generated with the output turned off and the voltage programmed to zero.

REG: ALC is enabled; regulation is accomplished through the RMS digital regulator; if the RMS digital regulator exceeds its control capability and cannot maintain regulation, the output will remain on, but the voltage will deviate from the setpoint, and a fault condition will not be generated.

OFF: ALC disabled; regulation is accomplished without the use of the RMS digital regulator, and shutdown that is dependent on loss of regulation will not occur.

DC OFFSET

Programs the DC offset value, V(DC), when in the (AC+DC) -mode; entries with positive and negative polarity are allowed. The AC component of the output voltage is set separately using the VOLTAGE selection field (above) or through the Dashboard screen. In AC-mode and DC mode, this function is not available, and the function is listed as “N/A”. The default is zero.

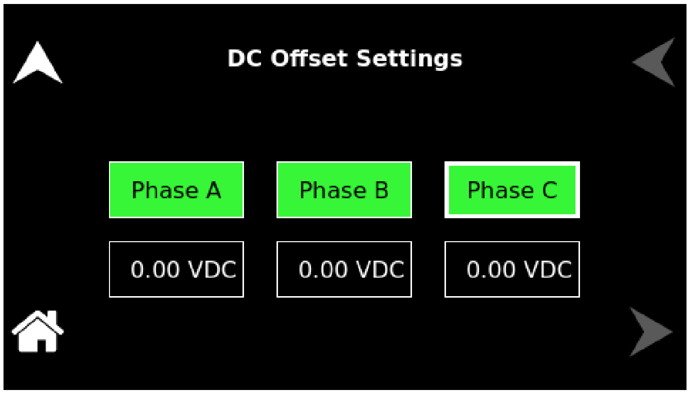


Figure 5-60: DC Offset Settings

PROFILES

Selects the operational state of the power source; the default is Profile-0. Up to 15 unique profiles, including transient lists, can be stored; refer to Figure 5-61. CONFIGURATION Menu, PROFILES Sub-Menu. Subsequently, a profile can be loaded to automatically set the unit to that configuration. To save the present state, tap on the profile selection button. The profile must be given an alphanumeric identifier by using the Name function; refer to Figure 5-61. CONFIGURATION Menu, PROFILES Sub-Menu Figure

5-62. PROFILES Menu, NAME Sub-Menu. Tap the SAVE field to store the present configuration. Tap on the Load field to recall a configuration and set the power source to that state.

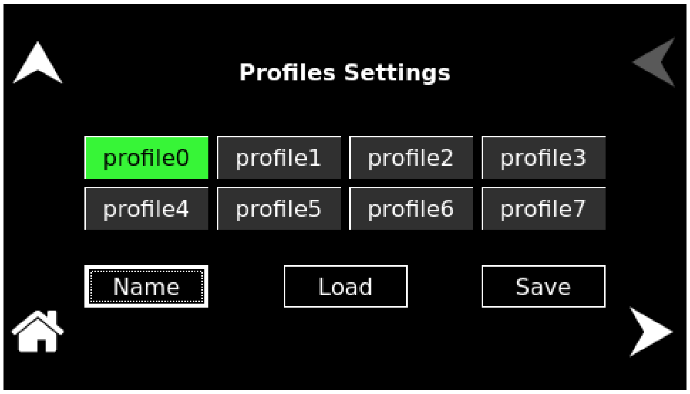


Figure 5-61: CONFIGURATION Menu, PROFILES Sub-Menu

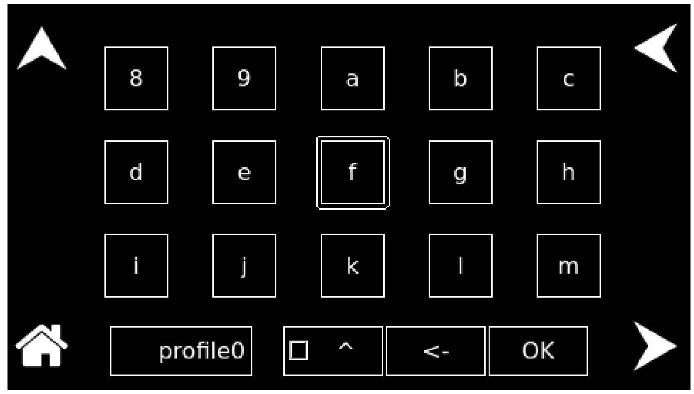


Figure 5-62: PROFILES Menu, NAME Sub-Menu

USER F-LIMITS

Sets soft limits for the minimum and maximum output frequency to which the unit can be programmed using the front panel or remote digital interface; the default is full-scale.

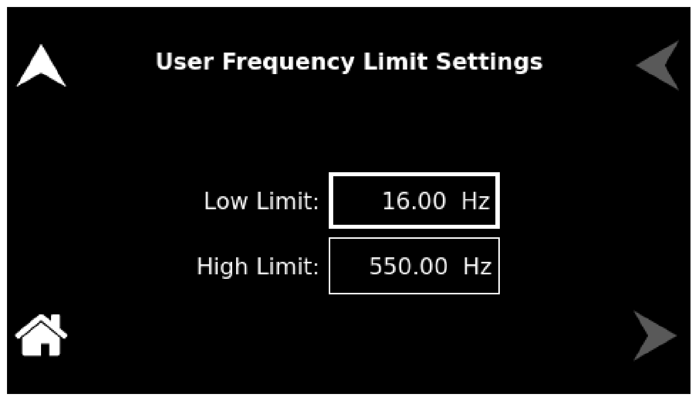


Figure 5-63: User Frequency Limit Settings

USER V-LIMITS

Sets soft limits for the minimum and maximum output voltage to which the unit can be programmed using the front panel or remote digital interface; the default is full-scale.

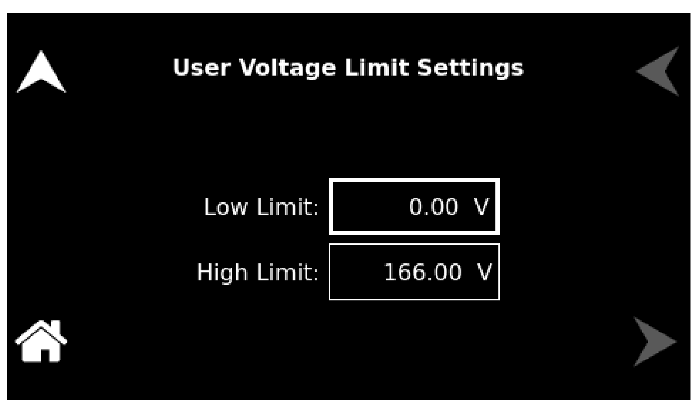


Figure 5-64: User Voltage Limit Settings

USER Curr LIMITS

Sets soft limits for the minimum and maximum output current to which the unit can be programmed using the front panel or remote digital interface; the default is full-scale.

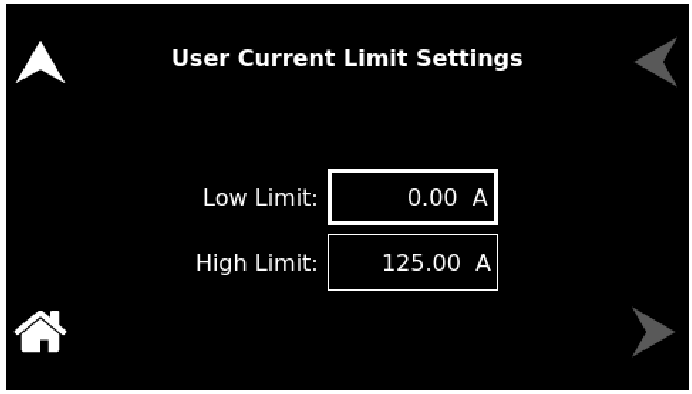


Figure 5-65: User Current Limit Settings

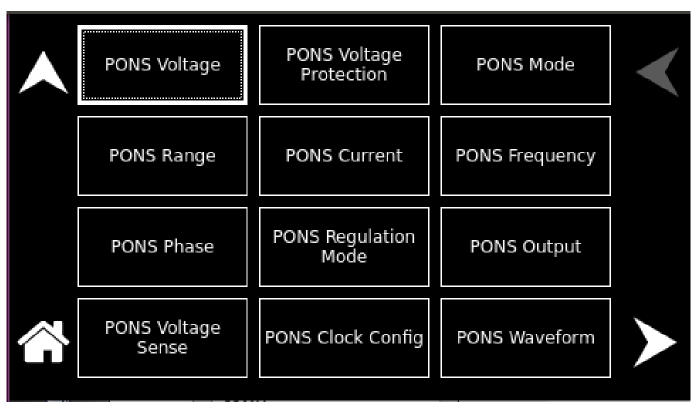
PONS

The PONS (Power ON Settings) menus allow setting the conditions that would be present after power up; refer to Figure 5-66.

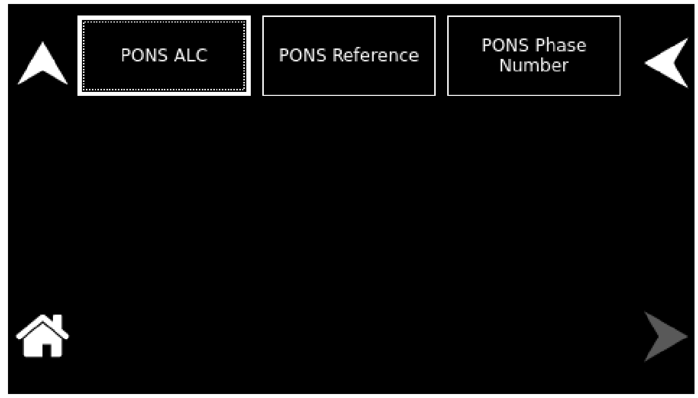
The AC input must be cycled off/on for a change in a PONS setting to take effect. The functions and parameters have the same programmability as described in the menus of the OUTPUT PROGRAM screen.

CAUTION!

The PONS menus allow selecting that the output would be turned on and programmed to a high voltage when the unit is initially powered up. Ensure that suitable protection is provided to prevent accidentally energizing the load. The factory-default setting is with the output off and programmed to zero to provide the safest start-up condition.



PONS Menu-1



PONS Menu-2

Figure 5-66: CONFIGURATION Menu, PONS Menu-1/2

The PONS menu has the following fields:

Entry	Description
PONS VOLTAGE	**PONS menu:** Sets the value of the output voltage; the default is zero.

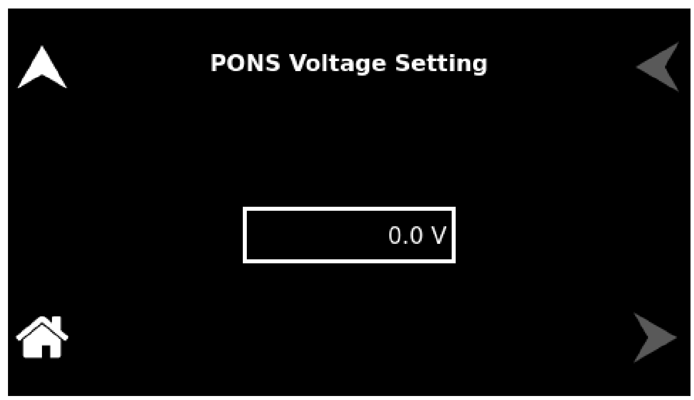


Figure 5-67: PONS Voltage Settings

PONS OVP	**PONS menu:** Programs the PONS Voltage Protection threshold for the output voltage of each output phase. Exceeding the OVP threshold will result in a shutdown of the output, with the output isolation relay opened and the output voltage programmed to zero. The maximum OVP setpoint is 115% FS low- range/high-range output voltage: AC- mode and (AC+DC)-mode, 191 V/383 V; DC- mode, 253 V/506 V. The default value is 115% FS.

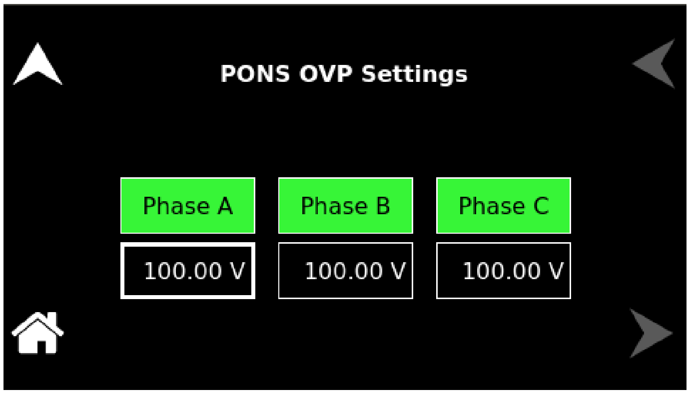


Figure 5-68: PONS OVP Settings

PONS MODE

PONS menu: Selects the mode of operation for the output voltage of the power source: either AC only, DC only, or

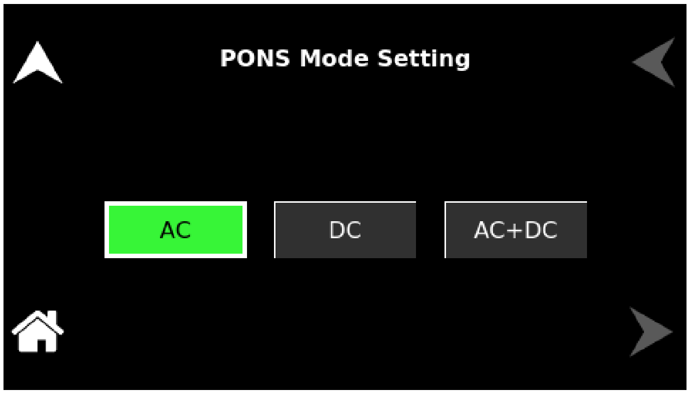


Figure 5-69: PONS Mode Settings

AC with a DC offset (AC+DC); the default is AC.

PONS RANGE

PONS menu: Selects the output voltage range, either low-range, 166 VAC or 220 VDC, or high range, 333 VAC or 440 VDC. The available ranges are dependent on the selection of the VOLTAGE mode, either AC, DC, or AC+DC; the default is low-range, 166 VAC.

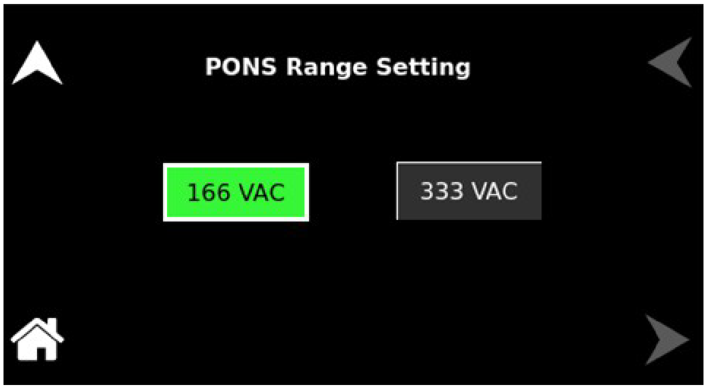


Figure 5-70: PONS Range Settings

PONS CURRENT

PONS menu: Sets the value of the output current; the default is full-scale for the model.

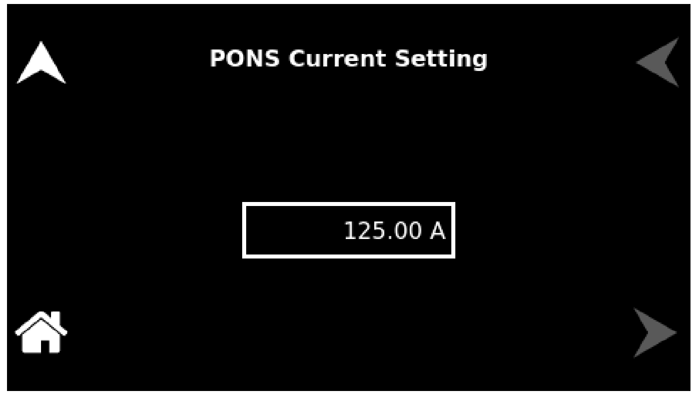


Figure 5-71: PONS Current Settings

PONS FREQUENCY

PONS menu: Sets the value of the output frequency; the default is 60 Hz.

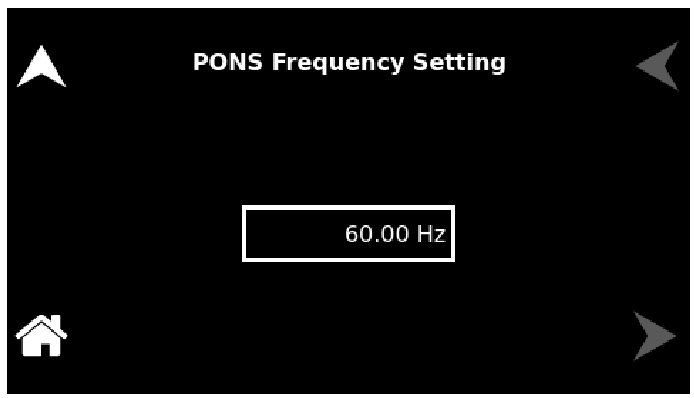


Figure 5-72: PONS Frequency Settings

PONS PHASE

PONS menu: Sets the phase of the output voltage in relation to the external synchronization signals, SYNC, or Clock/Lock; the default is zero.

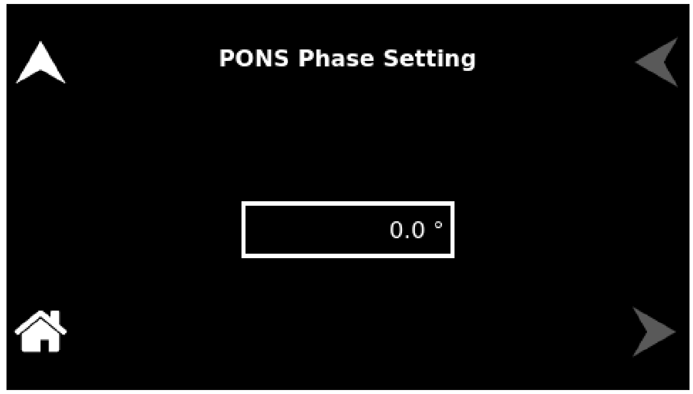


Figure 5-73: PONS Phase Settings

PONS REGULATION

Selects either Current-Limit mode (CL), where the output would be shut down when the current reaches the set value, or Constant-Current mode (CC), where the output current would be regulated when it reaches the set value; the default is Current-Limit.

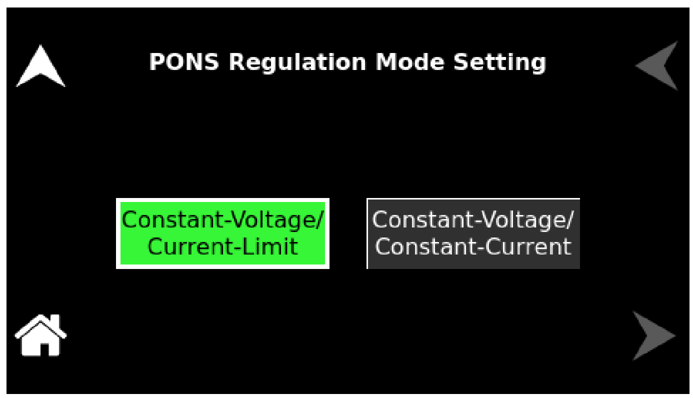


Figure 5-74: PONS Regulation Settings

PONS OUTPUT

PONS menu: Selects whether the output is turned on or off when the unit is powered up. If output-on is selected, the output voltage will be programmed to the value sets in the PONS VOLTAGE sub- menu; the default is off.

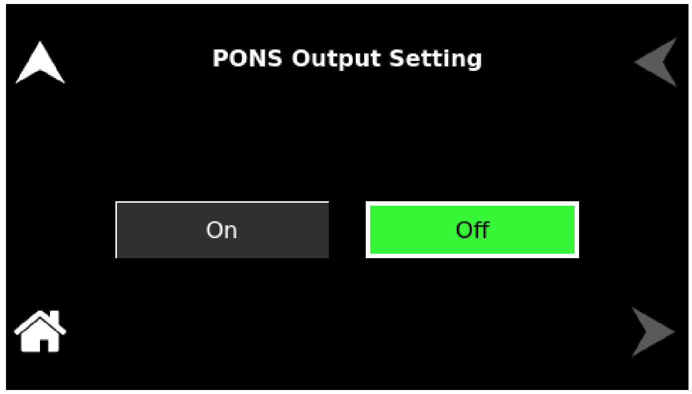


Figure 5-75: PONS Output Settings

PONS VOLTAGE SENSE

PONS menu: Selects the point for the sensing of the output voltage for regulation, either Internal (local, at the rear panel terminals) or External (remote, through the Remote Sense connection to the load); the default is Internal.

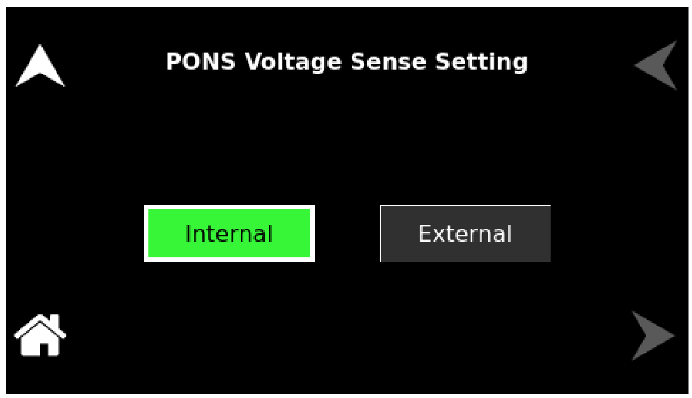


Figure 5-76: PONS Voltage Sense Settings

PONS CLOCK CONFIG

PONS menu: Configures the synchronization of the output frequency and phase, dependent on whether the unit is operating Standalone (also applicable to the Leader of a parallel group), as a Leader of a multi-phase group, or as an Auxiliary of a multi- phase group:

Standalone: Derives synchronization from either the user interface SYNC signal or the internal waveform generator (with full frequency resolution), as selected in the PONS CLOCK MODE menu (either Internal or SYNC).

Leader: Derives synchronization from either the user interface SYNC signal or the internal waveform generator (with internal synchronization, the phase programming resolution is limited to 1 Hz), as selected in the PONS CLOCK MODE menu (either SYNC or Internal); this setting is available only with the Clock/Lock option, LKM; for multi-phase operation, the Leader unit must have the setting at Leader.

Auxiliary: Derives synchronization from either the internal waveform generator or the external Clock/Lock interface (with external synchronization, the phase programming resolution is limited to 1 Hz), as selected in the PONS CLOCK MODE menu (either Internal or External); this setting is available only with the Clock/Lock option, LKS; for multi-phase operation, the Auxiliary unit must have the setting at Auxiliary.

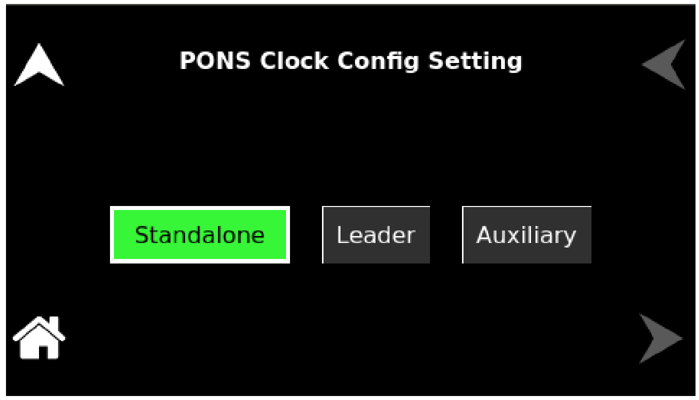


Figure 5-77: PONS Clock Config Settings

PONS WAVEFORM

PONS menu: Selects the type of output waveform, either the standard sine, square, or clipped-sine, or one that is user-defined; the default is a sine wave. The clipped-sine waveform has an additional programmable parameter, CLIP % THD. Refer to Section 6, Waveform Management for more information on the use of the menus.

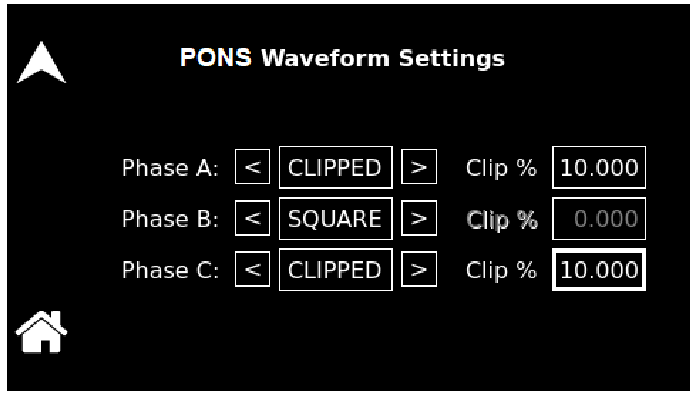


Figure 5-78: PONS Waveform Settings

PONS ALC

PONS menu: Selects how the output voltage will be regulated; default is ALC on.

ON: The RMS digital regulator is enabled, and shutdown will be executed if a loss of regulation occurs.

OFF: Regulation of the output voltage does not utilize the RMS digital regulator, and shutdown that is dependent on regulation would not occur.

Regulate: The RMS digital regulator is enabled, but shutdown will not be executed if loss of regulation occurs.

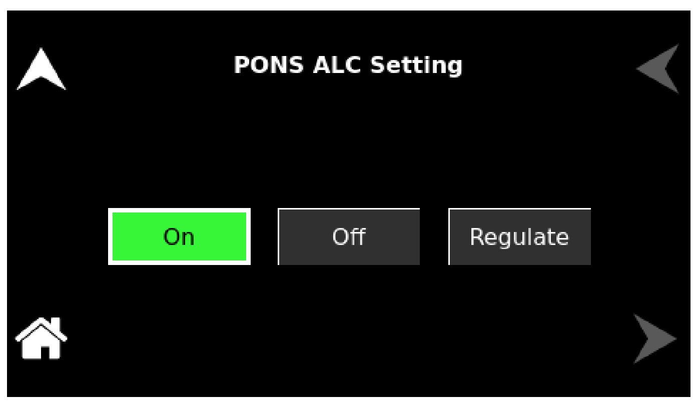


Figure 5-79: PONS ALC Settings

PONS REFERENCE

PONS menu: Selects either the internal waveform generator or the external analog inputs for programming the output waveform and amplitude; the default is Internal:

Internal: Enables the internal waveform generator using the standard waveforms or one of the user-defined waveforms.

External: Enables the external analog interface programming input that sets waveform and amplitude.

RPV: Enables the external analog interface programming input that sets the amplitude, while the internal waveform generator is used to set the waveform.

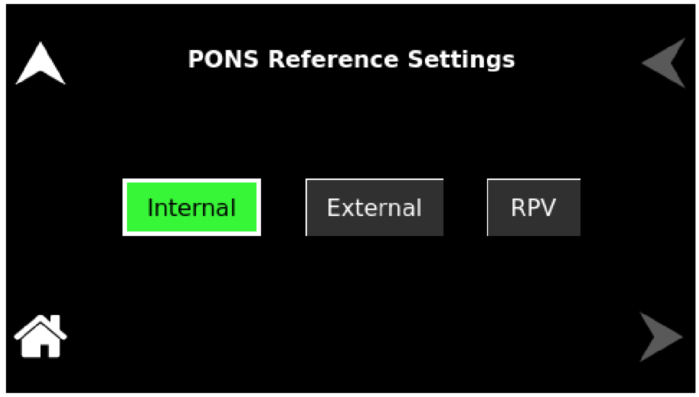


Figure 5-80: PONS Reference Settings

PONS PHASE NUMBER

<u>PONS menu:</u> Selects the output configuration, either 1-Phase or 3 Phase, the default is 3-Phase.

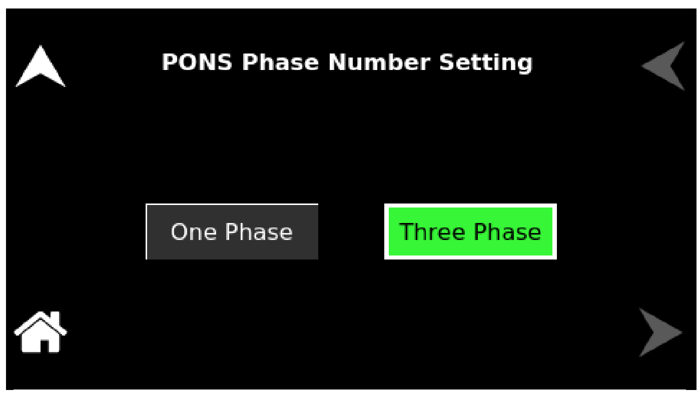


Figure 5-81: PONS Phase Number Settings

CLOCK MODE

Selects the source for the synchronization of the output frequency; default is Internal:

Internal: Derives synchronization from the internal waveform generator.

SYNC: Derives synchronization from the user interface SYNC signal; available only in a Standalone unit or Leader unit.

External: Derives synchronization from the external Clock/Lock interface; available only in the Auxiliary unit with the Clock/Lock option, LKS; for multi-phase operation, the Auxiliary unit must have the setting at External.

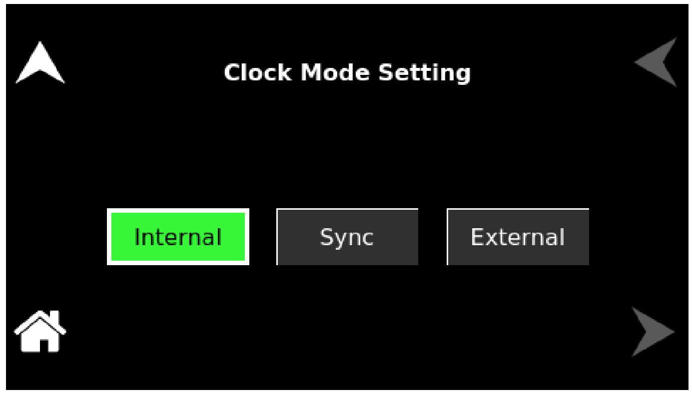


Figure 5-82: Clock Mode Settings

OUTPUT SENSE

Selects the point for the sensing of the output voltage for regulation; the default is external:

Internal: Local, at the rear panel terminals.

External: Remote, through the Remote Sense connection to the load.

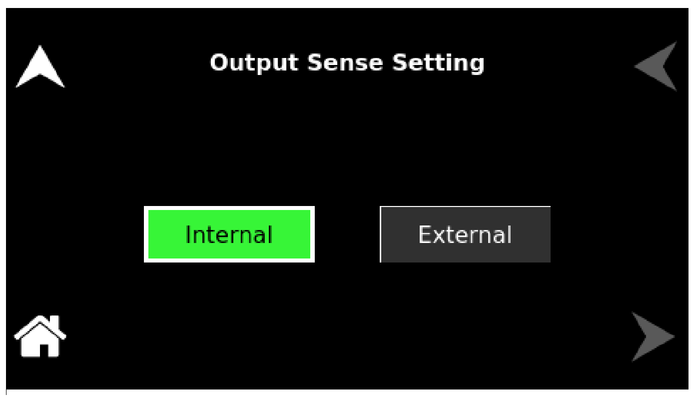


Figure 5-83: Output Sense Settings

DEFAULT SCREEN

Selects whether the Default screen (showing only voltage and current amplitude) is enabled and configures its operational characteristics; the defaults are Default screen enabled, 10-second timeout.

Timeout Interval: Select the time, in seconds, for how long a screen must be inactive for the Default screen to be displayed.

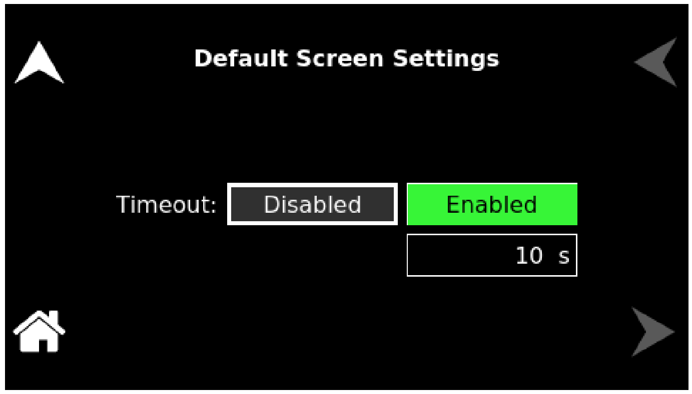


Figure 5-84: Default Screen Settings

5.8 HOME Screen Top-Level Menu - (Grid Simulator Mode)

5.8.1 Banner Screen

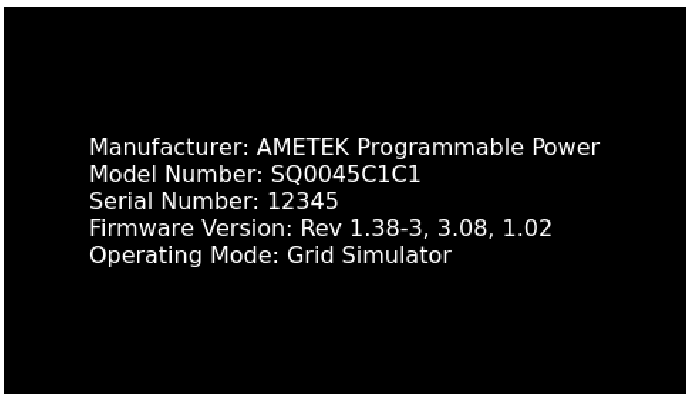


Figure 5-85: Banner Screen for Grid Simulator Mode

5.8.2 HOME Screen

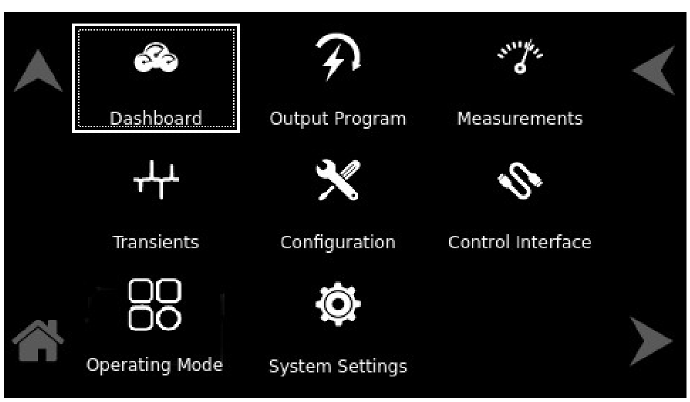


Figure 5-86: HOME Screen for Grid Simulator Mode

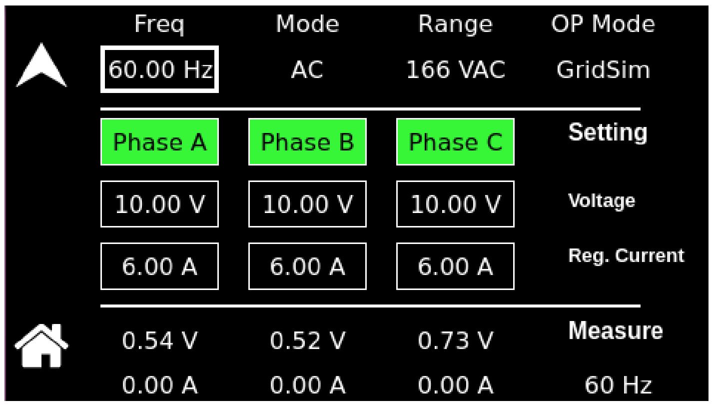
5.8.3 Dashboard Screen Top-Level Menu

The DASHBOARD screen top-level menu is used to change output parameters and simultaneously view output measurements. The most used output parameters are in the DASHBOARD screen menu. The DASHBOARD screen is the default menu that is displayed after powering on.

The top-level menu of the DASHBOARD screen is shown in Figure 5-87. It can be reached in one of two ways:

1. Tapping DASHBOARD on the HOME Screen of the front panel touchscreen.
2. Scrolling to DASHBOARD with the encoder and depressing the encoder switch.

The Up-arrow button will return to the previously selected screen menu (in this case the HOME Screen-1). The HOME button will return to the HOME screen that has the top-level menu for the sub-menu being displayed; for the DASHBOARD screen top-level menu, which is the HOME Screen.



3-Phase Mode

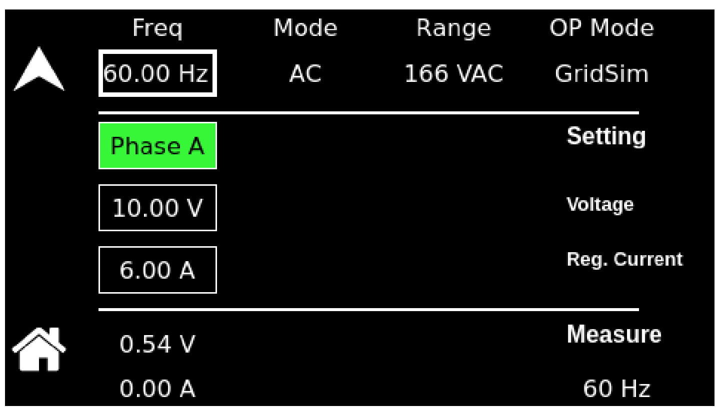


Figure 5-87: DASHBOARD Screen Top-Level Menu

1-Phase Mode

The following selections are available in the DASHBOARD screen top-level menu. Functions that accept a numeric value require that the value be within the allowed range, otherwise, an error will be generated, and the value will not be accepted.

When the unit is configured for 3-Phase output, each phase has individual settings. When the unit is configured for 1-Phase output, only Phase-A is displayed. Tapping on a phase button toggles the selection of that phase for inputting values. When a phase is selected, its button is displayed with a green color.

When a phase is not selected, its button is displayed with a gray color. When all phases are selected, entry for one phase will make the same changes for the other phases.

Entry	Description Setting
VOLTAGE	Programs the output voltage in RMS value, Vrms when in AC-mode and DC mode, and the AC component when in (AC+DC) -mode. In (AC+DC)-mode, the DC component is programmed using the DC OFFSET sub-menu in the OUTPUT PROGRAM menu. In DC mode, negative values can also be entered.
REGENERATIVE CURRENT	Programs the output current in RMS value, A(RMS).
FREQUENCY	Programs the output frequency in Hz when in AC mode. If the unit is in DC mode, the value for FREQ will be set to DC and cannot be changed until AC mode is selected. When in AC-mode, the frequency can be changed from 16 Hz to 905 Hz (depending on the options).
RANGE	Displays 166 VAC or 333 VAC range for AC-mode and (AC+DC) -mode, and 220 VDC or 440 VDC range for DC-mode operation. The OUTPUT state must be OFF for a change in range to be executed.
MODE	Displays the source mode of operation.
Measure	
VOLTAGE	Displays the true RMS value of the output voltage measured at the voltage sense lines (user selectable to be local or remote). In DC-mode only, the voltage is the DC voltage including polarity.
CURRENT	Displays the true RMS value of the output current. In DC mode only, the current is the DC including polarity.
FREQUENCY	When in AC-mode or (AC+DC)-mode, the output frequency is measured at the sense lines. When in DC mode, this value always reads "DC."
OP MODE	Displays the current operating mode.

5.8.4 Real-Time Parameter Adjustment

Refer to Section 5.7.4

5.8.5 Output Program Screen

The OUTPUT PROGRAM screen provides the setting of output-related items such as individual output parameters, mode of regulation and current limit, output waveform selection, and display of real-time output waveform or harmonics spectrum.

The top-level menus of the OUTPUT PROGRAM screen are shown in Figure 5-88. They can be reached in one of two ways:

1. Tapping the OUTPUT PROGRAM screen on the HOME Screen of the front panel touchscreen.
2. Scrolling to the OUTPUT PROGRAM screen with the encoder and depressing the encoder switch.

The Up-arrow button will return to the previously selected screen menu (in this case the HOME Screen). The HOME button will return to the HOME screen that has the top-level menu for the sub-menu being displayed; for the OUTPUT PROGRAM screen top-level menu, is the HOME Screen.

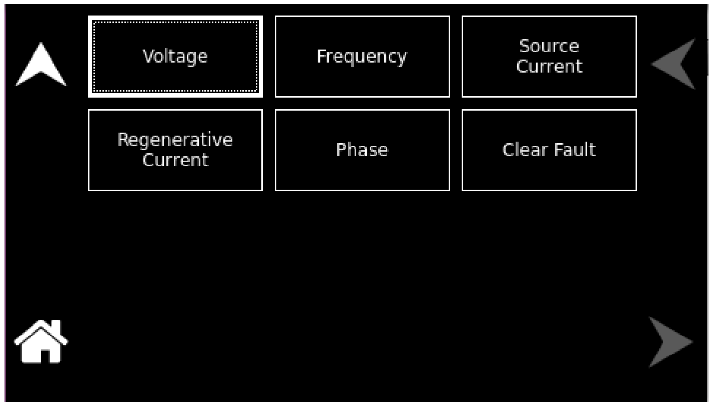


Figure 5-88: OUTPUT PROGRAM Screen Top-Level Menu

The following choices are available in the OUTPUT PROGRAM screen top-level menu. Functions that accept a numeric value require that the value be within the allowed range, otherwise, an error will be generated, and the value will not be accepted.:

Entry	Description Settings
VOLTAGE	Programs the output voltage in RMS value, Vrms, when in AC-mode and DC-mode, and the AC component when in (AC+DC) -mode. In (AC+DC)-mode, the DC component is set separately using the DC OFFSET selection field (below), or through the Dashboard screen. In DC mode, negative values can also be entered. The default is zero.

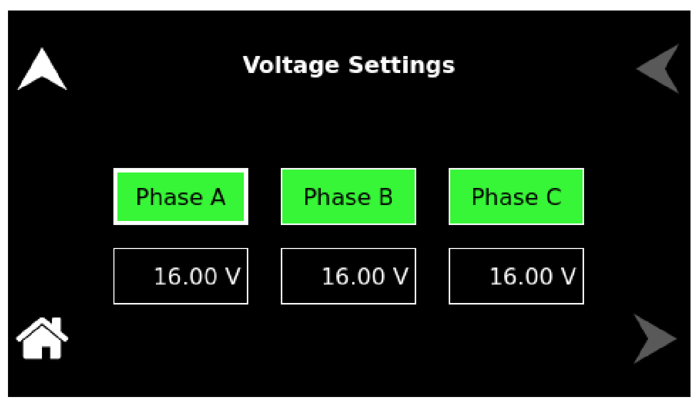


Figure 5-89: Voltage Settings

FREQUENCY	Programs the output frequency in Hz when in AC mode. If the unit is in DC mode, the value for FREQ will be set to DC and cannot be changed until AC mode is selected. When in AC-mode, the frequency can be changed from 16 Hz to 905 Hz (depending on the options). The default is 60 Hz.

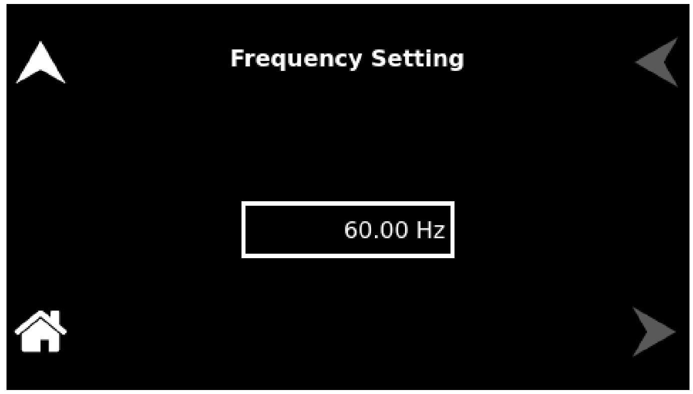


Figure 5-90: Frequency Settings

SOURCE CURRENT

Programs the output current in RMS value, A(RMS). The default
is full-scale for the model.

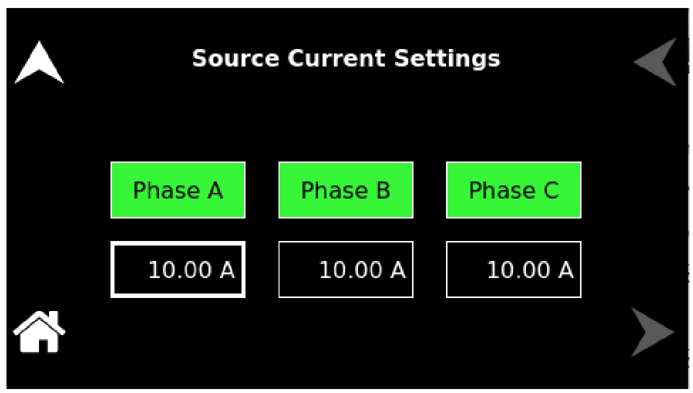


Figure 5-91: Source Current Settings

PHASE

Programs the phase angle of the output voltage in a standalone unit operating in a 1-Phase configuration; the phase angle would be with respect to the external SYNC signal. In an auxiliary unit (with LKS option) of a multi-phase group, the phase angle would be with respect to Phase-A, while Phase-A would be the reference at 0°. If the clock source is selected to be internal, this parameter has no effect. The default is zero.

In a 3-Phase configuration, programs the Phase-B and Phase-C with respect to the Phase-A reference.

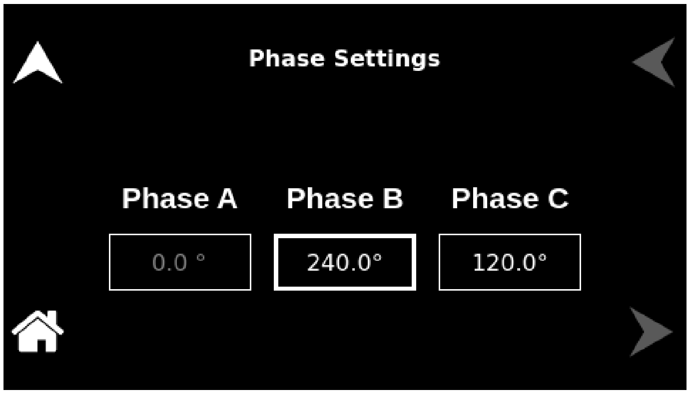


Figure 5-92: Phase Settings

REGENERATIVE CURRENT Programs the Regenerative current value, (Amperes).

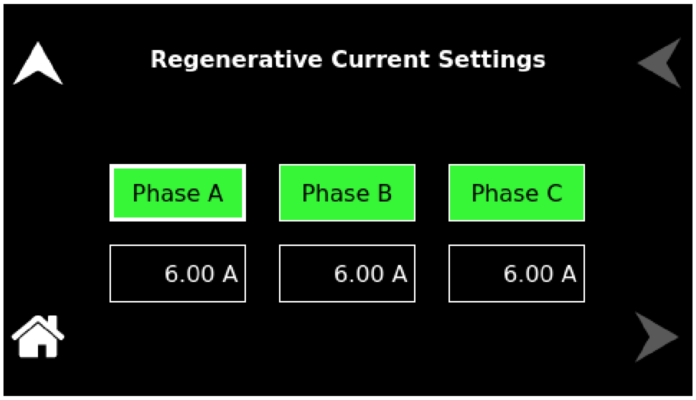


Figure 5-93: Regenerative Current Settings

Clear Fault Programs the unit to clear all the faults. This button will be enabled only when fault bit is high and disabled when fault bit is low.

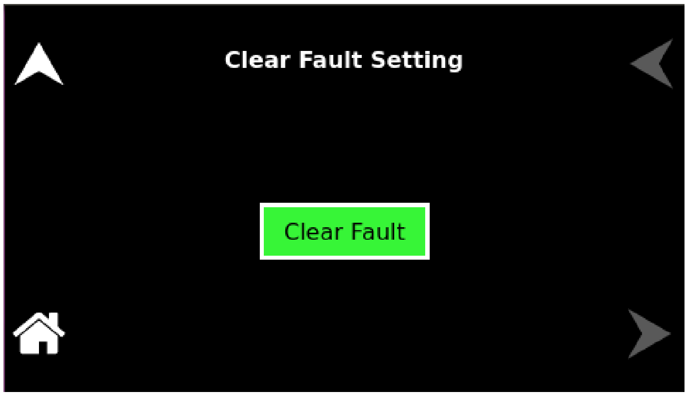


Figure 5-94: Clear Fault Settings

5.8.6 Transients Screen

Refer to Section 5.7.6.

5.8.7 Configuration Screen

The CONFIGURATION screen provides a setup of the output mode of operation, power-on states, operation profiles, parameter limits, and selection of clock mode.

The top-level menu of the CONFIGURATION screen is shown in Figure 5-95. It can be reached in one of two ways:

1. Tapping CONFIGURATION on the HOME Screen of the front panel touchscreen.
2. Scrolling to CONFIGURATION with the encoder and depressing the encoder switch.

The Up-arrow button returns to the previously selected screen menu (e.g., the HOME Screen). The HOME button takes you to the HOME screen, which is the top-level menu for the displayed sub-menu. For the CONFIGURATION screen, the HOME screen is the top-level menu.

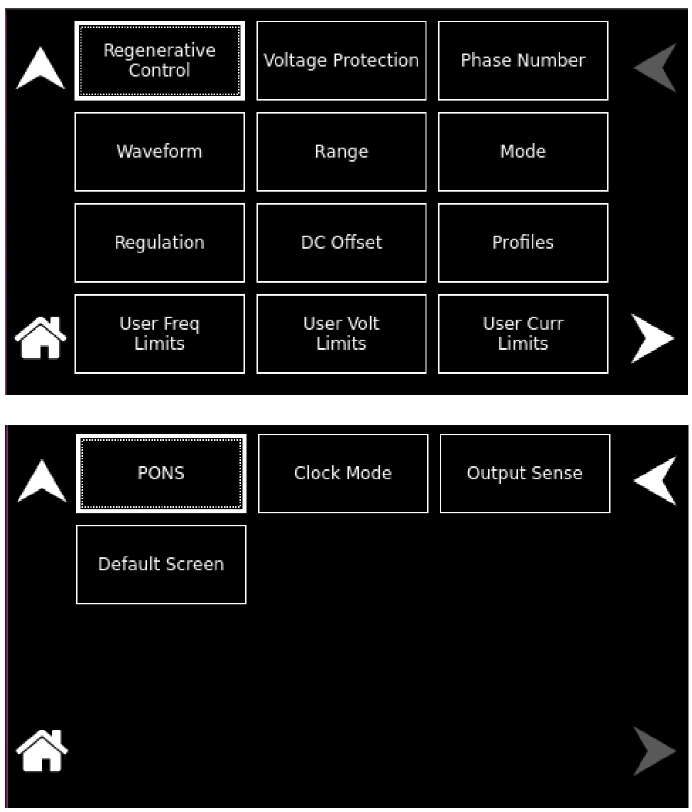


Figure 5-95: CONFIGURATION Screen Top-Level Menu

The following sub-menus are available in the CONFIGURATION menu:

Entry	Description
REGENERATIVE CONTROL	
UNDER VOLT	Sets the UUT shut-off voltage, Active only if the dFREQ listed below is set to zero. This is the voltage (AC or DC) at which the UUT will shut off. If set to a value that will allow the UUT to continue operating, the SEQUOIA may be unable to limit the current being fed back by the UUT.
OVER VOLT	Sets the UUT over voltage limit. This is the maximum allowable voltage (AC or DC) at which the UUT can operate. The output voltage may be increased up to this level if the current limit is exceeded to keep the current below the set current limit value. This over-voltage threshold also triggers the power source to either change the programming frequency or reduce the output voltage depending on the delta frequency setting (0.0Hz to reduce the output voltage and any delta frequency to change the programming frequency) after the DELAY F delay is reached.
dFREQ	This setting determines the size of the frequency shift that will be applied to the UUT after the current limit has been exceeded. If set to 0.0 Hz, no frequency shift will be applied, irreverent in DC mode.
DELAY	This delay setting field is used to set the delay time for both the Frequency shift event (Delay F) and the Output relay open event (Delay R).

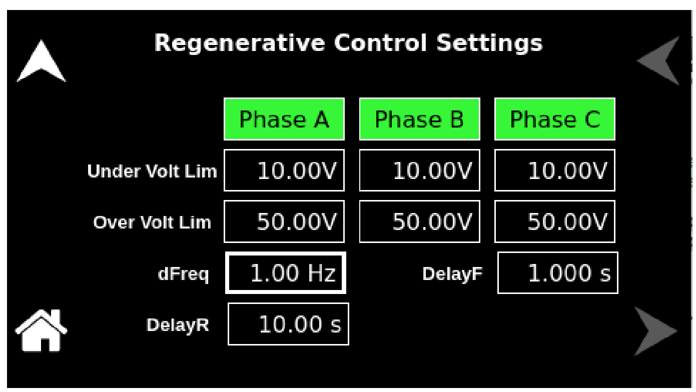


Figure 5-96: Regenerative Control Settings

VOLTAGE PROTECTION	Programs the Voltage Protection threshold for the output voltage of each output phase. Exceeding the OVP threshold will result in the shutdown of the output, with the output isolation relay opened and the output voltage programmed to zero. The maximum OVP setpoint is 115% FS low-range/high- range output voltage: AC- mode and (AC+DC)-mode, 191V/383V; DC-mode, 253 V/506 V. The default value is 115% FS.

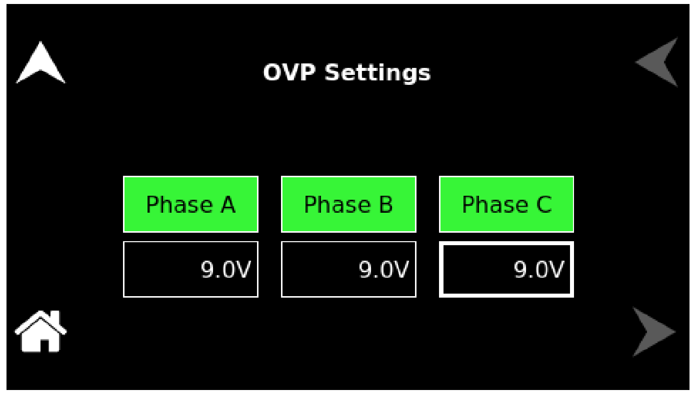


Figure 5-97: OVP Settings

PHASE NUMBER

Programs the output phase configuration:
One-Phase or Three-Phase. The default is Three-Phase.

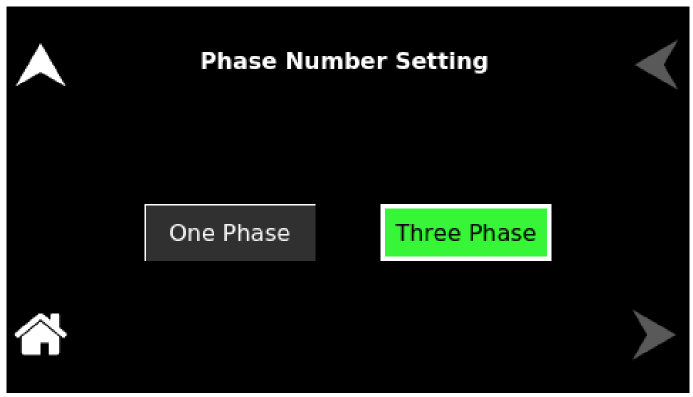


Figure 5-98: Phase Number Settings

WAVEFORM

Selects the waveform for the output voltage: either standard waveforms for sine wave, square wave, clipped-sine wave, or user-defined waveforms; The default is a sine wave.

The standard waveforms are always available, and do not consume any of the user-defined waveform memory registers; they are always displayed in the waveform list. The clipped-sine waveform has a waveform where the peak amplitude of the positive and negative alternation is clipped (flattened appearance). The level of clipping is dependent on the amount of harmonic distortion present in the output waveform. An additional programmable parameter, CLIP % THD, is available for setting the percentage of total harmonic distortion (THD); the range is 0- 43%.

The user-defined waveforms are selected from up to fifty waveforms in one of four groups (group 0-3, totaling 200 waveforms) that are active. The waveform group that is active at the power-on of the unit is selected with the SCPI command, `PONSetup:WGRoup <n>`, through the digital interface. For information on generating user-defined waveforms and their selection, refer to the Sequoia Series Programming Manual P/N M447353-01 or the Sequoia Virtual Panels GUI; refer to AMETEK PPD website, www.programmablepower.com, to download the latest version.

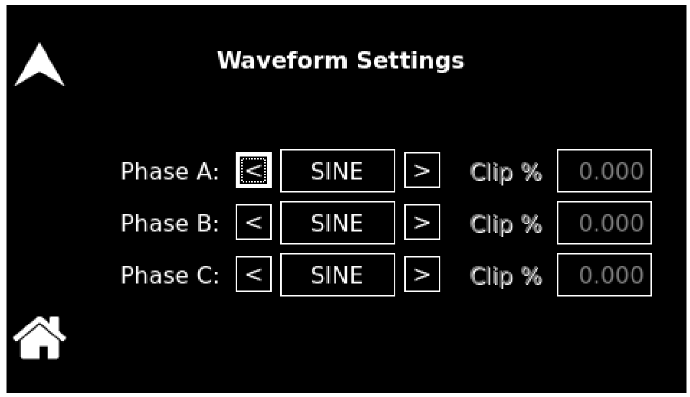


Figure 5-99: Waveform Settings

RANGE

Selects the 166 VAC or 333 VAC range for AC-mode and (AC+DC) - mode, and 220 VDC or 440 VDC range for DC-mode operation. The output must be turned off for a change in range to be executed. The default is low-range, 166 VAC.

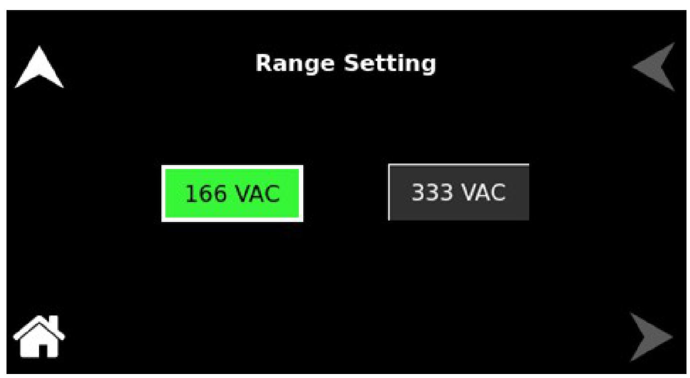


Figure 5-100: Range Settings

MODE SETTING

Selects the mode of operation of output voltage: either AC only, DC only, or AC with a DC offset, AC+DC. This selection also determines the available output voltage ranges: 166/333 Vrms in AC and AC+DC modes, and 220/440 VDC in DC mode. The output must be turned off to change this setting. The default is AC.

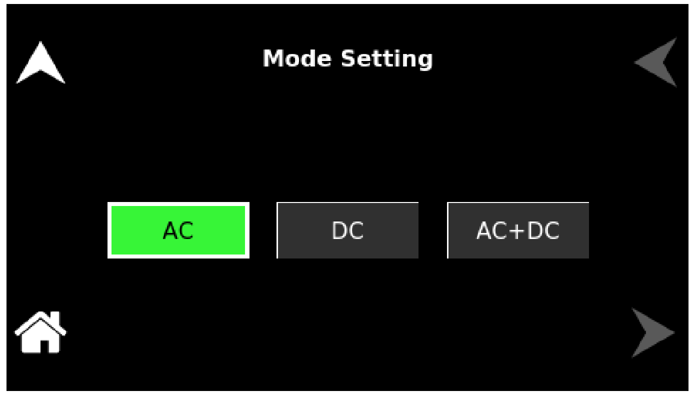


Figure 5-101: Mode Settings

REGULATION

Selects options for regulation of the output voltage: whether ALC is enabled, and what control action will be performed when the load current reaches the current setpoint. The defaults are CV/CL, with a Delay of 0.2 seconds, and ALC on.

Constant-Voltage/Constant-Current (CV/CC): CV/CC mode will regulate the output voltage to the set value until the load current reaches the current setpoint; after the Delay interval, if the current exceeds the setpoint, the output current will be controlled to equal the setpoint. Regulation of the load current is accomplished by reducing the output voltage as needed to satisfy the load. As such, the voltage will be reduced from the set value down to zero, depending on the load requirement. This mode is useful for starting up motor or capacitor loads that may require a high inrush current.

In the constant-voltage mode of operation, the waveform and instantaneous amplitude of the output voltage is regulated to equal the programmed values; if Volt ALC is enabled, the RMS value is also precisely regulated. In the constant-current mode of operation, the RMS value of the output current is regulated to equal the programmed value. However, this is accomplished by controlling the voltage amplitude and waveform, and not directly the current; therefore, the current instantaneous amplitude and waveform and dependent on load characteristics.

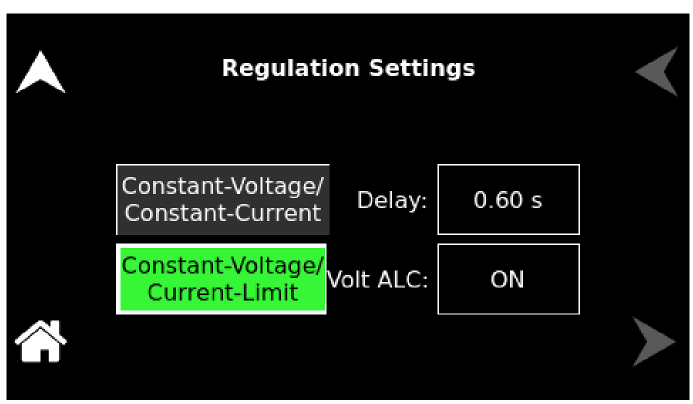


Figure 5-102: Regulation Settings

Constant-Voltage/Current-Limit (CV/CL): CV/CL mode will regulate the output voltage to the set value until the load current reaches the current setpoint; after the Delay interval, if the current equals or exceeds the setpoint, a fault condition will be generated, and the output voltage will be programmed to zero and the isolation relay opened. This effectively turns off the AC source output in case of an overload condition, after the user- programmable trip time-delay.

Delay: Sets the time duration that the output current can equal or exceed the current setpoint before control action is taken. After the delay, if CV/CC mode is selected, the output current will be regulated to its setpoint; if CV/CL mode is selected, an overcurrent fault condition will be generated, and the output will be turned off. The Delay is programmable from 0.1-5 seconds.

Volt ALC: Volt ALC selects whether the automatic loop control, ALC, is enabled. ALC provides improved output regulation and accuracy by regulating the RMS value of the output voltage through the action of a digital regulator that measures the output voltage and controls it to equal the setpoint.

ON: ALC is enabled; regulation is accomplished through the RMS digital regulator; if the RMS digital regulator exceeds its control capability and is unable to maintain regulation, the output will be shut down and a fault condition will be generated with the output turned off and the voltage programmed to zero.

REG: ALC is enabled; regulation is accomplished through the RMS digital regulator; if the RMS digital regulator exceeds its control capability and unable to maintain regulation, the output will remain on, but the voltage will deviate from the setpoint, and a fault condition will not be generated.

OFF: ALC disabled; regulation is accomplished without the use of the RMS digital regulator, and shutdown that is dependent on loss of regulation will not occur.

DC OFFSET

Programs the DC offset value, V(DC), when in the (AC+DC) -mode; entries with positive and negative polarity are allowed. The AC component of the output voltage is set separately using the VOLTAGE selection field (above) or through the Dashboard screen; the default is zero. In AC-mode and DC mode, this function is not available, and the function is listed as “N/A.”

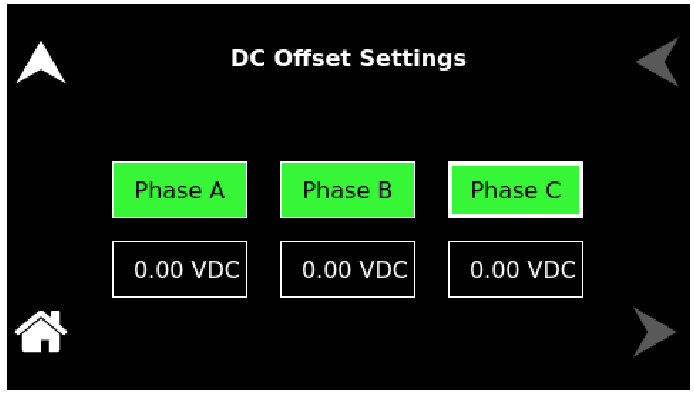


Figure 5-103: Offset Settings

PROFILES

Selects the operational state of the power source; the default is Profile-0. Up to 15 unique profiles, including transient lists, can be stored; refer to Figure 5-105. Subsequently, a profile can be loaded to automatically set the unit to that configuration. To save the present state, tap on the profile selection button. The profile must be given an alphanumeric identifier by using the Name function; refer to Figure 5-104. Tap the SAVE field to store the present configuration. Tap on the Load field to recall a configuration and set the power source to that state.

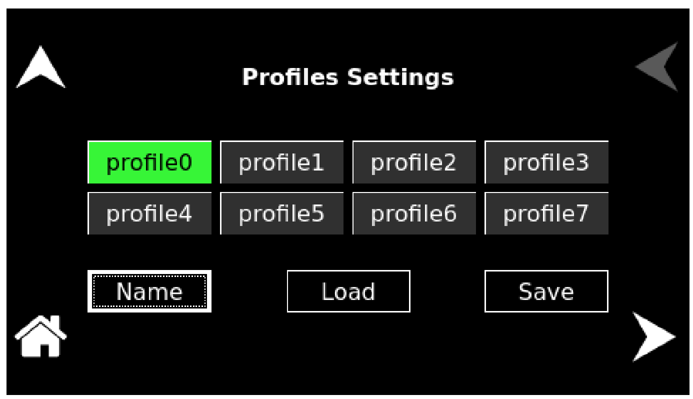


Figure 5-105: CONFIGURATION Menu, PROFILES Sub-Menu

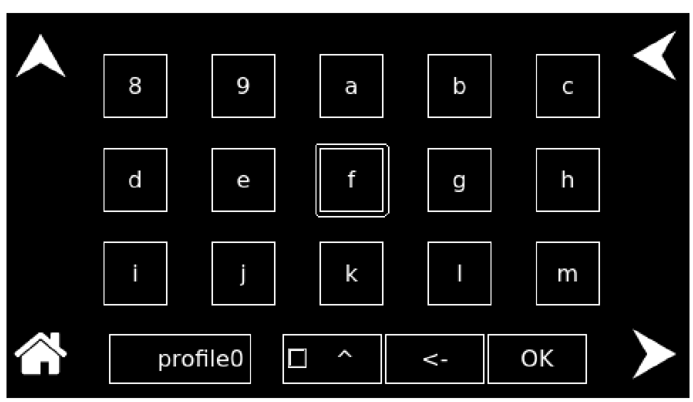


Figure 5-104: PROFILES Menu, NAME Sub-Menu

USER F-LIMITS

Sets soft limits for the minimum and maximum output frequency to which the unit can be programmed using the front panel or remote digital interface; the default is full-scale.

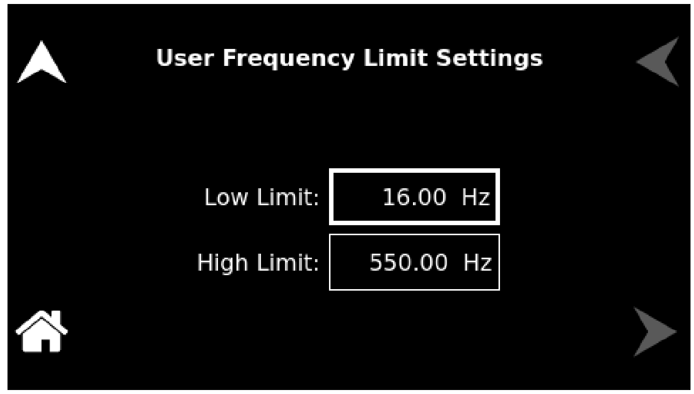


Figure 5-106: User Frequency Limit Settings

USER V-LIMITS

Sets soft limits for the minimum and maximum output voltage to which the unit can be programmed using the front panel or remote digital interface; the default is full-scale.

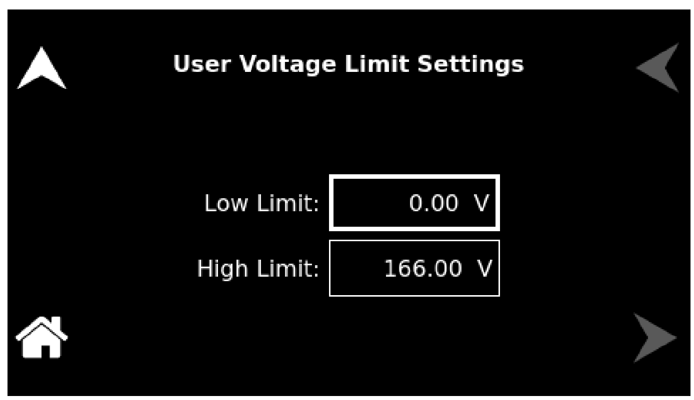


Figure 5-107: User Voltage Limit Settings

USER Curr LIMITS

Sets soft limits for the minimum and maximum output voltage to which the unit can be programmed using the front panel or remote digital interface; the default is full-scale.

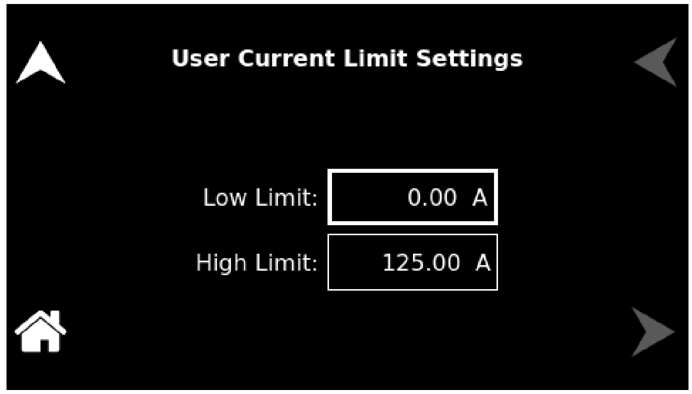


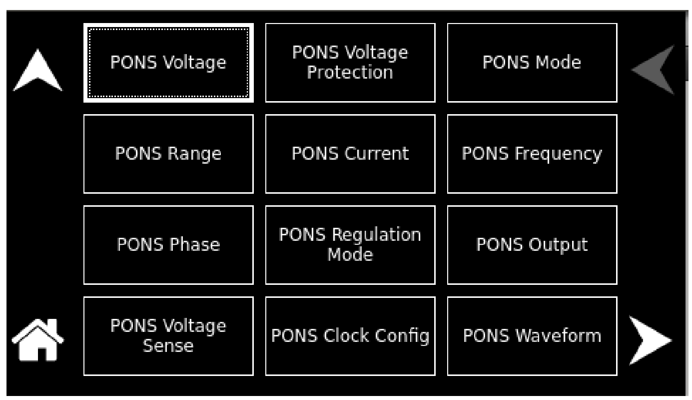
Figure 5-108: User Current Limit Settings

PONS

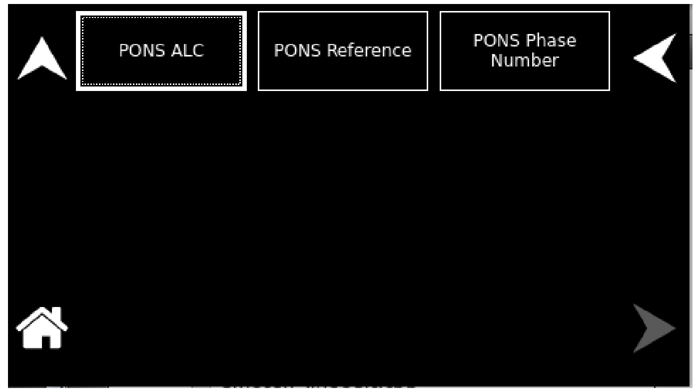
The PONS menus allow setting the conditions that would be present after power up; The AC input must be cycled OFF/ON for a change in a PONS setting to take effect. The functions and parameters have the same programmability as described in the menus of the OUTPUT PROGRAM screen.

CAUTION!

The PONS menus allow selecting that the output would be turned on and programmed to a high voltage when the unit is initially powered up. Ensure that suitable protection is provided to prevent accidentally energizing the load. The factory-default setting is with the output off and programmed to zero to provide the safest start-up condition.



PONS Menu-1



PONS Menu-2

Figure 5-109: CONFIGURATION Menu, PONS Menu-1/2

The PONS menu has the following fields:

Entry	Description
PONS VOLTAGE	**PONS menu:** Sets the value of the output voltage; the default is zero.

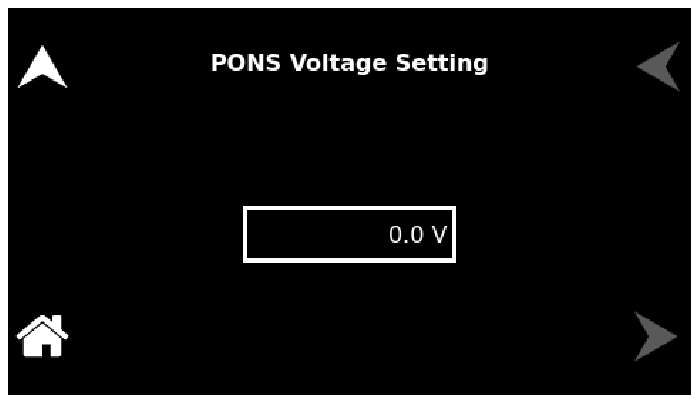


Figure 5-110: PONS Voltage Settings

PONS OVP	**PONS menu:** Programs the PONS Voltage Protection threshold for the output voltage of each output phase. Exceeding the OVP threshold will result in a shutdown of the output, with the output isolation relay opened and the output voltage programmed to zero. The maximum OVP setpoint is 115% FS low- range/high-range output voltage: AC- mode and (AC+DC)-mode, 191 V/383 V; DC- mode, 253 V/506 V. The default value is 115% FS.

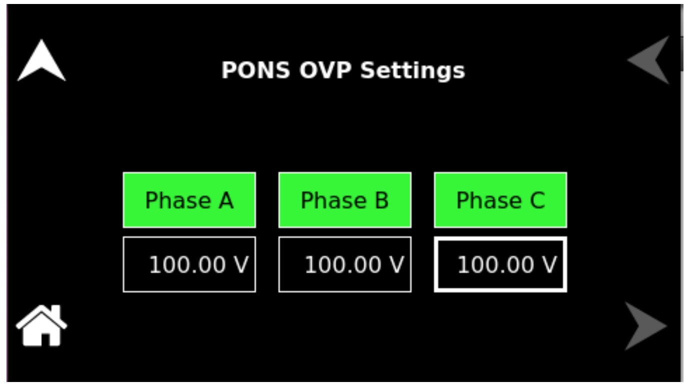


Figure 5-111: PONS OVP Settings

PONS MODE

PONS menu: Selects the mode of operation for the output voltage of the power source: either AC only, DC only, or AC with a DC offset, AC+DC; the default is AC.

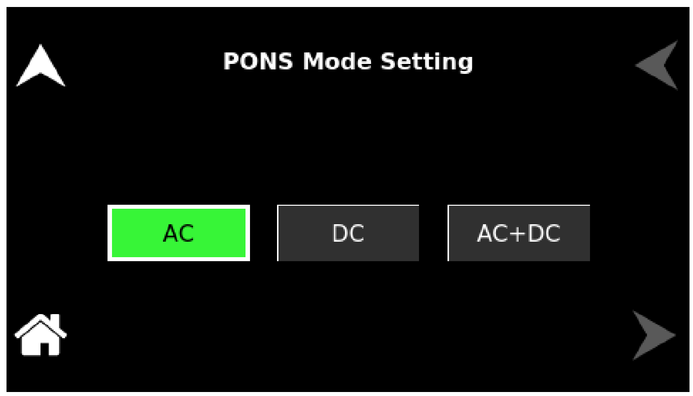


Figure 5-112: PONS Mode Settings

PONS RANGE

PONS menu: Selects the output voltage range, either low range,166 VAC or 220 VDC, or high range, 333 VAC or 440 VDC. The available ranges are dependent on the selection of the PONS mode, either AC, DC, or AC+DC; the default is low-range, 166 VAC.

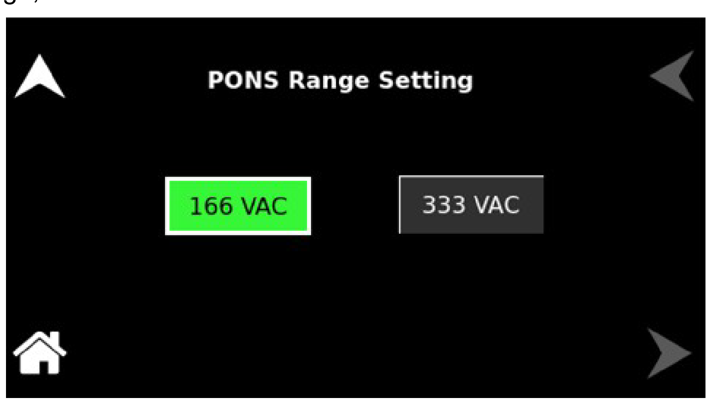


Figure 5-113: PONS Range Settings

PONS CURRENT

PONS menu: Sets the value of the output current; the default is full-scale for the model.

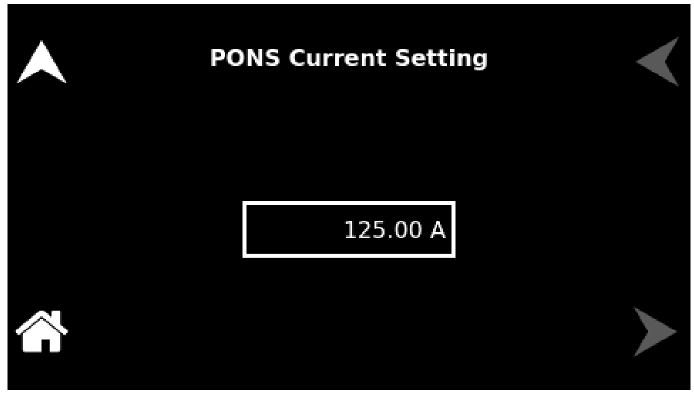


Figure 5-114: PONS Current Settings

PONS FREQUENCY

PONS menu: Sets the value of the output frequency; the default is 60 Hz.

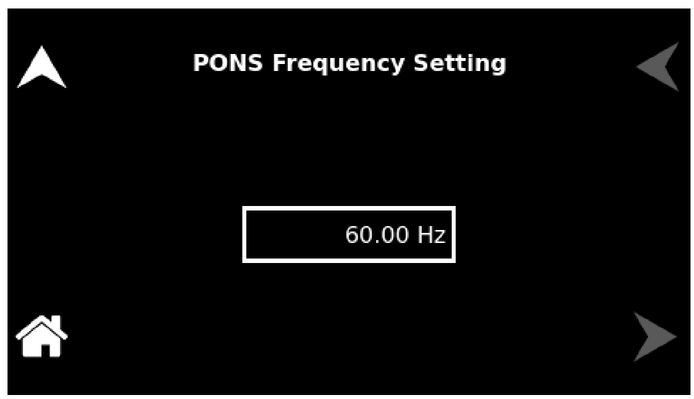


Figure 5-115: PONS Frequency Settings

PONS PHASE

PONS menu: Sets the phase of the output voltage in relation to the external synchronization signals, SYNC, or Clock/Lock; the default is zero.

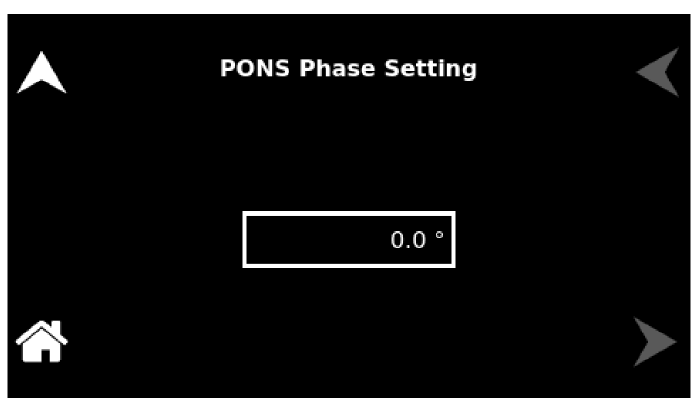


Figure 5-116: PONS Phase Settings

PONS REGULATION

Selects either Current-Limit mode (CL), where the output would be shut down when the current reaches the set value, or Constant-Current mode (CC), where the output current would be regulated when it reaches the set value; the default is Current- Limit

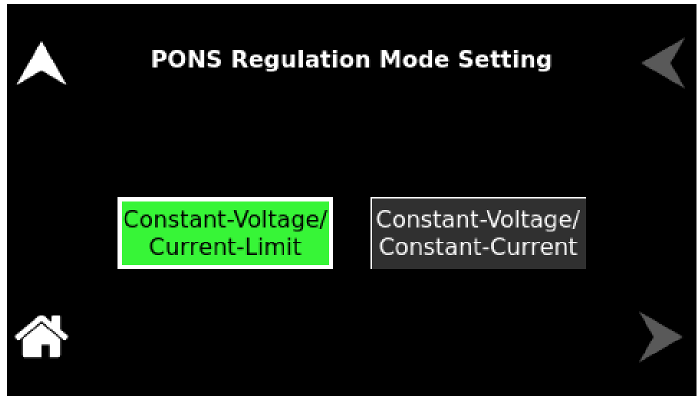


Figure 5-117: PONS Regulation menu

PONS OUTPUT

PONS menu: Selects whether the output is turned on or off when the unit is powered up. If output-on is selected, the output voltage will be programmed to the value sets in the PONS VOLTAGE sub- menu; the default is off.

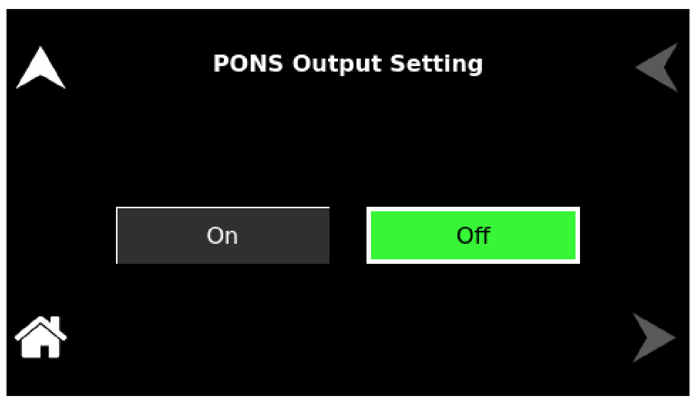


Figure 5-118: PONS Output Settings

PONS VOLTAGE SENSE

PONS menu: Selects the point for the sensing of the output voltage for regulation, either Internal (local, at the rear panel terminals) or External (remote, through the Remote Sense connection to the load); the default is External.

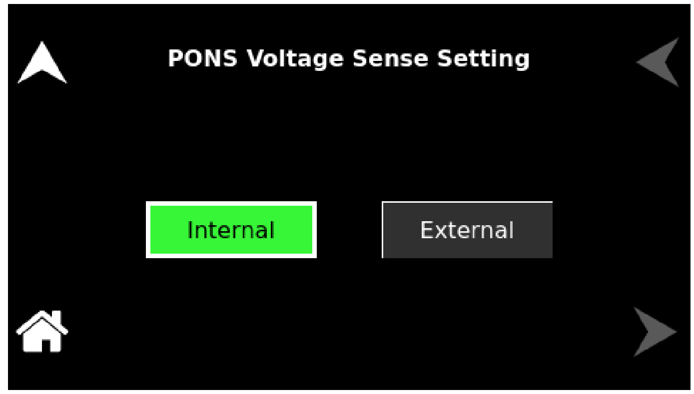


Figure 5-119: PONS Voltage Sense Settings

PONS CLOCK CONFIG

PONS menu: Configures the synchronization of the output frequency and phase, dependent on whether the unit is operating Standalone (also applicable to the Leader of a parallel group), as a Leader of a multi-phase group, or as an Auxiliary of a multi- phase group.

Standalone: Derives synchronization from either the user interface SYNC signal or the internal waveform generator (with full frequency resolution), as selected in the PONS CLOCK mode menu (either Internal or SYNC).

Leader: Derives synchronization from either the user interface SYNC signal or the internal waveform generator (with internal synchronization, the phase programming resolution is limited to 1 Hz), as selected in the PONS CLOCK mode menu (either SYNC or Internal); this setting is available only with the Clock/Lock option, LKM; for multi-phase operation, the Leader unit must have the setting at Leader.

Auxiliary: Derives synchronization from either the internal waveform generator or the external Clock/Lock interface (with external synchronization, the phase programming resolution is limited to 1 Hz), as selected in the PONS CLOCK mode menu (either Internal or External); this setting is available only with the Clock/Lock option, LKS; for multi-phase operation, the Auxiliary unit must have the setting at Auxiliary.

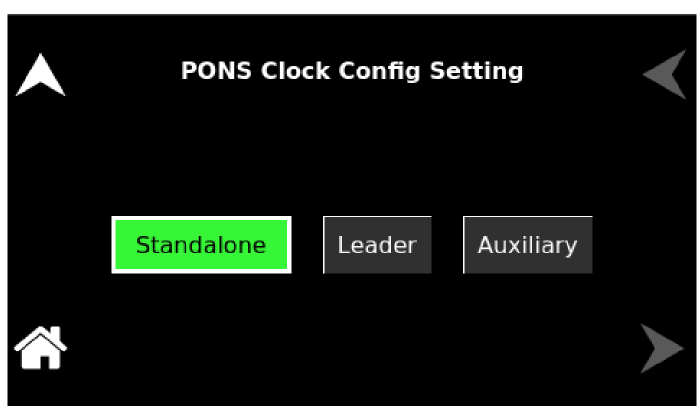


Figure 5-120: PONS Clock Config Settings

PONS WAVEFORM

PONS menu: Selects the type of output waveform, either the standard sine, square, or clipped-sine, or one that is user-defined; the default is a sine wave. The clipped-sine waveform has an additional programmable parameter, CLIP % THD. Refer to Section 6, Waveform Management for more information on the use of the menus.

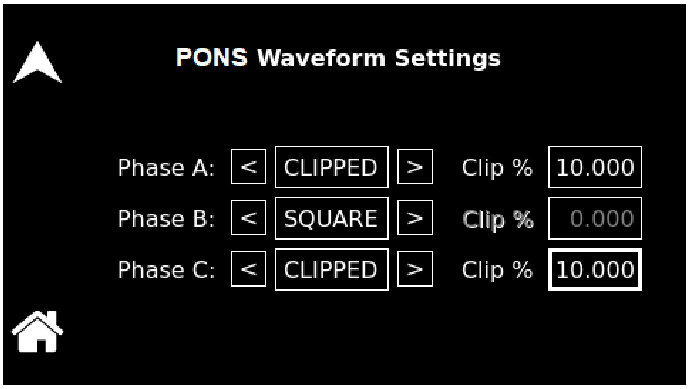


Figure 5-121: PONS Waveform Settings

PONS ALC

PONS menu: Selects how the output voltage will be regulated; default is ALC on.

ON: The RMS digital regulator is enabled, and shutdown will be executed if loss of regulation occurs.

OFF: Regulation of the output voltage does not utilize the RMS digital regulator, and shutdown that is dependent on regulation would not occur.

Regulate: The RMS digital regulator is enabled, but shutdown will not be executed if loss of regulation occurs.

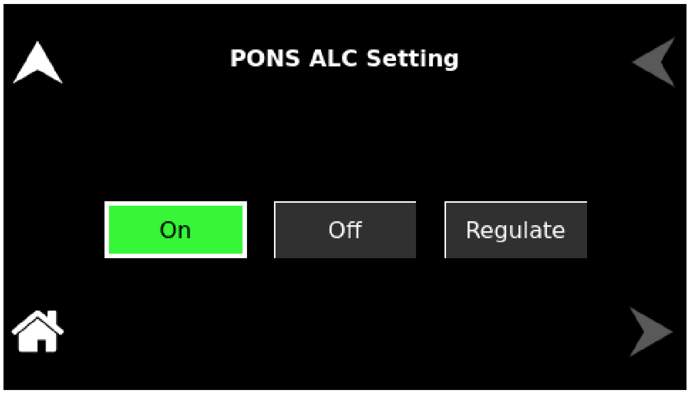


Figure 5-122: PONS ALC Settings

PONS REFERENCE

PONS menu: Selects either the internal waveform generator or the external analog inputs for programming the output waveform and amplitude; the default is Internal.

Internal: Enables the internal waveform generator using the standard waveforms or one of the user-defined waveforms.

External: Enables the external analog interface programming input that sets waveform and amplitude.

RPV: Enables the external analog interface programming input that sets the amplitude, while the internal waveform generator is used to set the waveform.

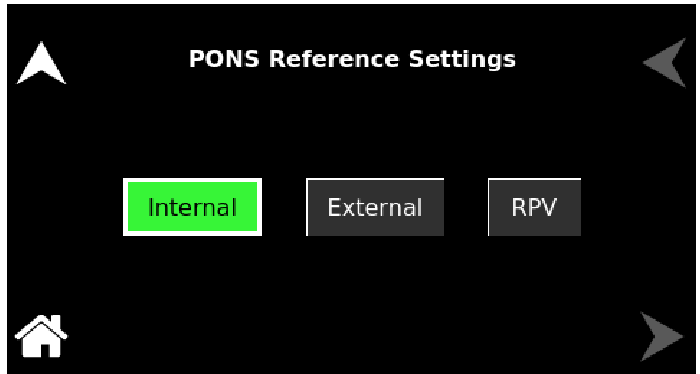


Figure 5-123: Reference Settings

PONS PHASE NUMBER

PONS menu: Selects the output configuration, either 1-Phase or 3 Phase, for 3-Phase models; the default is 3-Phase.

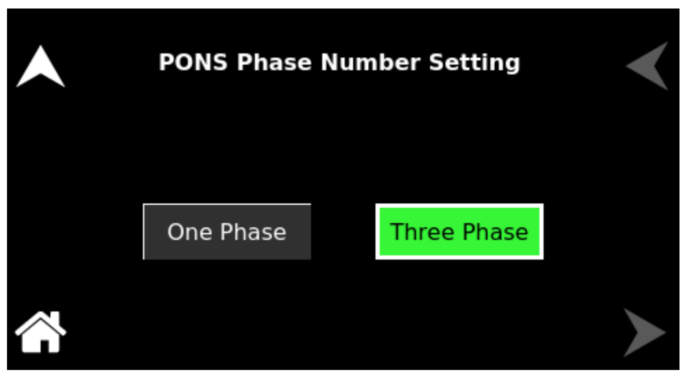


Figure 5-124: PONS Phase Number Settings

CLOCK MODE

Selects the source for the synchronization of the output frequency; default is Internal.

Internal: Derives synchronization from the internal waveform generator.

SYNC: Derives synchronization from the user interface SYNC signal; available only in a Standalone unit or Leader unit.

External: Derives synchronization from the external Clock/Lock interface; available only in the Auxiliary unit with the Clock/Lock option, LKS; for multi-phase operation, the Auxiliary unit must have the setting at External.

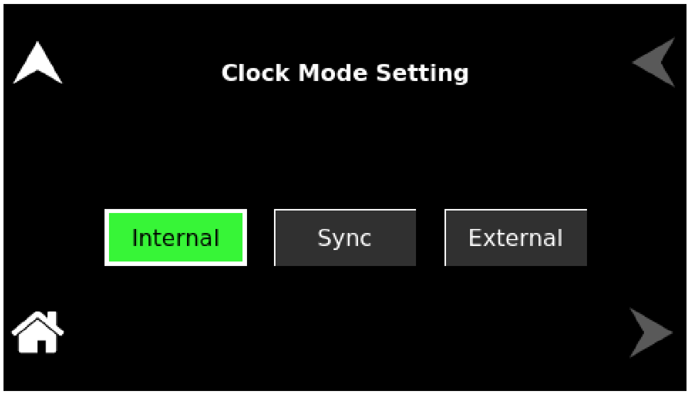


Figure 5-125: Clock Mode Settings

OUTPUT SENSE

Selects the point for the sensing of the output voltage for regulation; the default is external.

Internal: Local, at the rear panel terminals.

External: Remote, through the Remote Sense connection to the load.

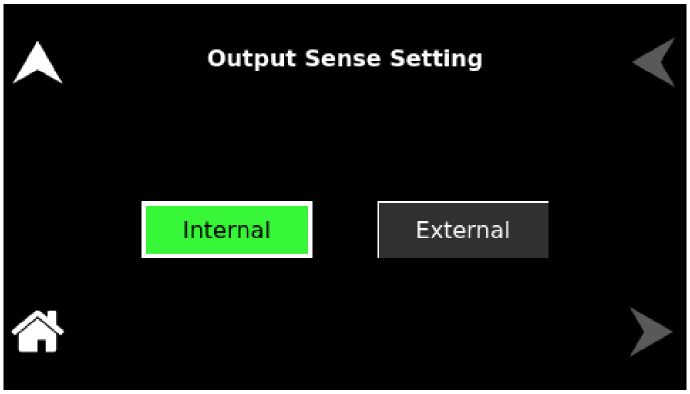


Figure 5-126: Output sense Settings

DEFAULT SCREEN

Selects whether the Default screen (showing only voltage and current amplitude) is enabled and configures its operational characteristics; the defaults are Default screen enabled, 10-second timeout.

Timeout Interval: Select the time, in seconds, for how long a screen must be inactive before the Default screen is displayed.

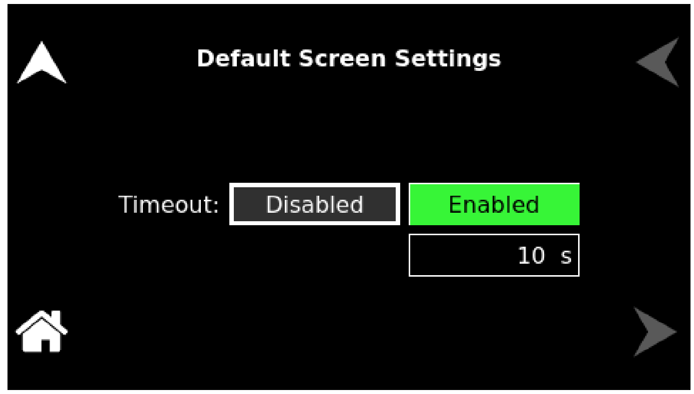


Figure 5-127: Default Screen Settings

5.9 HOME Screen Top-Level Menu - (Electronic load Current Programming Mode)

5.9.1 Banner Screen

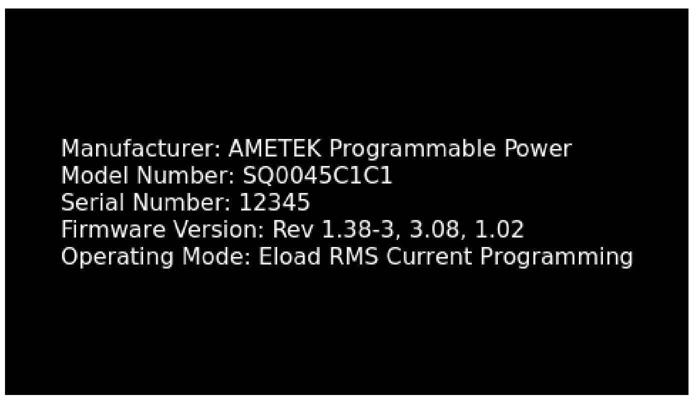


Figure 5-128: Banner Screen for Electronic load Current Programming Mode

5.9.2 HOME Screen

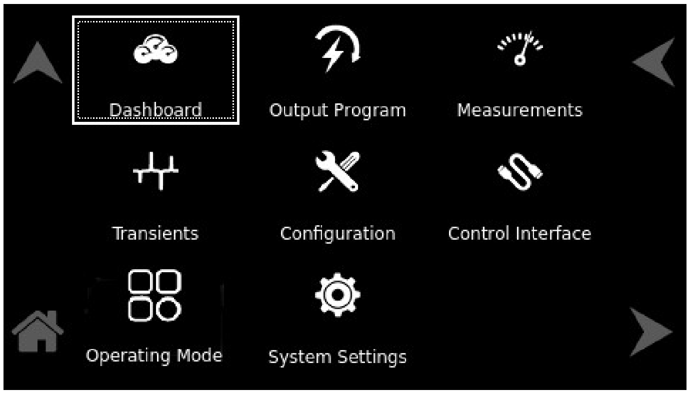


Figure 5-129: Screen for Electronic load -Current Programming Mode

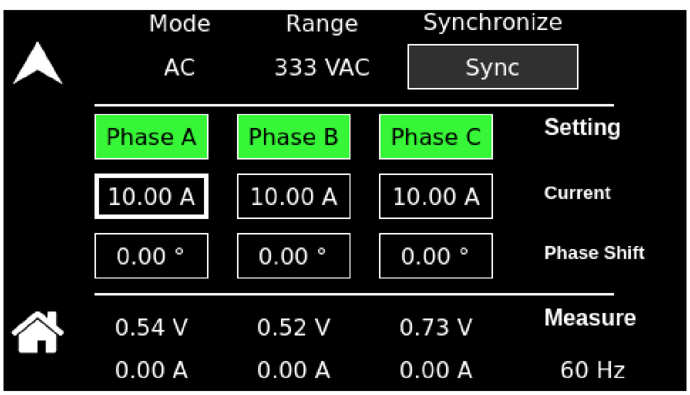
5.9.3 Dashboard Screen Top-Level Menu

The DASHBOARD screen top-level menu allows you to change output parameters and view output measurements simultaneously. The most used output parameters are available in the DASHBOARD menu. This screen is the default menu displayed upon powering on.

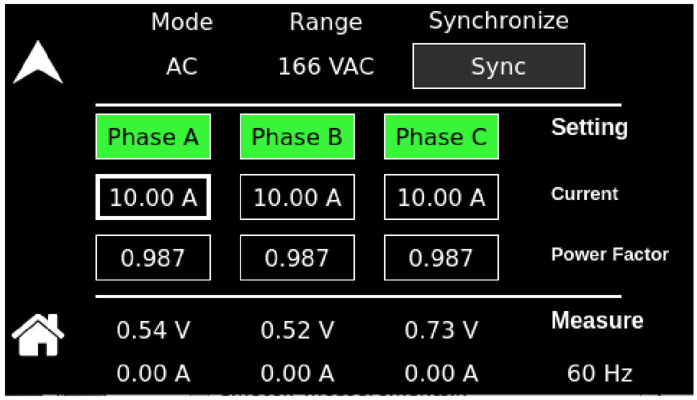
The top-level menu of the DASHBOARD screen is shown in Figure 5-130. It can be reached in one of two ways:

1. Tapping DASHBOARD on the HOME Screen of the front panel touchscreen.
2. Scrolling to DASHBOARD with the encoder and depressing the encoder switch.

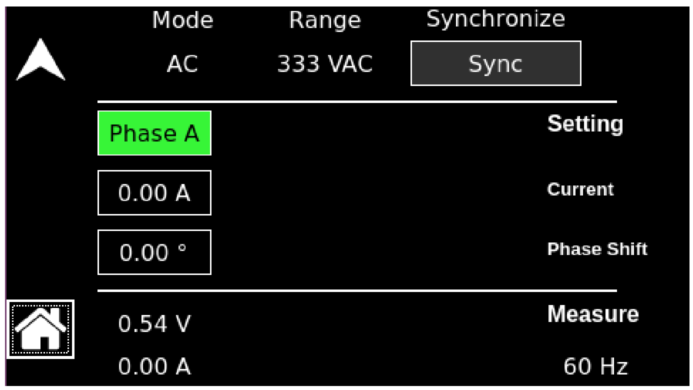
The Up-arrow button returns to the previously selected screen menu (e.g., HOME Screen-1). The HOME button takes you to the HOME screen, which is the top-level menu for the displayed sub-menu. For the DASHBOARD screen, the HOME screen is the top-level menu.



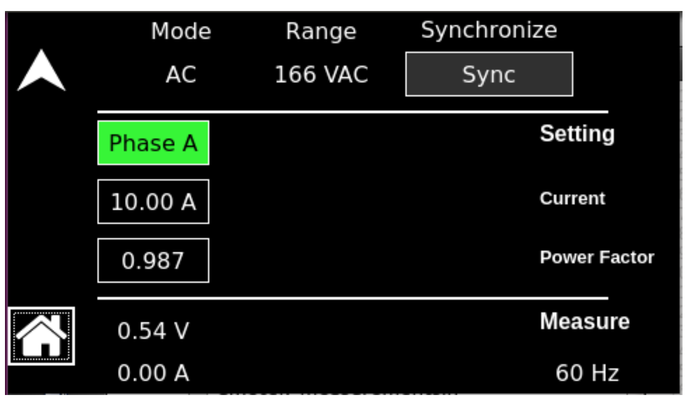
3-Phase Mode: Phase Shift Current Programming Type



3-Phase Mode: Power Factor Current Programming Type



1-Phase Mode: Phase Shift Current Programming Type



1-Phase Mode: Power Factor Current Programming Type

Figure 5-130: DASHBOARD Screen Top-Level Menu

The following selections are available in the DASHBOARD screen top-level menu. Functions that accept a numeric value require that the value be within the allowed range, otherwise, an error will be generated, and the value will not be accepted.

When the unit is configured for 3-Phase output, each phase has individual settings. When the unit is configured for 1-Phase output, only Phase-A is displayed. Tapping on a phase button toggles the selection of that phase for inputting values. When a phase is selected, its button is displayed with a green color. When a phase is not selected, its button is displayed with a gray color. When all phases are selected, entry for one phase will make the same changes for the other phases.

Entry	Description Setting
CURRENT	Programs the output current required as a load for the UUT.
PHASE SHIFT	Programs the Phase shift required as a load for the UUT.
POWER FACTOR	Programs the Power factor value required as a load for the UUT.
RANGE	Displays 166 VAC or 333 VAC range for AC-mode, and 220 VDC or 440 VDC range for DC-mode operation. The OUTPUT state must be OFF for a change in range to be executed.
MODE	Displays the source mode of operation.
SYNCHRONIZE	Starts the Synchronization between Sequoia and UUT and once the Synchronization is successful it will display “SYNCED.”
Measure	
VOLTAGE	Displays the true RMS value of the output voltage measured at the voltage sense lines. In DC-mode only, the voltage is the DC voltage including polarity.
CURRENT	Displays the true RMS value of the output current. In DC mode only, the current is the DC current including polarity.
FREQUENCY	When in AC mode, the output frequency is measured at the sense lines. When in DC mode, this value always reads “DC.”

5.9.4 Real-Time Parameter Adjustment

The DASHBOARD screen menu provides the capability for output parameter entry that has a real-time, immediate effect on the output. This allows manual adjustment of the output parameters where the tuning of a value is desired. Enabling this function requires tapping on a parameter selection-field box with the encoder switch to select the parameter and display its selection-field highlighted and with a value entry window. The rotary encoder can then be used to continuously adjust the parameter value, up and down, as it is rotated. The value change has an immediate effect on the output.

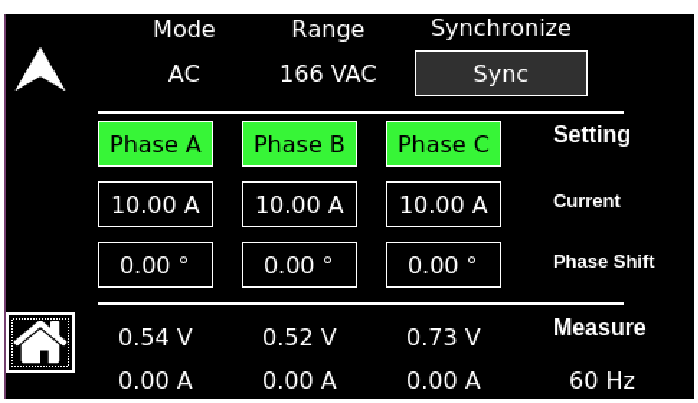


Figure 5-131: Real-Time, Immediate Output Parameter Adjustment

5.9.5 Output Program Screen

The OUTPUT PROGRAM screen provides the setting of output-related items such as individual output parameters, mode of regulation and current limit, output waveform selection, and display of real-time output waveform or harmonics spectrum.

The top-level menus of the OUTPUT PROGRAM screen are shown in Figure 5-132. They can be reached in one of two ways:

1. Tapping the OUTPUT PROGRAM screen on the HOME Screen of the front panel touchscreen.
2. Scrolling to the OUTPUT PROGRAM screen with the encoder and depressing the encoder switch.

The Up-arrow button will return to the previously selected screen menu (in this case the HOME Screen). The HOME button will return to the HOME screen that has the top-level menu for the sub-menu being displayed; for the OUTPUT PROGRAM screen top-level menu, is the HOME Screen.

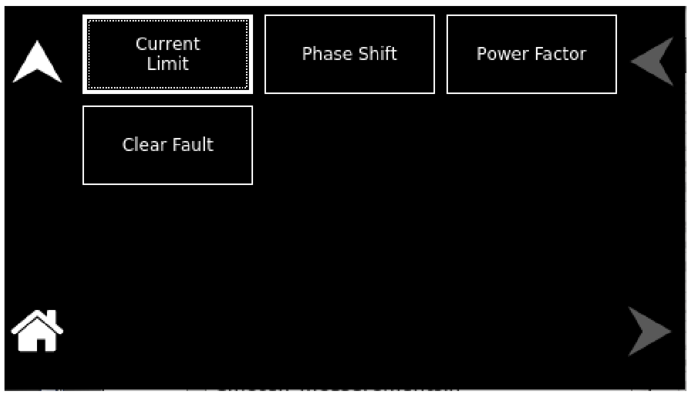


Figure 5-132: OUTPUT PROGRAM Screen Top-Level Menu

The following choices are available in the OUTPUT PROGRAM screen top-level menu. Functions that accept a numeric value require that the value be within the allowed range, otherwise, an error will be generated, and the value will not be accepted.

Entry	Description Settings
CURRENT LIMIT	Programs the current, required as a load for the UUT.

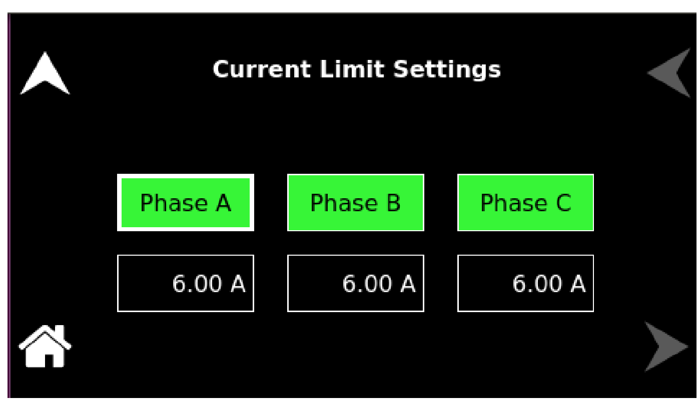


Figure 5-133: Current Limit Settings

PHASE SHIFT	Programs the phase shift values required as a load for the UUT.

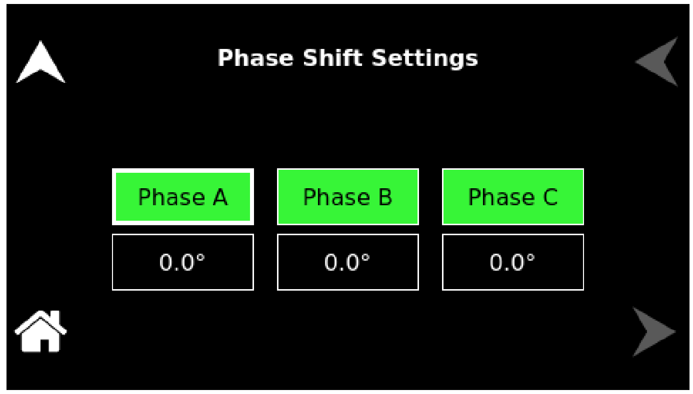


Figure 5-134: Phase Shift Settings

POWER FACTOR Programs the Power factor value required as a load for the UUT.

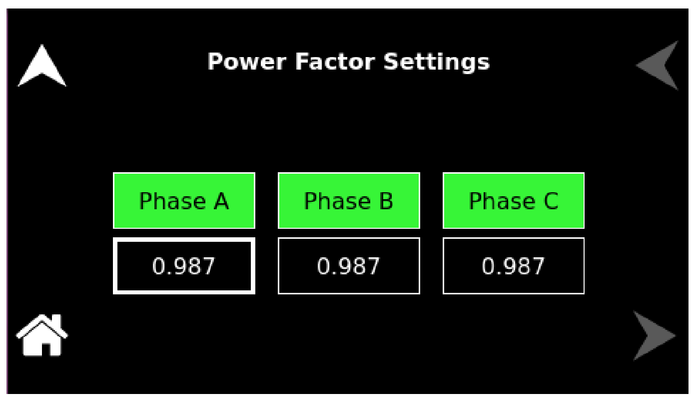


Figure 5-135: Power Factor Settings

Clear Fault Programs the unit to clear all the faults. This button will be enabled only when fault bit is high and disabled when fault bit is low.

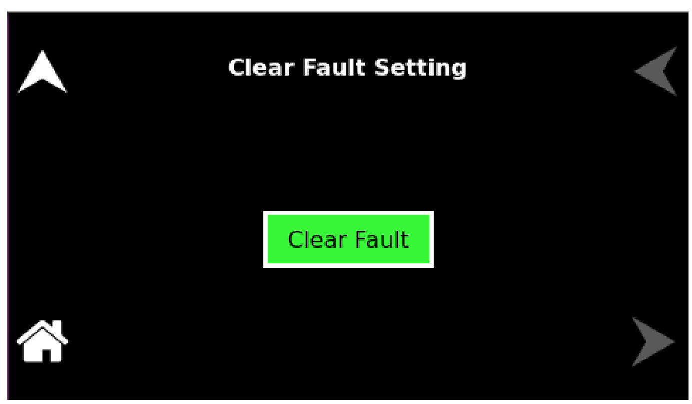


Figure 5-136: Clear Fault Settings

5.9.6 Current Transients Screen

5.9.6.1 LIST Menu

The LIST menu shows the transient list, with sequence numbers that are stored in the transient list buffer.

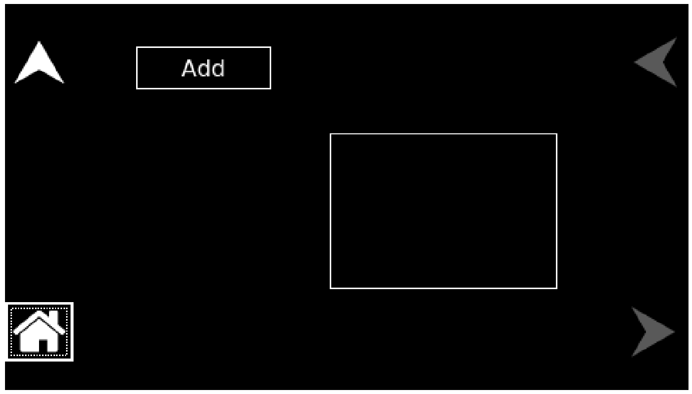


Figure 5-137: LIST Menu, With Empty Buffer

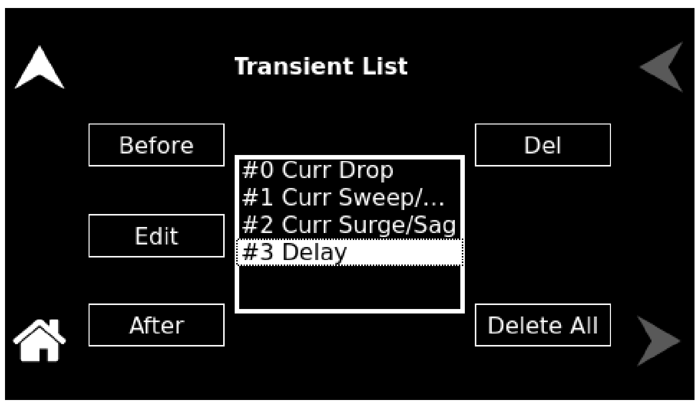


Figure 5-138: Menu, With Transient List Entry

The LIST menu has the following fields:

Entry	Description
Add	Allows generating of a new transient list.
Before	Inserts a step before the selected transient step.
Edit	Opens the selected step for editing parameters.
After	Inserts a step after the selected transient step.
Del	Permanently deletes the selected transient step.
Delete All	Clears the transient list buffer.

5.9.6.2 ADD Sub-Menu

The ADD sub-menu is opened when the ADD function is selected on the VIEW screen; it allows the selection of the type of transient to be added to the sequence.

Figure 5-139: LIST Menu, ADD Sub-Menu

The ADD sub-menu has the following fields:

Entry	Description
DROP	Causes the output current to go to zero volts for a specified period. As with the step transient, the current change is instantaneous. At the end of the drop, the current will return to the beginning of the step.

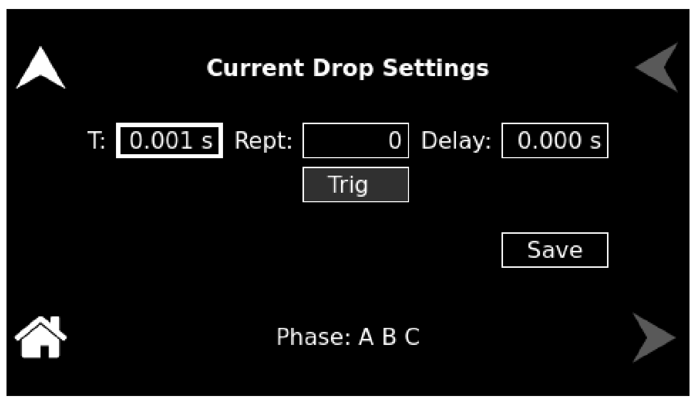


Figure 5-140: Current Drop Settings

CURRENT SWEEP/STEP	CURRENT SWEEP causes the output current to change from the present value to a specified end value at a specified rate of change, while a CURRENT STEP causes an instantaneous change in output current. The new value will be held for the specified time duration. The final output current value of a sweep and a step transient step should be different than the value at the start of the transient step, or no change in output current will occur.

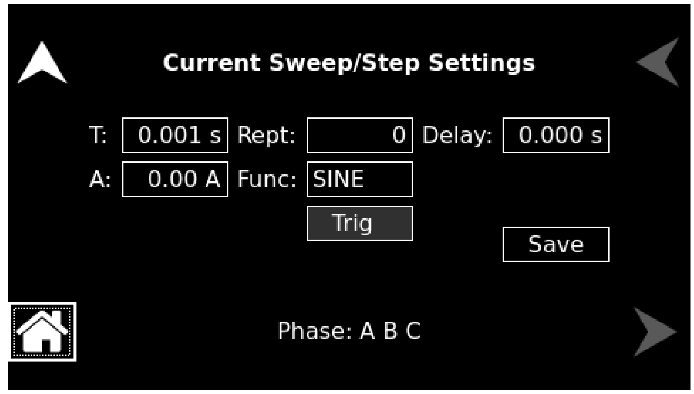


Figure 5-141: Current Sweep/Step Settings

CURRENT SURGE/SAG

CURRENT SURGE and SAG are temporary changes. The output current will change from its present value to a specified value for a specified duration. Surge is a change to a higher value, while sag is a change to a lower value. After the time duration has expired, the output current returns to a specified end value. This value can be the same or different from the value present prior to the start of the surge or sag.

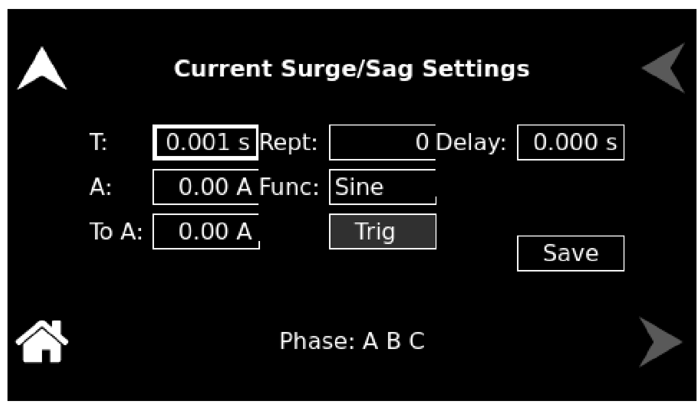


Figure 5-142: Current Surge/Sag Settings

DELAY

Sets the time duration, in seconds or cycles, that the current and frequency will stay at their existing levels before the next transient event is executed, or the transient list is complete.

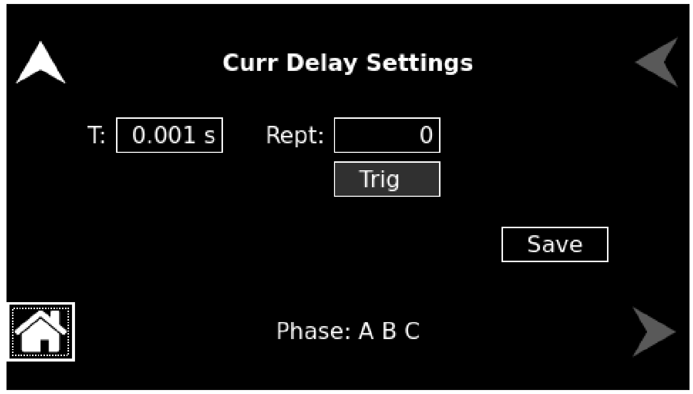


Figure 5-143: Current Delay Settings

5.9.6.3 CURRENT DROP Sub-Menu

The Current DROP menu allows you to program the output current to drop to zero at the maximum slew rate. After the specified drop time, the current returns to its previous level. Once the transient definition is complete, tap SAVE to store the settings in non-volatile memory and return to the ADD menu.

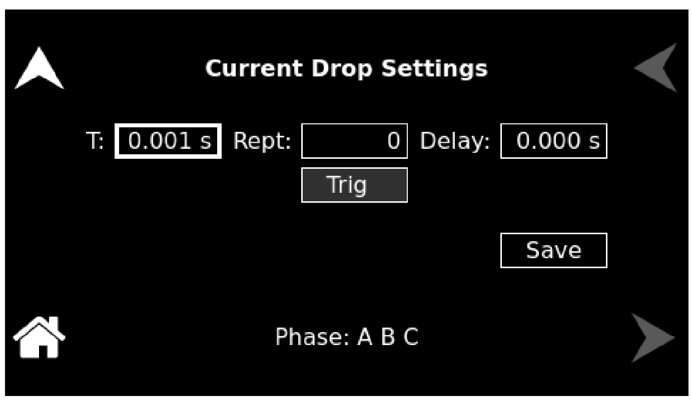


Figure 5-144: LIST Menu, CURRENT DROP Sub-Menu

The VOLTAGE DROP sub-menu has the following fields:

Entry	Description
T(ime)	Sets the time, in seconds or cycles, that the output voltage will dwell at zero.
Rep(ea)t	Sets the number of times the sweep/step transient event will be repeated before execution will proceed to the next event or exit the transient list. The number of times the transient event is generated is equal to the value, REPEAT+1. The value should be zero if only one execution of this event in the list is desired.
Trig(ger)	Causes a trigger pulse to be generated for the selected event when LIST is selected for Trig(ger) Out Source in the

	SETTINGS menu.
Delay	Sets the time duration, in seconds or cycles, that the voltage amplitude will stay at the previous level (before the drop to zero), before the next transient event is executed, or the transient list is completed.
Save	Completes the transient editing. All data fields should be entered before saving. The event number is automatically set based on the selection of either BEFORE or AFTER in the LIST menu and will be a value between 0 and 99. The event number determines the order of execution of the transient events in a multiple-event transient.
Phase	Displays the phases that had been selected in the Settings menu.

5.9.6.4 CURRENT SWEEP/STEP Sub-Menu

The CURRENT SWEEP/STEP menu allows you to change the current during a transient. A current sweep continuously changes over a specified period, while a current step changes at the maximum slew rate. Once the transient definition is complete, tap SAVE to store the settings in non-volatile memory and return to the ADD menu.

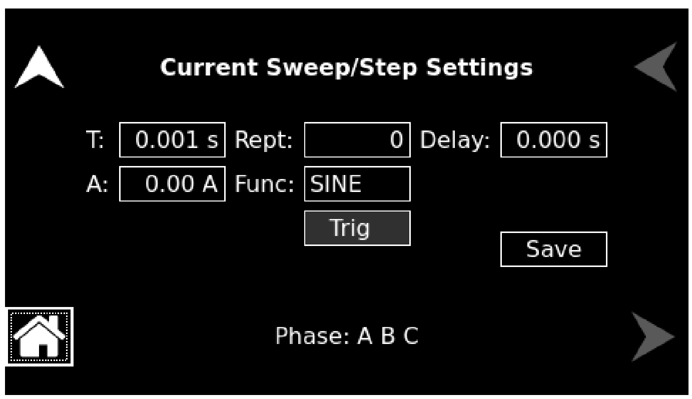


Figure 5-145: LIST Menu, CURRENT SWEEP/STEP Sub-Menu

The CURRENT SWEEP/STEP sub-menu has the following fields:

Entry	Description
T(ime)	Sets the time, in seconds or cycles, that it will take for the output current to reach the level set in the A(mpere) field (end Current). As such, the T(ime) value will define the slew rate of the output current for the event. A duration of 0.001 seconds will cause the output current to reach the end current at the maximum slew rate.
A(mpere)	Sets the Current, in Ampere, that will be reached after the sweep or step.
Rep(ea)t	Sets the number of times the sweep/step transient event will be repeated before execution will proceed to the next event or exit the transient list. The number of times the transient event is generated is equal to the value, REPEAT+1. The value should

be zero if only one execution of this event in the list is desired.

Func(tion) Selects the waveform to be used during this section of the transient sequence. Each section can use a different waveform from the available user-defined waveforms or the three standard waveforms. The output waveform changes upon entry into each section and remains in effect for the duration of the section. The default waveform is always the SINE (sine wave).

Trig(ger) Causes a trigger pulse to be generated for the selected event when LIST is selected for Trig(ger) Out Source in the SETTINGS menu.

Delay Sets the time duration, in seconds or cycles that the Current will stay at the level, A(mpere), before the next transient event is executed, or the transient list is completed.

Save Completes the transient editing. All data fields should be entered before saving. The event number is automatically set based on the selection of either BEFORE or AFTER in the LIST menu and will be a value between 0 and 99. The event number determines the order of execution of the transient events in a multiple-event transient.

Phase Displays the phases that had been selected in the Settings menu.

5.9.6.5 CURRENT SURGE/SAG Sub-Menu

The CURRENT SURGE/SAG menu allows you to temporarily change the current during a transient. The output current will change from its current value to a specified value for a set duration. After the duration ends, the output current will return to a specified end value. Once the transient definition is complete, tap SAVE to store the settings in non-volatile memory and return to the ADD menu.

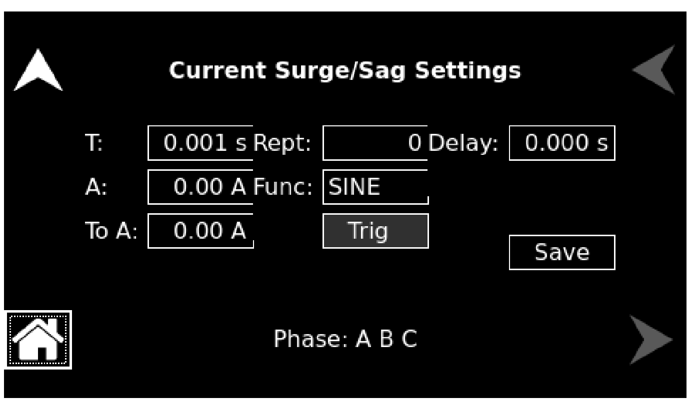


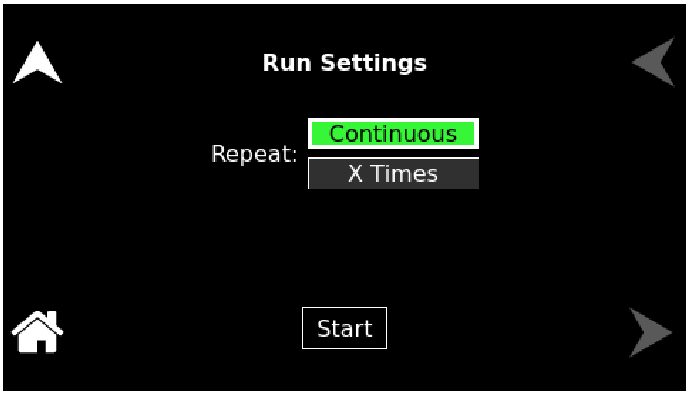
Figure 5-146: LIST Menu, CURRENT SURGE/SAG Sub-Menu

The CURRENT SURGE/SAG sub-menu has the following fields:

Entry	Description
T(ime)	Sets the time, in seconds or cycles, that the output current will dwell at the level set in the A(mpere) field.
A(mpere)	Sets the current, in Ampere, that will be reached during the surge or sag time duration.
To A(mpere)	Sets the output current level, in ampere, at the end of the transient surge/sag event and after a time specified by T(ime).
Rep(ea)t	Sets the number of times the surge/sag transient event will be repeated before execution will proceed to the next event or exit the transient list. The number of times the transient event is generated is equal to the value, REPEAT+1. The value should be zero if only one execution of this event in the list is desired.
Func(tion)	Selects the waveform to be used during this section of the transient sequence. Each segment can use a different waveform from the available library of user-defined waveforms or the three standard waveforms. The output waveform changes upon entry into each section and remains in effect for the duration of the section. The default waveform is always the SINE (sinewave).
Trig(ger)	Causes a trigger pulse to be generated for the selected event when LIST is selected for Trig(ger) Out Source in the SETTINGS menu.
Delay	Sets the time duration, in seconds or cycles, that the voltage amplitude will stay at the level, To V(olts), before the next transient event is executed, or the transient list is completed.
Save	Completes the transient editing. All data fields should be entered before saving. The event number is automatically set based on the selection of either BEFORE or AFTER in the LIST menu and will be a value between 0 and 99. The event number determines the order of execution of the transient events in a multiple-event transient.
Phase	Displays the phases that had been selected in the Settings menu.

5.9.6.6 RUN Menu

The RUN menu is used to control transient execution; It provides two selections, CONTINUOUS and X TIMES, and START/ABORT functions to begin and stop the execution of a list.



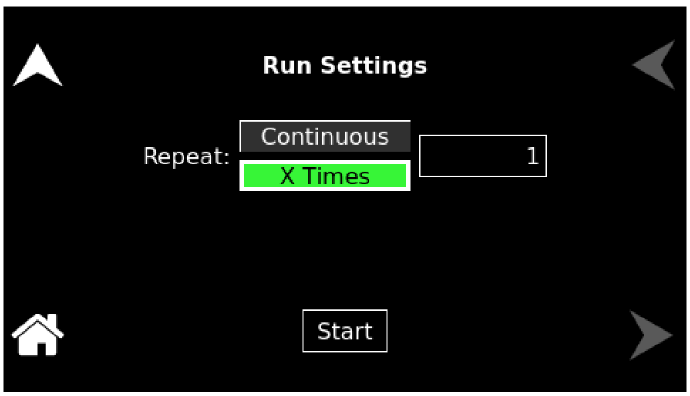


Figure 5-147: RUN Menu

The RUN menu has the following fields:

Entry	Description
Continuous	Causes the transient execution to continue indefinitely. The execution must be stopped manually.
X Times	Determines the number of times a transient list is repeated. The default value is zero, which means the programmed list runs only once. The range for this field is from 0 through 99999. This repeatable function should not be confused with the REPEAT function available for individual events. The event-specific repeat value will cause only that event to be repeated, not the complete list.
Start	Starts a transient execution. The output relay must be closed, or an error message will appear, and the transient will not start.
Abort	Once the START command has been set, the START selection-button will change to an ABORT button, which is used to stop the run and abort the transient list.

5.9.7 Configuration Screen

The CONFIGURATION screen provides a setup of the output mode of operation, power-on states, operation profiles, parameter limits, and selection of clock mode.

The top-level menu of the CONFIGURATION screen is shown in Figure 5-148. It can be reached in one of two ways:

1. Tapping CONFIGURATION on the HOME Screen of the front panel touchscreen.
2. Scrolling to CONFIGURATION with the encoder and depressing the encoder switch.

The Up-arrow button returns to the previously selected screen menu (e.g., the HOME Screen). The HOME button takes you to the HOME screen, which is the top-level menu for the displayed sub-menu. For the CONFIGURATION screen, the top-level menu is the HOME Screen.

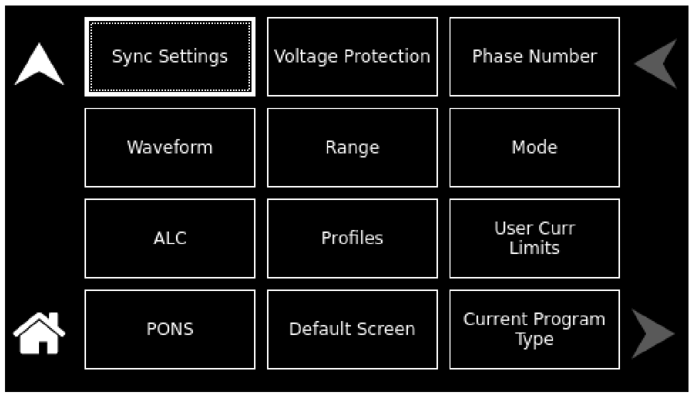


Figure 5-148: CONFIGURATION Screen Top-Level Menu

The following sub-menus are available in the CONFIGURATION menu:

Entry	Description
SYNC SETTINGS	Programs the Sync Voltage, Sync Phase of each output phase, and Sync Freq.0

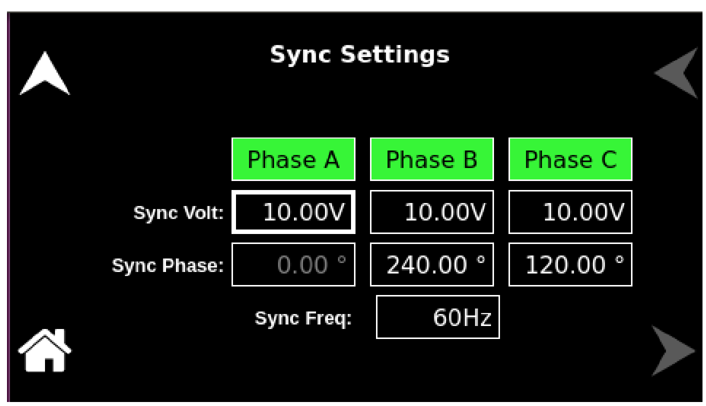


Figure 5-149: Sync Settings

VOLTAGE PROTECTION

Programs the Voltage Protection threshold for the output voltage of each output phase. Exceeding the OVP threshold will result in the shutdown of the output, with the output isolation relay opened and the output voltage programmed to zero. The maximum OVP setpoint is 115% FS low-range/high- range output voltage: AC-mode and (AC+DC)-mode, 191 V/383 V; DC- mode, 253 V/506 V. The default value is 115% FS.

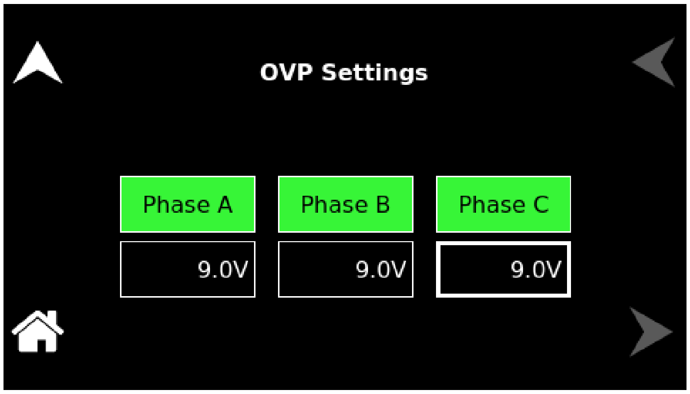


Figure 5-150: OVP Settings

PHASE NUMBER

Programs the output phase configuration:
One-Phase or Three-Phase; the default is Three-Phase.

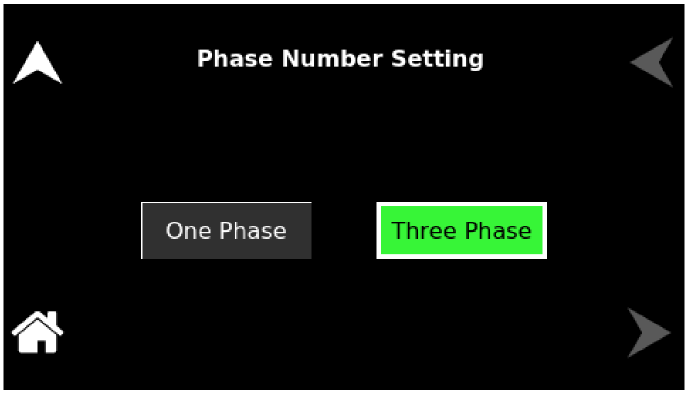


Figure 5-151: Phase Number Settings

WAVEFORM

Selects the waveform for the output voltage. Available settings are the three standard waveforms, SINE, SQUARE, and CLIP; or user-defined waveforms; the default is a sine wave.

The standard waveforms are always available, and do not consume any of the user-defined waveform memory registers; they are always displayed in the waveform list. The clipped-sine waveform has a waveform where the peak amplitude of the positive and negative alternation is clipped (flattened appearance). The level of clipping is dependent on the amount of harmonic distortion present in the output waveform. An additional programmable parameter, CLIP % THD, is available for setting the percentage of total harmonic distortion (THD); the range is 0- 43%.

The user-defined waveforms can be selected from up to fifty waveforms in one of four groups (groups 0 to 3, totaling 200 waveforms). The waveform group that is active at the power-on of the unit is selected with the SCPI command, `PONSetup:WGRoup <n>`, through the digital interface. For information on generating user-defined waveforms and their selection, refer to the Sequoia Series Programming Manual P/N M447353-01 or the Sequoia Virtual Panels GUI; refer to AMETEK PPD website, www.programmablepower.com, to download the latest version.

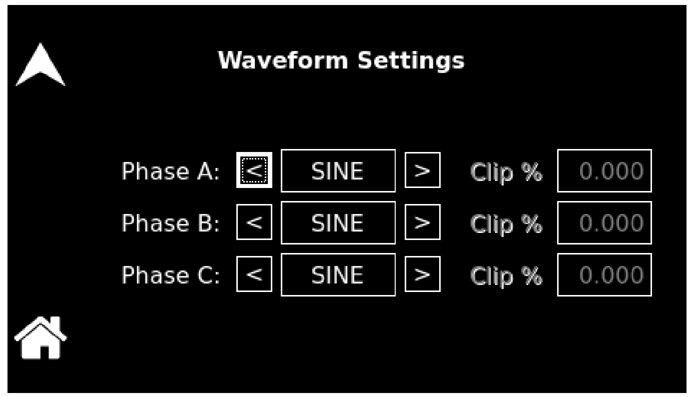


Figure 5-152: Waveform Settings

RANGE

Selects the 166 VAC or 333 VAC range for AC mode and 220 VDC or 440 VDC range for DC-mode operation. The output must be turned off to perform a range change. The default is low-range, 166 VAC.

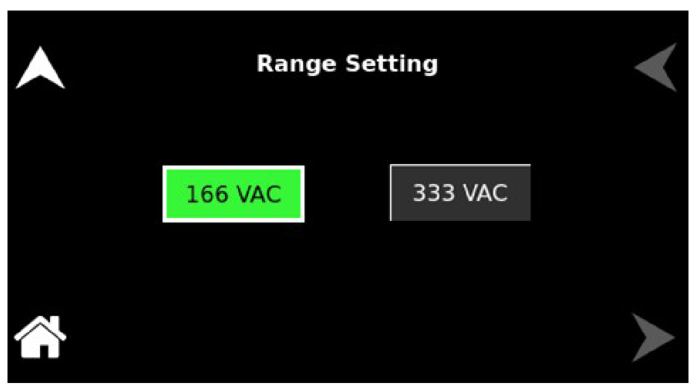


Figure 5-153: Range Settings

MODE

Selects the mode of operation of output, either AC or DC mode. This selection also determines the available output voltage ranges: 166/333 Vrms in AC mode, and 220/440 VDC in DC mode. The output must be turned off to change this setting. The default is AC.

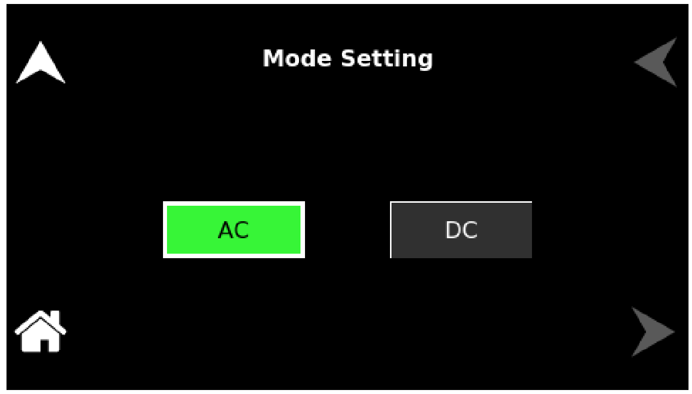


Figure 5-154: Mode Settings

ALC

Selects how the output voltage will be regulated; the default is ALC on:

ON: The RMS digital regulator is enabled, and shutdown will be executed if a loss of regulation occurs.

OFF: Regulation of the output voltage does not utilize the RMS digital regulator, and shutdown that is dependent on regulation would not occur.

Regulate: The RMS digital regulator is enabled, but shutdown will not be executed if loss of regulation occurs.

Figure 5-155: ALC Settings

PROFILES

Selects the operational state of the power source; the default is Profile-0. Up to 15 unique profiles, including transient lists, can be stored. Subsequently, a profile can be loaded to automatically set the unit to that configuration. To save the present state, tap on the profile selection button. The profile must be given an alphanumeric identifier by using the Name function; Tap the SAVE field to store the present configuration. Tap on the Load field to recall a configuration and set the power source to that state.

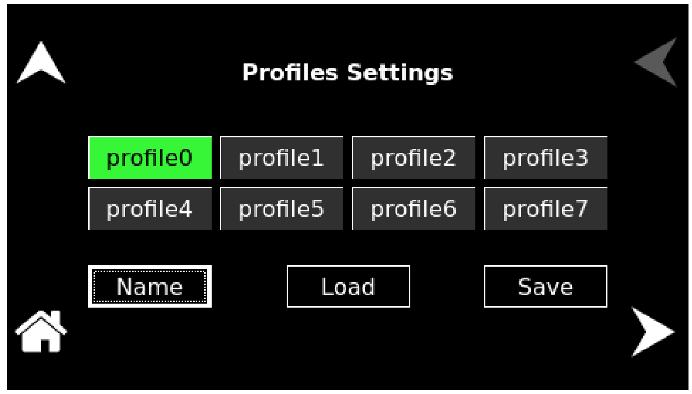


Figure 5-157: CONFIGURATION Menu, PROFILES Sub- Menu

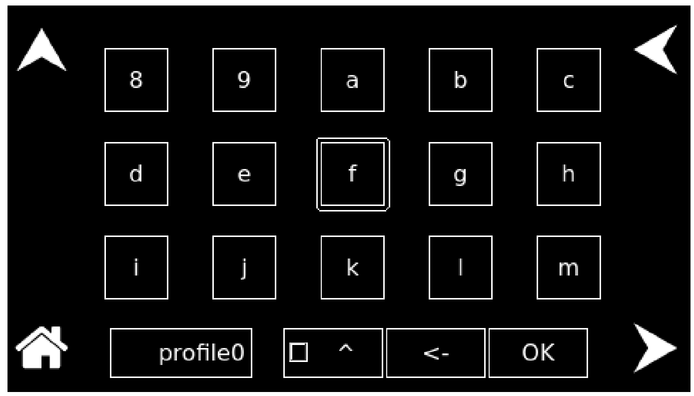


Figure 5-156: PROFILES Menu, NAME Sub-Menu

USER CURRENT LIMITS Sets soft limits for the minimum and maximum output voltage to which the unit can be programmed using the front panel or remote digital interface; the default is full-scale.

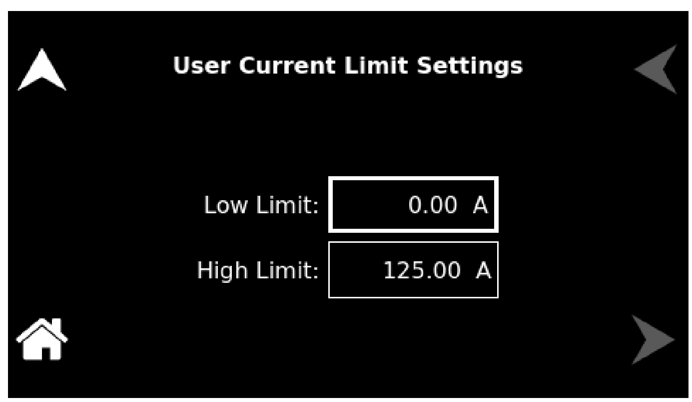


Figure 5-158: User Current Limit Settings

CURRENT PROGRAM TYPE

Selects the current program type, either Phase Shift or Power Factor.

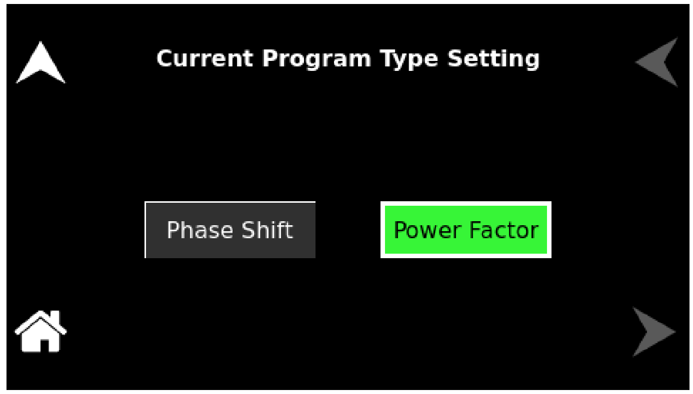


Figure 5-159: Current Program Settings

DEFAULT SCREEN

Selects whether the Default screen (showing only voltage and current amplitude) is enabled and configures its operational characteristics; the defaults are Default screen enabled, 10- second timeout.

Timeout Interval: Select the time, in seconds, for how long a screen must be inactive before the Default screen is displayed.

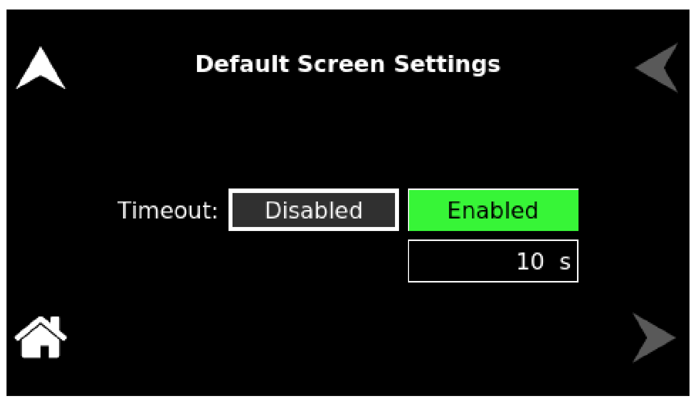


Figure 5-160: Default Screen Settings

PONS

The PONS menus allow setting the conditions that would be present after power-up. The AC input must be cycled off/on for a change in a PONS setting to take effect. The functions and parameters have the same programmability as described in the menus of the OUTPUT PROGRAM screen.

CAUTION!

The PONS menus allow selecting that the output would be turned on and programmed to a high voltage when the unit is initially powered up. Ensure that suitable protection is provided to prevent accidentally energizing the load. The factory-default setting is with the output off and programmed to zero to provide the safest start-up condition.

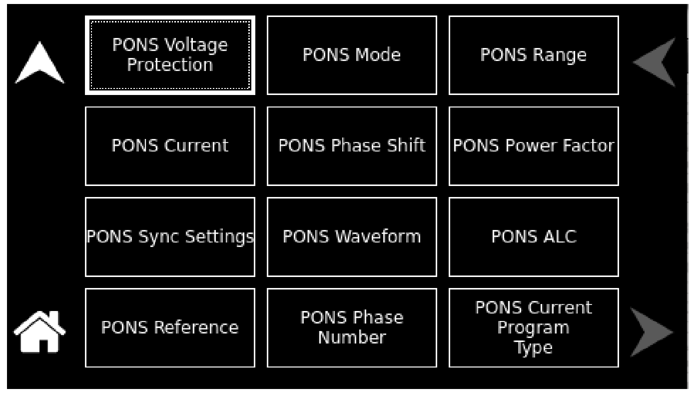


Figure 5-161: CONFIGURATION Menu, PONS Menu

The PONS menu has the following fields:

Entry	Description
PONS OVP	**PONS menu:** Programs the PONS Voltage Protection threshold for the output voltage of each output phase. Exceeding the OVP threshold will result in the shutdown of the output, with the output isolation relay opened and the output voltage programmed to zero. The maximum OVP setpoint is 115% FS low- range/high-range output voltage: AC- mode and (AC+DC)-mode, 191 V/383 V; DC- mode, 253 V/506 V. The default value is 115% FS.

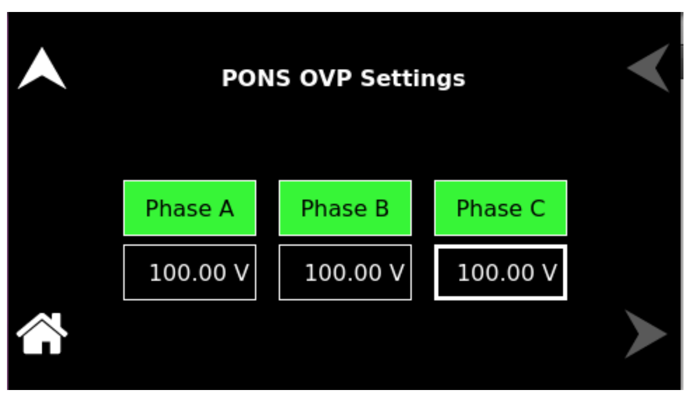


Figure 5-162: PONS OVP Settings

PONS MODE	**PONS menu:** Selects the mode of operation for the output voltage of the power source: either AC only, DC only, or AC with a DC offset, AC+DC; the default is AC.

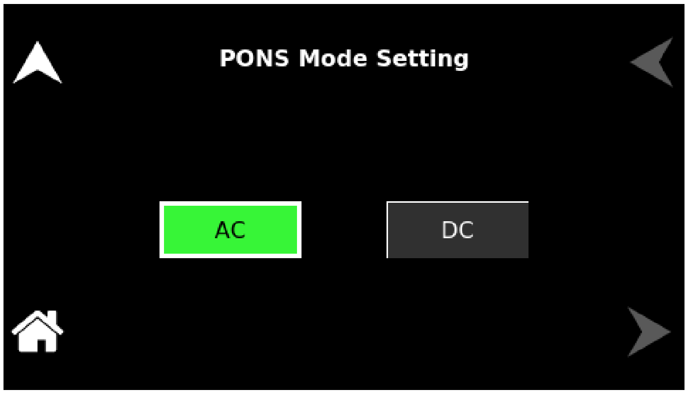


Figure 5-163: PONS Mode Settings

PONS RANGE

PONS menu: Selects the output voltage range, either low range,166 VAC or 220 VDC, or high range, 333 VAC or 440 VDC. The available ranges are dependent on the selection of the VOLTAGE mode, either AC or DC; the default is low-range, 166 VAC.

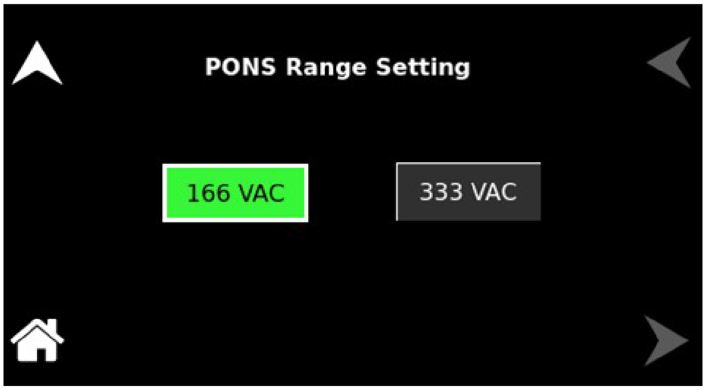


Figure 5-164: PONS Range Settings

PONS CURRENT

PONS menu: Sets the value of the output Current.

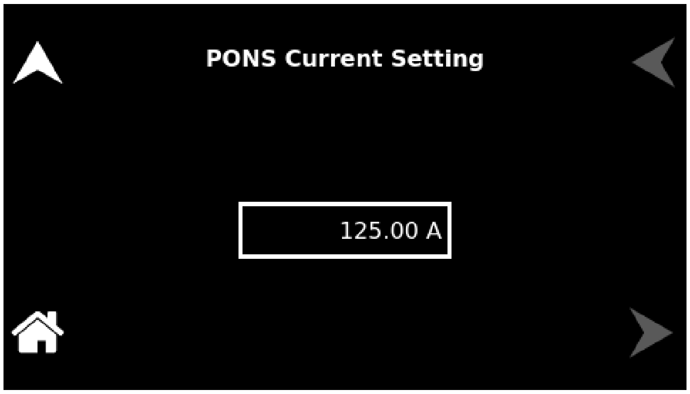


Figure 5-165: PONS Current Settings

PONS PHASE SHIFT

PONS menu: Sets the value of the output Phase shift

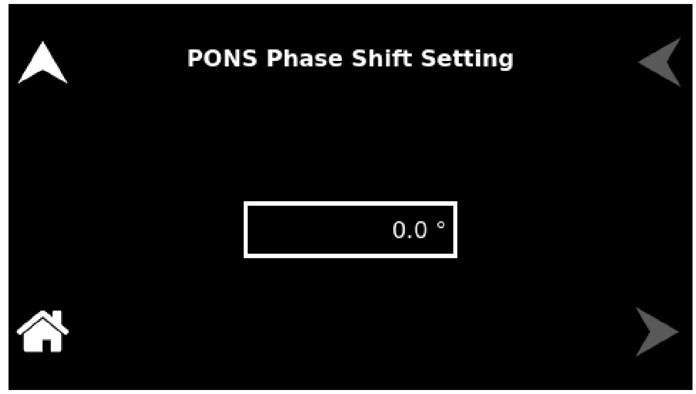


Figure 5-166: PONS Phase Shift Settings

PONS POWER FACTOR

PONS menu: Sets the value of the output Power factor.

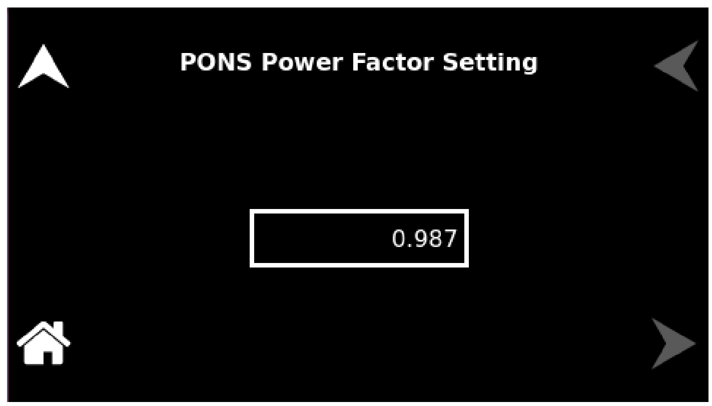


Figure 5-167: PONS Power Factor Settings

PONS SYNC

PONS menu: Programs the Sync Voltage, Sync Phase of each output phase, and Sync Freq.

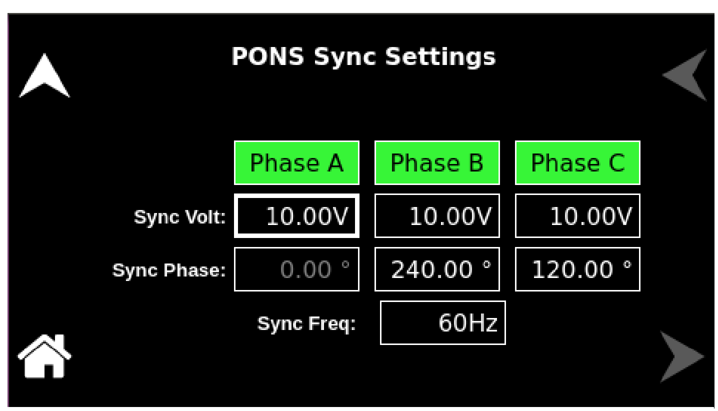


Figure 5-168: PONS Sync Settings

PONS WAVEFORM

PONS menu: Selects the type of output waveform, either the standard sine, square, or clipped-sine, or one that is user-defined; the default is a sine wave. The clipped-sine waveform has an additional programmable parameter, CLIP % THD. Refer to Section 6, Waveform Management for more information on the use of the menus.

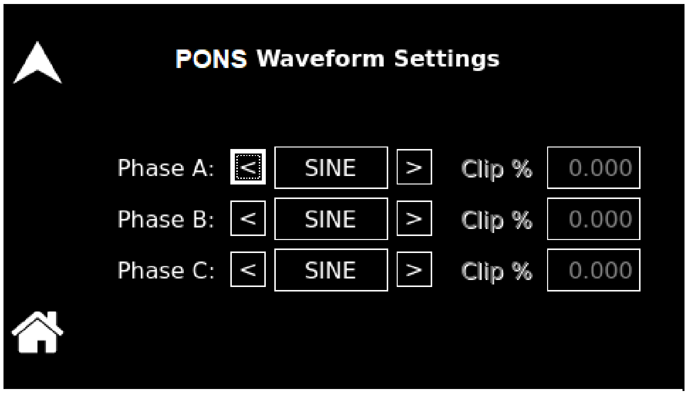


Figure 5-169: PONS Waveform Settings

PONS ALC

PONS menu: Selects how the output voltage will be regulated; default is ALC on:

ON: The RMS digital regulator is enabled, and shutdown will be executed if a loss of regulation occurs.

OFF: Regulation of the output voltage does not utilize the RMS digital regulator, and shutdown that is dependent on regulation would not occur.

Regulate: The RMS digital regulator is enabled, but shutdown will not be executed if loss of regulation occurs.

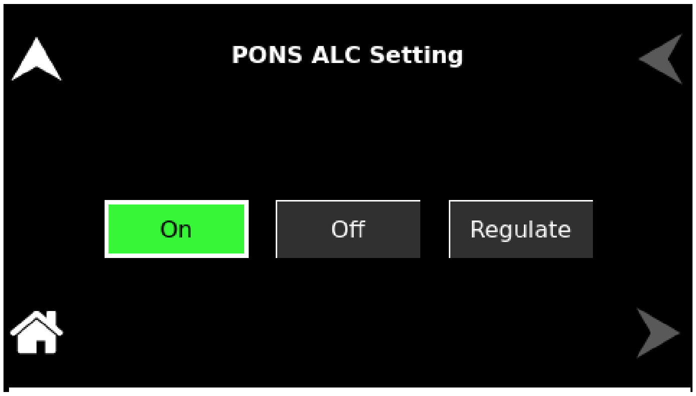


Figure 5-170: PONS ALC Settings

PONS REFERENCE

PONS menu: Selects either the internal waveform generator or the external analog inputs for programming the output waveform and amplitude; the default is Internal:

Internal: Enables the internal waveform generator using the standard waveforms or one of the user-defined waveforms.

RPV: Enables the external analog interface programming input that sets the amplitude, while the internal waveform generator is used to set the waveform.

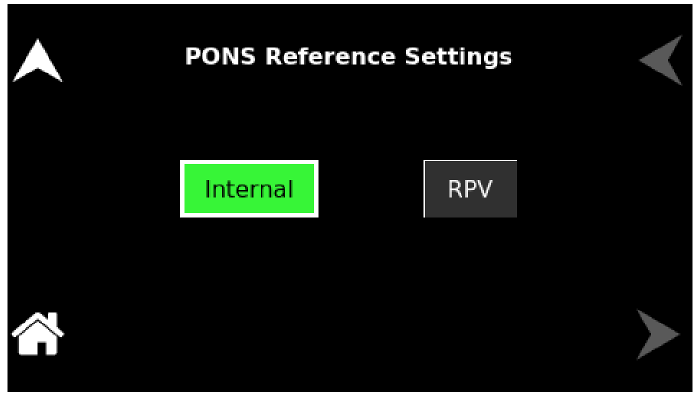


Figure 5-171: PONS Reference Settings

PONS PHASE NUMBER

__PONS menu:__ Selects the output configuration, either 1-Phase or 3 Phase, for 3-Phase models; the default is 3-Phase.

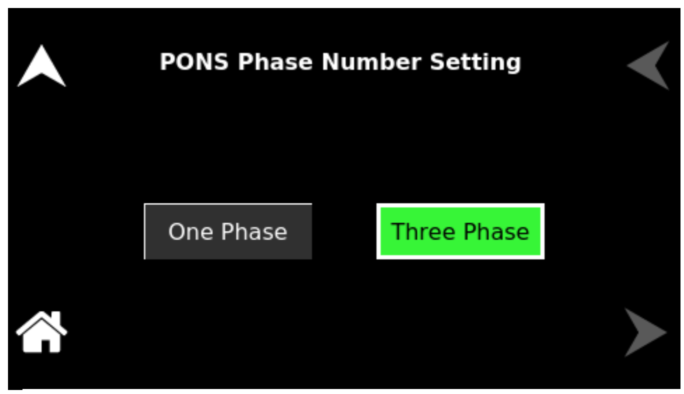


Figure 5-172: PONS Phase Number Settings

PONS CURRENT PROGRAM TYPE

__PONS menu:__ Selects the current program type, either Phase Shift or Power Factor.

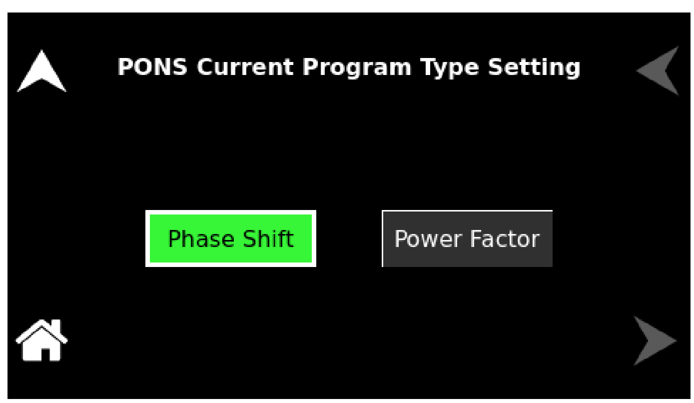


Figure 5-173: PONS Current Program Settings

5.10 HOME Screen Top-Level Menu - (Electronic load Power Programming Mode)

5.10.1 Banner Screen

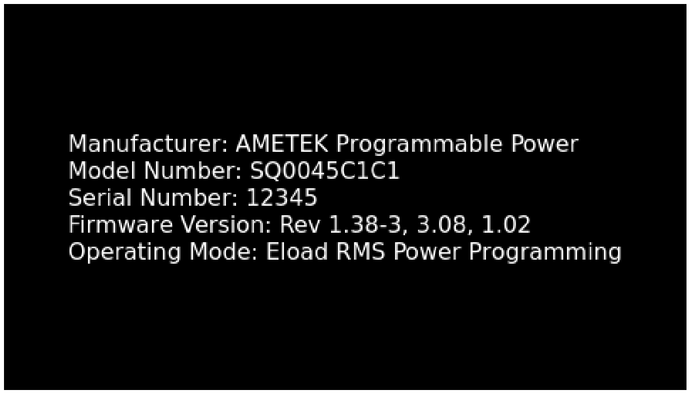


Figure 5-174: Banner Screen for Electronic load – Power Programming

5.10.2 HOME Screen

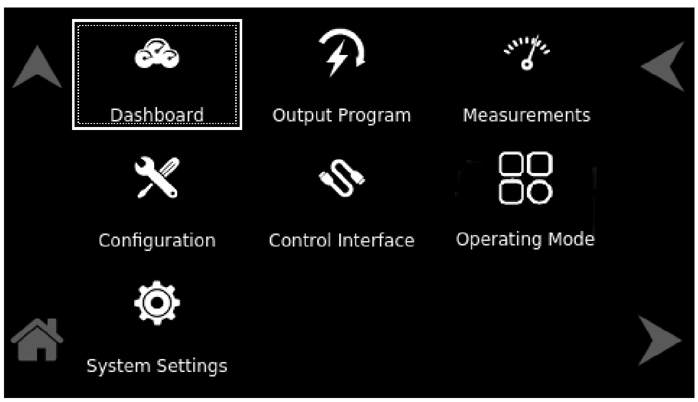


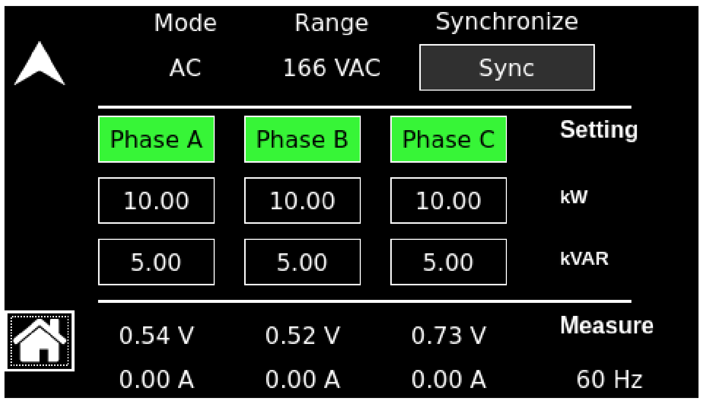
Figure 5-175: HOME Screen for Electronic load – Power Programming Mode

5.10.3 Dashboard Screen Top-Level Menu

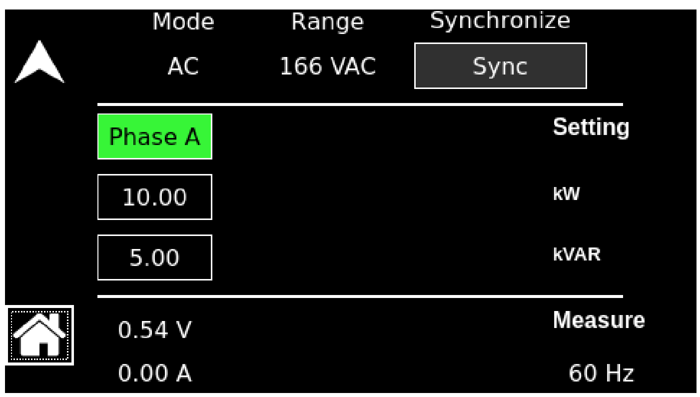
The DASHBOARD screen top-level menu allows you to adjust output parameters and view output measurements at the same time. The most used output parameters are available in the DASHBOARD screen menu. This screen is the default menu displayed after powering on. The top-level menu of the DASHBOARD screen is shown in Figure 5-176. It can be reached in one of two ways:

1. Tapping DASHBOARD on the HOME Screen of the front panel touchscreen.
2. Scrolling to DASHBOARD with the encoder and depressing the encoder switch.

The Up-arrow button returns to the previously selected screen menu (e.g., the HOME Screen-1). The HOME button takes you to the HOME screen, which is the top-level menu for the displayed sub-menu. For the DASHBOARD screen, the top-level menu is the HOME Screen.



3-Phase



1-Phase

Figure 5-176: DASHBOARD Screen Top-Level Menu

The following selections are available in the DASHBOARD screen top-level menu. Functions that accept a numeric value require that the value be within the allowed range, otherwise, an error will be generated, and the value will not be accepted.

When the unit is configured for 3-Phase output, each phase has individual settings. In 1-Phase output mode, only Phase-A is displayed. Tapping on a phase button toggles its selection for inputting values. A selected phase button is displayed in green, while an unselected phase button is gray. When all phases are selected, changes made to one phase will apply to the others.

Entry	Description Setting
Active Power	Programs the Active power required as a load for the UUT.
Re-Active Power	Programs the Reactive Power is required as a load for the UUT.
RANGE	Displays 166 VAC or 333 VAC range for AC-mode and 220 VDC or 440 VDC range for DC-mode operation. The OUTPUT state must be OFF for a change in range to be executed.
MODE	Displays the source mode of operation.
SYNCHRONIZE	Stars the Synchronization between Sequoia and UUT. Once the Synchronization is successful it will display "SYNCED."
<u>Measure</u>	
VOLTAGE	Displays the true RMS value of the output voltage measured at the voltage sense lines. In DC-mode only, the voltage is the DC voltage including polarity.
CURRENT	Displays the true RMS value of the output current. In DC mode only, the current is the DC current including polarity.
FREQUENCY	When in AC mode, the output frequency is measured at the sense lines. When in DC mode, this value always reads "DC."

5.10.4 Real-Time Parameter Adjustment

The DASHBOARD screen menu provides the capability for output parameter entry that has a real-time, immediate effect on the output. This allows manual adjustment of the output parameters where the tuning of a value is desired. Enabling this function requires tapping on a parameter selection-field box with the encoder switch to select the parameter and display its selection-field highlighted and with a value entry window. The rotary encoder can then be used to continuously adjust the parameter value, up and down, as it is rotated. The value change has an immediate effect on the output.

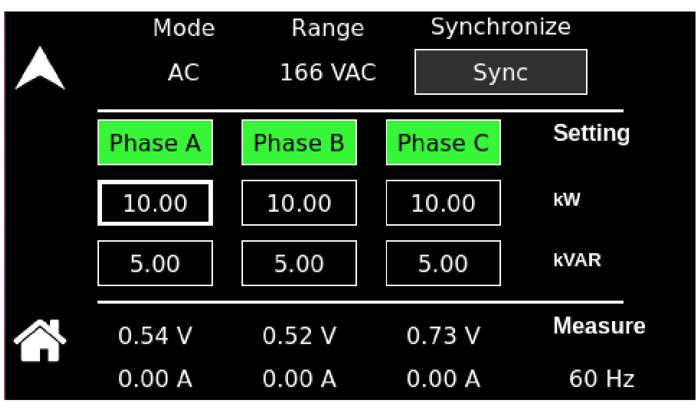


Figure 5-177: Real-Time, Immediate Output Parameter Adjustment

5.10.5 Output Program Screen

The OUTPUT PROGRAM screen provides the setting of output-related items such as individual output parameters, mode of regulation and current limit, output waveform selection, and display of real-time output waveform or harmonics spectrum.

The top-level menus of the OUTPUT PROGRAM screen are shown in Figure 5-178. They are reached in one of two ways:

1. Tapping the OUTPUT PROGRAM screen on the HOME Screen of the front panel touchscreen.
2. Scrolling to the OUTPUT PROGRAM screen with the encoder and depressing the encoder switch.

The Up-arrow button will return to the previously selected screen menu (in this case the HOME Screen). The HOME button will return to the HOME screen that has the top-level menu for the sub-menu being displayed; for the OUTPUT PROGRAM screen top-level menu, is the HOME Screen.

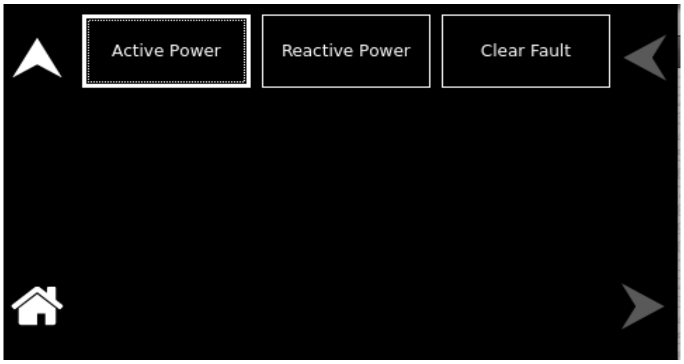


Figure 5-178: OUTPUT PROGRAM Screen Top-Level Menu

The following choices are available in the OUTPUT PROGRAM screen top-level menu. Functions that accept a numeric value require that the value be within the allowed range, otherwise, an error will be generated, and the value will not be accepted:

Entry	Description Settings
Active Power	Programs the Active power required as a load for the UUT. The default is zero.

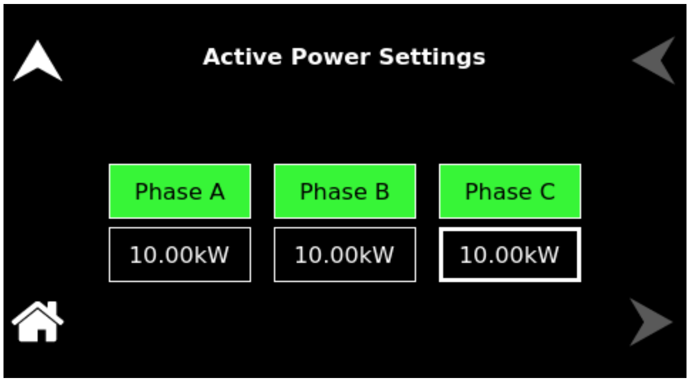


Figure 5-179: Active Power Settings

Entry	Description Settings
Reactive Power	Programs the Reactive power is required as a load for the UUT. The default is zero.

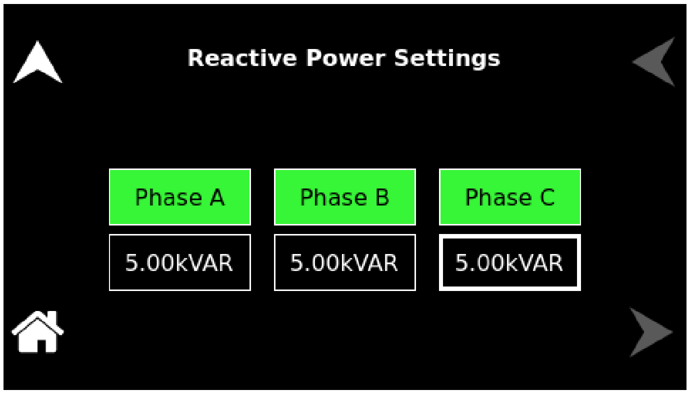


Figure 5-180: Reactive Power Settings

Clear Fault Programs the unit to clear all the faults. This button will be enabled only when fault bit is high and disabled when fault bit is low.

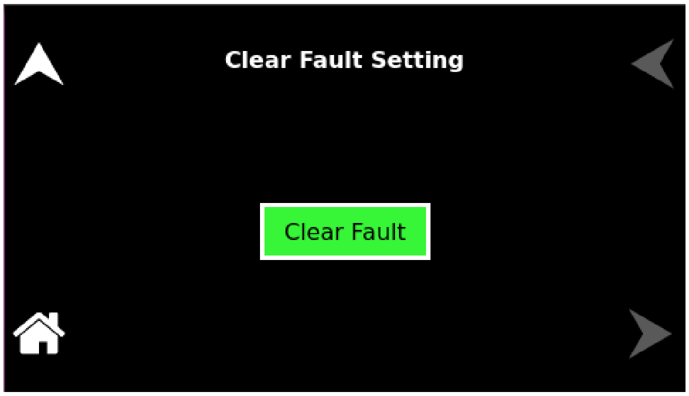


Figure 5-181: Clear Fault Settings

5.10.6 Configuration Screen

The CONFIGURATION screen provides a setup of the output mode of operation, power-on states, operation profiles, parameter limits, and selection of clock mode.

The top-level menu of the CONFIGURATION screen is shown in Figure 5-182. It can be reached in one of two ways:

1. Tapping CONFIGURATION on the HOME Screen of the front panel touchscreen.
2. Scrolling to CONFIGURATION with the encoder and depressing the encoder switch.

The Up-arrow button will return to the previously selected screen menu (in this case the HOME Screen). The HOME button will return to the HOME screen that has the top-level menu for the sub-menu being displayed; for the CONFIGURATION screen top-level menu, is the HOME Screen.

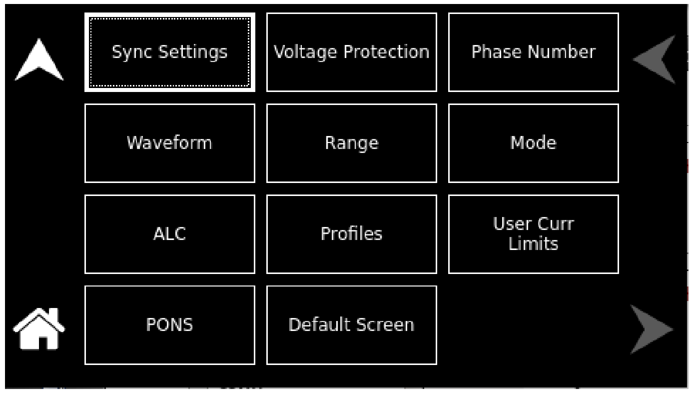


Figure 5-182: CONFIGURATION Screen Top-Level Menu

The following sub-menus are available on the CONFIGURATION menu:

Entry	Description
SYNC SETTINGS	Programs the Sync Voltage, Sync Phase of each output phase, and Sync Freq.

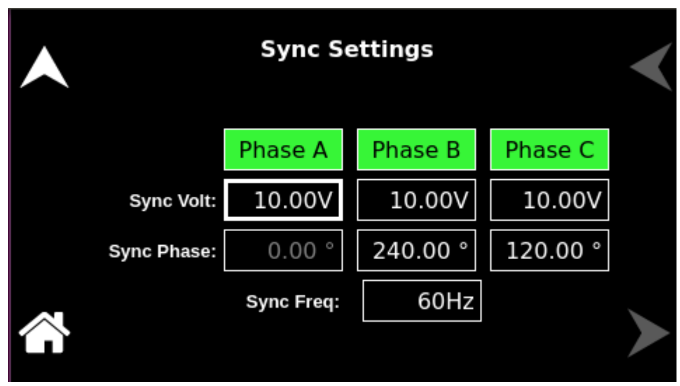


Figure 5-183: Sync Settings

VOLTAGE PROTECTION	Programs the Voltage Protection threshold for the output voltage of each output phase. Exceeding the OVP threshold will result in a shutdown of the output, with the output isolation relay opened and the output voltage programmed to zero. The maximum OVP setpoint is 115% FS low-range/high- range output voltage: AC- mode and (AC+DC)-mode, 191V/383V; DC-mode, 253 V/506 V. The default value is 115% FS.

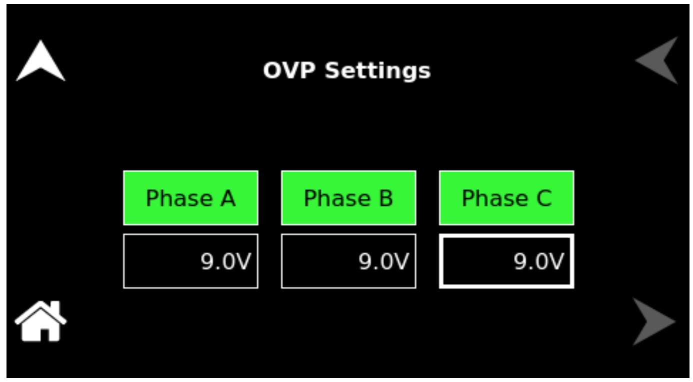


Figure 5-184: OVP Settings

PHASE NUMBER

Programs the output phase configuration: One-Phase or Three-Phase. The default is Three-Phase.

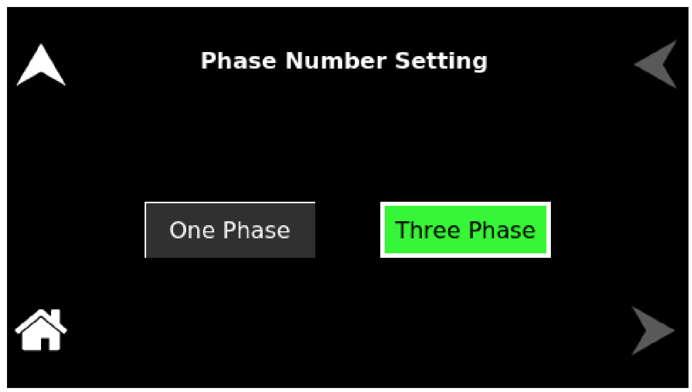


Figure 5-185: Phase Number Settings

WAVEFORM

Selects the waveform for the output voltage: either standard waveforms for sine wave, square wave, clipped-sine wave; or user-defined waveforms. The default is a sine wave.

The standard waveforms are always available, and do not consume any of the user-defined waveform memory registers; they are always displayed in the waveform list. The clipped-sine waveform has a waveform where the peak amplitude of the positive and negative alternation is clipped (flattened appearance). The level of clipping is dependent on the amount of harmonic distortion present in the output waveform. An additional programmable parameter, CLIP % THD, is available for setting the percentage of total harmonic distortion (THD); the range is 0- 43%.

The user-defined waveforms are selected from up to fifty waveforms in one of four groups (group 0-3, totaling 200 waveforms) that are active. The waveform group that is active at the power-on of the unit is selected with the SCPI command, `PONSetup:WGRoup <n>`, through the digital interface.

For information on generating user-defined waveforms and their selection, refer to the Sequoia Series Programming

Manual P/N M447353-01 or the Sequoia Virtual Panels GUI; refer to AMETEK PPD website, www.programmablepower.com, to download the latest version.

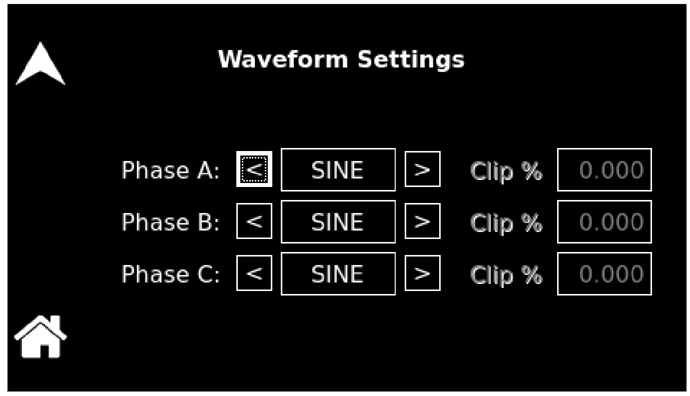


Figure 5-186: Waveform Settings

RANGE

Selects the 166 VAC or 333 VAC range for AC mode, and 220 VDC or 440 VDC range for DC-mode operation. The output must be turned off for a change in range to be executed. The default is low-range, 166 VAC.

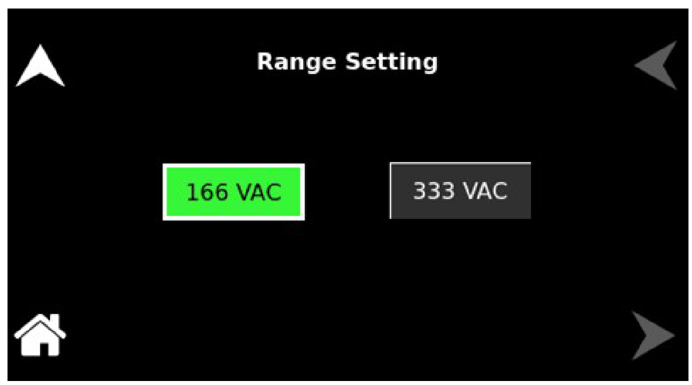


Figure 5-187: Range Settings

MODE

Selects the mode of operation of output voltage: either AC only, DC only, or AC with a DC offset. This selection also determines the available output voltage ranges: 166/333 Vrms in AC and 220/440 VDC in DC mode. The output must be turned off to change this setting. The default is AC.

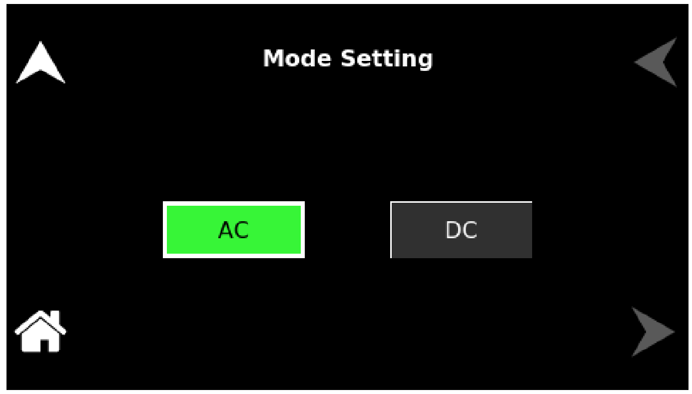


Figure 5-188: Mode Settings

ALC

Selects how the output voltage will be regulated; the default is ALC on:

ON: The RMS digital regulator is enabled, and shutdown will be executed if a loss of regulation occurs.

OFF: Regulation of the output voltage does not utilize the RMS digital regulator, and shutdown that is dependent on regulation would not occur.

Regulate: The RMS digital regulator is enabled, but shutdown will not be executed if loss of regulation occurs.

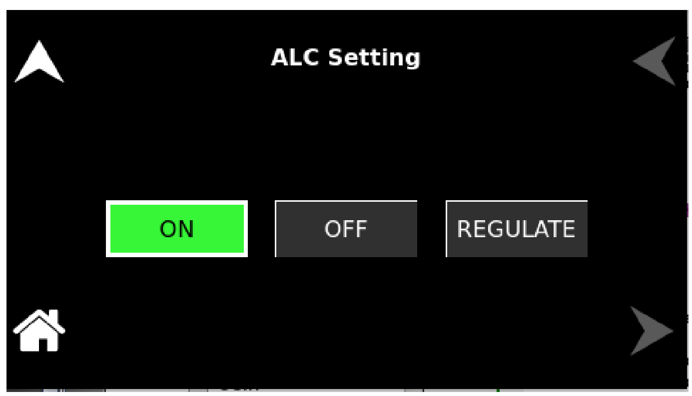


Figure 5-189: ALC Settings

PROFILES

Selects the operational state of the power source; the default is Profile-0. Up to 15 unique profiles, including transient lists, can be stored. Subsequently, a profile can be loaded to automatically set the unit to that configuration. To save the present state, tap on the profile selection button. The profile must be given an alphanumeric identifier by using the Name function; Tap the SAVE field to store the present configuration. Tap on the Load field to recall a configuration and set the power source to that state.

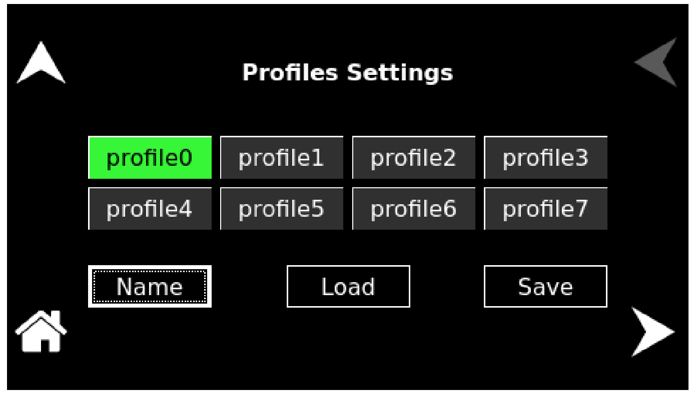


Figure 5-190: CONFIGURATION Menu, PROFILES Sub-Menu

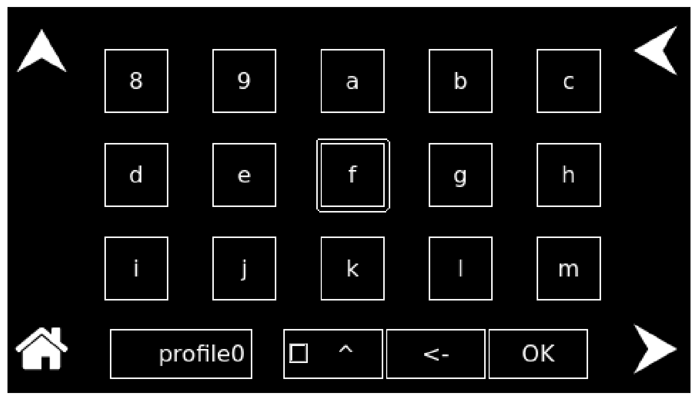


Figure 5-191: PROFILES Menu, NAME Sub-Menu

USER CURR LIMITS

Sets soft limits for the minimum and maximum output voltage that the unit can be programmed to, either via the front panel or remote digital interface. The default is full-scale.

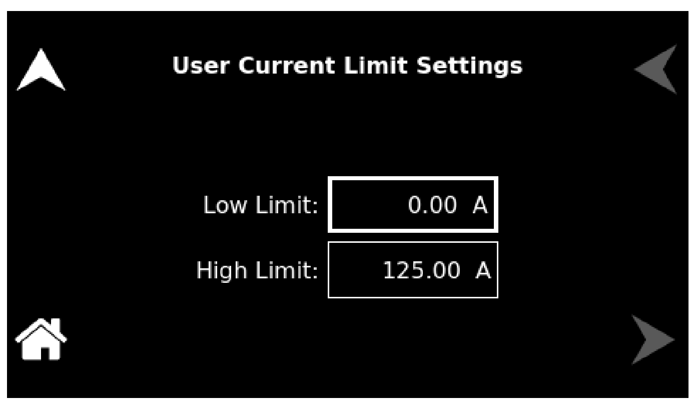


Figure 5-192: User Current Limit Settings

DEFAULT SCREEN

Selects whether the Default screen (showing only voltage and current amplitude) is enabled and configures its operational settings. The default settings are the Default screen enabled with a 10-second timeout.

Timeout Interval: Select the time, in seconds, for how long a screen must be inactive before the Default screen is displayed.

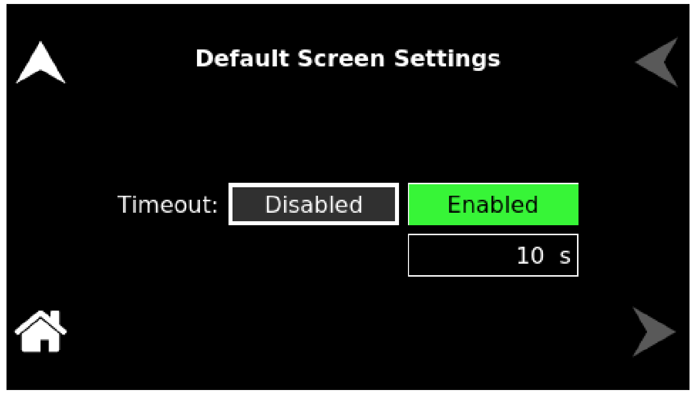


Figure 5-193: Default Screen Settings

PONS

The PONS menus allow setting the conditions that would be present after power up; The AC input must be cycled off/on for a change in a PONS setting to take effect. The functions and parameters have the same programmability as described in the menus of the OUTPUT PROGRAM screen.

CAUTION!

The PONS menus allow selecting that the output would be turned on and programmed to a high voltage when the unit is initially powered up. Ensure that suitable protection is provided to prevent accidentally energizing the load. The factory-default setting is with the output off and programmed to zero to provide the safest start-up condition.

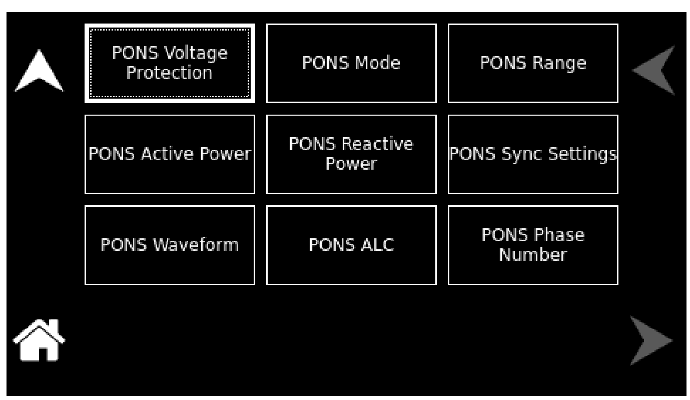


Figure 5-194: CONFIGURATION Menu, PONS Menu

The PONS menu has the following fields:

Entry	Description
PONS OVP	**PONS menu:** Programs the PONS Voltage Protection threshold for the output voltage of each output phase. Exceeding the OVP threshold will result in the shutdown of the output, with the output isolation relay opened and the output voltage programmed to zero. The maximum OVP setpoint is 115% FS low- range/high-range output voltage: AC- mode and (AC+DC)-mode, 191 V/383 V; DC- mode, 253 V/506 V. The default value is 115% FS.

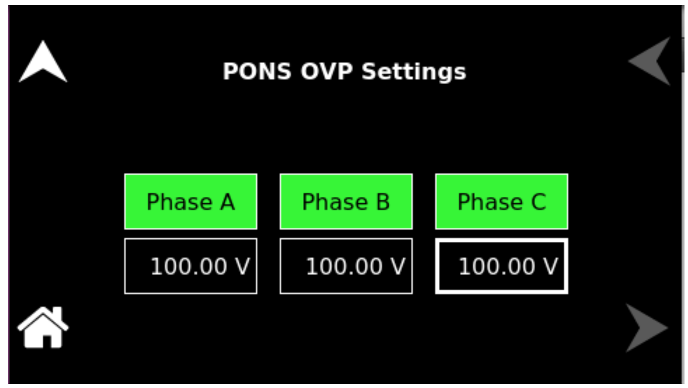


Figure 5-195: PONS OVP Settings

PONS MODE	**PONS menu:** Selects the mode of operation for the output voltage of the power source: either AC or DC the default is AC.

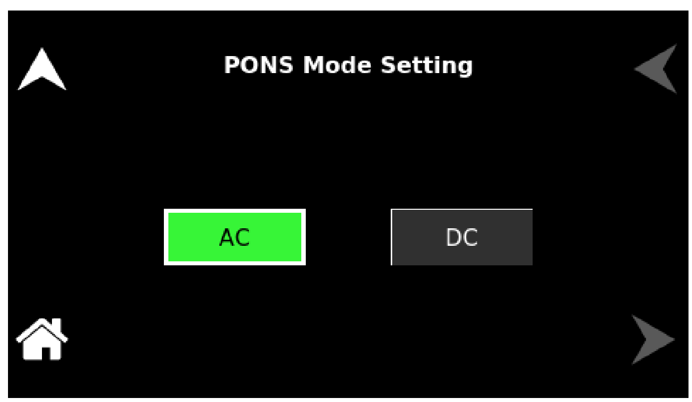


Figure 5-196: PONS Mode Settings

PONS RANGE	**PONS menu:** Selects the output voltage range, either low range,166 VAC or 220 VDC, or high range, 333 VAC or 440 VDC. The available ranges are dependent on the selection of the VOLTAGE mode, either AC or DC; the default is low-range, 166 VAC.

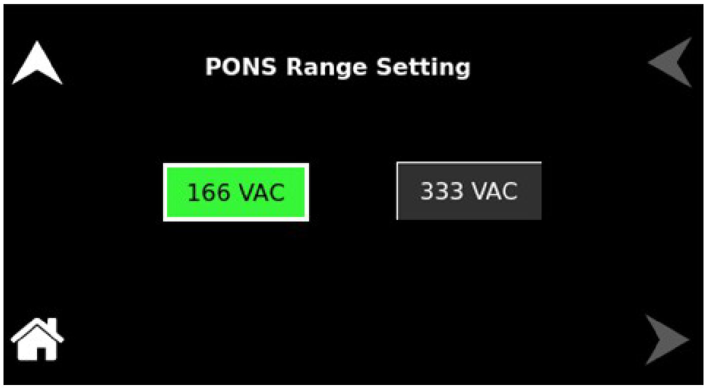


Figure 5-197: PONS Range Settings

PONS ACTIVE POWER

PONS menu: Sets the value of the active power required as a load for the UUT.

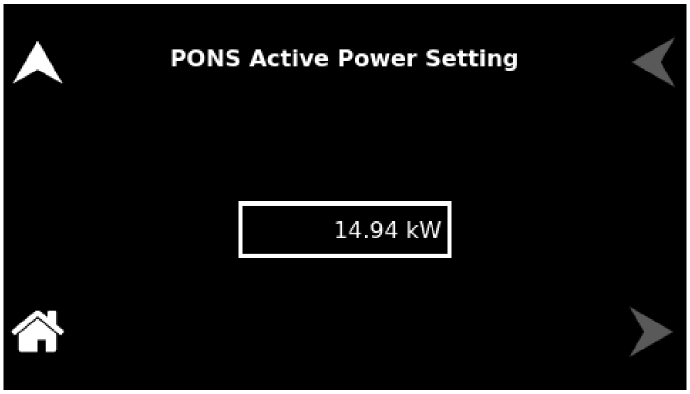


Figure 5-198: PONS Active Power Settings

PONS REACTIVE POWER

PONS menu: Sets the value of the output Reactive power required as a load for the UUT.

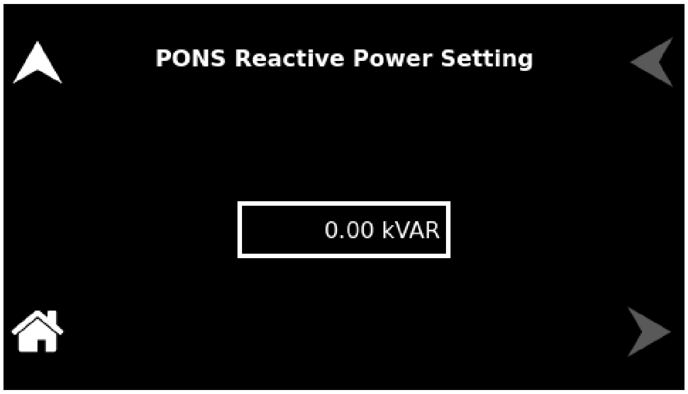


Figure 5-199: PONS Reactive Power Settings

PONS SYNC

PONS menu: Programs the Sync Voltage, Sync Phase of each output phase and Sync Freq required to sync with

UUT.

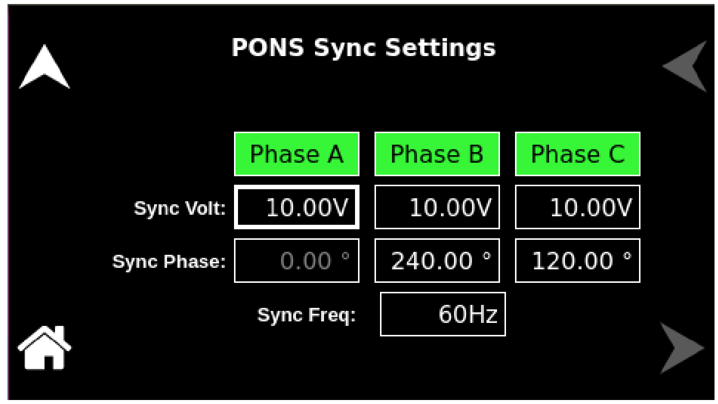


Figure 5-200: PONS Sync Settings

PONS WAVEFORM

PONS menu: Selects the type of output waveform, either the standard sine, square, or clipped-sine, or one that is user-defined; the default is a sine wave. The clipped-sine waveform has an additional programmable parameter, CLIP % THD. Refer to Section 6, Waveform Management for more information on the use of the menus.

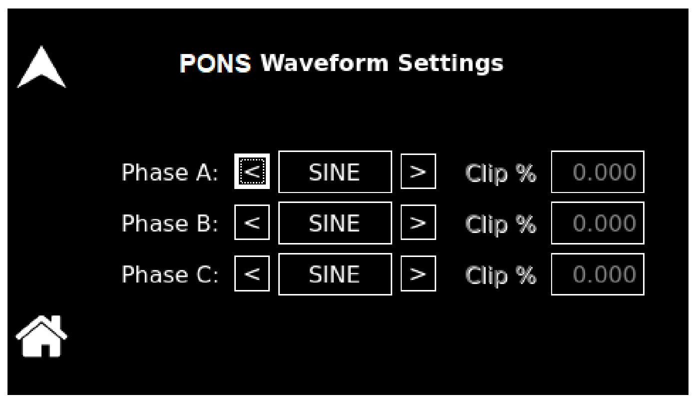


Figure 5-201: PONS Waveform Settings

PONS ALC

PONS menu: Selects how the output voltage will be regulated; default is ALC on:

ON: The RMS digital regulator is enabled, and shutdown will be executed if a loss of regulation occurs.

OFF: Regulation of the output voltage does not utilize the RMS digital regulator, and shutdown that is dependent on regulation would not occur.

Regulate: The RMS digital regulator is enabled, but shutdown will not be executed if loss of regulation occurs.

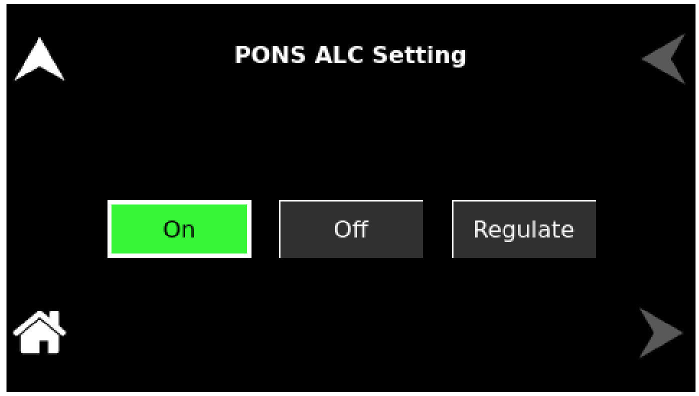


Figure 5-202: PONS ALC Settings

PONS PHASE NUMBER

<u>PONS menu:</u> Selects the output configuration, either 1-Phase or 3 Phase, for 3-Phase models; the default is 3-Phase.

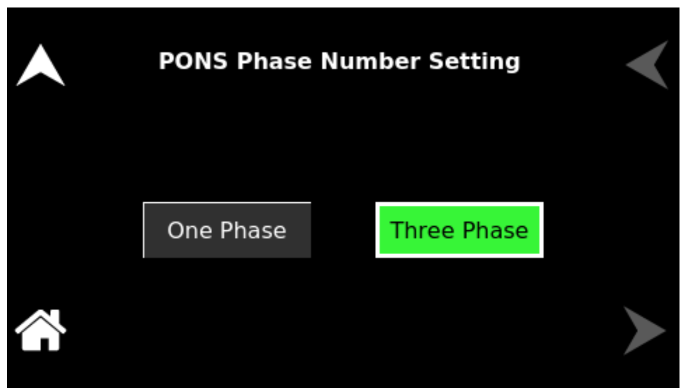


Figure 5-203: PONS Phase Number Settings

5.11 HOME Screen Top-Level Menu - (Electronic load RLC Programming Mode)

5.11.1 Banner Screen

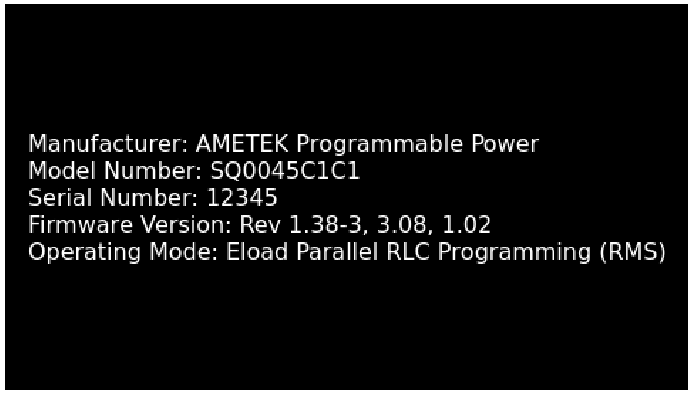


Figure 5-204: Banner Screen for Electronic load – RLC Programming Mode

5.11.2 Home Screen

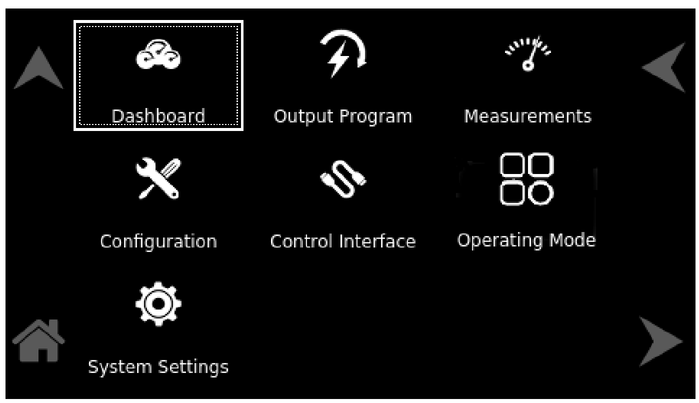


Figure 5-205: HOME Screen for Electronic load – RLC Programming Mode

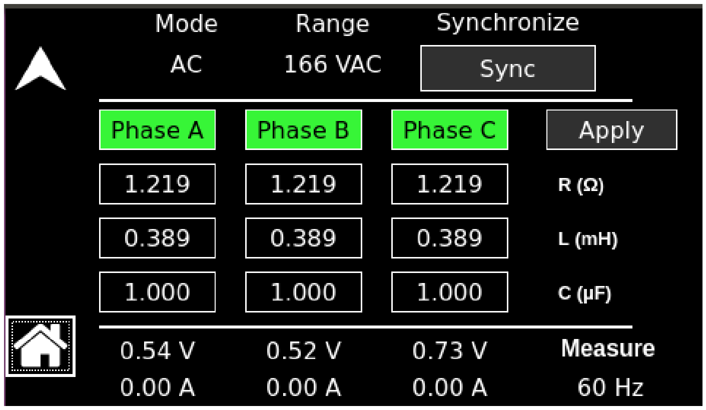
5.11.3 Dashboard Screen Top-Level Menu

The DASHBOARD screen top-level menu is used to adjust output parameters and view output measurements simultaneously. The most used output parameters are available in the DASHBOARD screen menu. This screen is the default menu displayed after powering on.

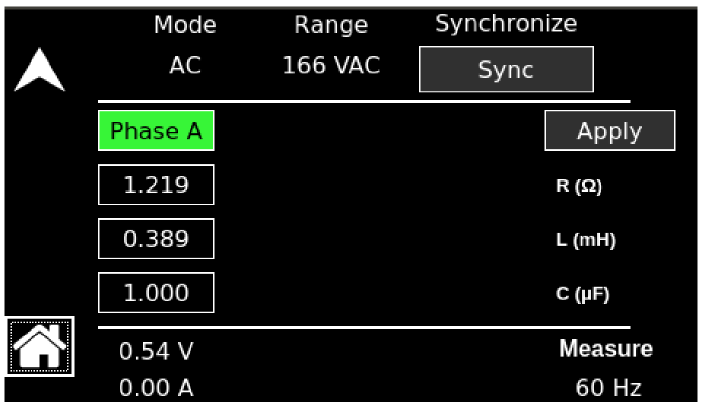
The top-level menu of the DASHBOARD screen is shown in Figure 5-205. It can be reached in one of two ways:

1. Tapping DASHBOARD on the HOME Screen of the front panel touchscreen.
2. Scrolling to DASHBOARD with the encoder and depressing the encoder switch.

The Up-arrow button returns to the previously selected screen menu (e.g., the HOME Screen-1). The HOME button takes you to the HOME screen, which is the top-level menu for the currently displayed sub-menu. For the DASHBOARD screen, the top-level menu is the HOME Screen.



3-Phase Mode



1-Phase Mode

Figure 5-206: DASHBOARD Screen Top-Level Menu

The following selections are available in the DASHBOARD screen top-level menu. Functions that accept a numeric value require that the value be within the allowed range, otherwise, an error will be generated, and the value will not be accepted.

When the unit is configured for 3-Phase output, each phase has individual settings. When the unit is configured for 1-Phase output, only Phase-A is displayed. Tapping on a phase button toggles the selection of that phase for inputting values. When a phase is selected, its button is displayed with a green color. When a phase is not selected, its button is displayed with a gray color. When all phases are selected, entry for one phase will make the same changes for the other phases.

Entry	**Description Setting**
Resistance	User can program the Resistance required as a load for the UUT. If the user wants to remove the Resistance connection, select NC on the keyboard. NC refers to “No Connection.” Refer to Figure 5-206.

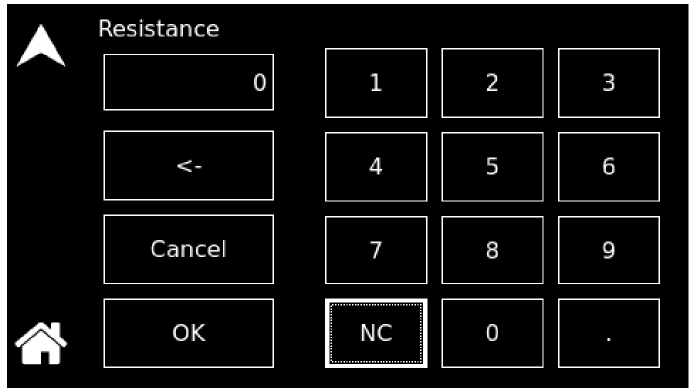


Figure 5-207: Touch-Screen Numeric Keypad - RLC

Inductance User can program the Inductance required as a load for the UUT. If the user wants to remove the Inductance connection, select NC on the keyboard. NC refers to No Connection. Refer to Figure 5-206.

Capacitance User can program the Capacitance required as a load for the UUT. If the user wants to remove the Capacitance connection, select NC on the keyboard. NC refers to No Connection. Refer to Figure 5-206.

NC NC refers to "No Connection."

APPLY To adjust the settings, the user must input a value for R, L, or C and then press the apply button for the configured value to be programmed. Only if there is a change in Resistance, Inductance, or Capacitance, APPLY button will be enabled, for the user to configure the settings. Refer to Figure 5-207. If there is no change, APPLY button will be disabled refer to Figure 5-208.

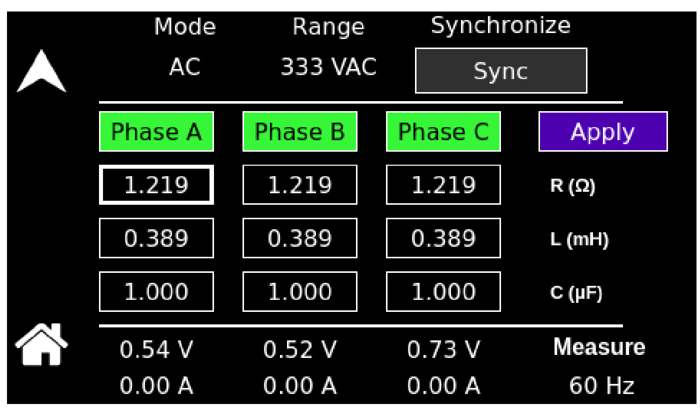


Figure 5-208: Apply button enabled when there is a configuration change

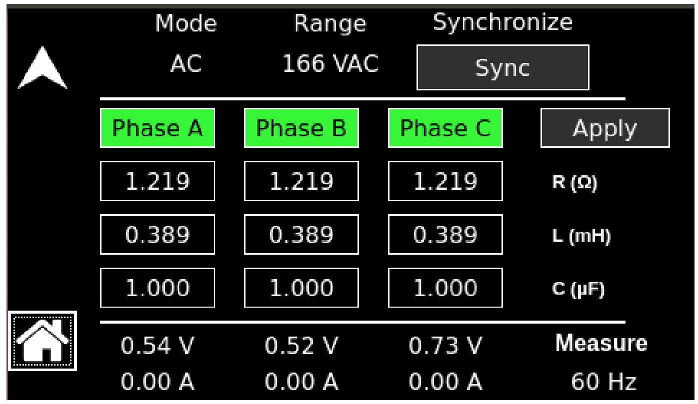


Figure 5-209: Apply button Disabled when there is no change in R, L, or

RANGE Displays 166 VAC or 333 VAC range for AC-mode, and 220 VDC or 440 VDC range for DC mode operation. The OUTPUT state must be OFF for a change in range to be executed.

MODE Displays the source mode of operation.

Synchronize Starts the Synchronization between Sequoia and UUT. Once the Synchronization is successful it will display "SYNCED."

Measure

VOLTAGE Displays the true RMS value of the output voltage measured at the voltage sense lines. In DC-mode only, the voltage is the DC voltage including polarity.

CURRENT Displays the true RMS value of the output current. In DC mode only, the current is the DC including polarity.

FREQUENCY When in AC mode, the output frequency is measured at the sense lines. When in DC mode, this value always reads "DC."

5.11.4 Output Program Screen

The OUTPUT PROGRAM screen displays settings for output-related items, such as individual output parameters, mode of regulation, current limit, output waveform selection, and the real-time output waveform or harmonics spectrum.

The top-level menus of the OUTPUT PROGRAM screen are shown in Figure 5-209. They can be reached in one of two ways:

1. Tapping the OUTPUT PROGRAM screen on the HOME Screen of the front panel touchscreen.
2. Scrolling to the OUTPUT PROGRAM screen with the encoder and depressing the encoder switch.

The Up-arrow button returns to the previously selected screen menu (e.g., the HOME Screen). The HOME button takes you to the HOME screen, which is the top-level menu for the currently displayed sub-menu. For the OUTPUT PROGRAM screen, the top-level menu is the HOME Screen.

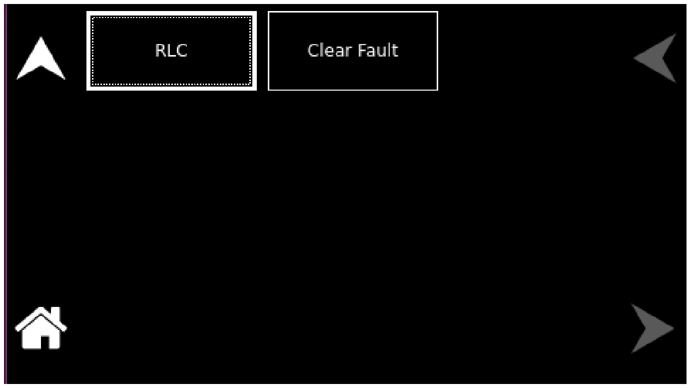


Figure 5-210: OUTPUT PROGRAM Screen Top-Level Menu

The following choices are available in the OUTPUT PROGRAM screen top-level menu. Functions that accept a numeric value require that the value be within the allowed range, otherwise, an error will be generated, and the value will not be accepted.

<u>**Entry**</u>	<u>**Description Settings**</u>
RLC	Users can program the Resistance, Inductance and Capacitance required as a load for the UUT. To adjust the settings, the user must input a value for R, L, or C and then press the apply button for the configured value to be programmed. Only if there is a change in Resistance, Inductance, or Capacitance, APPLY button will be enabled, for the user to configure the settings. Refer to Figure 5-207. If there is no change APPLY button will be disabled.

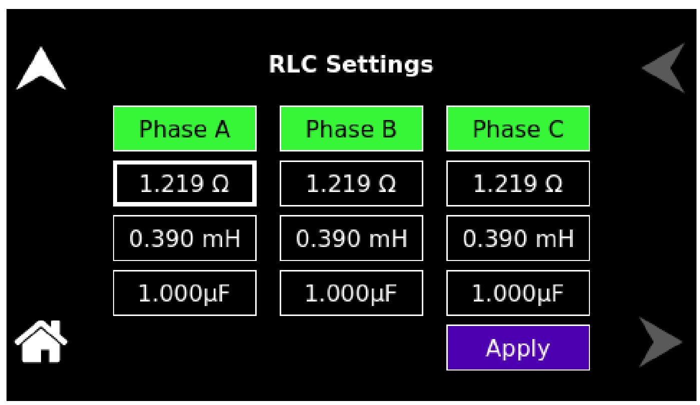


Figure 5-211: RLC Settings

Clear Fault	Programs the unit to clear all the faults. This button will be enabled only when fault bit is high and disabled when fault bit is low.

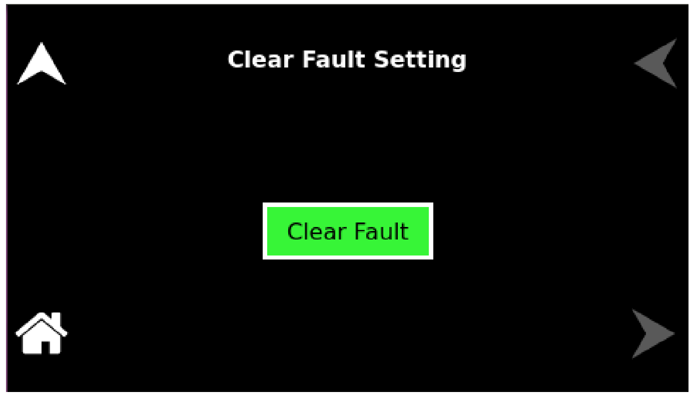


Figure 5-212: Clear Fault Settings

5.11.5 Configuration Screen

The CONFIGURATION screen provides a setup of the output mode of operation, power-on states, operation profiles, parameter limits, and selection of clock mode.

The top-level menu of the CONFIGURATION screen is shown in Figure 5-212. It can be reached in one of two ways:

1. Tapping CONFIGURATION on the HOME Screen of the front panel touchscreen.
2. Scrolling to CONFIGURATION with the encoder and depressing the encoder switch.

The Up-arrow button returns to the previously selected screen menu (e.g., the HOME Screen). The HOME button takes you to the HOME screen, which is the top-level menu for the currently displayed sub-menu. For the CONFIGURATION screen, the top-level menu is the HOME Screen.

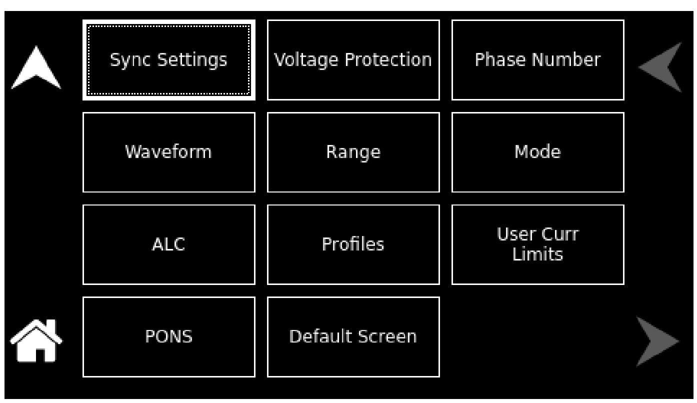


Figure 5-213: CONFIGURATION Screen Top-Level Menu

The following sub-menus are available on the CONFIGURATION menu:

Entry	Description
SYNC SETTINGS	Programs the Sync Voltage, Sync Phase of each output phase, and Sync Freq required to sync between SEQUOIA and UUT.

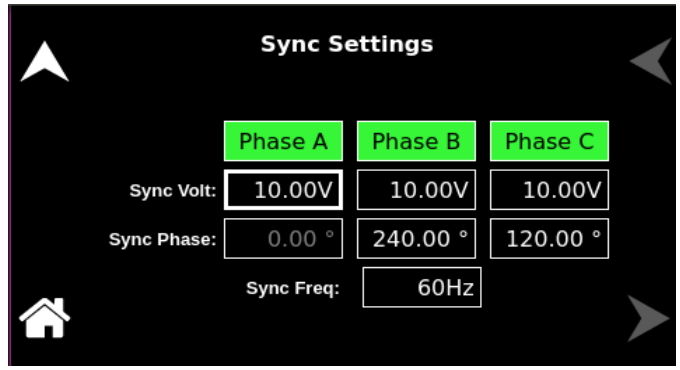


Figure 5-214: Sync Settings

VOLTAGE PROTECTION

Programs the Voltage Protection threshold for the output voltage of each output phase. Exceeding the OVP threshold will result in a shutdown of the output, with the output isolation relay opened and the output voltage programmed to zero. The maximum OVP setpoint is 115% FS low-range/high- range output voltage: AC- mode and (AC+DC)-mode, 191 V/383 V; DC- mode, 253 V/506 V. The default value is 115% FS.

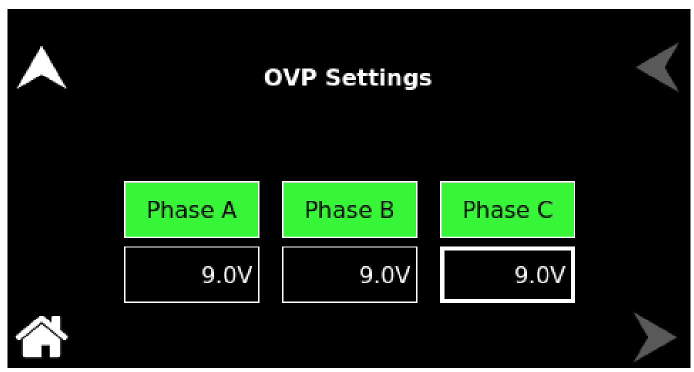


Figure 5-215: OVP Settings

PHASE NUMBER

Programs the output phase configuration: One-Phase or Three-Phase. The default is Three-Phase.

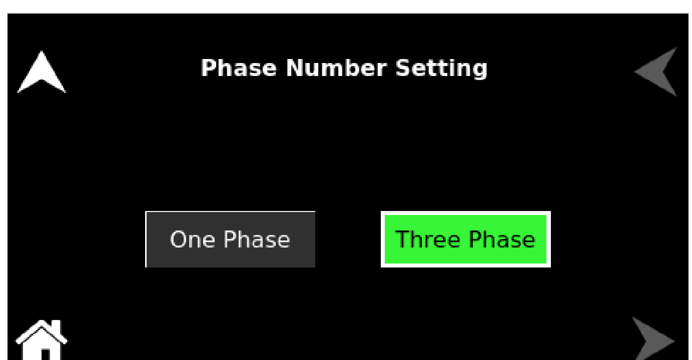


Figure 5-216: Phase Number Settings

WAVEFORM

Selects the waveform for the output voltage: either standard waveforms for sine wave, square wave, clipped-sine wave; or user-defined waveforms. The default is a sine wave.

The standard waveforms are always available, and do not consume any of the user-defined waveform memory registers; they are always displayed in the waveform list. The clipped-sine waveform has a waveform where the peak amplitude of the positive and negative alternation is clipped (flattened appearance). The level of clipping is dependent on the amount of harmonic distortion present in the output waveform. An additional programmable parameter, CLIP % THD, is available for setting the percentage of total harmonic distortion (THD); the range is 0- 43%.

The user-defined waveforms are selected from up to fifty waveforms in one of four groups (group 0-3, totaling 200 waveforms) that are active. The waveform group that is active at the power-on of the unit can be selected with the SCPI command, `PONSetup:WGRoup <n>`, through the digital interface. For information on generating user-defined waveforms and their selection, refer to the Sequoia Series Programming Manual P/N M447353-01 or the Sequoia Virtual Panels GUI; refer to AMETEK PPD website, www.programmablepower.com, to download the latest version.

NOTE: Waveform settings are not available in the DC mode of operation

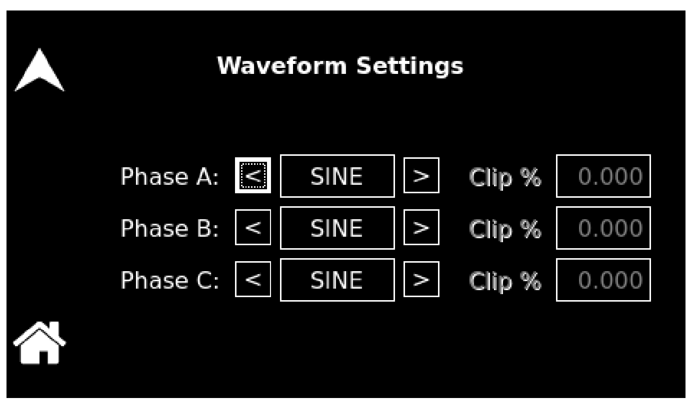


Figure 5-217: Waveform Settings – AC mode

RANGE

Selects the 166 VAC or 333 VAC range for AC mode and 220 VDC or 440 VDC range for DC-mode operation. The output must be turned off for a change in range to be executed. The default is low-range, 166 VAC.

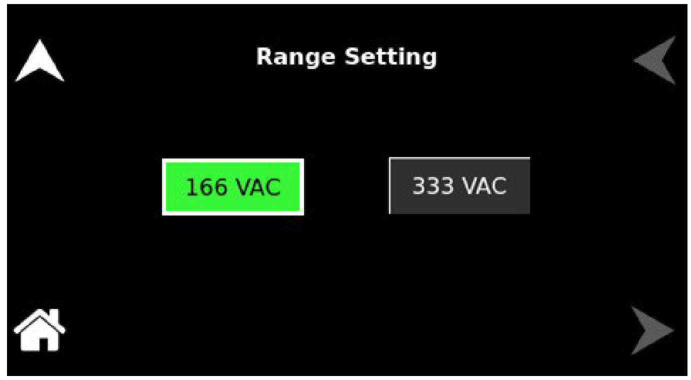


Figure 5-218: Range Settings

MODE

Selects the mode of operation of output voltage: either AC or DC. This selection also determines the available output voltage ranges: 166/333 Vrms in AC and 220/440 VDC in DC mode. The output must be turned off to change this setting. The default is AC.

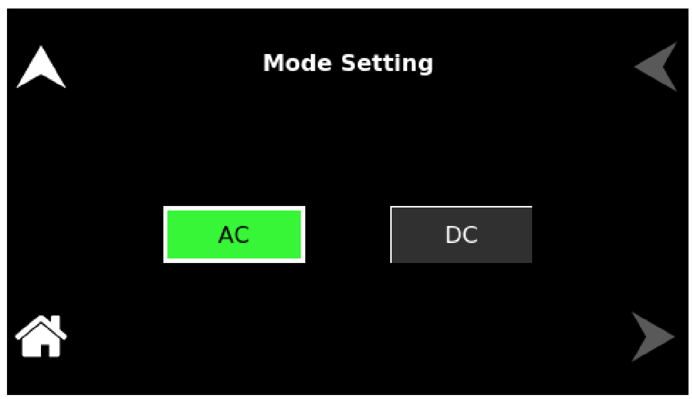


Figure 5-219: Mode Settings

ALC

Selects how the output voltage will be regulated; the default is ALC on:

ON: The RMS digital regulator is enabled, and shutdown will be executed if a loss of regulation occurs.

OFF: Regulation of the output voltage does not utilize the RMS digital regulator, and shutdown that is dependent on regulation would not occur.

Regulate: The RMS digital regulator is enabled, but shutdown will not be executed if loss of regulation occurs.

Figure 5-220: ALC Settings

PROFILES

Selects the operational state of the power source; the default is Profile-0. Up to 15 unique profiles, including transient lists, can be stored. Subsequently, a profile can be loaded to automatically set the unit to that configuration. To save the present state, tap on the profile selection button. The profile must be given an alphanumeric identifier by using the Name function; Tap the SAVE field to store the present configuration. Tap on the Load field to recall a configuration and set the power source to that state.

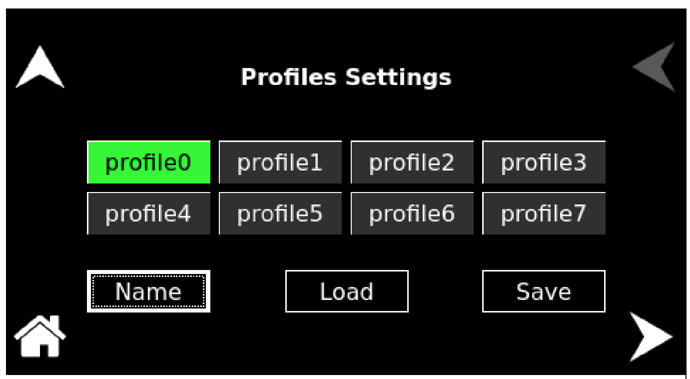


Figure 5-221: CONFIGURATION Menu, PROFILES Sub-Menu

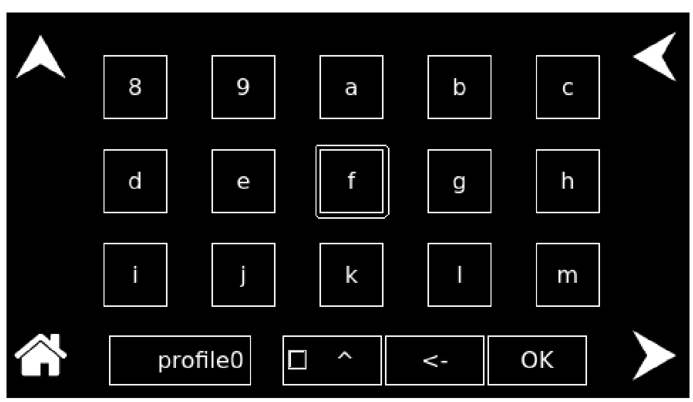


Figure 5-222: PROFILES Menu, NAME Sub-Menu

USER CURRENT LIMITS

Sets soft limits for the minimum and maximum output voltage to which the unit can be programmed using the front panel or remote digital interface; the default is full-scale.

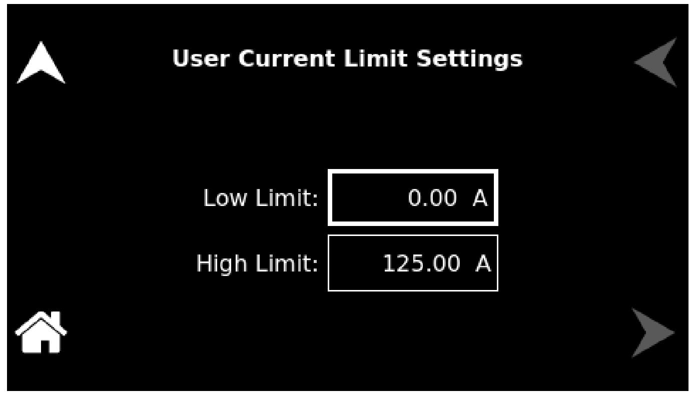


Figure 5-223: User Current Limit Settings

DEFAULT SCREEN

Selects whether the Default screen (showing only voltage and current amplitude) is enabled and configures its operational characteristics; the defaults are Default screen enabled, 10- second timeout.

Timeout Interval: Select the time, in seconds, for how long a screen must be inactive before the Default screen is displayed.

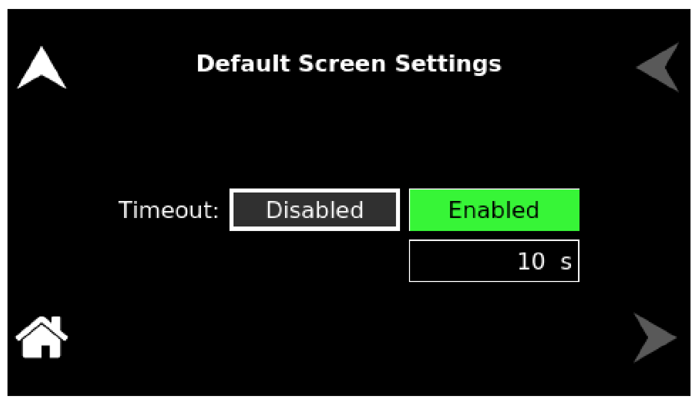


Figure 5-224: Default Screen Settings

PONS

The PONS menus allow setting the conditions that would be present after power up; The AC input must be cycled off/on for a change in a PONS setting to take effect. The functions and parameters have the same programmability as described in the menus of the OUTPUT PROGRAM screen.

CAUTION!

The PONS menus allow selecting that the output would be turned on and programmed to a high voltage when the unit is initially powered up. Ensure that suitable protection is provided to prevent accidentally energizing the load. The factory-default setting is with the output off and programmed to zero to provide the safest start-up condition.

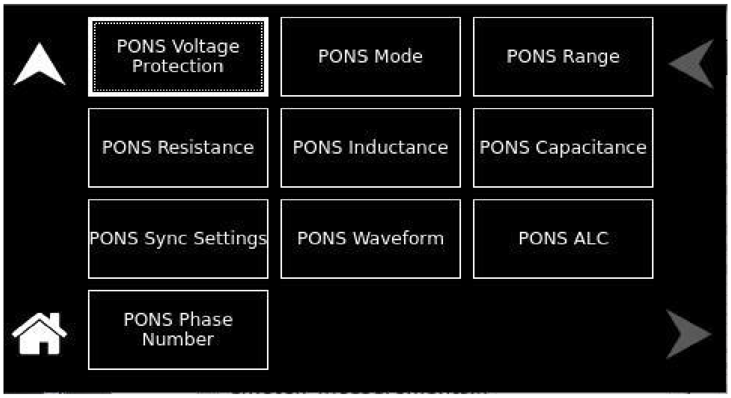


Figure 5-225: CONFIGURATION Menu, PONS Menu

The PONS menu has the following fields:

Entry	**Description**
PONS OVP	PONS menu: Programs the PONS Voltage Protection threshold for the output voltage of each output phase. Exceeding the OVP threshold will result in a shutdown of the output, with the output isolation relay opened and the output voltage programmed to zero. The maximum OVP setpoint is 115% FS low- range/high-range output voltage: AC- mode and (AC+DC)-mode, 191 V/383 V; DC- mode, 253 V/506 V. The default value is 115% FS.

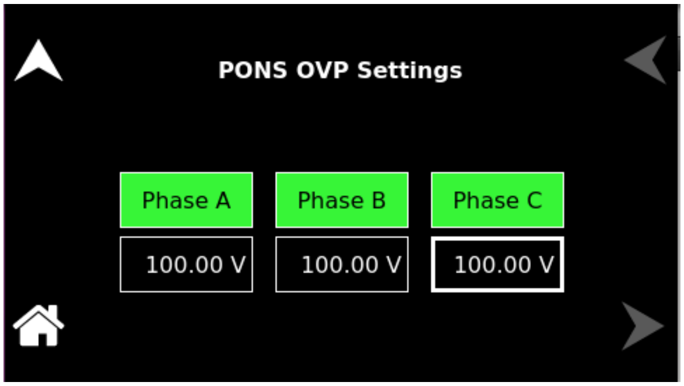


Figure 5-226: PONS OVP Settings

PONS MODE	**PONS menu:** Selects the mode of operation for the output voltage of the power source: either AC or DC; the default is AC.

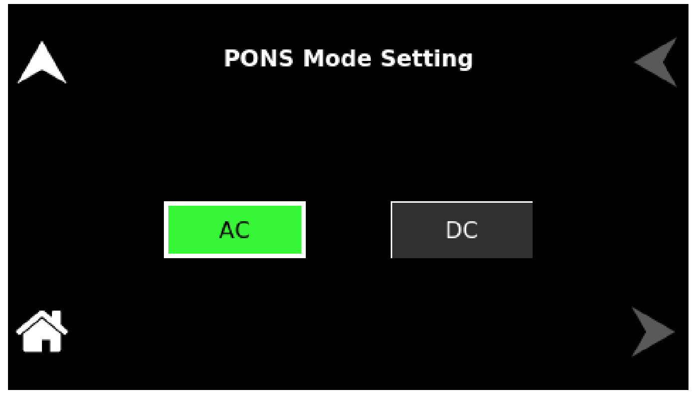


Figure 5-227: PONS Mode Settings

PONS RANGE

<u>PONS menu:</u> Selects the output voltage range, either low range,166 VAC or 220 VDC, or high range, 333 VAC or 440 VDC. The available ranges are dependent on the selection of the VOLTAGE mode, either AC or DC; the default is low-range, 166 VAC.

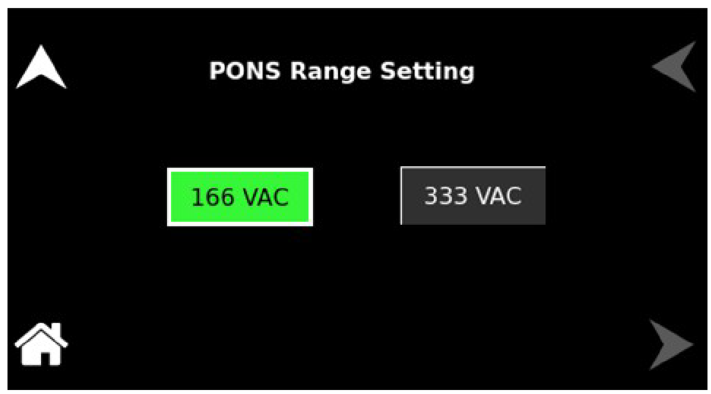


Figure 5-228: PONS Range Settings

PONS RESISTANCE

<u>PONS menu:</u> Sets the value of the output Resistance.

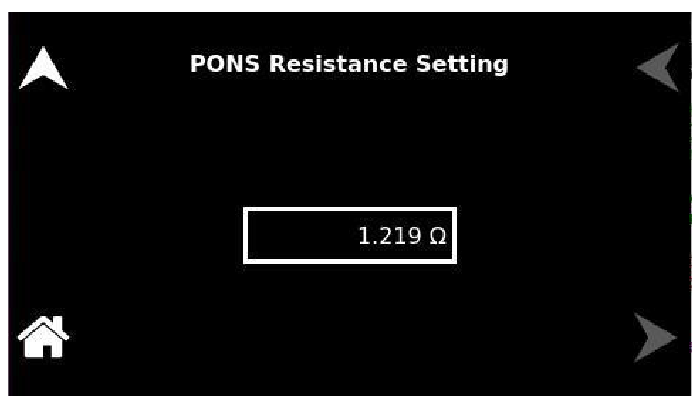


Figure 5-229: PONS Resistance Settings

PONS INDUCTANCE

PONS menu: Sets the value of the output Inductance.

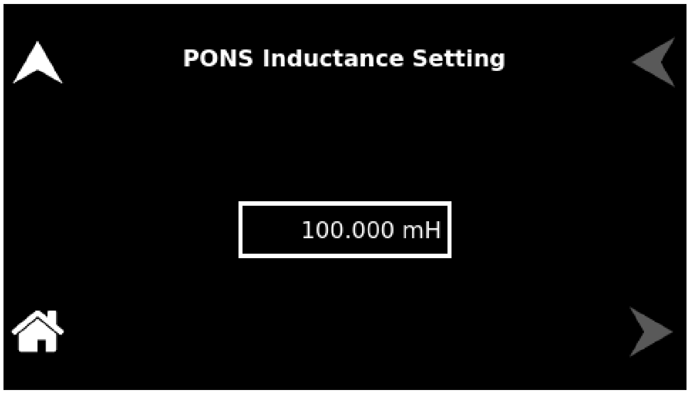


Figure 5-230: PONS Inductance Settings

PONS CAPACITANCE

PONS menu: Sets the value of the output Capacitance.

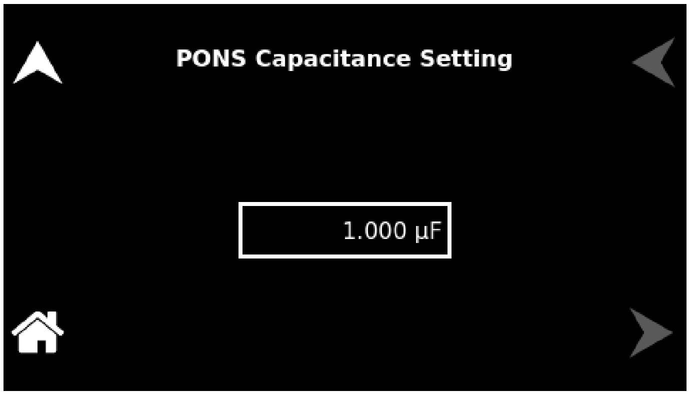


Figure 5-231: PONS Capacitance Settings

PONS SYNC

Programs the Sync Voltage, Sync Phase of each output phase, and Sync Freq

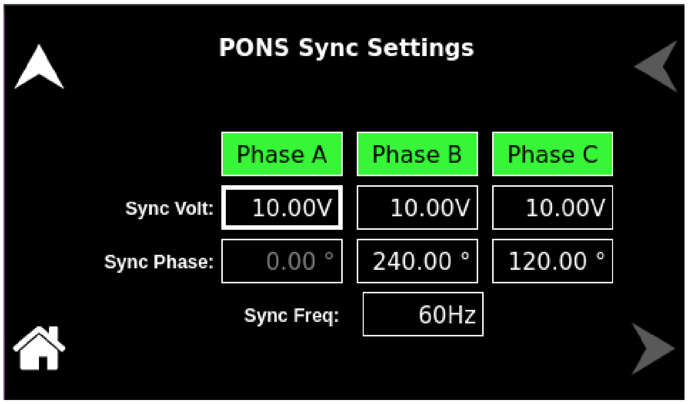


Figure 5-232: PONS Sync Settings

PONS WAVEFORM

PONS menu: Selects the type of output waveform, either the standard sine, square, or clipped-sine, or one that is user-defined; the default is a sine wave. The clipped-sine waveform has an additional programmable parameter, CLIP % THD. Refer to Section 6, Waveform Management for more information on the use of the menus.

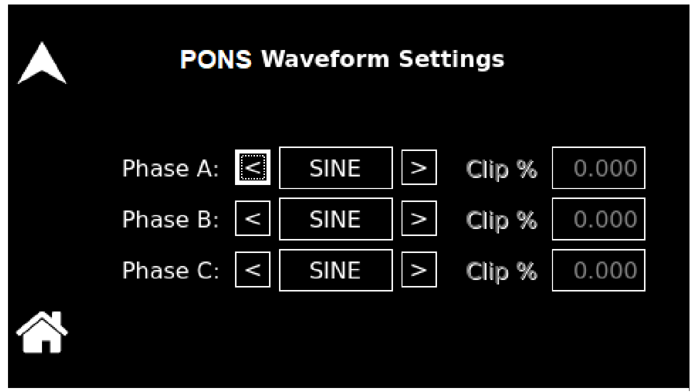


Figure 5-233: PONS Waveform Settings

PONS ALC

PONS menu: Selects how the output voltage will be regulated; default is ALC on:

ON: The RMS digital regulator is enabled, and shutdown will be executed if a loss of regulation occurs.

OFF: Regulation of the output voltage does not utilize the RMS digital regulator, and shutdown that is dependent on regulation would not occur.

Regulate: The RMS digital regulator is enabled, but shutdown will not be executed if loss of regulation occurs.

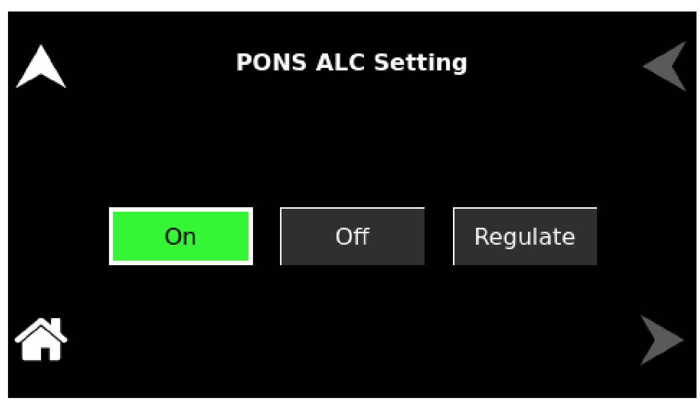


Figure 5-234: PONS ALC Settings

PONS PHASE NUMBER

PONS menu: Selects the output configuration, either 1-Phase or 3 Phase, for 3-Phase models; the default is 3-Phase.

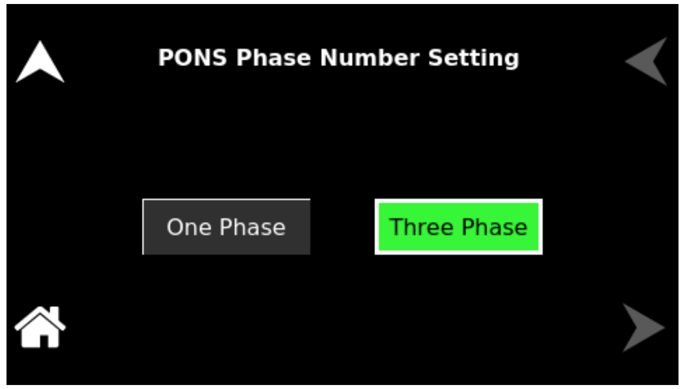


Figure 5-235: PONS Phase Number Settings

5.12 Measurements Screen

The Sequoia\Tahoe Series power source uses a DSP-based data acquisition system to provide extensive information regarding the output parameters. This data acquisition system digitizes the voltage and current waveforms and calculates parameter values from the data. The result of these calculations is displayed in a series of measurement data screens. The actual digitized waveforms can also be displayed by selecting the Trace Capture screen. The MEASUREMENTS screen top-level menu is used to display the results of output parameter measurements, harmonics analysis, and output waveforms.

The top-level menus of the MEASUREMENTS screens are shown in Figure 5-236. They can be reached in one of two ways:

1. Tapping MEASUREMENTS on the HOME Screen of the front panel touchscreen.
2. Scrolling to MEASUREMENTS with the encoder and depressing the encoder switch.

The Up-arrow button returns to the previously selected screen menu (e.g., the HOME Screen). The HOME button takes you to the HOME screen, which is the top-level menu for the currently displayed sub-menu. For the MEASUREMENTS screen, the top-level menu is the HOME Screen.

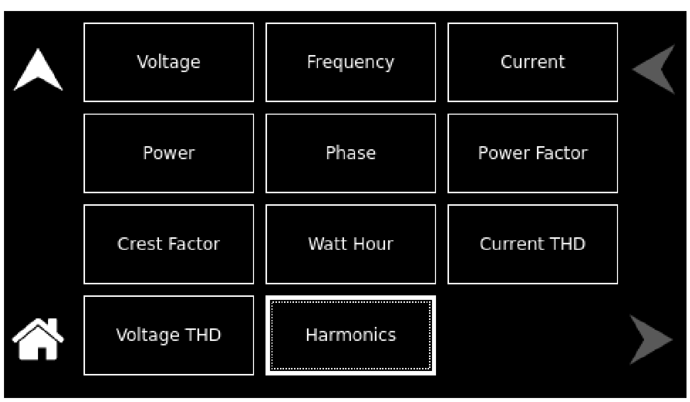


Figure 5-236: MEASUREMENTS Screen Top-Level Menu

The following functions are available on the menus of the MEASUREMENTS screen:

Entry	Description
VOLTAGE	Displays the true RMS value of the output voltage measured at the voltage sense lines (user selectable as local or remote). In DC mode, the voltage represents the DC voltage, including polarity.

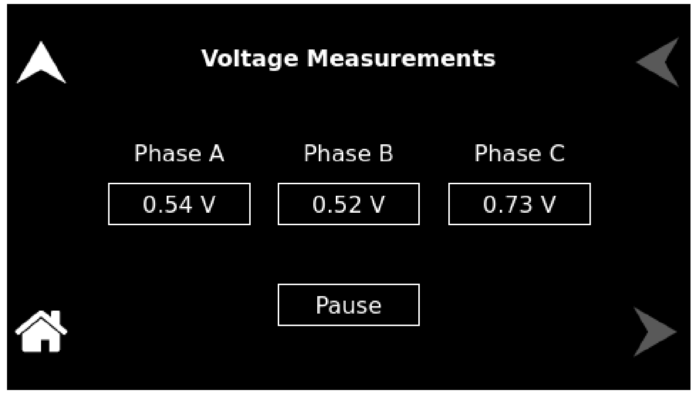


Figure 5-237: Voltage Measurements

FREQUENCY	In AC-mode or AC+DC-mode, this displays the output frequency. In DC mode, the value always shows "DC".

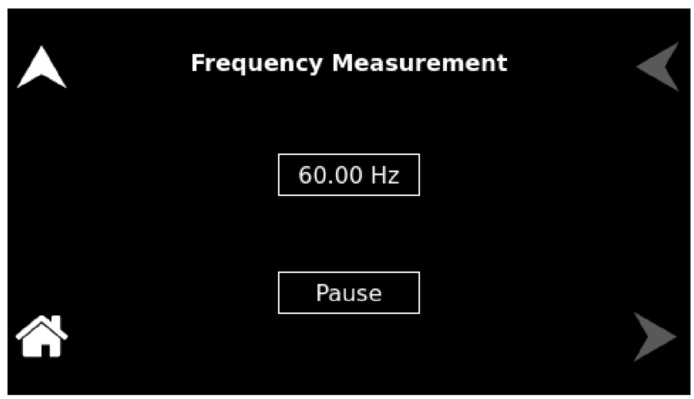


Figure 5-238: Frequency Measurements

POWER	Displays the true power, kW, and apparent power, kVA, of the load.

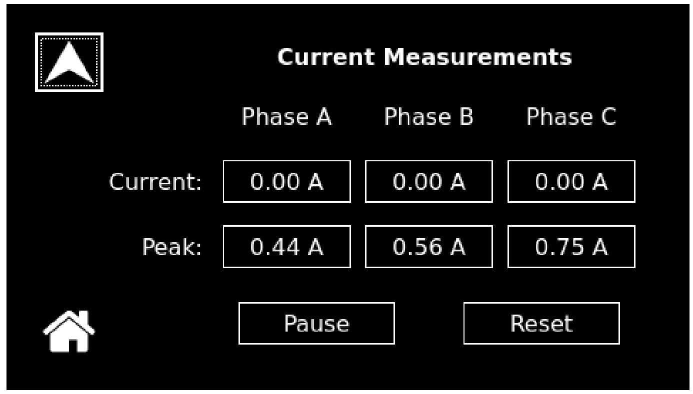


Figure 5-239: Power Measurements – Source, Grid Simulator, Electronic load – RMS Current and Electronic load RLC Programming Mode

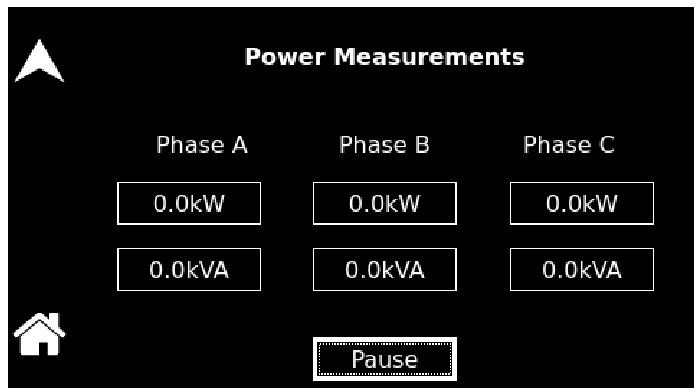


Figure 5-240: Power Measurements – Electronic load – Power Programming Mode

CURRENT

When in AC-mode or (AC+DC)-mode, displays the RMS output current. In the DC mode, displays the DC current, including polarity. The Peak Current displayed is the maximum instantaneous value that has been detected. The Reset function allows resetting the peak value to zero and restarting current tracking. The peak current measurement will continuously track the maximum current value detected until reset.

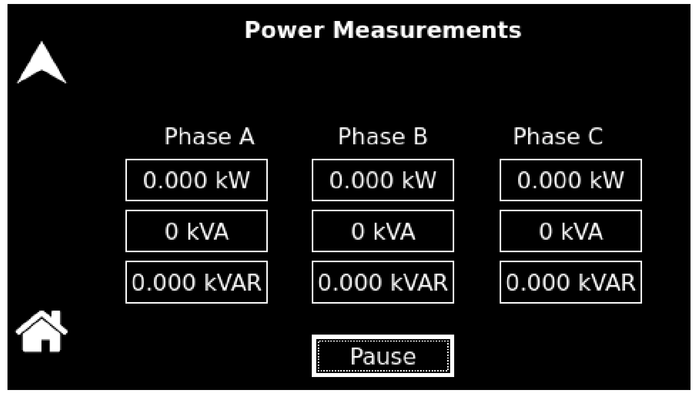


Figure 5-241: Current Measurements

PHASE

Displays the phase angle of the output of the power source: in a standalone unit, the phase angle would be with respect to the external SYNC signal; in an auxiliary unit (with LKS option) of a multi-phase group, the phase angle would be between the Auxiliary output and the Leader output. If the clock source is selected to be internal, this parameter is not used.

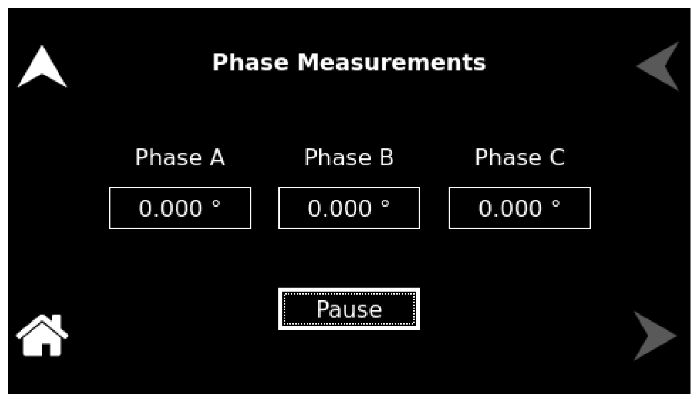


Figure 5-242: Phase Measurements

POWER FACTOR

Displays the power factor of the load.

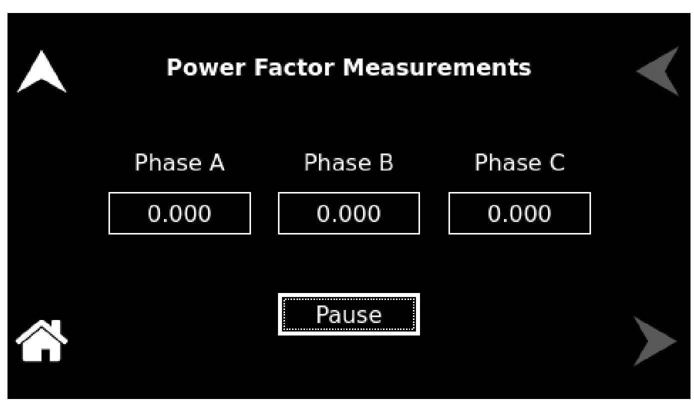


Figure 5-243: Power Factor Measurements

CREST FACTOR

Displays the crest factor of the output current as the ratio of its peak value to its RMS value.

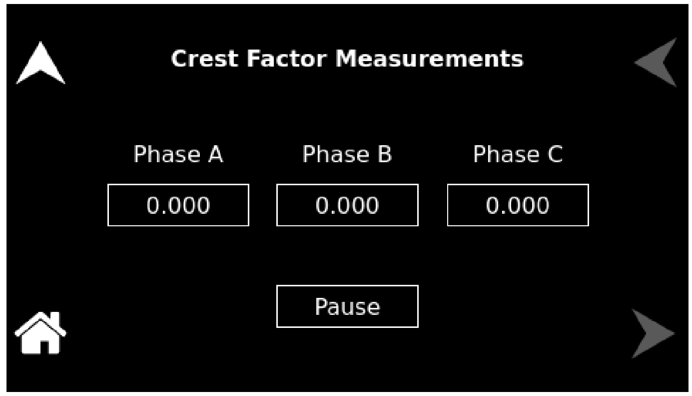


Figure 5-244: Cress Factor Measurements

WATT HOUR

Displays the energy, kWh, consumed by the load, and the true power in kW. The Start and Stop function determines the interval during which energy is calculated. The Clear function resets the accumulated energy value.

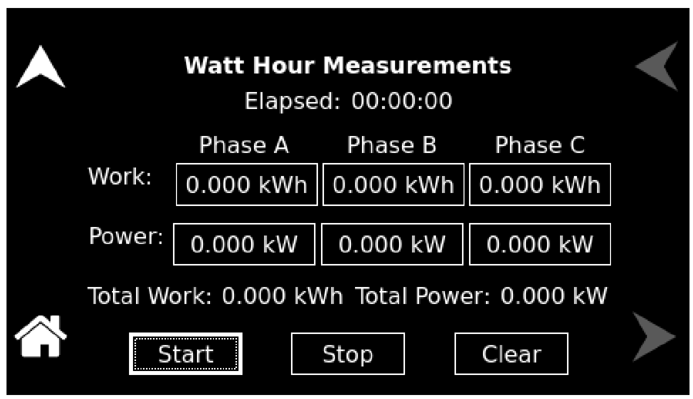


Figure 5-245: Watt Hour Measurements

CURRENT THD

Displays the total distortion of the output current. The distortion calculation is based on the harmonic currents, H2 through H50, relative to the total RMS value of the current. Another common definition of THD calculates the harmonics relative to the value of the fundamental current H1. There might be a difference in results depending on the harmonic content. The method is selectable over the digital interface with the SCPI command, `MEAS:THD:MODE <value>`, with the value being either RMS (relative to total RMS) or FUND (relative to fundamental).

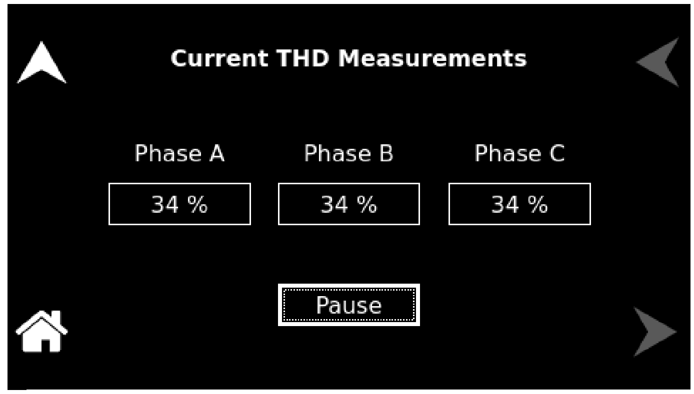


Figure 5-246: Current THD Measurements

VOLTAGE THD

Displays the total distortion of the output voltage. The distortion calculation is based on the harmonic voltages, H2 through H50, relative to the total RMS value of the voltage. Another common definition of THD calculates the harmonics relative to the value of the fundamental voltage H1. There might be a difference in results depending on the harmonic content. The method is selectable over the digital interface with the SCPI command, `MEAS:THD:MODE <value>`, with the value being either RMS (relative to total RMS) or FUND (relative to fundamental).

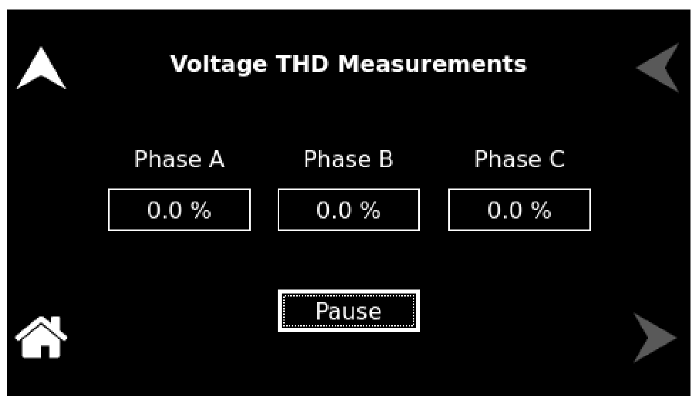


Figure 5-247: Voltage THD Measurements

HARMONICS

Displays harmonic content of voltage and current waveforms derived from an FFT analysis. The amplitude and phase of harmonics up to the 50th (bandwidth limited) are calculated and displayed.

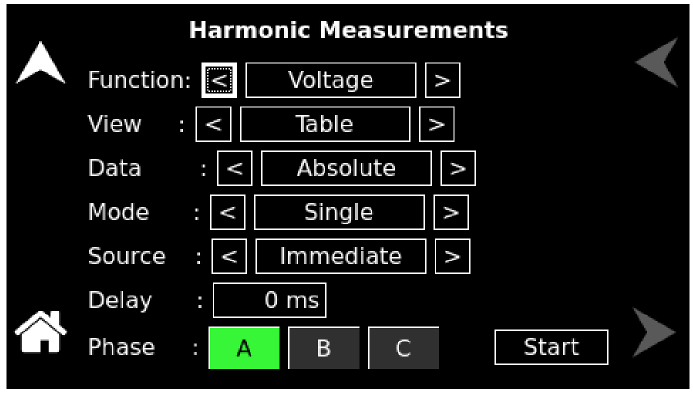


Figure 5-248: HARMONICS Menu

The HARMONICS menu has the following fields:

Entry	Description
FUNCTION	**HARMONICS menu:** Selects Voltage or Current for display.
VIEW	**HARMONICS menu:** Selects display modes, as follows: **Table**: Displays the first 50 harmonics (bandwidth limited) in a tabular text format, shown below. **Bar**: Displays the first 50 harmonics (bandwidth limited) in a graphical bar chart display, shown below.
DATA	**HARMONICS menu:** Selects absolute or relative harmonics display for TABLE and BAR view modes. In relative mode, all harmonics are shown in a percentage of the fundamental which is normalized at 100%. In absolute mode, the harmonic amplitudes are shown in absolute volts or amperes.
MODE	**HARMONICS menu:** Selects the trigger mode for the acquisition, as follows: **SINGLE**: Single-shot acquisition; in this mode, the acquisition is triggered once each time the START field is selected. The selected trigger source is used to determine the trigger point. Once the acquisition has been triggered, the data are displayed and do not change until the next acquisition is triggered. This mode is most appropriate for single-shot events, such as startup currents. **CONTINUE** Continuous acquisition; in this mode, acquisitions occur repeatedly, and the data is updated on screen after each trigger occurrence. This provides a continuous update of the data and is most appropriate for repetitive signals.
SOURCE	**HARMONICS menu:** Selects the event that will trigger a measurement acquisition, as follows: **IMMEDIATE**: Causes the acquisition to trigger immediately when the START field is selected. This is an asynchronous trigger event. The acquisition will always be triggered in this mode and data is available immediately. **PHASE**: Causes the acquisition to trigger on the occurrence of zero phase angle of the output voltage. When started, the

acquisition holds until the next zero-phase angle occurs, before triggering the acquisition. This mode allows the exact positioning of the acquisition data window with respect to the voltage waveform.

DELAY

HARMONICS menu: Selects the time delay to position the trigger point relative to the acquisition window. A negative value will provide pre-trigger information on data leading up to the trigger event. The pre-trigger delay cannot exceed the length of the acquisition buffer, for details. A positive trigger delay positions the data window after the trigger event. Positive trigger delays can exceed the length of the acquisition buffer in which case the trigger event itself will not be in the buffer anymore. The maximum value of the trigger delay is 1000 ms. The default trigger delay value is 0.0 ms which puts the trigger event at the beginning of the acquisition window.

PHASE

HARMONICS menu: Selects the output phase (Phase-A, Phase- B, or Phase-C) for the harmonic measurement.

START

HARMONICS menu; Starts a new acquisition run. When the start field is selected, and after the trigger event occurs, the display changes to the data display mode that was selected in the VIEW field of the HARMONICS menu; refer to Figure 5-247. To return to the HARMONICS menu, tap the HOME button while on the data display screen.

Harmonics Table View:

This function displays the frequency spectrum of the output voltage or current waveform (selected by the Function selection field) derived through FFT (fast Fourier transform) analysis. The frequency spectrum is listed in tabular format, ranging from the fundamental through the 50th harmonic, in five groups of ten harmonics; refer to Figure 5-249. The groups are selected using the Right and Left arrow buttons. Each harmonic has the following parameter data: harmonic number, amplitude, and phase angle. Refer to Section 6.2.1 for additional information on the harmonics tabular view.

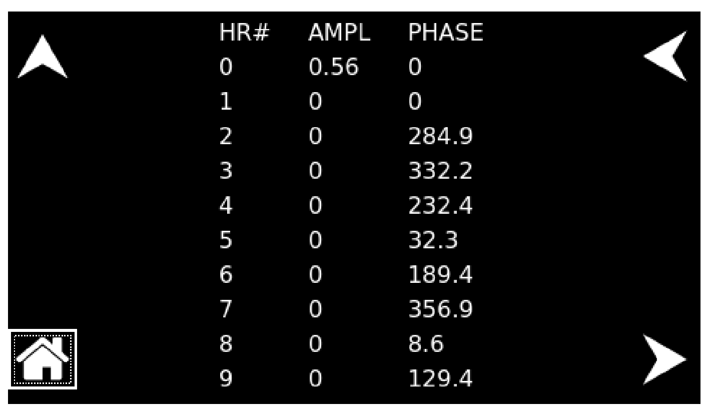


Figure 5-249: HARMONICS Menu, Table View

Harmonics Bar View: This function displays the frequency spectrum of the output voltage or current waveform derived through FFT (fast Fourier transform) analysis. The frequency spectrum is displayed in graphical format, ranging from DC through the 49th harmonic, with up to 25 harmonic components shown per screen; refer to Figure 5-250. Individual harmonics can be selected (shown with a triangle along the horizontal axis at the bottom) to display their parameter data using the Right and Left arrow buttons, touchscreen, or encoder. The upper right side presents the data for the selected harmonic: harmonic number, frequency, percentage of fundamental, and phase angle). Refer to 6.2.1 for additional information on the harmonics graphical view.

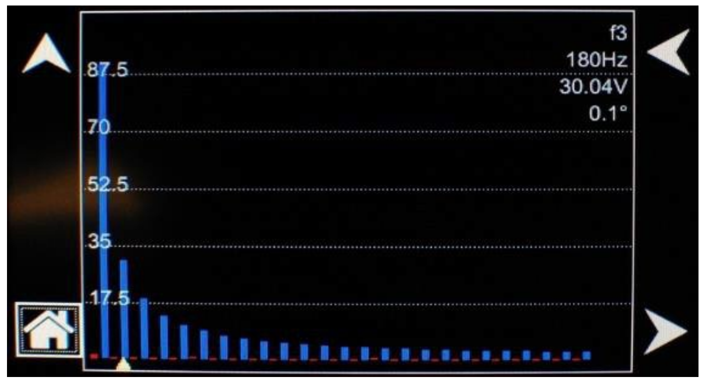


Figure 5-250: HARMONICS Menu, Bar Graph View

5.13 Control Interface Screen

The CONTROL INTERFACE screen provides the ability to configure the power source for remote control through the data communications interfaces, and to set up the functionality of the Remote Inhibit signal. For detailed information on setting up the data communications digital interfaces using the SCPI commands or the Sequoia\Tahoe Virtual Panels GUI, refer to the Sequoia Series Programming Manual P/N M447353-01, refer to AMETEK PPD website, www.programmablepower.com, to download the latest version.

In the Electronic Load Mode of operation, the External Analog programming feature is not applicable for the Power Programming and Parallel RLC Programming modes. Submenu for the Analog programming will not be available on the Control Interface screen, refer to Figure 5-251.

Additionally, there may be a delay when operating in Electronic Load Mode, which refers to the period before the electronic load responds to changes in the input signal or load settings.

The top-level menu of the CONTROL INTERFACE screen is shown in Figure 5-251 and Figure 5-252. It can be reached in one of two ways:

1. Tapping CONTROL INTERFACE on the HOME Screen of the front panel touchscreen.
2. Scrolling to CONTROL INTERFACE with the encoder and depressing the encoder switch.

The Up-arrow button will return to the previously selected screen menu (in this case the HOME Screen). The HOME button will return to the HOME screen that has the top-level menu for the sub-menu being displayed; for the CONTROL INTERFACE screen top-level menu, is the HOME Screen.

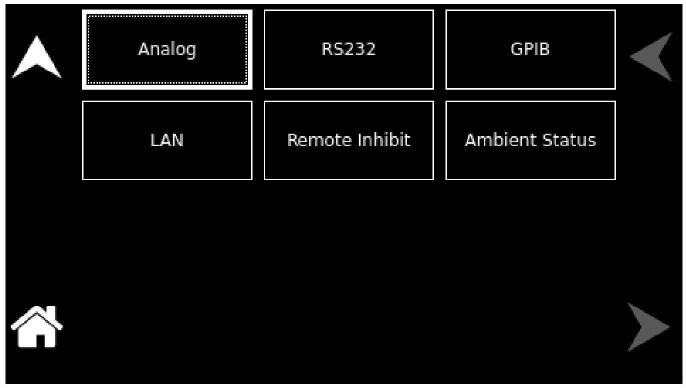


Figure 5-251: CONTROL INTERFACE Screen

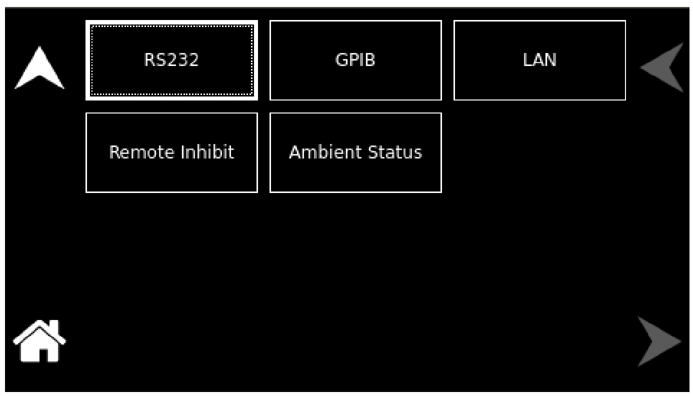


Figure 5-252: CONTROL INTERFACE Screen for Electronic Load-Power and Parallel RLC Programming

The following sub-menus are available in the CONTROL INTERFACE menu:

Entry	Description
ANALOG	Selects the reference that determines the output voltage waveform and amplitude; the default is INT. The options are as follows: **INT:** Selects programming of the output voltage waveform and amplitude by the internal controller reference. **RPV:** Selects programming of output voltage amplitude with an external analog interface signal, with the waveform being set by the internal controller reference. A Voltage field is provided for entry of DC input signal range: user-selectable maximum range value within 2.5 VDC to10 VDC, for full-scale RMS of the internally programmed output voltage waveform. **EXT:** Selects programming of the output voltage waveform and amplitude with an external analog interface signal. A Voltage field is provided for entry of AC or DC input signal range: 0 V to user-selectable maximum range value within 2.5 V(PK) to 10 V(PK), corresponding to the maximum range of 1.77 Vrms to 7.07 Vrms, for zero to full-scale RMS output voltage; with AC waveform, from 16 Hz to 5 kHz (option dependent).

Note: External Reference is not supported in Electronic Load Mode.

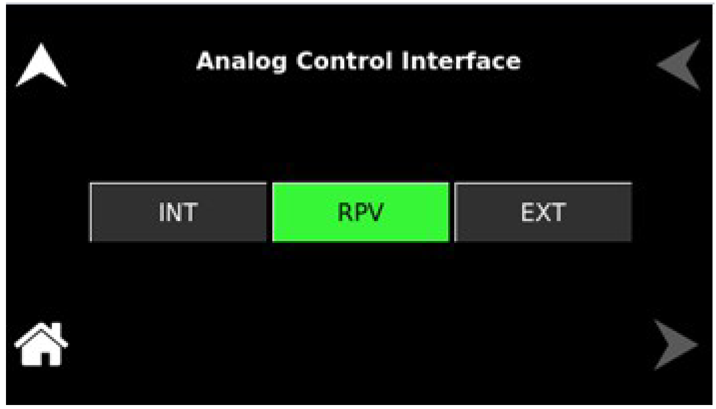


Figure 5-253: CONTROL INTERFACE Menu, ANALOG Sub- Menu

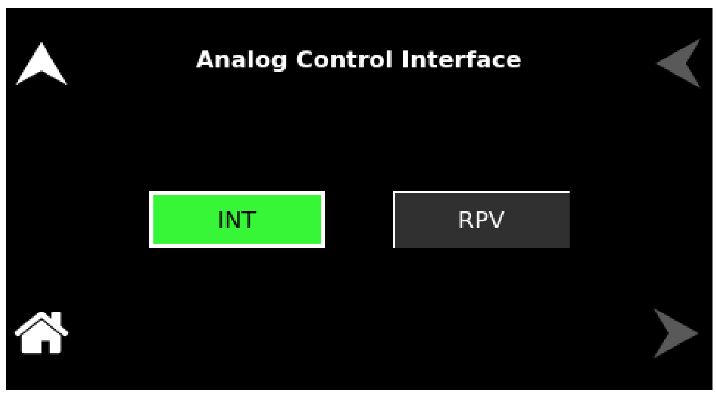


Figure 5-254: ANALOG Sub-Menu for Electronic Load-Current Programming Mode

RS232

Configures the RS-232C communications interface; These settings must match those set for the communications port of the user's external controller. The setup parameters are as follows:

Baud Rate: sets the baud rate to either 9600, 19,200, 38,400, 57600, or 115,200 baud. The default setting is 115,200 baud.

Data: sets the number of data bits to either 7 or 8. The default setting is 8 bits.

Parity: sets the parity to either Even, E, Odd, O or no parity, N. The default setting is no parity, N.

Stop Bits: sets the number of stop bits to either 1 or 2 bits. The default setting is 1 stop bit.

Start Bits: always set to 1.

Terminator for Received Messages: LF (ASCII 13) is necessary, but CR/LF (ASCII 10 / ASCII 13) would be accepted. Terminator for Transmitted Messages: LF (ASCII 13).

Flow Control: available hardware handshake RTS/CTS; utilization is recommended, but not mandatory.

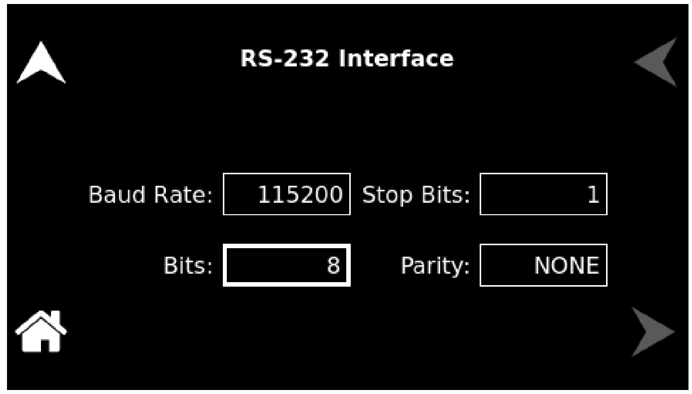


Figure 5-255: CONTROL INTERFACE Menu, RS232 Sub-Menu

GPIB

Sets the IEEE-488 address; the default is 1. The address can be set from 0 through 31, though address 0 is often reserved for the IEEE-488 external controller.

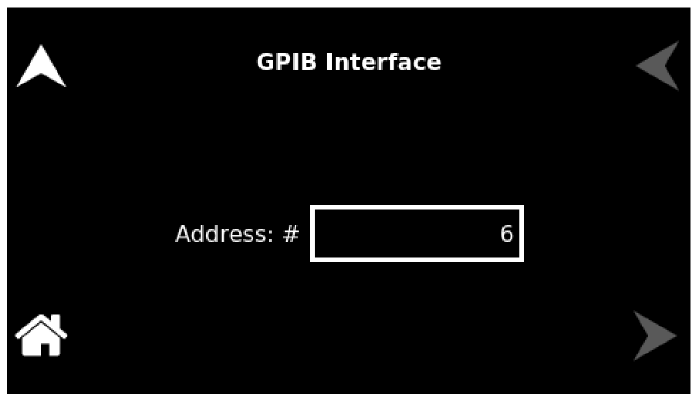


Figure 5-256: CONTROL INTERFACE Menu, GPIB

LAN

Configures the LAN (Ethernet) communications interface. After settings are changed, the unit must be turned off/on for them to take effect.

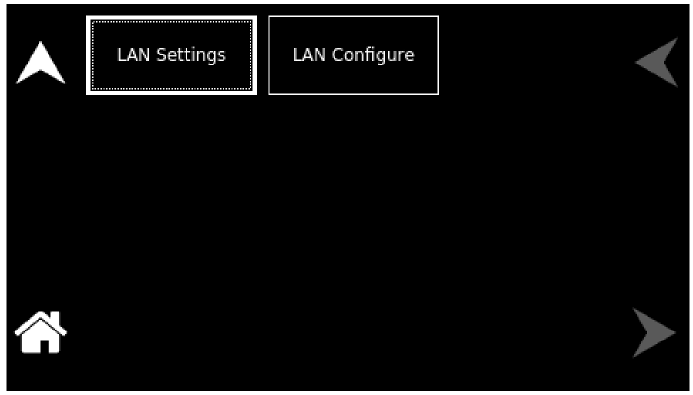


Figure 5-257: CONTROL INTERFACE, LAN Menu

The following sub-menus are available in the LAN menu:

Entry	Description
LAN SETTINGS	Lists the configuration settings of the LAN interface, and the DNS-SD service name; a number, (n), would be appended to the service name, if necessary, to differentiate duplicate power source names.

Figure 5-258: LAN Settings

LAN CONFIGURE	Sets parameter values and controls the operation of the LAN interface.

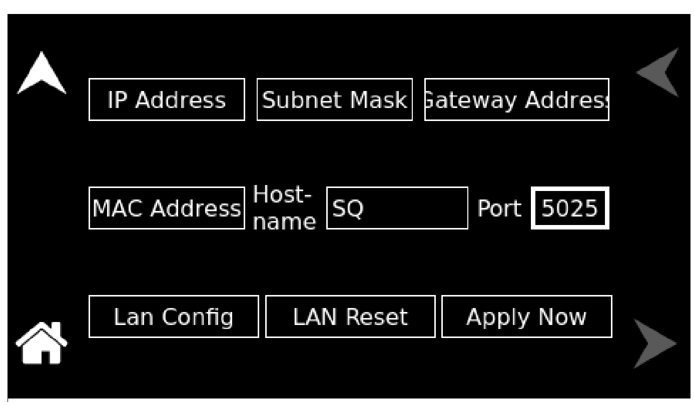


Figure 5-259: CONTROL INTERFACE, LAN CONFIGURE Sub-Menu

IP Address: Sets the IP address, when DHCP is turned off in the LAN CONFIG sub-menu (see below); when AUTO IP is selected, set the IP address to all zeros so that the IP address would be requested from the network; when DHCP is selected, the IP address is assigned by the network DHCP server.

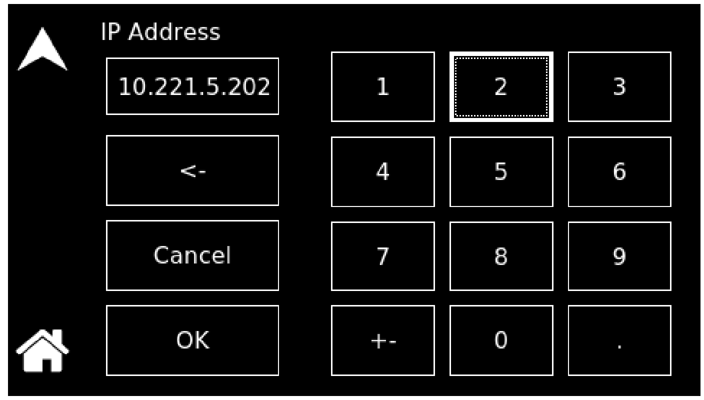


Figure 5-260: IP Address

Subnet Mask: Sets the subnet mask, when DHCP is turned off in the LAN CONFIG sub-menu (see below).

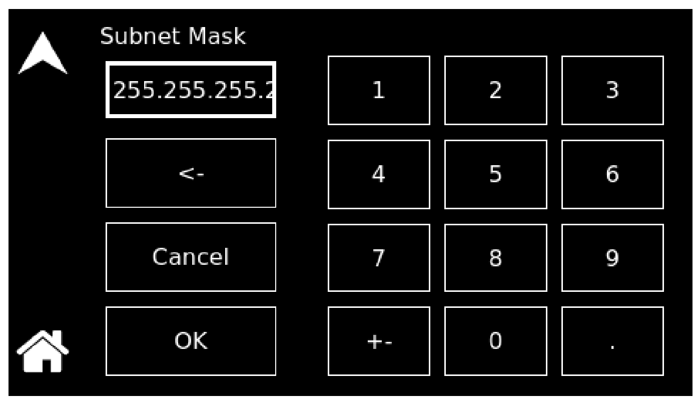


Figure 5-261: Subnet Mask

LAN CONFIG: Selects whether DHCP and Auto-IP are enabled.

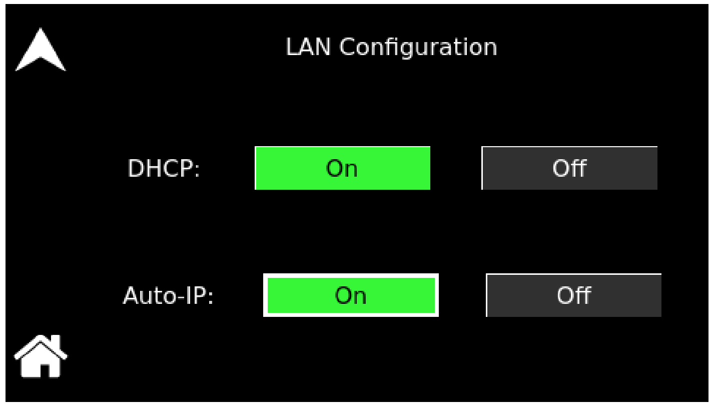


Figure 5-262: LAN Configuration

Gateway Address: Sets the gateway address when DHCP is turned off in the LAN CONFIG sub-menu; when AUTO IP is selected, set the gateway address to all zeros so that the gateway address would be requested from the network; when DHCP is selected, the gateway address is assigned by the network DHCP server.

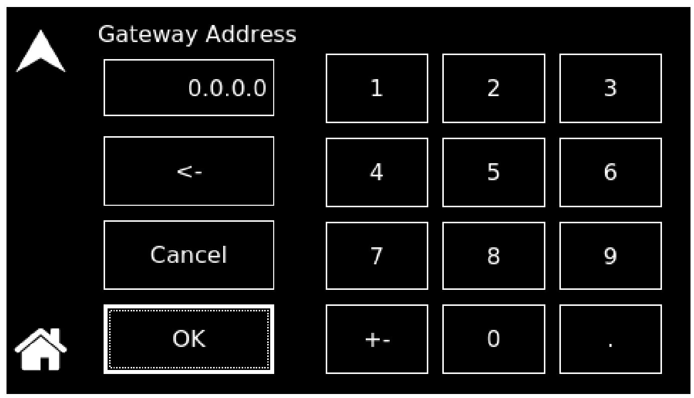


Figure 5-263: Gateway Address

Port: Sets the port number; the factory-default value is 5025.

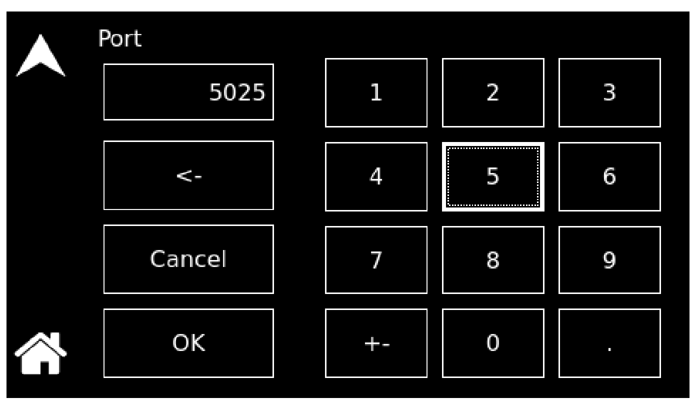


Figure 5-264: Port

MAC Address: Displays the MAC address; the MAC address is listed on a label on the chassis of the unit.

Figure 5-265: MAC Address

Host Name: Allows setting a unique alpha-numeric hostname.

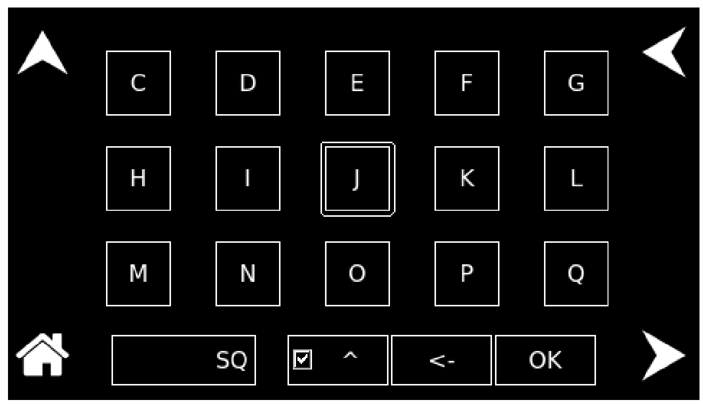


Figure 5-266: Host Name

Restore Default: Performs an LXI reset to default settings.

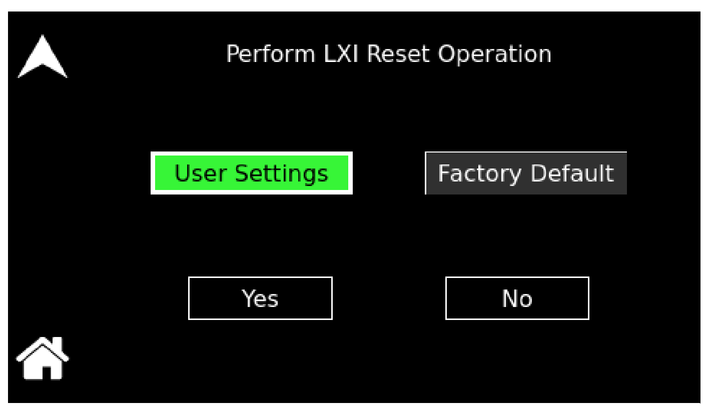


Figure 5-267: Restore Default

REMOTE INHIBIT Configures the external Remote Inhibit signal, between /INHIBIT_ISO (Pin-12) and ISO_COM (Pin-9), for turning the output ON/OFF. The default settings are Live and Low logic level.

Latching: A TTL logic signal at the external Remote Inhibit input latches the output in the shutdown state; when the output is turned off, it is programmed to zero volts, and the output relays are opened; this state can only be cleared by the remote digital interface SCPI command, `OUTPut:PROTection:CLEar;`

Live: The output state follows the state of the external Remote Inhibit input, turning the output ON/OFF.

Low/High: Selects the logic level of the Remote Inhibit signal that would cause the output to be turned off: either a logic low or contact closure, or a logic-high or open circuit.

Off: The power source ignores the external Remote Inhibit input.

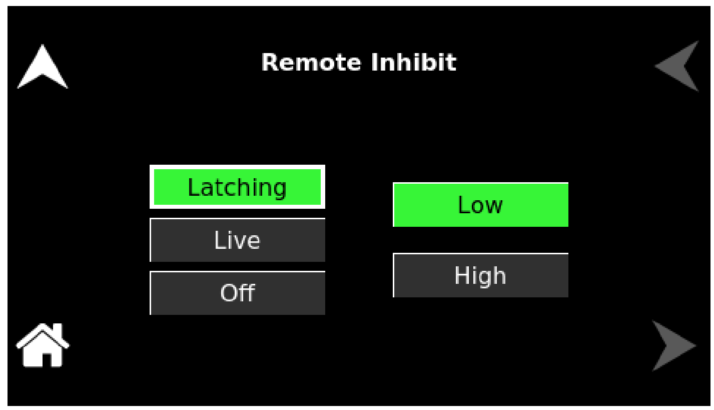


Figure 5-268: CONTROL INTERFACE REMOTE INHIBIT Menu

AMBIENT STATUS

Configures the Ambient led status feature to turn ON/OFF.

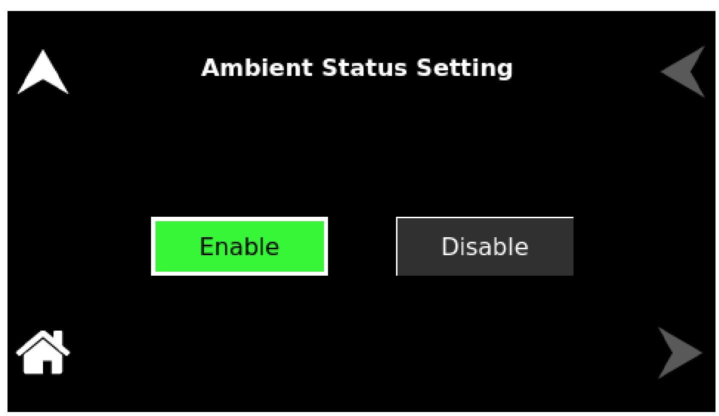


Figure 5-269: Ambient Status LED setting Screen

5.14 System Settings Screen

The SYSTEM SETTINGS screen provides information on versions of firmware and which options are installed. It also allows for selecting the language used for the display, performing calibration of the touch-screen, and viewing hardware limits settings.

The top-level menu of the SYSTEM SETTINGS menu is shown in Figure 5-268. It can be reached in one of two ways:

1. Tapping SYSTEM SETTINGS on the HOME Screen of the front panel touchscreen.

2. Scrolling to SYSTEM SETTINGS with the encoder and depressing the encoder switch.

The Up-arrow button will return to the previously selected screen menu (in this case the HOME Screen). The HOME button will return to the HOME screen that has the top-level menu for the sub-menu being displayed; for the SYSTEM SETTINGS screen top-level menu, is the HOME Screen.

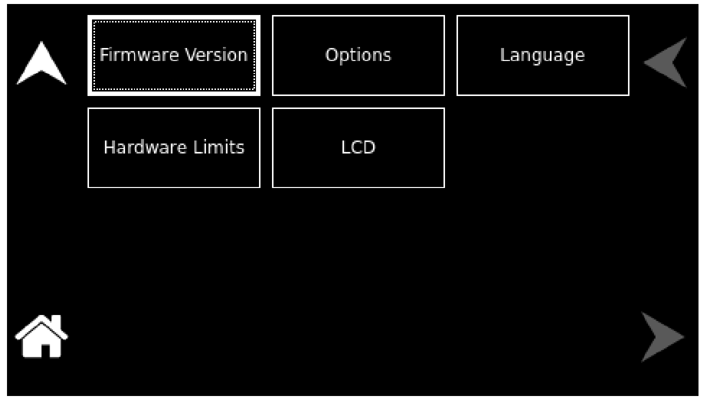


Figure 5-270: SYSTEM SETTINGS Screen

The following sub-menus are available in the SYSTEM SETTINGS menu:

Entry	Description
FIRMWARE VERSION source.	Displays information about the configuration of the power It has information such as manufacturer, model number, serial number, and firmware version. This information helps identify the unit and options installed.

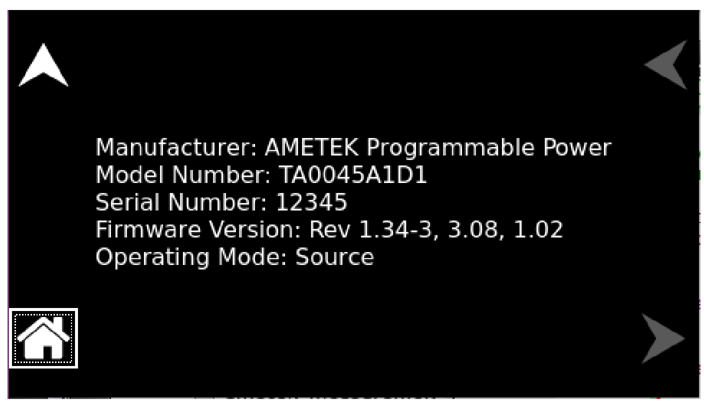


Figure 5-271: Model and Firmware Version for TAHOE Series

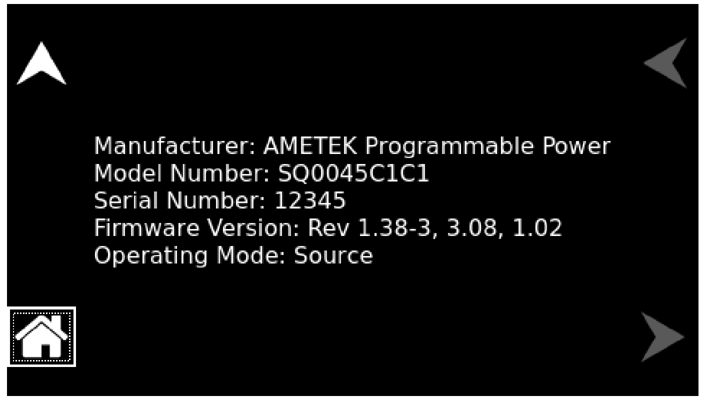


Figure 5-272: Model and Firmware Version Screen for Source Mode

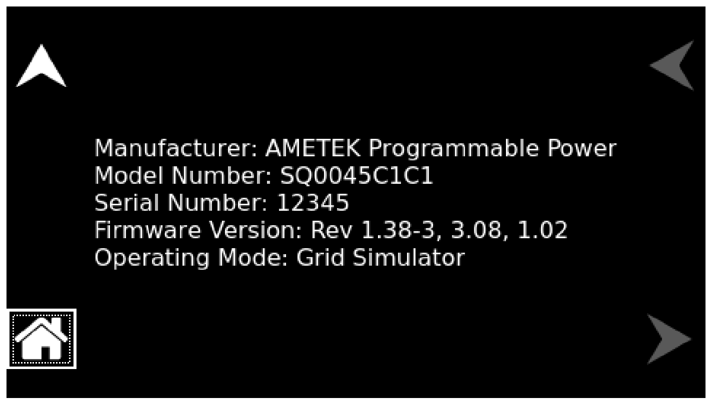


Figure 5-273: Model and Firmware Version Screen for Grid Simulator

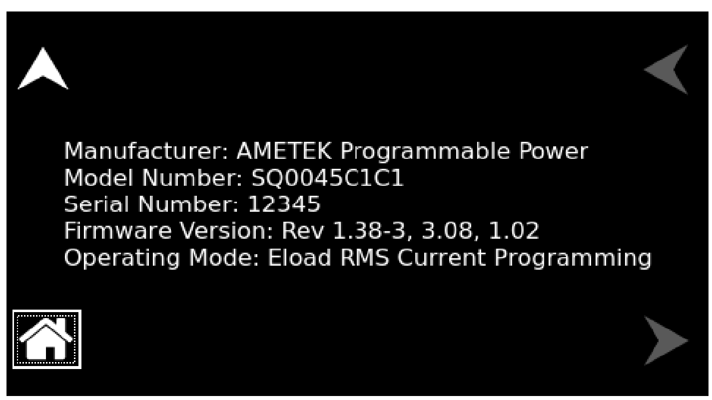


Figure 5-274: Model and Firmware Version Screen for Electronic load – Current Programming Mode

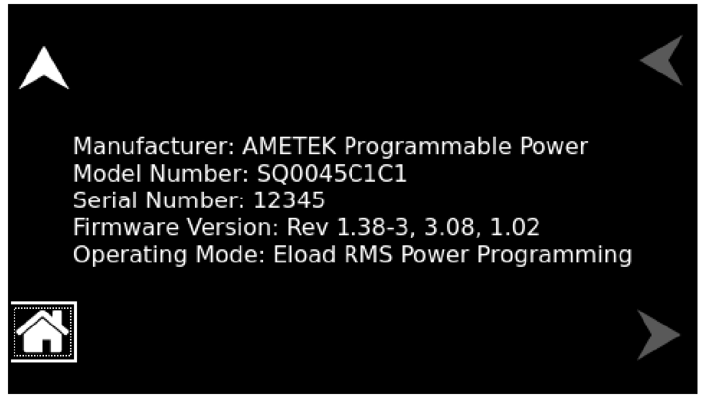


Figure 5-275: Model and Firmware Version Screen for Electronic load – Power Programming Mode

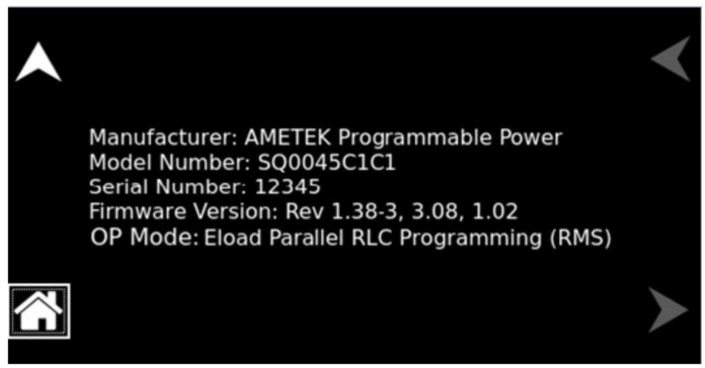


Figure 5-276: Model and Firmware Version Screen for Electronic load – RLC Programming Mode

OPTIONS Displays options that have been installed in the power source.

Figure 5-277: Options Screen

Figure 5-278: Options Screen

LANGUAGE

Selects the language of the display menus: English, German, French, Russian, Japanese, Chinese, or Korean.

Figure 5-279: Language Screen

HARDWARE LIMITS

Displays the parameter limit values that are asserted at power-on.

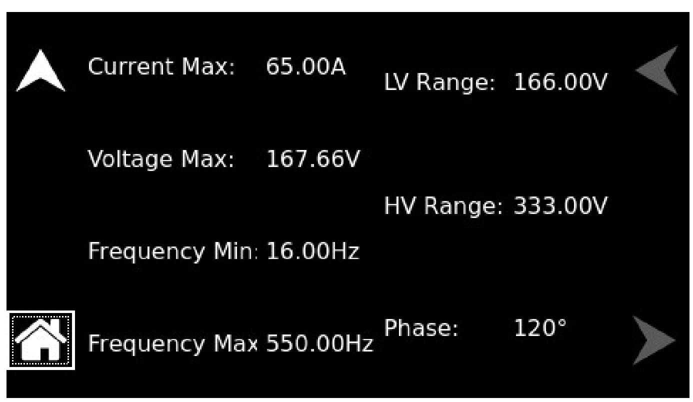


Figure 5-280: Hardware Limits Screen

LCD Provides settings for the calibration of the display touchscreen.

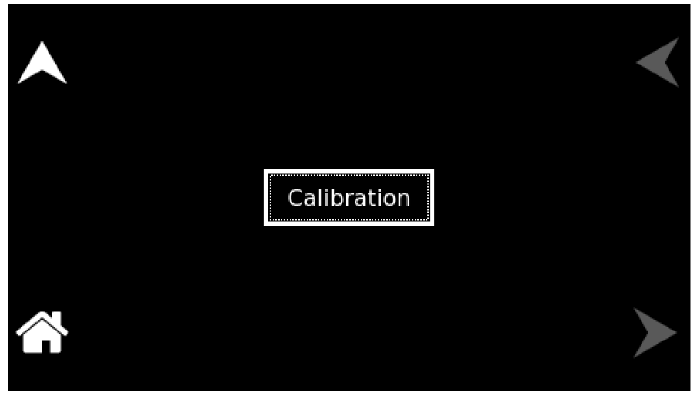


Figure 5-281: LCD Settings

Calibration Enables the calibration routine for the display touchscreen; the calibration is run by tapping the displayed target, as instructed on the display. The touchscreen depends on pressure being applied to the top surface of the screen to detect the position of the input. A fingertip, fingernail, or stylus pen can be used. To prevent scratching the surface layer, do not use a hard or sharp tip, such as a ball-point pen or mechanical pencil settings for the LCD brightness and calibration of the display.

Figure 5-282: Calibration Screen

5.15 Warning/Fault Screen

The following warning screen may appear during supply fault conditions, refer to Figure 5-283. Pressing on the OK warning screen will be closed. The user should Clear the Fault to continue the operations of the power supply and clear the fault.

These warnings indicate a description of Faults which have occurred in a power module. These conditions might clear themselves, however, if they continue to occur after sending the clear Fault command; Contact the factory for service assistance.

Figure 5-283: Warning Fault Screen

6. WAVEFORM MANAGEMENT

The Sequoia / Tahoe Series power source incorporates an arbitrary waveform generator that allows the user to create custom waveforms (up to 50) and download them into the memory of the unit. In addition, three standard waveforms are always available: sine wave, square wave, and clipped-sine wave. The full capability of waveform management is programmed through the remote digital interface using SCPI commands or the Sequoia Virtual Panels GUI; refer to the Sequoia Series Programming Manual P/N M447353-01 and Tahoe Series Programming Manual P/N M447354-01 in the AMETEK PPD website, www.programmablepower.com, to download latest version.

6.1 Standard Waveforms

For many AC applications, the sine wave is the prevalent waveform that is used. Therefore, it is one of the standard waveforms provided in the power supply and is the default waveform at power-on. In addition to the sine wave, two more standard waveforms are available, square wave and clipped-sine wave.

The square wave provides fast rise and fall times, with high harmonic content. Due to the power stage amplifier bandwidth limitations, the frequency content of the standard square wave is restricted to being within the capabilities of the amplifier. As the fundamental frequency is increased, the relative contribution of higher harmonics is reduced.

The clipped-sine wave may be used to simulate voltage distortion levels to the unit under test. The total harmonic distortion level may be programmed in percent using the CLIP % THD field of the WAVEFORMS menu of the CONFIGURATION screen; Changing the distortion level of the waveform through the display menu forces the power source to regenerate the data points of the clipped-sine wave, and reload the waveform register with the newly requested data; this process requires the output to be programmed to zero. To avoid interrupting the output voltage to the unit under test, SCPI commands are used through the digital interface to select a different waveform such as the standard sine wave first, change the CLIP LEVEL, and then change the waveform back to the clipped-sine wave.

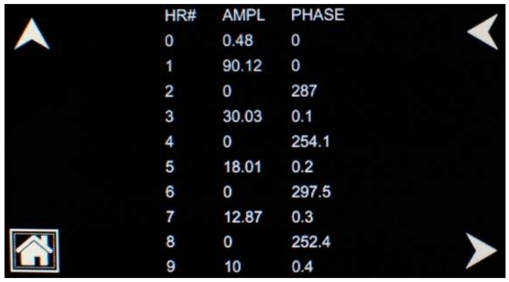
6.2 Creating Custom Waveforms

The Sequoia / Tahoe Series power source provides a library of four waveform groups (numbered 0 through 3), each containing 50 custom-defined waveforms for a total of 200 waveforms, in addition to the three standard waveforms. Of these four groups, only one can be active at a time. With front panel control, only the waveform group that was present at the power-on can be accessed. The available waveforms are selected through the WAVEFORMS menu of the CONFIGURATION screen.

Custom waveforms cannot be created or deleted from the front panel of the power source. Instead, this must be accomplished through the remote digital interface. The standard waveforms permanently reside in memory and cannot be deleted. A Windows-based graphical user interface program, Virtual Panels, is included with the power source that allows waveforms to be created and downloaded easily. Virtual Panels GUI allows waveforms to be created by specifying harmonic amplitudes and phase angles with respect to the fundamentals. It also offers an arbitrary waveform data entry mode that allows individual data points to be specified. For detailed information on creating waveforms, refer to the Sequoia Programming Manual P/N M447353-01 and Tahoe Programming Manual P/N M447354-01.

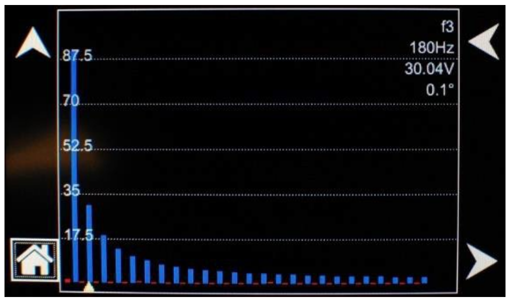
6.2.1 Viewing Custom Waveforms on the Display

Information on user-defined, custom waveforms can be viewed on the display using the HARMONICS menu of the MEASUREMENT screen. The harmonics can be displayed either in a tabular form or a bar graph (refer to Figure 6-1: HARMONICS Screen, Waveform Information) for an example of the information on the waveform that can be derived from the display. After loading a waveform, and programming the output with it, the TRACE CAPTURE screen of the MEASUREMENTS menu can be used to view it in real-time.



HR#	AMPL	PHASE
0	0.48	0
1	90.12	0
2	0	287
3	30.03	0.1
4	0	254.1
5	18.01	0.2
6	0	297.5
7	12.87	0.3
8	0	252.4
9	10	0.4

TABLE Sub-Menu



BAR Sub-Menu

Figure 6-1: HARMONICS Screen, Waveform Information

6.3 RMS Amplitude Restrictions

The maximum RMS value that can be programmed within a voltage range is dependent on the crest factor of the output voltage waveform due to constraints of the power stage amplifier on producing the peak voltage. The voltage range limit is based on a sine wave with a crest factor of 1.414: for example, in the High-Range, the full-scale AC sine wave voltage of 400 Vrms has a peak voltage of 566 V(PK), and that is the maximum peak voltage that can be produced for any other type of waveform. Therefore, if a custom waveform is used and the crest factor is greater than 1.414, the maximum programmable RMS voltage would be less than the maximum range value to stay within the peak voltage limit.

The power source automatically limits the maximum allowable programmed RMS voltage of any custom waveform by calculating the crest factor of the selected waveform to ensure that the peak output voltage capability is not exceeded and controlling the RMS limit accordingly. Therefore, each custom waveform might have a different maximum RMS value. The power source controller will prevent the user from programming the RMS voltage above this limit. If a value is entered above this value, a “Voltage peak error” message is generated.

If the power source is controlled through the remote digital interface, the SCPI query command, `:VOLT? MAX`, is used to determine the maximum allowable RMS voltage for the selected waveform. The query returned value should be used as part of a program to preclude range errors.

6.4 Frequency Response Restrictions

The user can create a waveform that contains several harmonic frequencies of the fundamental. However, the power source has a finite signal bandwidth and would attenuate frequency components of the signal that exceed that bandwidth. To limit the high-frequency components of the output signal, the power source controller automatically applies a band-pass filter to all custom waveforms as they are downloaded. The power source controller implements the following process for user-defined waveforms:

Each downloaded waveform will have a computed frequency limit that is less than or equal to the maximum frequency limit of the power source. The frequency limit is a function of the harmonic content of the waveform and is derived from the following relation:

$$F_{harmonic} \leq (V_{full\text{-}scale} \times F_{maximum}) / (V_{harmonic\text{-}amplitude} \times harmonic\text{-}number)$$

where, $F_{harmonic}$ *= harmonic frequency,*

$V_{full\text{-}scale}$ *= the full-scale rated voltage,*

$F_{maximum}$ *= the full-scale fundamental frequency,* $V_{harmonic\text{-}amplitude}$ *= the amplitude of the harmonic,*

harmonic-number = the multiple of the full-scale fundamental frequency.

The limits that are set assume a program FS output voltage. There is no accommodation for voltage settings that are made below the full-scale value. Waveform selection and frequency programming will be subject to the limit. If the $F_{harmonic}$ parameter is above the minimum limit value, the waveform will be rejected at the time of download, the entry label will be deleted from the waveform library, and an error message will be generated.

If the power source is controlled through the remote digital interface, the SCPI query command, `:FREQ? MAX` is used to determine the maximum allowable fundamental frequency for the selected waveform. The value returned for the query should be used as part of a program to preclude range errors.

6.5 Transient List Waveforms

Waveforms can be selected as part of a transient list. Each setup menu of a transient type has a FUNCTION field that allows you to choose from any of the standard or user-defined custom waveforms in the active waveform group (one of the four, 0-3). The active group is the one loaded at power-on or selected by SCPI commands through the remote digital interface. For more details on selecting output waveforms within transient lists.

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7. STANDARD MEASUREMENTS

The Sequoia Series power source is continuously sampling the instantaneous output voltage and current and storing the data in a buffer that holds 4096 voltage and current data points (frame). The data is used to calculate the values of the parametric measurements, with two cycles of measurement required to derive an RMS value. The voltage and current are sampled at two rates, 93.75 ksps or 31.25 ksps, depending on the output frequency. At ≥ 48 Hz, the sample rate is 93.75 ksps, giving a derivation time of 43.69 ms per frame. There is hysteresis of 4 Hz when switching to the lower sample rate, so at ≤ 44 Hz, the sample rate is reduced to 31.25 ksps, and the time required per frame is 131 ms.

Measurement of output parameters is available in either the MEASUREMENTS screen or the DASHBOARD screen. The MEASUREMENTS screen allows only for the display of measurements, and provides either a group display of parameters, or a dedicated screen for each parameter that can be selected when a single parameter is of concern. The DASHBOARD screen provides the display of voltage, current, and frequency, as well as the ability to set their values. The full extent of the measurements capability is accessed through the remote digital interface using SCPI commands or the Sequoia Virtual Panels GUI; refer to the Sequoia Series Programming Manual P/N M447353-01, Tahoe Series Programming Manual P/N M447354-01 or refer to AMETEK PPD website, www.programmablepower.com, to download the latest version.

7.1 Parameter Measurements

The output mode of operation, whether AC, DC, or AC+DC, determines which parameters are available in the MEASUREMENTS screens, as shown in Table 7-1.

Parameter	Output Mode of Operation		
	AC	DC	AC+DC
VOLTAGE	RMS of AC voltage	RMS voltage	RMS voltage
CURRENT	RMS of AC current	RMS current	RMS current
FREQUENCY	Frequency	N/A	Frequency
REAL POWER	Real power	Real power	Real power
APPARENT POWER	Apparent power	Apparent power	Apparent power
PHASE	Phase angle	N/A	Phase angle
POWER FACTOR	Power factor	N/A	Power factor
CREST FACTOR	Crest factor	N/A	Crest factor
VOLTAGE THD	%THD	N/A	%THD
CURRENT THD	%THD	N/A	%THD
ENERGY	Watt-Hour	Watt-Hour	Watt-Hour

Table 7-1: MEASUREMENTS Screen Parameters

The output voltage mode also determines how parameter value measurements are derived, and how the measurement signals are internally coupled, whether AC or DC; refer to Table 7-2.

Operating Voltage Mode	Measurement Value	Measurement System Signal Coupling
AC	RMS of AC component	AC
DC	Total RMS, AC plus DC components	DC
AC+DC	Total RMS, AC plus DC components	DC

Table 7-2: MEASUREMENTS Parameter Value Derivation

7.1.1 Accuracy Considerations

When using the power source for measurements, always consider the accuracy specifications when interpreting the results. Measurement inaccuracies are more noticeable when the signal being measured is at the low end of the measurement range, especially for low current measurements. The Sequoia Series power source is designed to provide and measure high-load currents. When supplying low-power loads, measurement inaccuracies in RMS and peak current values will also affect other derived parameters, such as power, power factor, and crest factor.

The power source's measurement system uses a data acquisition system with a 47 kHz bandwidth, meaning that high-frequency components of the measured signal are filtered out. Any voltage and current components above the filter cutoff frequency will not be reflected in the measurements. As a result, voltage and current measurements of waveforms with significant high-frequency harmonic content may have additional errors.

7.2 Advanced Measurements

The Sequoia / Tahoe Series power source offers advanced power analyzer measurement capabilities through DSP-based digitization of the output voltage and current waveforms. These functions may be accessed through the menus of the MEASUREMENTS screen. The full capability of advanced measurements is accessed through the remote digital interface using SCPI commands or the Sequoia Virtual Panels GUI; refer to the Sequoia Series Programming Manual P/N M447353-01, Tahoe Series Programming Manual P/N M445374-01 or refer to AMETEK PPD website, www.programmablepower.com, to download the latest version.

7.2.1 Harmonic Analysis

The power source analyzer performs a fast Fourier transform (FFT) on both voltage and current. The resulting frequency spectrum (DC through 49th harmonic) can be displayed on the LCD display in a tabular as well as a graphical format.

7.2.2 Acquiring FFT data

To perform an FFT analysis on the output of the power source using the front panel display, proceed as follows:

1. Navigate to the HARMONICS menu of the MEASUREMENTS screen; refer to Figure 7-1.

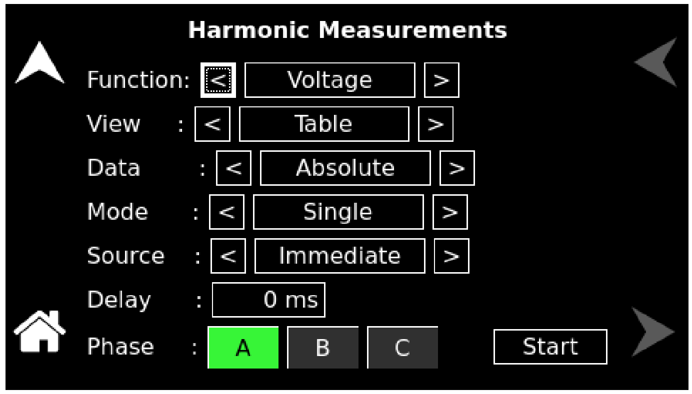
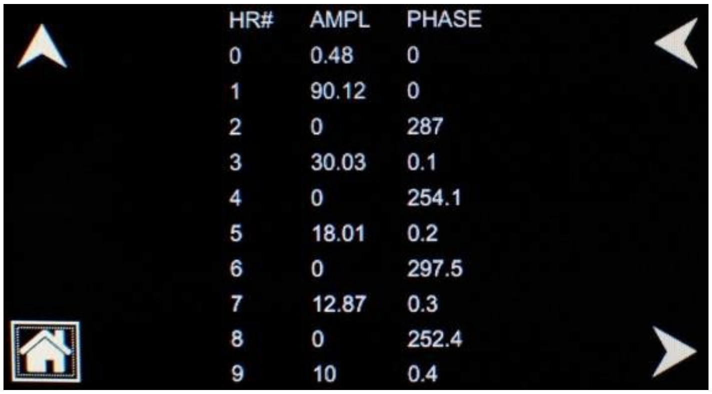


Figure 7-1: HARMONICS Menu

2. Scroll to the FUNCTION field and select VOLT or CURRENT.
3. Scroll to the VIEW field and select the TABLE or BAR display mode.
4. Scroll to the DATA field and select ABSOLUTE or RELATIVE. The ABSOLUTE display format will show all harmonic components in volts or amps. The RELATIVE display format will use the fundamental as a 100% reference and display all harmonics as a percentage of the fundamental. Phase angles are always shown with respect to the fundamental frequency.
5. Tap the MODE field and select SINGLE or CONTINUE. The SINGLE mode will acquire the data once and show the result, while the CONTINUE mode will update the data continuously.
6. Tap the SOURCE field and select IMMEDIATE; alternate trigger mode is PHASE.
7. Tap Phase-A, Phase-B, or Phase-C button to select which output phase would be analyzed.
8. Tap the START field to start the analysis. The display mode that was selected will be opened and the results displayed. If the trigger mode, CONTINUE, was selected, the data will be continually updated.
9. To return to the HARMONICS menu, tap the Up-arrow button. To display the data in a different format, the selections may be changed as desired, and a new acquisition executed by tapping the START button.

7.2.3 Analyzing FFT Data

The FFT results can be displayed for the entire data set in either tabular or graphical formats. In the tabular display, the harmonics are grouped into five sets, with ten harmonics per set. The LEFT and RIGHT arrow buttons are used to scroll through the data vertically, refer to Figure 7-2.



HR#	AMPL	PHASE
0	0.48	0
1	90.12	0
2	0	287
3	30.03	0.1
4	0	254.1
5	18.01	0.2
6	0	297.5
7	12.87	0.3
8	0	252.4
9	10	0.4

Figure 7-2: FFT data in Tabular Format

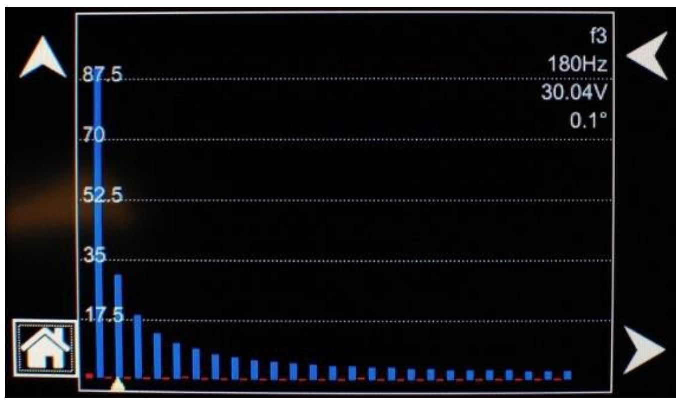


Figure 7-3: FFT data in Bar Graph Format

FFT data displayed in bar chart format shows the same data in a graphical format; refer to Figure 7-3. While the amplitude information is shown graphically, phase data is only displayed in numeric format at the right-side of the display. The display can display up to 25 harmonic components at a time. The triangle at the bottom of the display shows the currently selected component for which numeric data is shown on the right-side. This data includes the harmonic number (DC through 50), the harmonic frequency, the absolute or relative amplitude (depending on selection in DATA field), and the phase angle with respect to the fundamental. The rotary encoder is be used to scroll through the displayed harmonics horizontally, or the touchscreen can used to directly select an individual harmonic.

7.3 Triggering Measurements

Both FFT results and waveform acquisitions may need to be aligned with a specific instant in time. To ensure data acquisition coincides with user-specified events, the measurement system can be triggered in various ways. Trigger modes are available through both the digital interface and the front panel. For more details on this mode of operation, refer to the Sequoia Series Programming Manual (P/N M447353-01) or the Tahoe Series Programming Manual (P/N M445374-01).

7.3.1 Trigger Mode

Trigger mode is selected from the front panel using the MODE field in the HARMONICS menu of the MEASUREMENTS screen; refer to Figure 7-4.

The following trigger modes are available in the HARMONICS menu:

Single (SINGLE) This mode causes the acquisition system to be armed only once after the initial START. The power source waits until a trigger event occurs, after which data is acquired; when the acquisition is completed, the system is put in an idle state. A new START must be given to trigger a new acquisition. This mode is appropriate for capturing events that occur only once such as the inrush current when turning on a load.

Continuous (CONT) This mode causes the trigger system to re-arm itself after each trigger event. Every time a new trigger event occurs, new data is acquired, and the display is updated. No user intervention is required after the initial START. This mode is appropriate for capturing repetitive events or the source output continuously.

7.3.2 Trigger source

Trigger sources are selected from the front panel using the SOUR(CE) field in the HARMONICS menu of the MEASUREMENTS screen; refer to Figure 7-4.

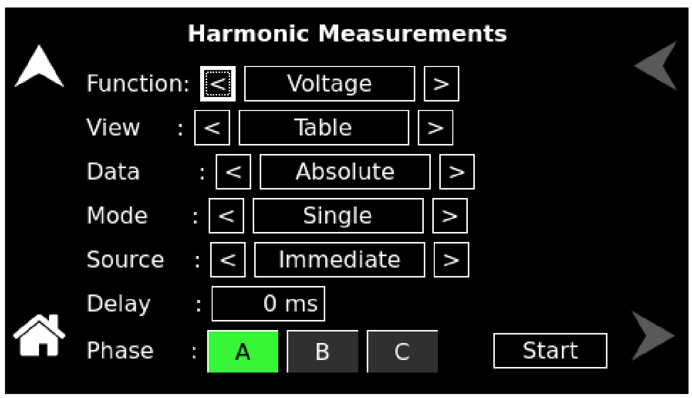


Figure 7-4: HARMONICS Menu, Triggering

The following trigger sources are available in the HARMONICS menu:

Entry	Description
Immediate	This mode causes a trigger to occur as soon as the START field is tapped. No trigger source needs to be specified for this trigger mode. This mode is equivalent to the SCPI command, `INIT:IMM:ACQ`. This trigger source is appropriate if no trigger condition is known or desired. When using this trigger source, the acquisition is always triggered.
Phase	This mode causes the acquisition system to wait for the zero-phase angle of the output voltage. The phase angle of the current with respect to the voltage is determined by the load, so triggering at a specific current phase angle is not possible, since it is not controlled by the power source. However, when capturing current waveform data, the phase relationship to the voltage can be determined easily by triggering at the 0° point on the voltage.

7.3.3 Trigger delay

The trigger DELAY field allows setting the amount of pre- or post-trigger data that should be used when positioning the data acquisition window with respect to the trigger event.

Entry	Description
POST-TRIGGER DELAY	Positive trigger delay value means the acquisition window is delayed by the amount of time specified. In this case, the actual trigger instant itself is no longer present in the acquisition buffer. This condition is shown in Figure 7-5, where a 20 ms trigger delay is used after triggering on phase = 180°, with an output frequency of 50 Hz. The trigger point is indicated by the dashed blue line; it occurs on the first 180° point that occurs after the START field is tapped. Once the trigger occurs, the acquisition holds off the specified 20 ms(indicated by Trigger Delay in Figure 7-5), after which the data is captured. Using a positive trigger delay value always yields post-trigger data. Positive trigger delay values may be set from 0.0 ms to 1000.0 ms (1 second) in 0.1 ms increments. The value may be entered directly with the touchscreen keypad or using the rotary encoder.

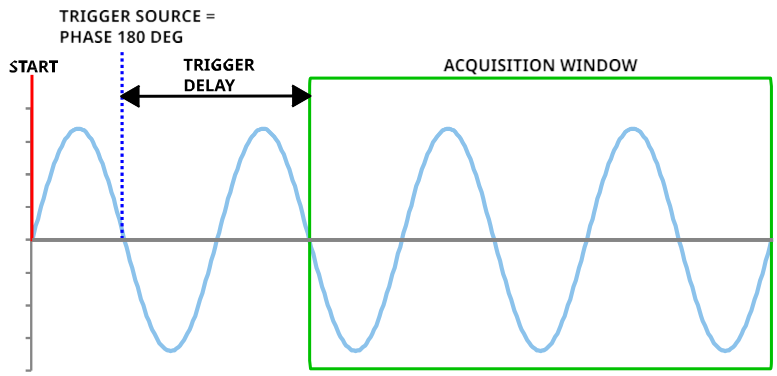


Figure 7-5: Post-Trigger (Positive Delay)

PRE-TRIGGER DELAY	Negative trigger delay value may be specified up to the maximum time depth of the acquisition window. The value may be entered directly with the touchscreen keypad or using the rotary encoder. The following time interval range is available: Negative trigger delay, 42.6ms to 426 ms. This condition is shown in Figure 7-6 where a 20ms trigger delay is used after triggering on phase = 0°, with an output frequency of 50Hz. The trigger point is indicated by the blue dashed line; it occurs on the first 0-degree point that occurs after the START field is tapped. Once the trigger occurs, the acquisition is captured beginning from the specified 20ms before the trigger point (shown by Trigger Delay in (shown by Trigger Delay in Figure 7-6). Using a negative trigger delay value always yields pre- trigger data.

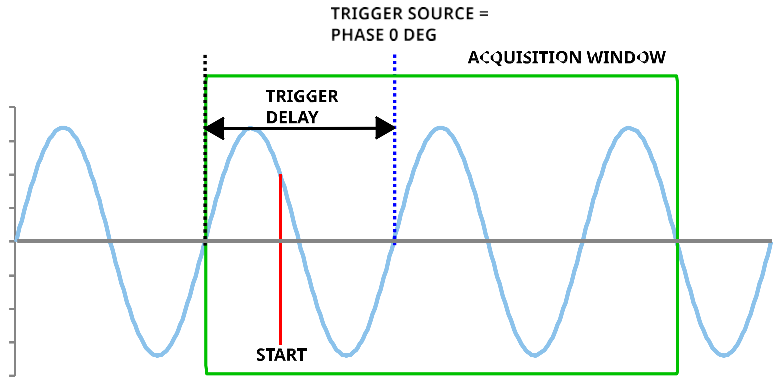


Figure 7-6: Pre-Trigger (Negative Delay)

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8. TRANSIENT PROGRAMMING

8.1 Voltage Transient Programming

Voltage transient programming is only applicable for source and grid simulator operation. It offers precise timing control over output voltage and frequency changes. This mode can be used to test a product's susceptibility to common AC and DC power conditions, such as surges, sags, brownouts, and spikes. By combining transient list programming with custom waveforms, complex AC or DC conditions can be simulated on the power source's output. Refer to Section 5 for specifics on using the display menus to program the transients from the front panel. The full capability of transients programming can accessed through the remote digital interface using SCPI commands or the Sequoia Virtual Panels GUI; refer to the Sequoia Series Programming Manual M447353-01, Tahoe Series Programming Manual P/N M445374-01 or refer to AMETEK PPD website, www.programmablepower.com, to download the latest version.

8.1.1 Using Transient Modes

Output transients are used to:

- Synchronize output changes with a particular phase of the voltage waveform.
- Synchronize output changes with internal or external trigger signals.
- Simulate surge, sag, and dropout conditions with precise control of duration and phase.
- Create complex, multi-level sequences of output changes.
- Create output changes that have rapid or precise timing requirements.

The following power source functions are subject to transient control:

- AC output voltage.
- DC output voltage.
- Frequency.
- Start phase angle.
- AC and DC voltage slew rate.
- Frequency slew rate.

The following transient modes can be generated using the Sequoia Virtual Panels GUI or SCPI commands:

Step	Generates a single triggered output change.
Pulse	Generates an output change which returns to its original state after a specified period.
List	Generates a sequence of output changes, each with an associated dwell time or paced by triggers.
Fixed	Turns off the transient functions; with SCPI commands, only the `IMM`ediate values are used as the data source for a particular function.

Figure 8-1 shows a representation of programming changes in the transient modes, and the output waveform that is generated in each mode.

When a trigger is received in Step or Pulse modes, the triggered functions are set from their SCPI command, `IMM`ediate, to their `TRI`Ggered value. In Step mode, the triggered value becomes the immediate value.

In Pulse mode, the functions return to their immediate value during the low portion of the pulse.

If there are no further pulses, the immediate value remains in effect. In List mode, the functions remain at the last list value at the completion of the list. STEP, PULSe, and LIST modes are not allowed to be mixed among functions.

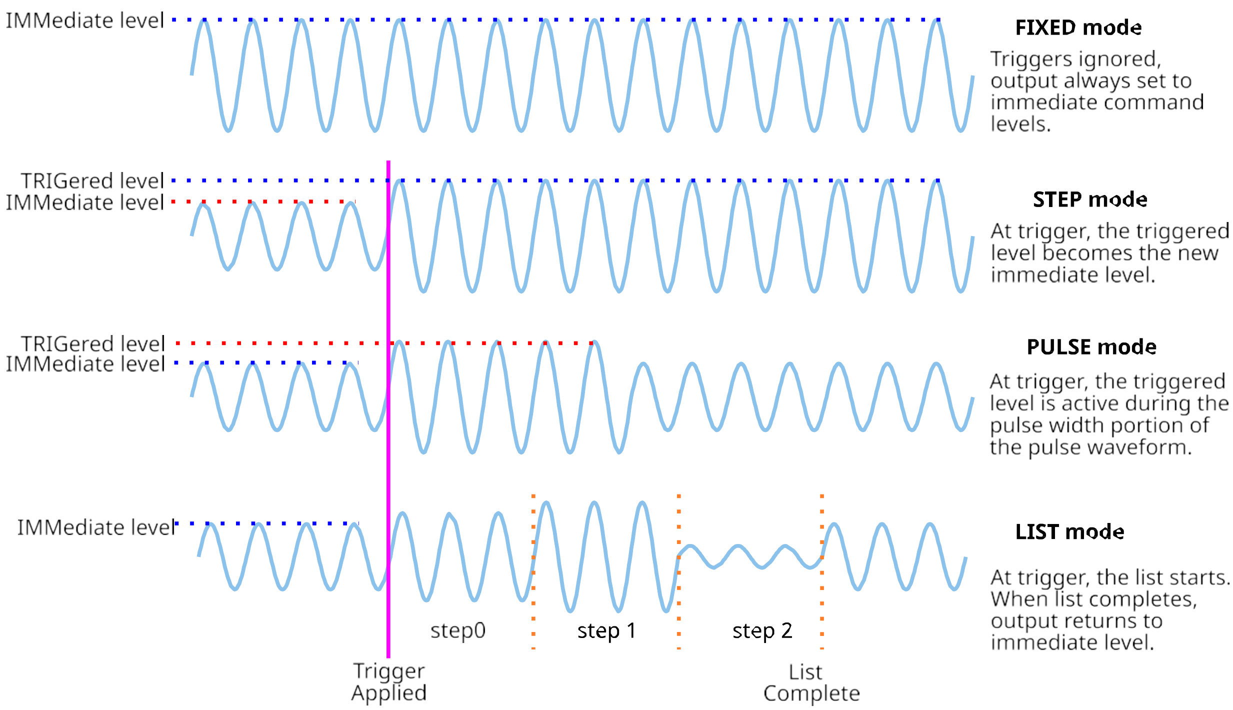


Figure 8-1: Pulse Transients

8.1.1.1 Step Transients

Step transients specify an alternate or triggered voltage level that the AC source will apply to the output when it receives a trigger. Because the default transient voltage level is zero volts, a triggered voltage level must be entered before a trigger to the power source can change the output amplitude. Step transients can only be programmed through the remote digital interface using the SCPI commands or the Sequoia Virtual Panels GUI; refer to the Sequoia Series Programming Manual M447353-01, Tahoe Series Programming Manual P/N M445374-01 or refer to AMETEK PPD website, www.programmablepower.com, to download the latest version.

8.1.1.2 Pulse Transients

Pulse transients program the output to a specified value for a predetermined amount of time. At the end of the Pulse transient, the output voltage returns to its previous value. Parameters required to set up a Pulse transient include the pulse count, pulse period, and pulse duty cycle. An example of a Pulse transient is shown in Figure 8-2. In this case, the count is 4, the pulse period is 16.6ms (for 60 Hz) and the duty cycle is 33%. Pulse transients can only be programmed through the remote digital interface using SCPI commands or the Sequoia Virtual Panels GUI; refer to the Sequoia Series Programming Manual M447353-01, Tahoe Series Programming Manual P/N M445374-01 or refer to AMETEK PPD website, www.programmablepower.com, to download the latest version.

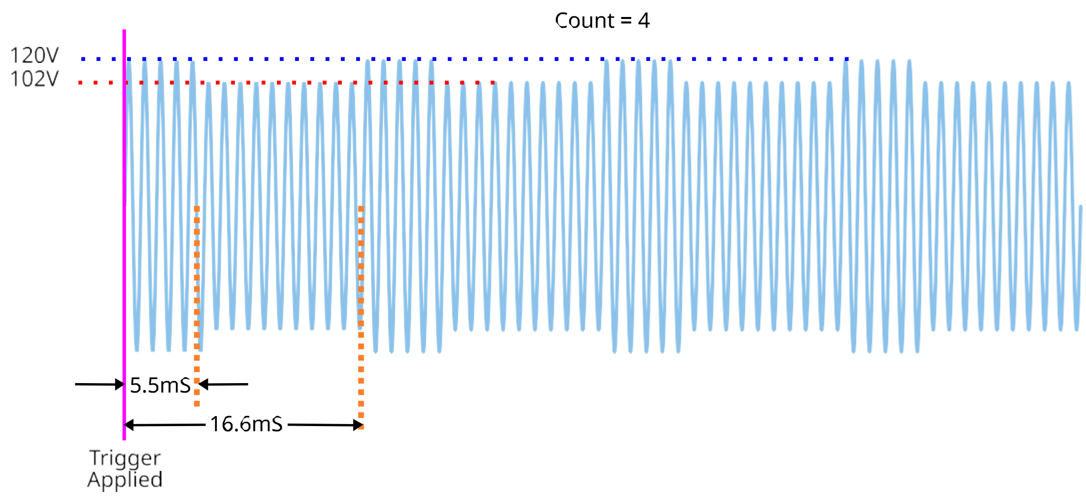


Figure 8-2: Pulse Transients

8.1.1.3 List Transients

List transients provide the most versatile means of controlling the output in a specific manner as they allow a series of parameters to be programmed in a timed sequence. Figure 8-3 shows a voltage output generated from a list. The output shown represents three different AC voltage steps: 160 volts for 33 milliseconds, 120 volts for 83 ms, and 80 volts for 150 ms, separated by three intervals of zero volts for 67 ms. The list specifies the pulses as three voltage points (points 0, 2, and 4), each with its corresponding dwell points. The intervals are three zero-voltage points (points 1, 3, and 5) of equal time duration. The count parameter causes the list to execute twice when started by a single trigger.

Transient list programming is supported through the front panel with the TRANSIENTS menu. Transient lists can also be programmed through the remote digital interface using SCPI commands or the Sequoia Virtual Panels GUI; refer to the Sequoia Series Programming Manual M447353-01, Tahoe Series Programming Manual P/N M445374-01 or refer to AMETEK PPD website, www.programmablepower.com, to download the latest version.

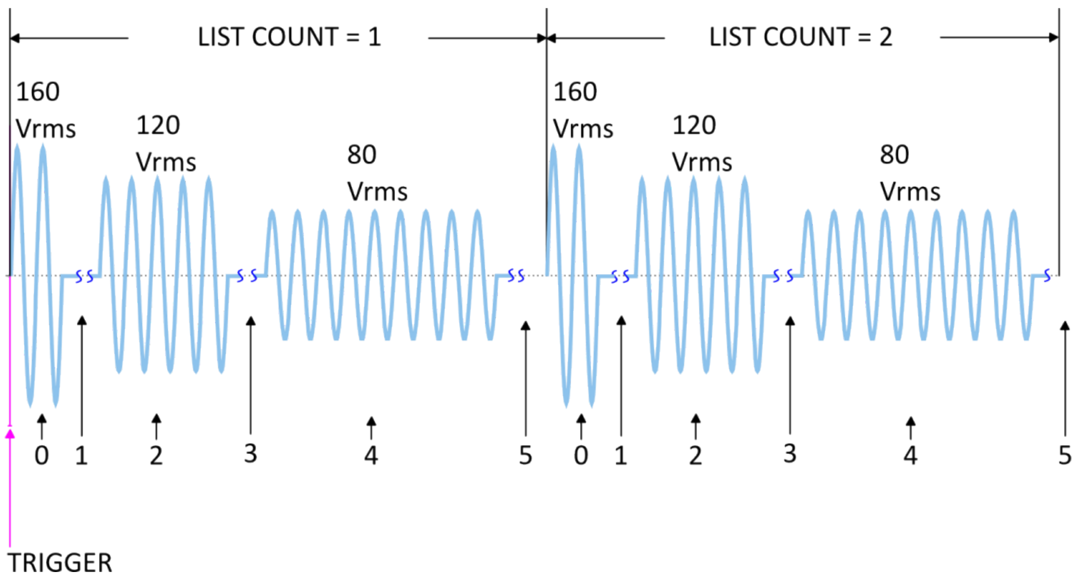


Figure 8-3: List Transients

To set up this type of transient list through the front panel, proceed as follows:

1. Navigate to the SETTINGS menu of the TRANSIENTS screen; refer to Figure 8-4 and Figure 8-5. Set the parameter values as follows:

   Phase: A, B, or C

   Time: sec

   Volt(age): V

   Freq(uency): Hz

   Trig(ger): All

   Step: All

   Start Phase A: Zero

Figure 8-4: Transients Screen Top-Level Menu

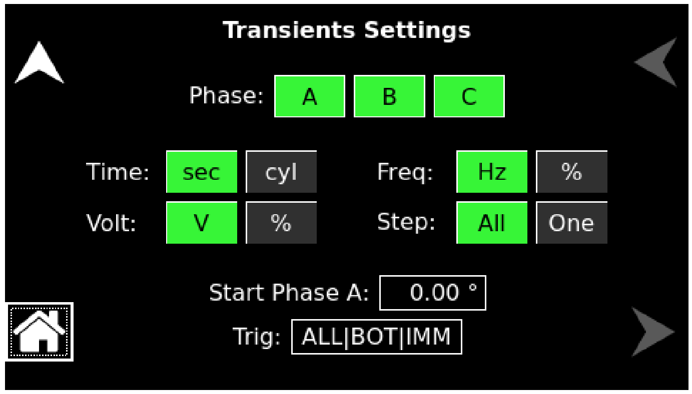


Figure 8-5: Transients Settings Screen

Tap on the TRIGGER sub-menu; refer to Figure 8-6. Set the parameter values as follows:

Phase Sync: All

Trig Out Source: BOT

Start Source: Immediate

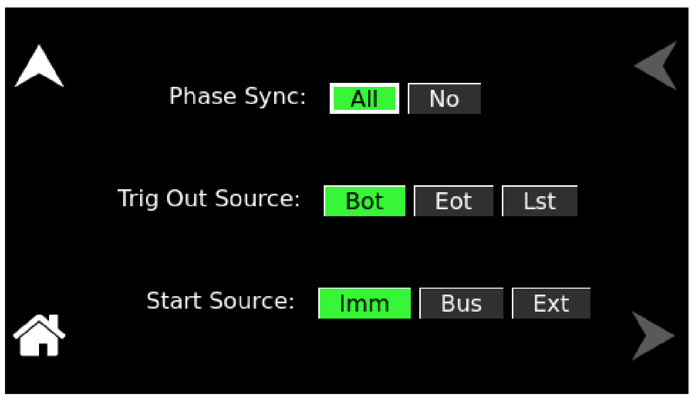


Figure 8-6: Settings Screen – Trigger Sub-Menu

2. Navigate to the List menu of the TRANSIENTS screen; refer to Figure 8-4 and Figure 8-7.

Figure 8-7: List Menu with Empty Buffer

3. Tap the ADD field to enter the ADD sub-menu; refer to Figure 8-8 and Figure 8-9.

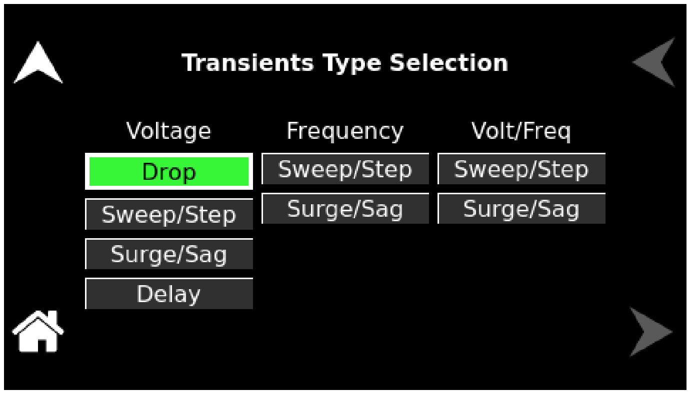


Figure 8-8: AC Mode Transients Type Selection for Source and Grid-Simulator Operating Modes

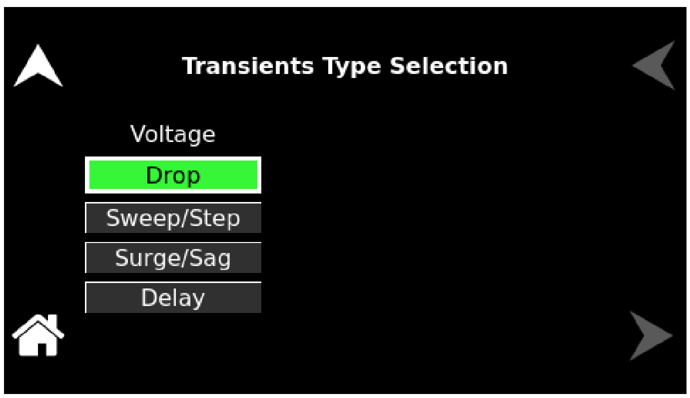


Figure 8-9: DC Mode Transients Type Selection for Source and Grid-Simulator Operating Modes

4. Tap the VOLTAGE SURGE/SAG selection button, refer to Figure 8-8 and Figure 8-10. Enter the following parameter values:

   T(ime): 0.083 sec; the value is entered as seconds, with a minimum time resolution of 0.001 sec;

   V(olts): 160 V; the surge voltage value;

   To V(olts): 0 V; the voltage value following the surge;

   Repeat: 0; number of times to repeat this transient event (not the entire transient list, as described in Step 10, below);

   Function: Sine; output waveform

   Trig: blank (no selection); not used in this example

   Delay: 0.067 sec; time interval to remain at To V(olts) level.

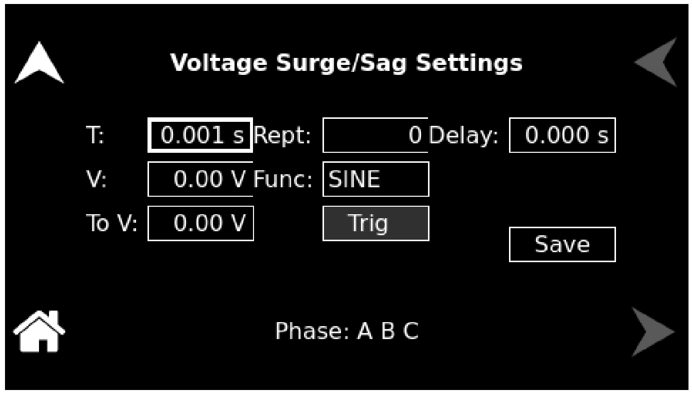
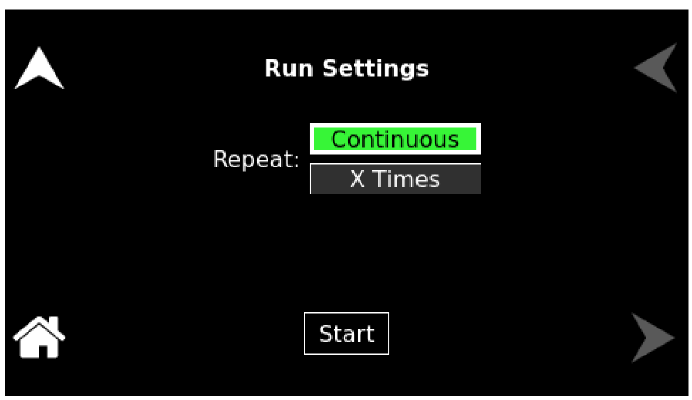


Figure 8-10: List Menu, Voltage Surge/Sag Settings sub-menu

5. Tap the SAVE field in the VOLTAGE SURGE/SAG sub-menu.
6. Repeat Steps 4 through 7 two more times using 120 V / 83 ms and 80 V / 150 ms as values.
7. Once the three events are programmed, navigate to the LIST menu of the TRANSIENTS screen to view all available events in the transient list. If more events are programmed than can fit in the window, the arrow buttons on the right-side are used to scroll through the list. To edit an existing event, move the selection field to the relevant event number and click the encoder switch to select it. Use the edit fields to edit or delete the event, or to add events before or after the selected one.
8. Navigate to the RUN menu of the TRANSIENTS screen; refer to Figure 8-11.



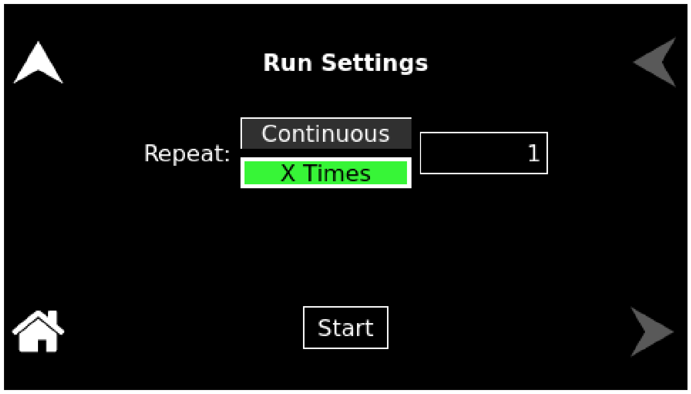


Figure 8-11: RUN Menu

9. Tap the X Times selection button and enter 1 in the X Times field. This will cause the transient program to repeat once and thus run two times total. Do not confuse this global list level repeat capability with the list event level repeat field mentioned in Step 5.
10. Tap the START field in the RUN menu of the TRANSIENTS screen. The transients list will be executed two times. The power source will remain at the last programmed value of the list (zero volts in this example).

8.1.2 Programming Slew Rates

As shown in the previous examples there are several ways that custom waveforms are generated. Programmable slew rates provide additional flexibility when customizing waveforms. Slew rates determine how fast the voltage is changed by the controller when a step, pulse, or list transient is triggered. To use programmable slew rates, the power supply must be programmed through the remote digital interface using SCPI commands or the Sequoia Virtual Panels GUI; refer to the Sequoia Series Programming Manual M447353-01, Tahoe Series Programming Manual P/N M445374-01 or refer to AMETEK PPD website, www.programmablepower.com, to download latest version.

8.1.3 Switching Waveforms in Transient Lists

The FUNCTION field available in each transient list event setup menu may be used to dynamically switch waveforms during transient execution. This allows different waveforms to be used during transient execution. Waveforms may be switched without the output of the source being turned off.

Figure 8-12 illustrates the concept of using different waveforms at different steps in a transient list. In this case, the change was programmed to occur at the zero crossing. Any phase angle can be used to start a transient step, however.

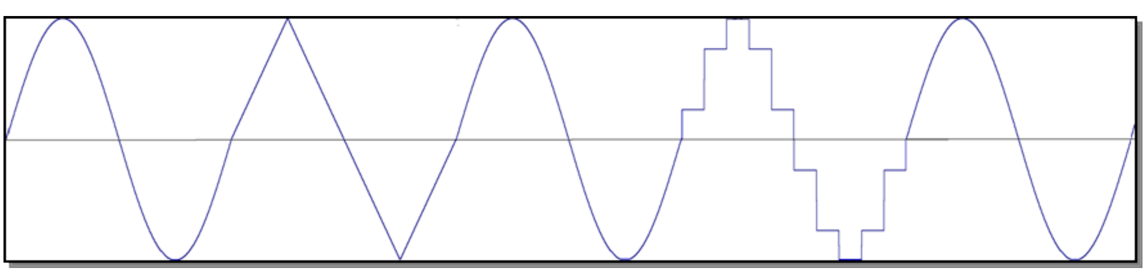


Figure 8-12: Switching Waveforms in a Transient List Transient Execution

A Transient list can be executed from the RUN menu of the Transients screen; refer to Figure 8-4. Tapping on the RUN selection-field will open the RUN menu; refer to Figure 8-13. A selection is made whether to run the transient list repetitively (Continuous button) or multiple times (X Times button). To start a transient list, tap on the START field. The list will begin to run, and a new selection field will open, ABORT. A long duration transient can be stopped and aborted by tapping on the ABORT field while a transient execution is in progress. For a short duration transient, this will not be visible, as the transient will be completed before the screen is updated.

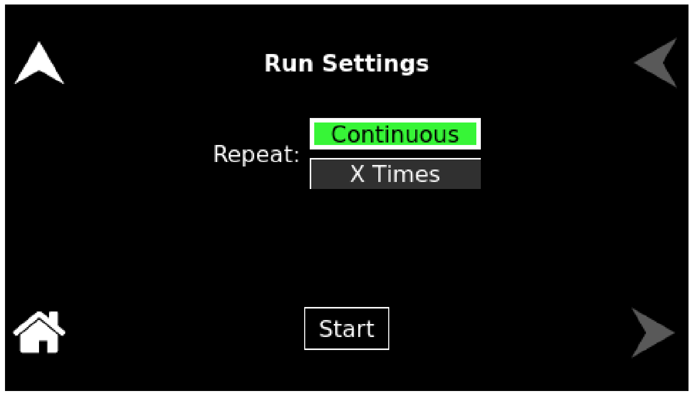


Figure 8-13: RUN Menu: Start and Abort Fields

8.1.4 Saving Transient List Programs

When the power source is turned off, the transient list that was programmed is not automatically saved. Therefore, the programmed transient list would be lost if the unit is turned off. However, transient programs are saved in nonvolatile memory for later recall. This allows multiple transient list programs to be recalled quickly without the need to enter all parameters each time. Transient lists are stored as part of the overall power source operational configuration state in any of the available profile state registers; refer to the CONFIGURATION screen in Section 5. To save a transient list, proceed as follows:

1. After setting up a transient list, run it so that it is transferred to main memory.
2. Tap on the PROFILES field in the CONFIGURATION menu; refer to Figure 8-14.
3. Tap on one of the fifteen PROFILEx buttons (x = 0 to 14) to select it.
4. Tap on the NAME field to open the NAME sub-menu to assign a unique name to the profile. Otherwise, tap on the SAVE field to save the configuration state of the power source to a profile memory register.

5. The profile can be recalled later by selecting the appropriate selection-button and tapping on the LOAD field.

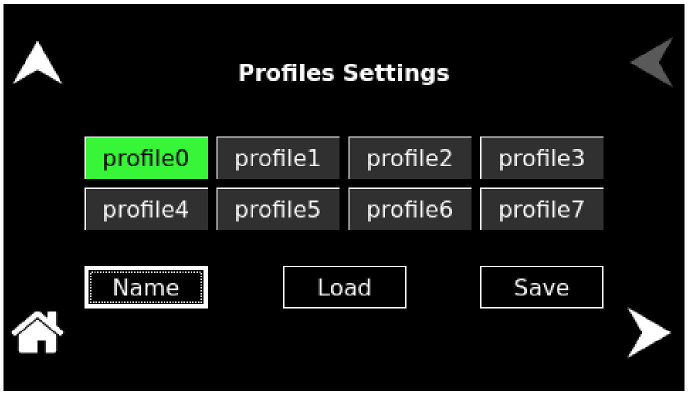


Figure 8-14: CONFIGURATION Menu, PROFILES Selection

8.2 Current Transient Programming

Current transient programming is only applicable for E-Load mode of operation, and it provides a precise timing control over output current changes. This mode of operation can be used to test a product for susceptibility to common AC and DC power conditions such as surges, sags, brownouts, and spikes. By combining transient list programming with custom waveforms complex AC or DC conditions can be simulated on the output of the power source. Refer to Section 5 for specifics on using the display menus to program the transients from the front panel. The full capability of transients programming is accessed through the remote digital interface using SCPI commands or the Sequoia Virtual Panels GUI; refer to the Sequoia Series Programming Manual P/N M447353-01, refer to AMETEK PPD website, www.programmablepower.com, to download latest version.

8.2.1 Using Transient Modes

Output transients are used to:

- Synchronize output changes with a particular phase of the current waveform.
- Synchronize output changes with internal or external trigger signals.
- Simulate surge, sag, and dropout conditions with precise control of duration and phase.
- Create complex, multi-level sequences of output changes.
- Create output changes that have rapid or precise timing requirements.

The following power source functions are subject to transient control:

- AC output current.
- AC output current phase shift.
- DC output current.
- Start phase angle.
- AC and DC current slew rate.

The following transient modes can be generated using the Sequoia Virtual Panels GUI or SCPI commands:

Step Generates a single triggered output change.

Pulse Generates an output change which returns to its original state after a specified time.

List Generates a sequence of output changes, each with an associated dwell time or paced by triggers.

Fixed Turns off the transient functions; with SCPI commands, only the `IMM`ediate values are used as the data source for a particular function.

Figure 8-15 shows a representation of programming changes in the transient modes, and the output waveform that is generated in each mode.

When a trigger is received in Step or Pulse modes, the triggered functions are set from their SCPI command, `IMM`ediate, to their `TRIG`gered value. In Step mode, the triggered value becomes the immediate value. In Pulse mode, the functions return to their immediate value during the low portion of the pulse. If there are no further pulses, the immediate value remains in effect. In List mode, the functions remain at the last list value at the completion of the list. `STEP`, `PULS`e, and LIST modes are not allowed to be mixed among functions.

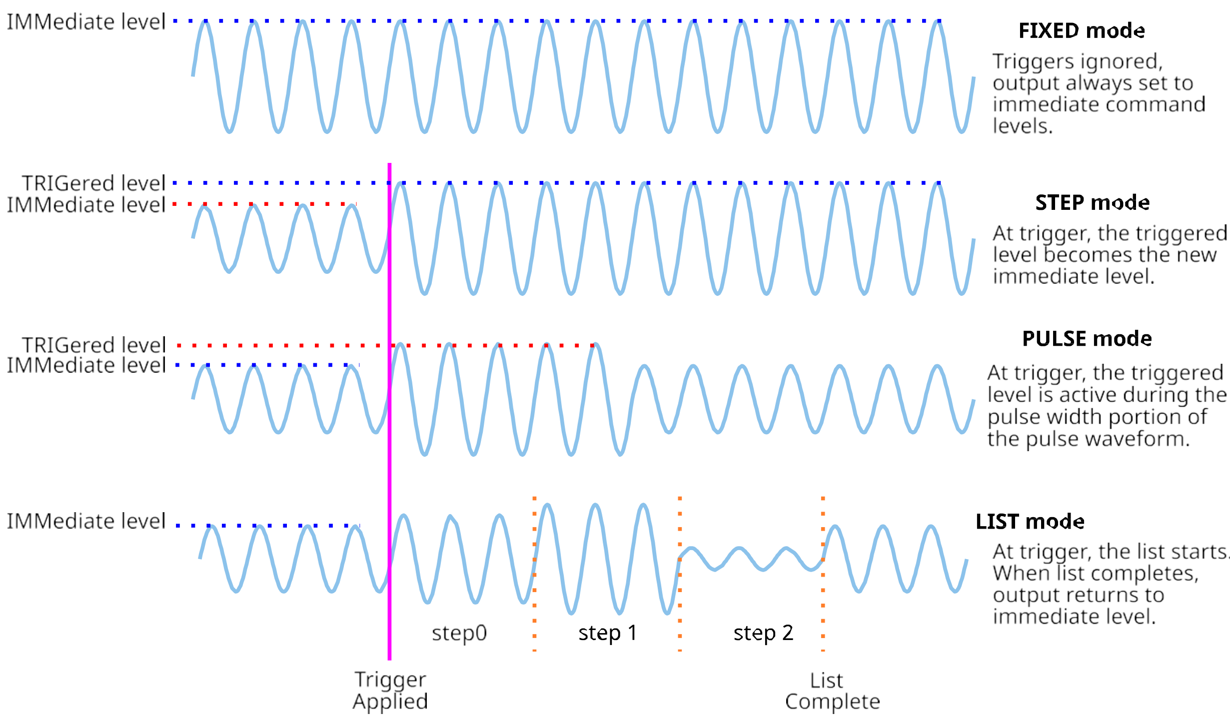


Figure 8-15: Output Transient Modes

8.2.1.1 Step Transients

Step transients specify an alternate or triggered current level that the AC source will apply to the output when it receives a trigger. Because the default transient current level is zero amps, a triggered current level must be entered before a trigger to the power source can change the output current amplitude. Step transients can only be programmed through the remote digital interface using the SCPI commands or the Sequoia Virtual Panels GUI; refer to the Sequoia Series Programming Manual, M447353-01, or refer to AMETEK PPD website, www.programmablepower.com, to download latest version.

8.2.1.2 Pulse Transients

Pulse transients program the output to a specified value for a predetermined amount of time. At the end of the Pulse transient, the output current returns to its previous value. Parameters required to set up a Pulse transient include the pulse count, pulse period, and pulse duty cycle. An example of a Pulse transient is shown in Figure 8-16. In this case, the count is 4, the pulse period is 16.6 ms (for 60 Hz) and the duty cycle is 33%. Pulse transients can only be programmed through the remote digital interface using SCPI commands or the Sequoia Virtual Panels GUI; refer to the Sequoia Series Programming Manual M447353-01, refer to AMETEK PPD website, www.programmablepower.com, to download latest version.

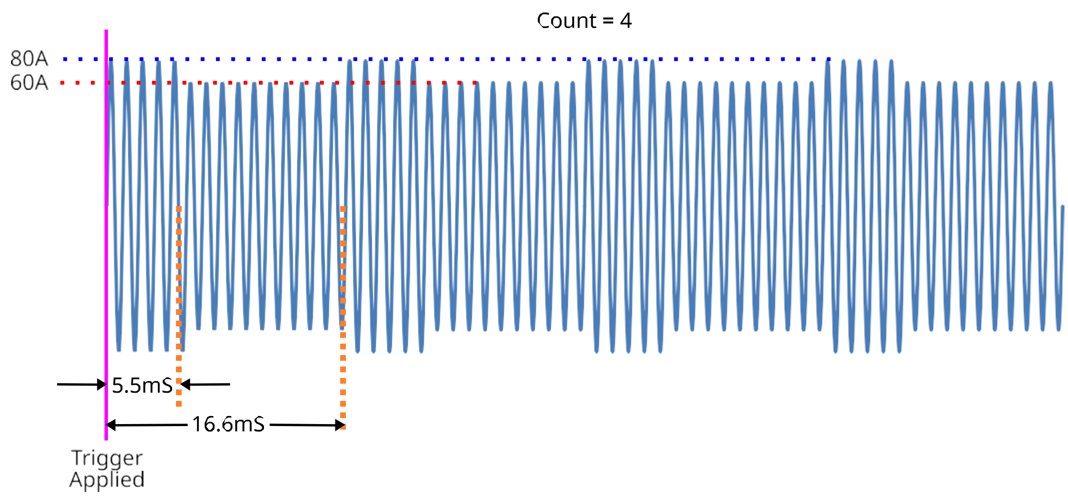


Figure 8-16: Pulse Transients - Current

8.2.1.3 List Transients

List transients provide the most versatile means of controlling the output in a specific manner as they allow a series of parameters to be programmed in a timed sequence. Figure 8-17 shows a current output generated from a list. The output shown represents three different AC current steps: 80 amps for 33 milliseconds, 60 amps for 83 ms, and 40 amps for 150 ms, separated by three intervals of zero amps for 67 ms. The list specifies the pulses as three current points (points 0, 2, and 4), each with its corresponding dwell points. The intervals are three zero-current points (points 1, 3, and 5) of equal time duration. The count parameter causes the list to execute twice when started by a single trigger.

Transient list programming is supported through the front panel with the TRANSIENTS menu. Transient lists can also be programmed through the remote digital interface using SCPI commands or the Sequoia Virtual Panels GUI; refer to the Sequoia Series Programming Manual M447353-01, refer to AMETEK PPD website, www.programmablepower.com, to download the latest version.

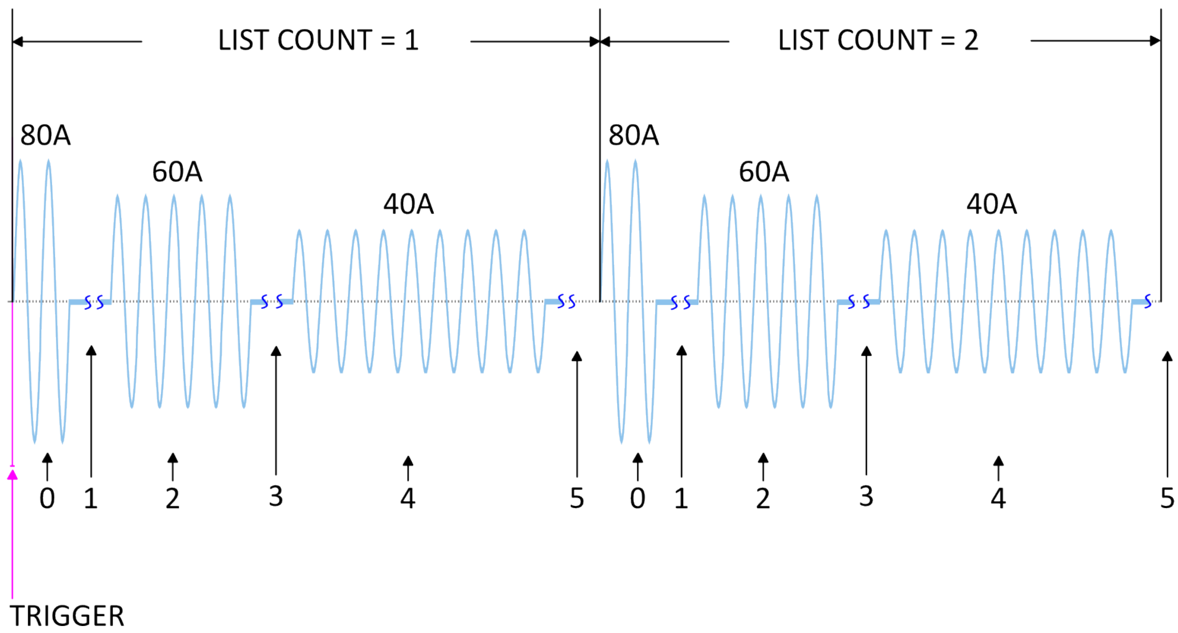


Figure 8-17: List Transients

To set up this type of transient list through the front panel, proceed as follows:

1. Navigate to the SETTINGS menu of the TRANSIENTS screen; refer to Figure 8-18 and Figure 8-19. Set the parameter values as follows:

   Phase: A, B, or C

   Time: sec

   Curr(ent): A

   Trig(ger): All

   Step: All

Figure 8-18: Transients Screen Top-Level Menu

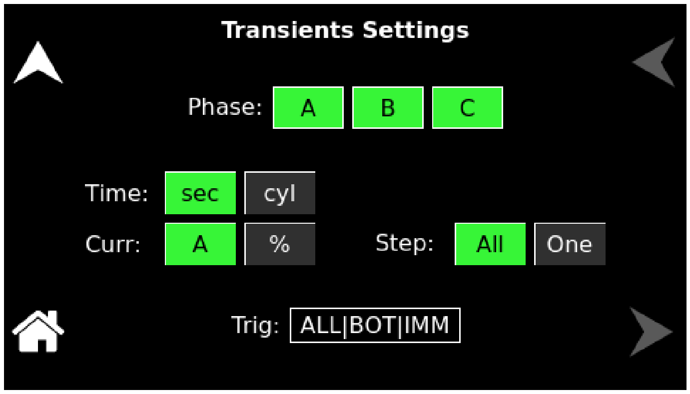


Figure 8-19: Transients Settings Screen

2. Tap on the TRIGGER sub-menu; refer to Figure 8-20. Set the parameter values as follows:

   Phase Sync: All
   Trig Out Source: BOT
   Start Source: Immediate

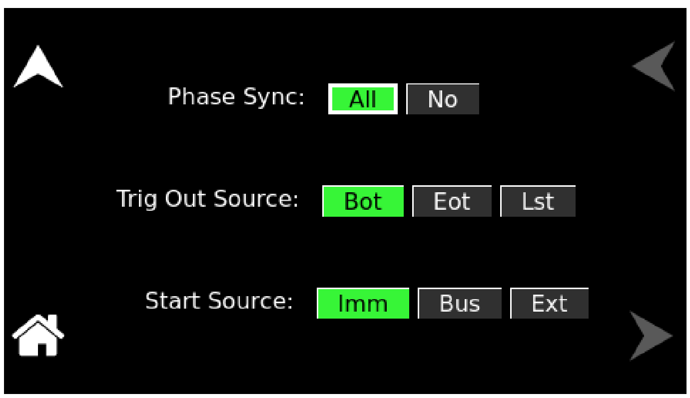


Figure 8-20: Settings Screen – Trigger Sub-Menu

3. Navigate to the LIST menu of the TRANSIENTS screen; refer to Figure 8-21.

Figure 8-21: List Menu with Empty Buffer

4. Tap the ADD field to enter the ADD sub-menu; refer to Figure 8-22.

Figure 8-22: Current Transients Type Selection for Electronic load – Current Programming Mode

5. Tap the CURRENT SURGE/SAG selection button, refer to Figure 8-23. Enter the following parameter values:

   T(ime): 0.083 sec (the value is entered as seconds, with a minimum time resolution of 0.001 sec.)

   A(mpere): 80 A (the surge current value.)

   To A(mpere): 0 A (the current value following the surge.)

   Repeat: 0 (the number of times to repeat this transient event (not the entire transient list, as described in Step 10, below.)

   Function: Sine (output waveform.)

   Trig: blank (no selection; not used in this example.)

   Delay: 0.067 sec (time interval to remain at To A(mpere) level.)

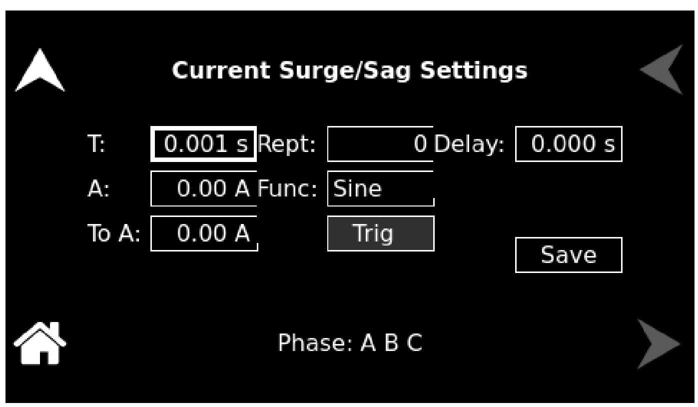


Figure 8-23: Current Surge/Sag Settings

6. Tap the SAVE field in the CURRENT SURGE/SAG sub-menu.
7. Repeat Steps 4 through 7 two more times using 60 A / 83 ms and 40 A / 150 ms as values.
8. Once the three events are programmed, navigate to the VIEW menu of the TRANSIENTS screen to view all available events in the transient list. If more events are programmed than can fit in the window, the arrow buttons on the right side are used to scroll through the list. To edit an existing

event, move the selection field to the relevant event number and click the encoder switch to select it. Use the edit fields to edit or delete the event, or to add events before or after the selected one.

9. Navigate to the RUN menu of the TRANSIENTS screen; refer to Figure 8-24.

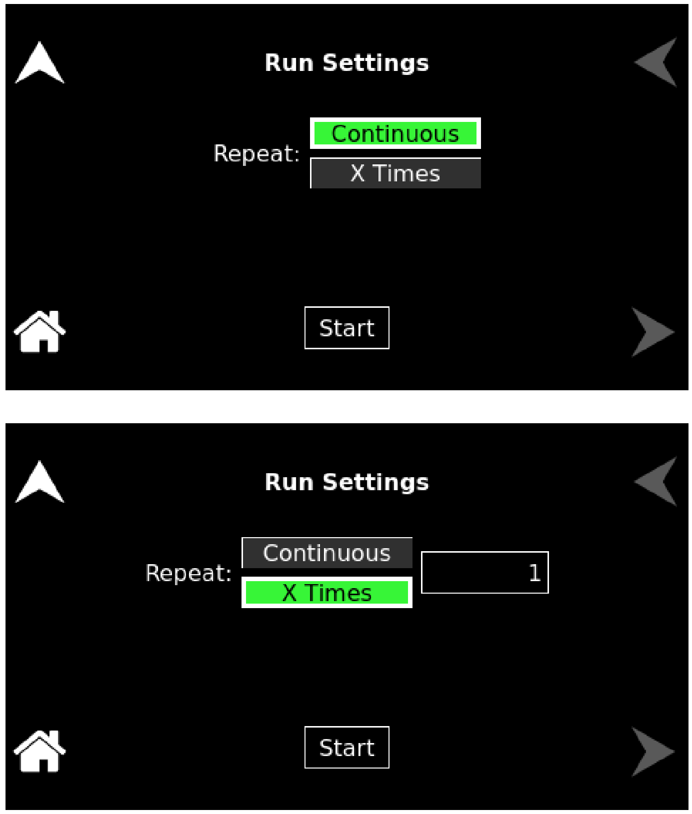


Figure 8-24: RUN Menu

10. Tap the X Times selection button and enter 1 in the X Times field. This will cause the transient program to repeat once and thus run two times in total. Do not confuse this global list-level repeat capability with the list event-level repeat field mentioned in Step 5.

11. Tap the START field in the RUN menu of the TRANSIENTS screen. The transients list will be executed two times. The power source will remain at the last programmed value of the list (zero amps in this example).

8.2.2 Programming Slew Rates

As shown in the previous examples there are several ways that custom waveforms are generated. Programmable slew rates provide additional flexibility when customizing waveforms. Slew rates determine how fast the current is changed by the controller when a step, pulse, or list transient is triggered. To use programmable slew rates, the power supply must be programmed through the remote digital interface using SCPI commands or the Sequoia Virtual Panels GUI; refer to the Sequoia Series Programming Manual M447353-01, refer to AMETEK PPD website, www.programmablepower.com, to download the latest version.

8.2.3 Switching Waveforms in Transient Lists

The FUNCTION field available in each transient list event setup menu may be used to dynamically switch waveforms during transient execution. This allows different waveforms to be used during transient execution. Waveforms may be switched without the output of the source is turned off.

The FUNCTION field in each transient list event setup menu can be used to dynamically switch waveforms during transient execution. This allows different waveforms to be used without turning off the output of the source.

Figure 8-25 illustrates the concept of using different waveforms at different steps in a transient list. In this case, the change was programmed to occur at the zero crossing. Any phase angle can be used to start a transient step, however.8-25: Switching Waveforms in a Transient List Transient Execution

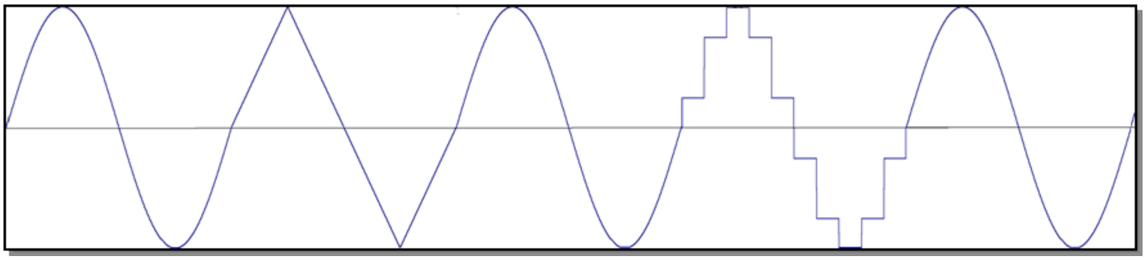


Figure 8-25: Switching Waveforms in a Transient List Transient Execution

A transient list can be executed from the RUN menu of the Transients screen; refer to Figure 8-18. Tapping on the RUN selection field will open the RUN menu; refer to Figure 8-26. A selection is made whether to run the transient list repetitively (Continuous button) or multiple times (X Times button). To start a transient list, tap on the START field. The list will begin to run, and a new selection field will open, ABORT. A long-duration transient can be stopped and aborted by tapping on the ABORT field while a transient execution is in progress. For a short-duration transient, this will not be visible, as the transient will complete before the screen is updated.

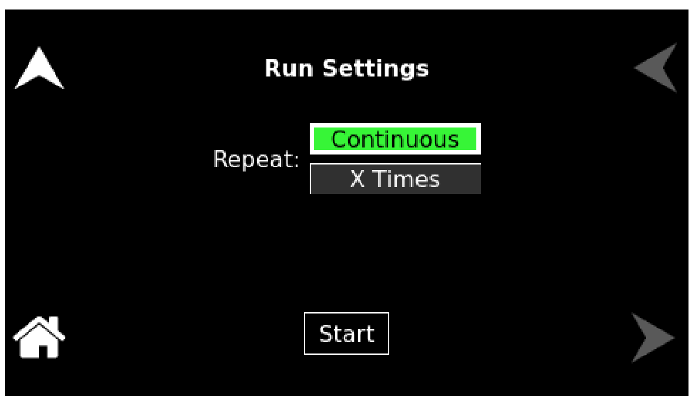


Figure 8-26: RUN Menu: Start and Abort Fields

8.2.4 Saving Transient List Programs

When the power source is turned off, the transient list that was programmed is not automatically saved. Therefore, the programmed transient list would be lost if the unit is turned off. However, transient programs are saved in nonvolatile memory for later recall. This allows multiple transient list programs to be recalled quickly without the need to enter all parameters each time. Transient lists are stored as part of the overall power source operational configuration state in any of the available profile state registers; refer to the CONFIGURATION screen in Section 5. To save a transient list, proceed as follows:

1. After setting up a transient list, run it so that it is transferred to the main memory.
2. Tap on the PROFILES field in the CONFIGURATION menu; refer to Figure 8-27.
3. Tap on one of the fifteen PROFILEx buttons (x = 0 to 14) to select it.
4. Tap on the NAME field to open the NAME sub-menu to assign a unique name to the profile. Otherwise, tap on the SAVE field to save the configuration state of the power source to a profile memory register.
5. The profile can be recalled later by selecting the appropriate selection button and tapping on the LOAD field.

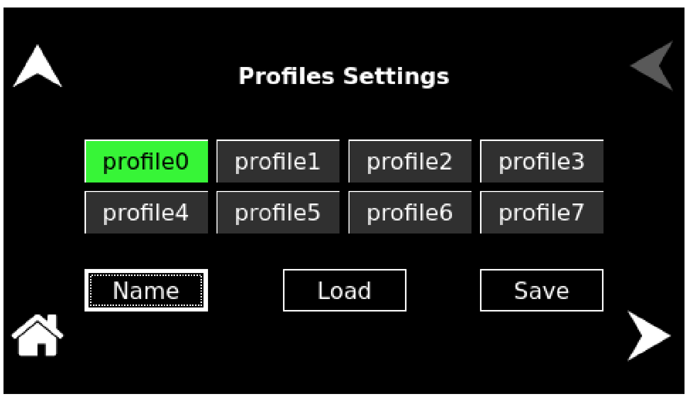


Figure 8-27: CONFIGURATION Menu, PROFILES Selection

9. OPTIONS

9.1 Introduction

There are several options available for the Sequoia/Tahoe Series. This section of the manual includes the user documentation for Option IEC 61000-4-11 and IEC 61000-4-13. There is no separate manual for these options except possible manual addenda for specials engineering request (SER) systems. If your system has an SER number as part of the model number, refer to any manual addendum that was shipped with the unit.

Note: For information on avionics options, refer to the Avionics Software Manual (P/N 4994-972).

9.2 Option –411: IEC 61000-4-11 Voltage Dips and Interruptions

9.2.1 General

The IEC 61000-4-11 option can perform IEC 61000-4 section 11 voltage dips, short interruptions and voltage variations immunity tests. On three phase Sequoia/Tahoe Series AC sources, the user can select one, two or all three phases to be active during the IEC 61000-4-11 tests in this configuration.

9.2.2 Standard Revisions and EUT Classes

The–411 option supports the first (1994-06), the second edition (2004-03) and the third edition (2020-01) of the IEC 61000-4-11 test standard. Contact techsupport.ppd@ametek.com for upgrade information. The standard revision can be selected when using the Virtual-Panel GUI-Windows program.

Generic tests files are distributed with the Virtual-Panel GUI-program for all editions of the test standard. Files applicable to Editions 2.0 and 3.0 have ED20 in their file name. Do not mix these files, as the data setup will not be correct if you do. To load a test file, select the Mode (Dips or Vars) and test standard revision first, then use the File, Open menu to load the test parameters. Test parameters can be a function of the EUT class. The different files provided with the program cover the various EUT classes. The relevant EUT class 1, 2, 3 or X is listed in the file names. When using front panel operation, the user must set levels for each individual test step in SINGLE mode.

9.2.3 Initial Setup

The user must set the operating frequency and voltage and close the output relay prior to the start of test. It is possible to change the normal voltage (Ut) from the IEC1000-4-11 menus before running each test.

9.2.4 Phase Selection

On three phase power source models, phase selection for individually executed dips or the preset RUN ALL selection can be made using the PHASE key on the front panel. The phase or phases selected will be displayed in the upper right-hand corner of the LCD as either A, B, C, AB, AC, BC or ABD.

With the introduction of Edition 2.0, three phase voltage dips testing has been redefined for both Wye and Delta loads.

For Star (Wye) connected three-phase EUT's,.voltage dips should be performed on both individual Line-to-Neutral voltages as well as on all three Line-to-Line voltages. Thus, each test should be run 6 times, each time selecting a different phase option: A, B, C, A+B, A+C and B+C. For Delta connected three-phase EUT's,.voltage dips, only Line-to-Line voltages dips must be run. Thus, each test can be run 3 times, each time selecting a different phase A+B, A+C and B+C.

Note that required phase angles and amplitudes are automatically set for dips of 0%, 40%, 70%, 80% and 100% to conform with method (A). For all other dip levels, method (A) can be used by programming the required phase angles to be used during the programmed dips. The amplitude and phase angles required to obtain the correct line-to-line voltage dip per method (A) for standard dip levels of 40%, 70% and 80%

are embedded in the firmware and conform to table C.2 of IEC 61000-4-34.

Since all phase programming on the Sequoia/Tahoe Series is referenced to phase A, voltage dip with a phase angle for phase A other than 0° are implemented by offsetting all three phases by the required number of degrees to get phase A at 0°. This is reflected in the actual output settings shown on the SQ/TA versus the data in table C.2 of the IEC61000-4-34. The actual output settings are shown in the last 3 columns.

9.2.4.1 Phase Mapping

The phase rotation on the Sequoia/Tahoe Series is ACB. This means phase A is mapped to L1, phase B is mapped to L3, and phase C is mapped to L2. The required phase selection letter combination for the required Line-to-line dip is shown in table C.2 for reference.

IEC Tables	SQ/TA Reference
L1	A
L2	B
L3	C

Table 9-1: Phase Mapping

To select the desired phase-to-phase dip, select the phase selection as shown in column 8 and either 80%, 70% or 40 % dip level from the IEC411 screen or the GUI.

	Line to Line			Line to Neutral			Phase	SQ/TA Setting		
	L1-L2	L2-L3	L3-L1	L1-N	L2-N	L3-N	Selection	A-N	C-N	B-N
100 % dip (no dip)	100 % 150°	100 % 270°	100 % 30°	100 % 0°	100 % 120°	100 % 240°	n/a	100 % 0°	100 % 120°	100 % 240°
80% dip L1-L2	80% 150°	100% 270°	92% 41°	72% 14°	100% 120°	100% 240°	AC	72% 0°	100% 106°	100% 226°
80% dip L2-L3	92% 161°	80% 270°	100% 30°	100% 0°	72% 134°	230% 240°	BC	100% 0°	72% 134°	100% 240°
80% dip L1-L3	100 % 150°	100 % 281°	100 % 30°	100 % 0°	100 % 120°	100 % 254°	AB	100 % 0°	100 % 120°	100 % 254°
70% dip L1-L2	70% 150°	100% 270°	89% 47°	61% 25°	100% 120°	100% 240°	AC	61% 0°	100% 95°	100% 215°
70% dip L2-L3	89% 167°	70% 270°	100% 30°	100% 0°	61% 145°	100% 240°	BC	100% 0°	61% 145°	100% 240°
70% dip L1-L3	100 % 150°	89 % 287°	70 % 30°	100 % 0°	100 % 120°	61 % 265°	AB	100 % 0°	100 % 120°	61 % 265°

40% dip L1-L2	40% 150°	100% 270°	87% 67°	53% 79°	100% 120°	100% 240°	AC	53% 0°	100% 41°	100% 161°
40% dip L2-L3	87% 187°	40% 270°	100% 30°	100% 0°	53% 199°	100% 240°	BC	100% 0°	53% 199°	100% 240°
40% dip L1-L3	100 % 150°	87 % 307°	40 % 30°	100 % 0°	100 % 120°	53 % 319°	AB	100 % 0°	100 % 120°	53 % 319°

Table 9-2: IEC 61000-3-34 Table C.2

9.2.4.2 Other Dip levels for 2 phase selections.

Note that any other dip level not listed in this table will result in voltage dips conform method (B) so both phases will dip by the actual dip percentage set. To implement user defined three phase dips other than those listed in this table, the IEC411 phase setting for phases A, B and C may be used to set the desired phase angle for each dip. This setting is ignored if the dip levels is set to 80%, 70% or 40% but otherwise controls the phase angle of the selected phase during the dip. To set the phase angle for a voltage dip, select the individual phase using the PHASE key and use the PHASE = field in the 411 screen to set the required phase angle. Note that this is not the start phase angle for the dip but rather the phase offset with respect to phase A.

9.2.5 Test Types

The IEC 61000-411 test suite consists of two types of tests:

1. Dips and Interruptions (Simulates short interruptions in AC supply)
2. Voltage Variations (Simulates slow changes in AC supply)

9.2.6 Using the Virtual-Panel GUI-Windows Program for IEC 61000-4-11 Tests

Figure 9-1: Virtual-Panel GUI-Windows Program for IEC 61000-4-11 Tests

The Virtual-Panel GUI-Windows control program will detect the presence of the –411 option on the SQ/TA AC power source. Test reports can be generated at the end of a test for documentation purposes.

The –411 option supports three versions (editions) of the IEC 61000-4-11 test standard:

1. First edition (released in June 1994)
2. Second edition (released in March 2004)
3. Third edition (released in January 2020)

However, this support is only available from firmware revision 0.32 onwards. If you are using an older firmware version, only the first edition is supported. For information on upgrading the firmware, you should techsupport.ppd@ametek.com If your system supports the second or third editions (Editions 2.0 and 3.0), you can select which version of the standard you want to use in the system settings.

Generic tests files are distributed with the GUI program for all editions of the test standard. Files applicable to Editions 2.0 and 3.0 have ED20 in their file name. Do not mix these files, as the data setup will not be correct if you do. To load a test file, select the Mode (Dips or Vars) and test standard revision first, then use the File, Open menu to load the test parameters. Test parameters can be a function of the EUT class. The different files provided with the program cover the various EUT classes. The relevant EUT class 1, 2, 3 or X is listed in the file names.

The user must select the desired test type before starting the test. Since both test types require several test parameters, the test sequence parameters must be entered in the data entry grid or loaded from a file using the File > Open menu option.

Note: For complete details on how to use the Virtual-Panel GUI program –411 option test screen and voltage variations specification of different Editions, refer to the on-line help of the Virtual-Panel GUI-Windows Program available from the Help menu.

9.3 Option –413: IEC 61000-4-13 Interharmonics Test

9.3.1 General

The IEC413 option can perform IEC 61000-4 section 13 Harmonics and inter harmonics low frequency immunity tests. The tests are based on IEC 61000-4-13:2002-03, First Edition. It is assumed that the user has a copy of the test standard available. This manual section only covers operation of the –413 option from the front-panel of the Sequoia/Tahoe Series power source.

9.3.2 Initial Setup

The user must set the operating voltage and close the output relay prior to the start of test. The following set of parameters must be set before the test begins:

1. Frequency to 50 or 60 Hz.
2. Voltage mode to AC.
3. Waveform to sine wave.

9.3.3 Test Types

The IEC1000-4-13 test consists of several types of tests.

1. Harmonic combination test flat curve and over swing.
2. Sweep in frequency and resonance frequency detection.
3. Individual harmonics and inter harmonics.
4. Meister curve test (Firmware revision 0.31 or higher required). Run the test

The test sequence depends on the EUT class. The end user must determine the appropriate EUT class. The test protocol is documented in the IEC 61000-4-13 test standard. For reference, the test flow charts are provided here. It is assumed that the end user has a copy of the actual test standard.

Note: EMC environment classes are defined in document IEC 61000-2-4 and Annex B of the IEC 61000-4-11:ED2.0 standard.

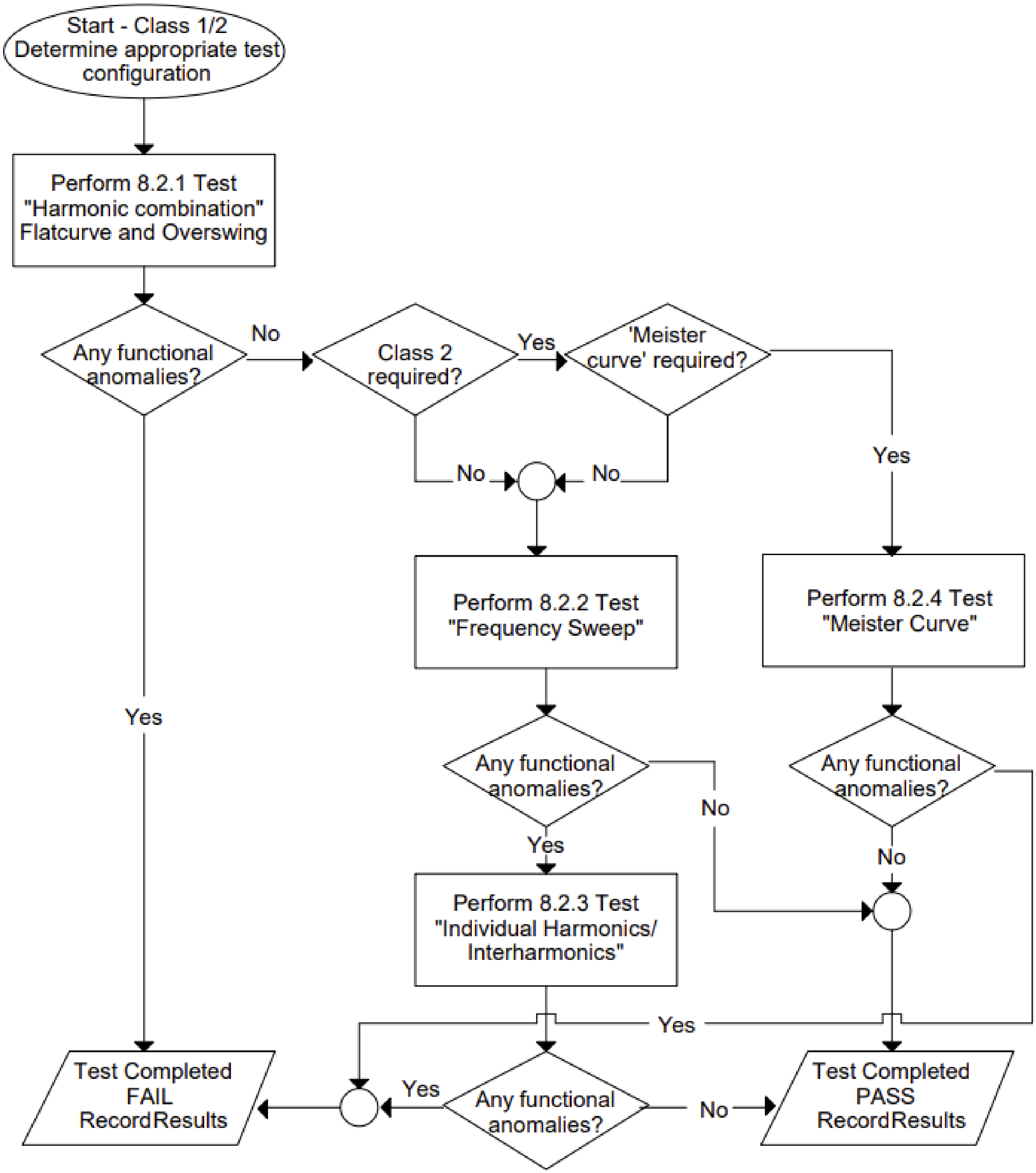


Figure 9-2: IEC 61000-4-13 Test Flowchart Class 1 and Class 2

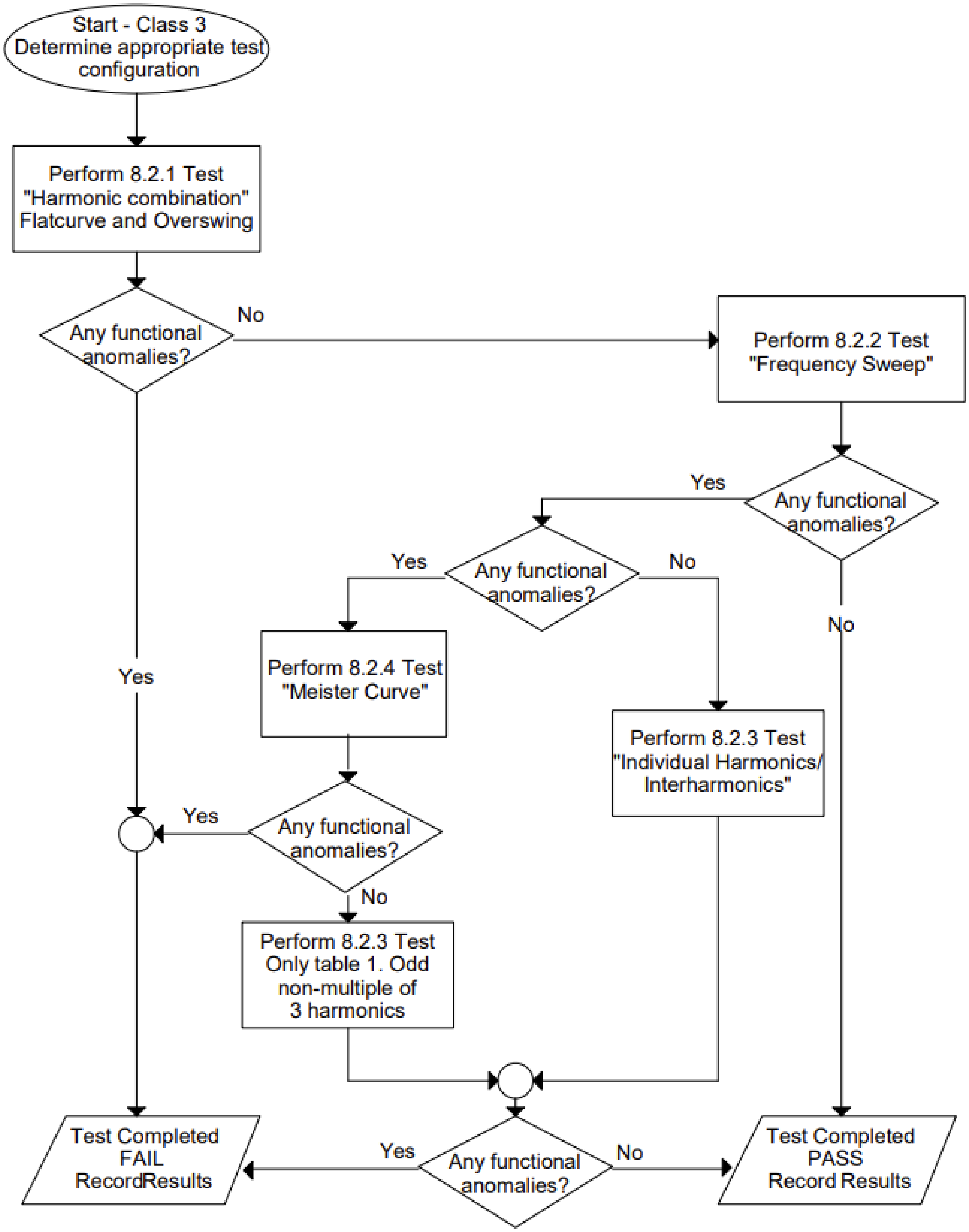


Figure 9-3: IEC 61000-4-13 Test Flowchart Class 3

9.3.4 Using the Virtual-Panel GUI-Windows Program for IEC 61000-4-13 Tests

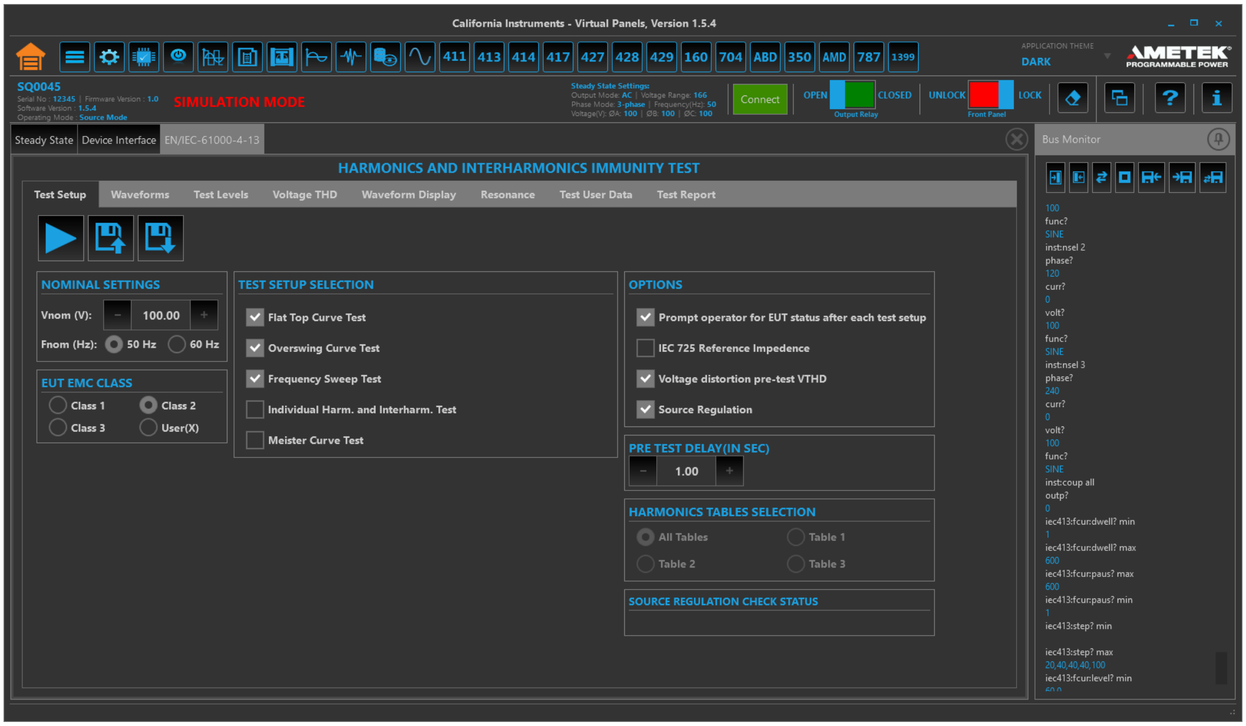


Figure 9-4: Virtual-Panel GUI-Windows Program for IEC 61000-4-13 Tests

The Virtual-Panel GUI-Windows control program will detect the presence of the –413 option on the SQ/TA AC power source. Test reports can be generated at the end of a test for documentation purposes.

10. CALIBRATION

This section explains the steps to calibrate the power supply. Calibration should be done every 12 months or after service if subassemblies are replaced. The procedures are performed using SCPI commands through the remote digital interface. You can use the Sequoia/Tahoe Virtual Panels GUI-program or a communications program like HyperTerminal. For details on operation through the remote digital interface, refer to the Sequoia Series Programming Manual (M447353-01) or the Tahoe Series Programming Manual (P/N M445374-01) for more information.

10.1 Calibration Equipment

Table 9-1 lists the equipment needed to perform the calibration.

Equipment	Model
Power Analyzer	Tektronix, Model PA3000, or equivalent
Digital Phase Meter	Krohn-Hite, Model 6620, or equivalent
DVM	Fluke, 8508A, or equivalent
Function Generator	Keysight, Model 33210A, or equivalent
Differential Probe	Tektronix, Model P5202A, or equivalent
Load Bank	Resistive loads resistors at power levels per model rating
Computer Controller	Remote communications program through LAN, USB, or RS-232C

Table 10-1: Calibration Equipment

10.2 Source Mode Calibration Procedures

10.2.1 Preparation for Calibration

WARNING!
Hazardous voltages exist at the rear of the power source. Care must be taken to avoid contact with the AC input and AC/DC output terminals. Only authorized personnel should perform these procedures.

Calibration should only be performed by technically trained personnel who understand the operation of the power source and can take accurate readings while following the procedure steps. The calibration procedures require precision instruments to measure voltage and current. If substituting recommended test equipment, ensure that the accuracy is sufficient to avoid excessive error compared to the specifications of the parameters being calibrated. To set up the alignment procedures, follow these initial steps:

1. Disconnect AC mains power when making setup connections.
2. Connect the test equipment and loads to the output and control inputs of the power source.
3. Connect the digital voltmeter to the output of the power source.
4. Allow a 30-minute warm-up period for the power source and test equipment before conducting the calibration procedure.

CAUTION!

The AC input power must be turned off and then on again after calibration is complete to end the alignment routines and apply the calibration. This is also required if only parts of the calibration procedure are performed.

10.2.2 Output Voltage DC Zero Alignment, AC-Mode

1. Cycle the AC input power to the unit off and then on.
2. With the external DVM set for DC, monitor the voltage at the power source output.
3. Ensure that there is no load connected to the output of the power source.
4. Enter the calibration password with the SCPI command CAL:PASS “5000”.
5. Send the following SCPI command to select Phase-A: INST:NSEL 1.
6. Send the fallowing SCPI commands to the power source; the ALC can be either ON/OFF (333 VAC range selected):
```
MODE AC
VOLT:RANGE 333
VOLT:ALC OFF
CURR 15
VOLT 0
FREQ 60 VOLT 0
OUTP 1
```
7. Perform the adjustment using the command CAL:VOLT:AC:HRAN:OFF <numeric value>. The numeric value is in the range of +/- 2000. Adjust until the DC output reading is < 0.020 V. The external DVM should be in the 10 or 20 VDC range.
8. Send the SCPI command INST:NSEL 2, and repeat Step-7 to align Phase-B.
9. Send the SCPI command INST:NSEL 3, and repeat Step-7 to align Phase-C.
10. For HF & EHF Option, set frequency to 820 Hz (Low Range); set the frequency to 820 Hz and perform the adjustment with: CAL:VOLT:AC:HRAN:HFOFF <numeric value>.(Numeric value range: +/- 2000.)Adjust until the DC output reading is < 0.020V.Use the external DVM in the 10 VDC or 20 VDC range.
11. For HF & EHF option, Send the SCPI command INST:NSEL 2, and repeat Step-7 to align Phase-B.
12. For HF & EHF option, Send the SCPI command INST:NSEL 3, and repeat Step-7 to align Phase-C.
13. Send the following SCPI commands to the power source; the ALC can be either ON/OFF (166 VAC range selected):
```
VOLT:RANGE 166
OUTP 1
```
14. Perform the adjustment using the command CAL:VOLT:AC:LRAN:OFF <numeric value>. The numeric value is in the range of +/- 2000. Adjust until the DC output reading is < 0.020 V. The external DVM should be in the 10 or 20 VDC range.
15. Send the SCPI command INST:NSEL 2, and repeat Step-7 to align Phase-B.
16. Send the SCPI command INST:NSEL 3, and repeat Step-7 to align Phase-B.
17. (HF & EHF option only) Set the frequency to 820 Hz and perform the adjustment using the command CAL:VOLT:AC:LRAN:HFOFF <numeric value>. The numeric value is in the range of +/- 2000. Adjust until the DC output reading is < 0.020 V. The external DVM should be in the 10 or 20 VDC range.

18. Send the SCPI command `INST:NSEL 2`, and repeat Step-7 to align Phase-B.
19. Send the SCPI command `INST:NSEL 3`, and repeat Step-7 to align Phase-C.

10.2.3 Output Voltage AC Zero Alignment, AC-Mode

1. With the external DVM set for AC, monitor the voltage at the power source output.
2. Ensure that there is no load connected to the output of the power source.
3. Enter the calibration password with the SCPI command `CAL:PASS "5000"`.
4. Send the following SCPI command to select Phase-A: `INST:NSEL 1`.
5. Send the following SCPI commands to the power source; the ALC can be either on or off (333 VAC range selected):
```
MODE AC
VOLT:RANGE 333
FREQ 60
VOLT 0
VOLT:ALC OFF
CURR 15
OUTP 1
```
6. Perform the adjustment using the command `CAL:VOLT:HRAN:ZERO <numeric value>`. The numeric value in the range of 0 to 255. The default value is 127. Adjust the voltage to minimum possible value and make sure that output voltage is less than 0.6 V. The external DVM should be in the 10 or 20 VAC range.
7. Send the SCPI command `INST:NSEL 2`, and repeat Step-6 to align Phase-B.
8. Send the SCPI command `INST:NSEL 3`, and repeat Step-6 to align Phase-C.

10.2.4 Output Voltage DC Zero Alignment, DC-Mode

1. With the external DVM set for DC, monitor the voltage at the power source output.
2. Ensure that there is no load connected to the output of the power source.
3. Enter the calibration password with the SCPI command `CAL:PASS "5000"`.
4. Send the following SCPI command to select Phase-A: `INST:NSEL 1`.
5. Send the following SCPI commands to the power source (440 VDC range selected; ALC off):
```
VOLT:ALC OFF
MODE DC
VOLT:RANGE 440
VOLT 0
CURR 10
OUTP ON
```
6. Monitor the Phase A output with the external DVM.
7. Program the zero-calibration value with the command `CAL:VOLT:DC:HRAN:ZERO <numeric value>`. Where the numeric value is in the range of +/- 2000. Start from a value of zero and increase or decrease the value until the measured value ≤ 0.005 VDC.
8. Send the SCPI command `INST:NSEL 2`, and repeat Step-6 and Step-7 to align Phase-B.
9. Send the SCPI command `INST:NSEL 3`, and repeat Step-6 and Step-7 to align Phase-C.
10. Set the unit to low-range `VOLT:RANGE 220`.
11. Program the zero-calibration value with the command `CAL:VOLT:DC:LRAN:ZERO <numeric value>`. Where the numeric value is in the range of +/- 2000. Start from a value of zero and

increase or decrease the value until the measured value ≤ 0.005 VDC.

12. Send the SCPI command `INST:NSEL 2`, and repeat Step-5 and Step-7 to align Phase-B.
13. Send the SCPI command `INST:NSEL 3`, and repeat Step-5 and Step-7 to align Phase-C.

10.2.5 Source Mode: ADC AC VOLT Offset calibration

1. With the external DVM set for DC, monitor the voltage at the power source output.
2. Ensure that there is no load connected to the output of the power source.
3. Enter the calibration password with the SCPI command `CAL:PASS "5000"`.
4. Send the following SCPI command to select Phase-A: `INST:NSEL 1`.
5. Send the following SCPI commands to the power source (333 VAC range selected; ALC off):
```
MODE AC
VOLT:ALC OFF
VOLT:RANGE 333
VOLT 0
CURR 0
OUTP 1
```
6. Monitor the measured value for phase A with the command `MEAS:VOLT?`.
7. Change the offset value with the command `CAL:ADC:VOLT:AC:HROF <numeric value>`, where the numeric value can be up to +/-65535. Update from the value of zero in increment of +/-100 until measured value equal value reported by external voltmeter. Verify the measured value from the unit and the external voltmeter are within +/- 20 mV.
8. Send the SCPI command `INST:NSEL 2`, and repeat Step-5 through Step-7 to align phase B.
9. Send the SCPI command `INST:NSEL 3`, and repeat Step-5 through Step-7 to align phase C.

10.2.6 ADC AC CURR Offset calibration

1. With the external DVM set for DC, monitor the voltage at the power source output.
2. Ensure that there is no load connected to the output of the power source.
3. Enter the calibration password with the SCPI command `CAL:PASS "5000"`.
4. Send the following SCPI command to select Phase-A: `INST:NSEL 1`.
5. Send the following SCPI commands to the power source (333 VAC range selected; ALC off):
```
MODE AC
VOLT:ALC OFF
VOLT:RANGE 333
VOLT 0
CURR 0
FREQ 60
OUTP 1
```
6. Monitor the measured value for phase A with the command `MEAS:CURR?`.
7. Change the offset value with the command `CAL:ADC:CURR:AC:HROF <numeric value>`, where the numeric value can be up to +/-65535. Update from the value of zero in increment of +/-100 until the measured value equals the value reported by the external meter current. Verify the measured value from the unit and the external meter are within +/- 5 mA.
8. Send the SCPI command `INST:NSEL 2`, and repeat Step-5 through Step-7 to align phase B.
9. Send the SCPI command `INST:NSEL 3`, and repeat Step-3 through Step-7 to align phase C.

10.2.7 Output Voltage Gain Initial Alignment, AC-Mode, and DC-Mode

1. With the external DVM set for AC, monitor the voltage at the power source output.
2. Ensure that there is no load connected to the output of the power source.
3. Send the following SCPI command to select Phase-A `INST:NSEL 1`.
4. Enter the calibration password with the SCPI command `CAL:PASS "5000"`.
5. Voltage Gain Initial Alignment, AC-Mode: Send the following SCPI commands to the power source (333 VAC range selected; ALC off):
```
VOLT:ALC OFF
MODE AC
VOLT:RANGE 333
VOLT 250
FREQ 60
CURR 15
OUTP ON
```
6. Adjust pot R530, R535, R576 till getting the maximum output voltage value for A, B & C phases respectively.
7. Verify the existing calibration coefficient using the SCPI command: `CAL:VOLT:FSC?`.
8. Monitor the Phase A output with the external DVM. Adjust the output voltage to 250 ± 0.3 volt as indicated on the external DVM using the command below by reducing or increasing the numeric value.
9. Send in the command `CAL:VOLT:FSC <numeric value>`, where numeric value can be up to 0 to 65535.
10. (EHF option only) Disable the power source output. Set the power source to `FREQ 1500`. Enable the power source output and adjust potentiometer 530 until the DMM reads 275 VAC +/- 0.3 V.
11. (EHF option only) Disable the power source output. Send the following SCPI commands to the power source:
```
VOLT:ALC ON
FREQ 60
OUTP ON
```
12. (EHF option only) Send the following SCPI commands to the power source to `FREQ 1500` and verify the UUT does not produce an "Output Volt Fault" error.
13. Send the SCPI command `INST:NSEL 2`, and repeat Step-4 through step-12 (pot 535) align Phase-B.
14. Send the SCPI command `INST:NSEL 3`, and repeat Step-4 through step-12 (pot 576) align Phase-C.
15. Change voltage mode to DC with SCPI commands:
```
OUTP OFF
MODE DC
VOLT:RANGE 440
VOLT 350
CURR 10
OUTP ON
```
16. Verify the existing calibration coefficient using the SCPI command `CAL:VOLT:FSC?`.
17. Monitor the Phase A output with the external DVM. Adjust the output voltage to 350 ±1 volt as indicated on the external DVM using the command below by reducing or increasing the value.
18. Send the SCPI command `CAL:VOLT:DC < numeric value >`, where numeric value can be up to 0 to 65535.

19. Send the SCPI command `INST:NSEL 2`, and repeat Step-15 through Step-18 to align Phase-B.
20. Send the SCPI command `INST:NSEL 3`, and repeat Step-15 through Step-18 to align Phase-C.

10.2.8 Output Voltage Measurement AC Gain Alignment, AC-Mode

1. With the external DMM set for AC, monitor the voltage at the power source output.
2. Ensure that there is no load connected to the output of the power source.
3. Enter the calibration password with the SCPI command `CAL:PASS “5000”`.
4. Send the following SCPI command to select Phase-A: `INST:NSEL 1`.
5. Send the following SCPI commands to the power source (333 VAC range selected; ALC off):
```
VOLT:ALC OFF
MODE AC
CURR 15
VOLT:RANG 333
VOLT 250
FREQ 60
OUTP 1
```
6. Perform the alignment with the SCPI command `CAL:MEAS:VOLT <numeric value>`. The numeric value for the selected phase is the actual output reading from the external DVM connected to the power source output.
7. Send the SCPI query command `*OPC?`, to determine when this alignment section has been completed. Ensure alignment has been completed (query returns a 1) before continuing.
8. Send the SCPI command `INST:NSEL 2`, and repeat Step-5 through Step-7 to align Phase-B.
9. Send the SCPI command `INST:NSEL 3`, and repeat Step-5 through Step-7 to align Phase-C.

10.2.9 Output Voltage Measurement DC-Positive Gain Alignment, DC-Mode

1. With the external DMM set for DC, monitor the voltage at the power source output.
2. Ensure that there is no load connected to the output of the power source.
3. Enter the calibration password with the SCPI command `CAL:PASS “5000”`.
4. Send the following SCPI command to select Phase-A: `INST:NSEL 1`.
5. Send the following SCPI commands to the power source (440 VDC selected; ALC off):
```
OUTP 0
VOLT:ALC OFF
MODE DC
VOLT:RANG 440
VOLT 350
CURR 10
OUTP 1
```
6. Perform the alignment with the command `CAL:MEAS:VOLT:DC <numeric value>`. The numeric value for the selected phase is the actual output reading from the external DMM connected to the power source output.
7. Send the SCPI query command `*OPC?`, to determine when this alignment section has been completed. Ensure alignment has been completed (query returns a 1) before continuing.
8. Monitor the measured value for phase A voltage with the command `MEAS:VOLT?`. Verify the measured value reported by the unit and the external voltmeter difference is within +/- 50 mV.
9. Send the SCPI command INST:NSEL 2, and repeat Step-5 through Step-7 to align Phase-B.

10. Send the SCPI command `INST:NSEL 3`, and repeat Step-5 through Step-7 to align Phase-C.

10.2.10 Output Voltage Measurement DC-Negative Gain Alignment, DC-Mode

1. With the external DMM set for DC, monitor the voltage at the power source output.
2. Ensure that there is no load connected to the output of the power source.
3. Enter the calibration password with the SCPI command `CAL:PASS "5000"`.
4. Send the following SCPI command to select Phase-A: `INST:NSEL 1`.
5. Send the following SCPI commands to the power source (440 VDC selected; ALC off):
```
OUTP 0
VOLT:ALC OFF
MODE DC
VOLT:RANG 440
VOLT -350
CURR 10
OUTP
```
6. Perform the alignment with the command `CAL:MEAS:VOLT:DC:NEG <numeric value>`. The numeric value for the selected phase is the actual output reading from the external DMM connected to the power source output.
7. Send the SCPI query command `*OPC?`, to determine when this alignment section has been completed. Ensure alignment has been completed (query returns a 1) before continuing.
8. Send the SCPI command `INST:NSEL 2`, and repeat Step-5 through Step-7 to align Phase-B.
9. Send the SCPI command `INST:NSEL 3`, and repeat Step-5 through Step-7 to align Phase-C.

10.2.11 Output Current Measurement AC Low-Range Gain Alignment, AC-Mode

1. Connect the power analyzer for AC current measurement.
2. Connect the load to the output of the power source.
3. Set load to the low-range resistance for 90% of the rated current, appropriate for the model that is to be aligned. Ensure that the load setting maintains the power source in the constant-voltage (CV) mode of operation.
4. Test the UUT at 100 Hz for standard frequency and 60 Hz for HF or EHF, using the low range.
5. Enter the calibration password with the SCPI command `CAL:PASS "5000"`.
6. Send the following SCPI command to select Phase-A: `INST:NSEL 1`.
7. Send the following SCPI commands to the power source (166 VAC range selected; ALC off):
   ```
   OUTP 0
   CURR:PROT OFF
   MODE AC
   INST:COUP NONE
   VOLT:RANGE 166
   VOLT 88
   FREQ {60 |100}
   CURR <Max value >
   VOLT:ALC OFF
   OUTP 1
   ```
8. Set the output current of the power supply to the low range and 90% of the rated current, appropriate for the model that is to be aligned, using the SCPI command, `CURR <90% of the rated current>`.
9. Perform the alignment with the SCPI command `CAL:MEAS:CURR <numeric value>`. The numeric value for the selected phase is the actual output current derived from the reading of the external power analyzer. Ensure that the temperature coefficient of the load is low so that the resistance value of the load does not change during the time interval required to read and enter the external reading.
10. Send the SCPI query command `*OPC?`, to determine when this alignment section has been completed. Ensure alignment has been completed (query returns a 1) before continuing.
11. Send the SCPI command `INST:NSEL 2`, and repeat Step-7 through Step-10 to align Phase-B.
12. Send the SCPI command `INST:NSEL 3`, and repeat Step-7 through Step-10 to align Phase-C.
13. For HF and EHF options, at 550 Hz frequency in low range, perform steps-7 to Step-12.
14. For HF and EHF options, at 819 Hz frequency in low range, perform steps-7 to Step-12.
15. For HF and EHF options, at 905 Hz frequency in low range, perform steps-7 to Step-12.
16. For EHF options, at 1500 Hz frequency in low range, perform steps-7 to Step-12.
17. The calibration coefficients are queried using the SCPI command `CAL:MEAS:CURR? ALL`. The command will return a command-separated number sequence of four calibration sets. Each set will have the calibration frequency and the corresponding coefficient for low-range and high-range, with the following format:
   `f1,dataL1,dataH1,f2,dataL2,dataH2,f3,dataL3,dataH3,f4,dataL4,dataH4,f5,dataL5,dataH5`.

10.2.12 Output Current Measurement AC High-Range Gain Alignment, AC-Mode

1. Connect the power analyzer for AC current measurement.
2. Connect the load to the output of the power supply.
3. Set load to the high-range resistance for 90% of the rated current, appropriate for the model that is to be aligned. Ensure that the load setting maintains the power supply in the constant-voltage (CV) mode of operation.
4. Test the UUT at 100 Hz for standard frequency and 60 Hz for HF or EHF, using the high range
5. Enter the calibration password with the SCPI command `CAL:PASS "5000"`.
6. Send the following SCPI command to select Phase-A: `INST:NSEL 1`.
7. Send the following SCPI commands to the power source (333 VAC range selected; ALC off):
```
OUTP 0
CURR:PROT OFF
MODE AC
VOLT:RANGE 333
VOLT 166
FREQ 100
VOLT:ALC OFF
CURR <Max value >
OUTP 1
```
8. Set the output current of the power source to the high-range and 90% of the rated current, appropriate for the model that is to be aligned, using the SCPI command, `CURR <90% of the rated current>`.
9. Perform the alignment with the SCPI command `CAL:MEAS:CURR <numeric value>`. The numeric value for the selected phase is the actual output current derived from the reading of the external power analyzer. Ensure that the temperature coefficient of the load is low so that the resistance value of the load does not change during the time interval required to read and enter the external reading.
10. Send the SCPI query command `*OPC?`, to determine when this alignment section has been completed. Ensure alignment has been completed (query returns a 1) before continuing.
11. The SCPI command, `FREQ`, must be changed for each frequency, e.g., `FREQ 550, FREQ 819, FREQ 905`.
12. Send the SCPI command `INST:NSEL 2`, and repeat Step-7 through Step-10 to align Phase-B.
13. Send the SCPI command `INST:NSEL 3`, and repeat Step-7 through Step-10 to align Phase-C.
14. For HF and EHF options, at 550 Hz frequency in high range, perform steps-7 to Step-12.
15. For HF and EHF options, at 819 Hz frequency in high range, perform steps-7 to Step-12.
16. For HF and EHF options, at 905 Hz frequency in high range, perform steps-7 to Step-12.
17. For EHF options, at 1500 Hz frequency in high range, perform steps-7 to Step-12.
18. The calibration coefficients are queried using the SCPI command, `CAL:MEAS:CURR? ALL`. The command will return a command-separated number sequence of four calibration sets. Each set will have the calibration frequency and the corresponding coefficient for low-range and high-range, with the following format:`f1,dataL1,dataH1,f2,dataL2,dataH2,f3,dataL3,dataH3,f4,dataL4,dataH4,f5,dataL5,dataH5`.

10.2.13 Output Current Measurement AC Low-Range Offset Alignment, AC-Mode

1. Ensure that there is no load connected to the output of the power source.

2. Enter the calibration password with the SCPI command CAL:PASS "5000".
3. Send the following SCPI command to select Phase-A: INST:NSEL 1.
4. Send the following SCPI commands to the power source (166 VAC range selected; ALC off):
   ```
   INST:COUP ALL
   MODE AC
   VOLT:RANGE 166
   VOLT 0
   FREQ 60
   VOLT:ALC OFF
   OUTP 1
   ```
5. Reset the low range offset alignment with the SCPI command CAL:MEAS:CURR:LROF 0.
6. Measure the output current with the SCPI command: MEAS:CURR?.
7. Perform the alignment with the SCPI command CAL:MEAS:CURR:LROF <numeric value>. The numeric value is the actual output current measured by the command MEAS:CURR?.
8. Send the SCPI query command *OPC?, after each numeric value entry to determine when this alignment has been completed. Ensure alignment has been completed (query returns a 1) before continuing.
9. Send the SCPI command INST:NSEL 2, and repeat Step-4 through Step-8 to align Phase-B.
10. Send the SCPI command INST:NSEL 3, and repeat Step-4 through Step-8 to align Phase-C.

10.2.14 Output Current Measurement AC High-Range Offset Alignment, AC-Mode

1. Ensure that there is no load connected to the output of the power source.
2. Enter the calibration password with the SCPI command CAL:PASS "5000".
3. Send the following SCPI command to select Phase-A: INST:NSEL 1.
4. Send the following SCPI commands to the power source (333 VAC range selected; ALC off):
   ```
   INST:COUP ALL
   MODE AC
   VOLT:RANGE 333
   VOLT 0
   FREQ 60
   VOLT:ALC OFF
   OUTP 1
   ```
5. Reset the high range offset alignment with the SCPI command CAL:MEAS:CURR:HROF 0.
6. Measure the output current with the SCPI command MEAS:CURR?.
7. Perform the alignment with the SCPI command CAL:MEAS:CURR:HROF <numeric value>. The numeric value is the actual output current measured by the command MEAS:CURR?.
8. Send the SCPI query command *OPC?, after each numeric value entry to determine when this alignment has been completed. Ensure alignment has been completed (query returns a 1) before continuing.
9. Send the SCPI command INST:NSEL 2, and repeat Step-4 through Step-8 to align Phase-B.
10. Send the SCPI command INST:NSEL 3, and repeat Step-4 through Step-8 to align Phase-C.

10.2.15 Inter-Harmonics Board Calibration (IEC413 Option Only)

1. Ensure that there is no load connected to the output of the power source.
2. Enter the calibration password with the SCPI command CAL:PASS "5000".

3. Send the following SCPI command to select Phase-A: `INST:NSEL 1`.
4. Enable the IEC413 option.
5. Send the following SCPI commands to the power source (333 VAC range selected):
```
MODE AC
VOLT:RANGE 333
FREQ 50
OUTP ON
```
6. Locate Adjustment pot R9, R10 and R11 in 7003-719 board.
7. Monitor the output voltage of phase A with the Fluke 8508 A external voltmeter.
8. Send the following SCPI commands to the power source (20 V and 400 Hz output from the harmonics board):
```
IHAR ON
IHAR:COUP OFF
IHAR:REF 230
IHAR:VOLT 8.7
IHAR:FREQ 400
```
9. Adjust R9 so that the output voltage reading with external voltmeter is 20 V.
10. Repeat Step-9 for phase B and phase C by adjusting R10 and R11.
11. Set all three phases current limit to 0.3 A.
12. Set the Inter-Harmonics board frequency to 1800 Hz with the command `IHAR:FREQ 1800`.
13. Enable calibration password with the command `CAL:PASS "5000"`.
14. Use the 10 VAC or 20 VAC or VDC range to prevent an offset error in the External DVM caused by output noise.
15. Adjust the output voltage to 20 V by using the command `CAL:IHAR <value>`, Where value can be part of +/- of 2000. A value of 500 is 5% gain.

10.2.16 Source Mode: ADC DC VOLT Offset calibration

1. Ensure that there is no load connected to the output of the power source.
2. Enter the calibration password with the SCPI command `CAL:PASS "5000"`.
3. Send the following SCPI command to select Phase-A: `INST:NSEL 1`.
4. Send the following SCPI commands to the power source:
```
MODE DC
VOLT:RANGE 440
VOLT 0
OUTP 1
```
5. Monitor the measured value for phase A with the command `MEAS:VOLT?`.
6. Change the offset value with the command `CAL:ADC:VOLT:DC:HROF <numeric value>`, where numeric value can be up to +/-65535. Update from the value of zero in increment of +/-100 until measured value equal value reported by external voltmeter. Verify the measured value reported by the unit and the external voltmeter are within +/- 20 mV.
7. Send the SCPI command `INST:NSEL 2`, and repeat step 5 to align phase B.
8. Send the SCPI command `INST:NSEL 3`, and repeat step 5 to align phase C.

10.2.17 Output Current Measurement DC-Positive Low-Range Gain Alignment, DC-Mode

1. Connect the power analyzer for DC current measurement.

2. Connect the load to the output of the power supply.
3. Set load for the low-range resistance for 90% of the rated current, appropriate for the model that is to be aligned. Ensure that the load setting maintains the power source in the constant-voltage (CV) mode of operation.
4. Enter the calibration password with the SCPI command `CAL:PASS "5000"`.
5. Send the following SCPI command to select Phase-A: `INST:NSEL 1`
6. Send the following SCPI commands to the power source (220 VDC range selected; ALC off):
```
OUTP 0
CURR:PROT OFF
MODE DC
VOLT:RANGE 220
VOLT 110
CURR <max value >
VOLT:ALC OFF
OUTP 1
```
7. Set the output current of the power source to the low range and 90% of the rated current, appropriate for the model that is to be aligned, using the SCPI command, `CURR <90% of the rated current>`.
8. Perform the alignment with the SCPI command `CAL:MEAS:CURR:DC <numeric value>`. The numeric value for the selected phase is the actual output current derived from the reading of the external power analyzer.
9. Send the SCPI query command `*OPC?`, to determine when this alignment section has been completed. Ensure alignment has been completed (query returns a 1) before continuing.
10. Send the SCPI command `INST:NSEL 2`, and repeat Step-6 through Step-9 to align Phase-B.
11. Send the SCPI command `INST:NSEL 3`, and repeat Step-6 through Step-9 to align Phase-C.
12. The DC-positive calibration coefficients are queried using the SCPI command `CAL:MEAS:CURR:DC?`; the command will return a comma-separated number sequence, with the low-range coefficient followed by the high-range coefficient.

10.2.18 Output Current Measurement DC-Positive High-Range Gain Alignment, DC-Mode

1. Connect the power analyzer for DC current measurement.
2. Connect the load to the output of the power supply.
3. Set load for the high-range resistance for 90% of the rated current appropriate for the model that is to be aligned.
4. Enter the calibration password with the SCPI command `CAL:PASS "5000"`.
5. Send the following SCPI command to select Phase-A: `INST:NSEL 1`.
6. Send the following SCPI commands to the power source (440 VDC range selected; ALC off):
```
INST:COUP ALL
CURR:PROT OFF
MODE DC
VOLT:RANGE 440
VOLT 220
CURR <max value >
VOLT:ALC OFF
OUTP 1
```
7. Set the output current of the power supply to the high-range and 90% of the rated current, appropriate for the model that is to be aligned, using the SCPI command `CURR <90% of the`

rated current>.

8. Perform the alignment with the SCPI command CAL:MEAS:CURR:DC <numeric value>. The numeric value for the selected phase is the actual output current derived from the reading of the external power analyzer.
9. Send the SCPI query command *OPC?, to determine when this alignment section has been completed. Ensure alignment has been completed (query returns a 1) before continuing.
10. Send the SCPI command INST:NSEL 2, and repeat Step-6 through Step-9 to align Phase-B.
11. Send the SCPI command INST:NSEL 3, and repeat Step-6 through Step-9 to align Phase-C.
12. The DC-positive calibration coefficients are queried, using the SCPI command CAL:MEAS:CURR:DC?; the command will return a comma-separated number sequence, with the low-range coefficient followed by the high-range coefficient.

10.2.19 Output Current Measurement DC-Negative Low-Range Gain Alignment, DC-Mode

1. Connect the power analyzer for DC current measurement.
2. Connect the load to the output of the power supply.
3. Set load for the low-range resistance for 90% of the rated current appropriate for the model that is to be aligned.
4. Enter the calibration password with the SCPI command: CAL:PASS "5000".
5. Send the following SCPI command to select Phase-A: INST:NSEL 1.
6. Set the output current of the power source to the low-range and 90% of the rated current, appropriate for the model that is to be aligned, using the SCPI command CURR <90% of the rated current>.
7. Send the following SCPI commands to the power source (220 VDC range selected; ALC off):
   ```
   INST:COUP ALL
   CURR:PROT OFF
   MODE DC
   VOLT:RANGE 440
   VOLT -220
   CURR <max value
   VOLT:ALC OFF
   OUTP 1
   ```
8. Perform the alignment with the SCPI command CAL:MEAS:CURR:DC <numeric value>. The numeric value for the selected phase is the actual output current derived from the reading of the external power analyzer.
9. Send the SCPI query command *OPC?, to determine when this alignment section has been completed. Ensure alignment has been completed (query returns a 1) before continuing.
10. Send the SCPI command INST:NSEL 2, and repeat Step-6 through Step-9 to align Phase-B.
11. Send the SCPI command INST:NSEL 3, and repeat Step-6 through Step-9 to align Phase-C.
12. The DC-negative calibration coefficients are queried using the SCPI command, CAL:MEAS:CURR:DC:NEG?, as the comma-separated, low-range coefficient followed by the high-range coefficient.

10.2.20 Output Current Measurement DC-Negative High-Range Gain Alignment, DC-Mode

1. Connect the power analyzer for DC current measurement.
2. Connect the load to the output of the power source.

3. Set load for the high-range resistance for 90% of the rated current, appropriate for the Series model that is to be aligned.
4. Enter the calibration password with the SCPI command `CAL:PASS "5000"`.
5. Send the following SCPI command to select Phase-A: `INST:NSEL 1`.
6. Send the following SCPI commands to the power source (440 VDC range selected; ALC off):
```
OUTP 0
CURR:PROT OFF
MODE DC
VOLT:RANGE 440
VOLT -220
VOLT:ALC OFF
OUTP 1
```
7. Set the output current of the power source to the high range and 90% of the rated current, appropriate for the model that is to be aligned, using the SCPI command `CURR <90% of the rated current>`.
8. Perform the alignment with the SCPI command `CAL:MEAS:CURR:DC <numeric value>`. The numeric value for the selected phase is the actual output current derived from the reading of the external power analyzer.
9. Send the SCPI query command `*OPC?`, to determine when this alignment section has been completed. Ensure alignment has been completed (query returns a 1) before continuing.
10. Send the SCPI command `INST:NSEL 2`, and repeat Step-6 through Step-9 to align Phase-B.
11. Send the SCPI command `INST:NSEL 3`, and repeat Step-6 through Step-9 to align Phase-C.
12. The DC-negative calibration coefficients are queried using the SCPI command `CAL:MEAS:CURR:DC:NEG?`, the command will return a comma-separated number sequence, with the low-range coefficient followed by the high-range coefficient.

10.2.21 Output Current Measurement Low-Range Offset Alignment, DC-Mode

1. Ensure that there is no load connected to the output of the power source.
2. Enter the calibration password with the SCPI command `CAL:PASS "5000"`.
3. Send the following SCPI command to select Phase-A: `INST:NSEL 1`.
4. Send the following SCPI commands to the power source (220 VDC range selected; ALC off):
```
OUTP 0
MODE DC
INST:COUP ALL
VOLT:RANGE 220
VOLT 0
VOLT:ALC OFF
OUTP 1
```
5. Reset low range offset alignment with the SCPI command `CAL:MEAS:CURR:DC:LROF 0`.
6. Measure the output current with the SCPI command `MEAS:CURR:DC?`.
7. Perform the alignment with the SCPI command `CAL:MEAS:CURR:DC:LROF <numeric value>`. The numeric value is the actual output current measured by the command `MEAS:CURR:DC?`.
8. Send the SCPI query command `*OPC?`, after each numeric value entry to determine when this alignment has been completed. Ensure alignment has been completed (query returns a 1) before continuing.

9. Send the SCPI command `INST:NSEL 2`, and repeat Step-4 through Step-8 to align Phase-B.
10. Send the SCPI command `INST:NSEL 3`, and repeat Step-4 through Step-8 to align Phase-C.

10.2.22 Output Current Measurement High-Range Offset Alignment, DC-Mode

1. Ensure that there is no load connected to the output of the power source.
2. Enter the calibration password with the SCPI command `CAL:PASS "5000"`.
3. Send the following SCPI command to select Phase-A: `INST:NSEL 1`.
4. Send the following SCPI commands to the power source (440 VDC range selected; ALC off):
```
OUTP 0
CURR:PROT OFF
MODE DC
VOLT:RANGE 440
VOLT 0
VOLT:ALC OFF
OUTP 1
```
5. Reset high range offset alignment with the SCPI command: `CAL:MEAS:CURR:DC:HROF 0`.
6. Measure the output current with the SCPI command: `MEAS:CURR:DC?`.
7. Perform the alignment with the SCPI command `CAL:MEAS:CURR:DC:HROF <numeric value>`. The numeric value is the actual output current measured by the command `MEAS:CURR:DC?`.
8. Send the SCPI query command `*OPC?`, after each numeric value entry to determine when this alignment has been completed. Ensure alignment has been completed (query returns a 1) before continuing.
9. Send the SCPI command `INST:NSEL 2`, and repeat Step-4 through Step-8 to align Phase-B.
10. Send the SCPI command `INST:NSEL 3`, and repeat Step-4 through Step-8 to align Phase-C.

10.2.23 Output Phase-A Alignment, Output Relative to External SYNC

Note: Calibration is not performed on units with the LKA option.

1. Connect a function generator to External Input/Output Control connector Pin-2 (SYNC_HIGH) and Pin-3 (SYNC_LOW); refer to Section 3.8.3. Set the function generator to produce a pulse train with an output frequency of 16 Hz and an amplitude switching between 0 V and 5 V.
2. Set up the phase meter to make phase measurements of the power supply output relative to the External SYNC signal as a reference. Connect one input of the phase meter to the function generator output. Using a differential voltage probe for isolation, connect the other input of the phase meter to the power source output of Phase-A.
3. Enter the calibration password with the SCPI command `CAL:PASS "5000"`.
4. Send the following SCPI commands to the power source (166 VAC range selected):
```
OUTP 0
VOLT:RANGE 166
VOLT 100
FREQ:MODE SENSE
CURR 15
PHASE 0
SOUR:FUNC SINE
OUTP 1
```
5. Perform the alignment with the SCPI command `CAL:PHASE <numeric value>`, where the numeric value is derived from phase measurement using the phase meter. Initially set the phase to zero with the SCPI command `CAL:PHASE 0`. Record the phase angle reading from the phase

meter, Reprogram the calibration phase with the same value obtain from the phase meter with the command `CAL:PHASE < numeric value >`. You may have to add or subtract 0.4 degree to obtain a phase meter reading of a value near zero.

6. For standard frequency of 100 Hz, perform step-4 to Step-5.
7. For standard frequency of 200 Hz, perform step-4 to Step-5.
8. For HF and EHF options, at 550 Hz frequency in high range, perform step-4 to Step-5.
9. For HF and EHF options, at 819 Hz frequency in high range, perform step-4 to Step-5.
10. For HF and EHF options, at 905 Hz frequency in high range, perform step-4 to Step-5.
11. For EHF options, at 1500 Hz frequency in high range, perform step-4 to Step-5.
12. For output frequencies of 100 Hz, 200 Hz, 550 Hz, 819 Hz, 905 Hz (Only for HF & EHF Option).and 1500 Hz (Only for EHF Option). with SCPI command `FREQ <n>` or the highest frequency and extreme highest frequency of the power source model being aligned.
13. The calibration coefficients are verified with the SCPI query, `CAL:PHASE? SENSE`. First cycle the AC input power off then on, and then send the command, `CAL:PHASE?`. The command will return a command-separated number sequence of calibration coefficients with the following format:
`f1,data1,f2,data2,f3,data3,f4,data4,f5,data5,f6,data6,f7,data7,current-cal`.

10.2.24 Output Phase-A Alignment, Auxiliary Unit Relative to Leader Unit (LKS Option Only)

Note: Calibration is performed on units with the LKA option.

1. Connect two power sources in a Leader/Auxiliary configuration for multi-phase group. Refer to Section 3.8.3.
2. Connect the remote voltage sense leads of the Leader unit and the Auxiliary unit to their respective output terminals.
3. Set up the phase meter to make phase measurements of the Auxiliary power supply output of Phase-A relative to the Leader power supply output of Phase-A as a reference. Using differential voltage probes for isolation, connect one input of the phase meter to the Leader unit and the other input of the phase meter to the Auxiliary unit.
4. Send the following SCPI commands to the power sources (200 VAC range selected):

   To the Auxiliary unit:

   OUTP 0
   VOLT:RANGE 166
   VOLT:SENSE EXT
   VOLT 100
   FREQ:MODE EXT
   PHASE 0
   SOUR:FUNC S SQUARE
   OUTP 1

   To the Leader unit:

   OUTP 0
   VOLT:RANGE 166
   VOLT:SENSE EXT
   VOLT 100
   FREQ 16
   OUTP 1
   SOUR:FUNC SQUARE

5. To the Auxiliary unit, enter the calibration password with the SCPI command `CAL:PASS "5000"`.
6. Perform the alignment with the SCPI command `CAL:PHASE <numeric value>`, where the numeric value is derived from phase measurement using the phase meter. Initially, set the phase to zero with the SCPI command `CAL:PHASE 0`. Record the phase angle reading from the phase meter, Reprogram the calibration phase with the same value obtain from the phase meter with the command `CAL:PHASE < numeric value >`. You may have to add or subtract 0.4 degrees to obtain a phase meter reading of a value near zero.
7. For standard frequency of 50 Hz, perform step-4 to Step-6.
8. For standard frequency of 100 Hz, perform step-4 to Step-6.
9. For HF and EHF options, at 200 Hz frequency in high range, perform step-4 to Step-6.
10. For HF and EHF options, at 550 Hz frequency in high range, perform step-4 to Step-6.
11. For HF and EHF options, at 819 Hz frequency in high range, perform step-4 to Step-6.
12. For HF and EHF options, at 905 Hz frequency in high range, perform step-4 to Step-6.
13. For EHF options, at 1500 Hz frequency in high range, perform step-4 to Step-6.
14. For output frequencies in the leader unit of 50 Hz, 100 Hz, 550 Hz, 819 Hz, 905 Hz (Only for HF & EHF Option), 1500 Hz (Only for 1.5 kHz EHF Option), with SCPI command, FREQ <n> or the highest frequency and extreme highest frequency of the power source model being aligned.
15. The calibration coefficients can be verified with the SCPI query `CAL:PHASE? EXT`. First cycle the AC input power off then on and then send the command `CAL:PHASE?`. The command will return a command-separated number sequence of calibration coefficients with the following format:
`f1,data1,f2,data2,f3,data3,f4,data4,f5,data5,f6,data6,f7,data7,current-cal`.

10.2.25 Output Phase-B and Phase-C Alignment Relative to Phase-A

1. Set up the phase meter to make phase measurements of the power supply output of Phase-B relative to the power supply output of Phase-A as a reference. Using differential voltage probes for isolation, connect one input of the phase meter to Phase-B and the other input of the phase meter to Phase-A.
2. Send the following SCPI commands to the power source (200 VAC range selected):
```
SOURCE:MODE AC
VOLT:RANGE 166
VOLT 120
CURR 15
FREQ 50
INST:COUP ALL
OUTP 1
```
3. Enter the calibration password with the SCPI command `CAL:PASS "5000"`.
4. Send the following SCPI commands to select Phase-A and set the phase to zero:
```
INST:NSEL 1
CAL:PHASE 0
```
5. Send the SCPI command `INST:NSEL 2`, to select Phase-B.
6. Perform the alignment with the SCPI command `CAL:PHASE <numeric value>`, where the numeric value is derived from phase measurement using the phase meter. Initially, set the phase to zero with the SCPI command `CAL:PHASE 0`. Record the phase angle reading from the phase meter, Reprogram the calibration phase with the same value obtain from the phase meter with the command `CAL:PHASE < numeric value >`. You may have to add or subtract 0.2 degree to obtain a phase meter reading of a value near zero.

7. Repeat Step-5 for output frequencies in the Leader unit of 100 Hz, 200 Hz, 550 Hz, 819 Hz, 905 Hz (Only for HF & EHF Option). and 1500 Hz (Only for EHF Option). with SCPI command `FREQ <n>`, or the highest frequency of the power source model being aligned.

8. The calibration coefficients are verified with the SCPI query `CAL:PHASE?`. First cycle the AC input power off then on, and then send the command, `CAL:PHASE?`. The command will return a command-separated number sequence of calibration coefficients with the following format:
   `f1,data1,f2,data2,f3,data3,f4,data4,f5,data5,f6,data6,`
   `,f7,data7,current-cal.`

9. Send the SCPI command `INST:NSEL 3`, and repeat Step-6 through Step-8 to align Phase-C.

10. Reset Phase-B to 240°, Phase-C to 120º, and Phase-A to 0° with the following SCPI commands:
```
INST:NSEL 2
PHASE 240
INST:NSEL 3
PHASE 120
INST:NSEL 1
PHASE 0
```

16. For standard frequency of 100 Hz, perform step-4 to Step-6.

17. For HF and EHF options, at 200 Hz frequency in high range, perform step-2 to Step-10.

18. For HF and EHF options, at 550 Hz frequency in high range, perform step-2 to Step-10.

19. For HF and EHF options, at 819 Hz frequency in high range, perform step-2 to Step-10.

20. For HF and EHF options, at 905 Hz frequency in high range, perform step-2 to Step-10.

21. For EHF options, at 1500 Hz frequency in high range, perform step-2 to Step-10.

11. Calibration values can be verified with the query `CAL:PHASE?` for selected phase. The response will have the following format:
   `f1,data1,f2,data2,f3,data3,f4,data4,f5,data5,f6,data6,f7,data7`.

10.2.26 Alignment of External Programming Signal for Output Voltage Waveform/Amplitude

The external analog programming signals for setting the output voltage waveform/amplitude are available in the External Analog Control signal connector: Phase-A signal input at Pin-1; Phase-B signal input at Pin-2; Phase-C signal input at Pin-3; signal return at Pin-4 (refer to Section 3.8.4). The signal inputs have a dual function, and for this alignment is selected for waveform/amplitude programming using the SCPI command, `VOLT:REF EXT`. The alignment is performed with a sine wave input: for example, a 0-10 V(PK) signal, which has an RMS range of 0-7.07 Vrms, would produce an output voltage that would vary from zero to full-scale of the selected output voltage range.

1. Connect the signal inputs for Phase-A (Pin-1), Phase-B (Pin-2), and Phase-C (Pin-3) together for connection to the same function generator output in Step-2.

2. Connect a function generator to External Analog Control signal connector signals at Pin-1/Pin-2/Pin-3 (signal) and Pin-4 (signal return); refer to Section 3.8.4. Set up the function generator to produce a sine wave output and set the output initially to zero.

3. Send the following SCPI commands to the power source (333 VAC range selected; ALC off; do not turn on the output at this time):
```
OUTP 0 MODE AC
VOLT:RANG 333
FREQ 60
VOLT:ALC OFF
VOLT:REF EXT
```

4. Enter the calibration password with the SCPI command `CAL:PASS “5000”`.

5. DC Offset alignment, high-range AC output (333 VAC):

6. Send the following SCPI command to select Phase-A: `INST:NSEL 1`.
7. Perform the DC offset alignment with the SCPI command `CAL:MEAS:EXT:OFFS:DC 0`, with the output off and the external analog input at 0 VDC. Send the SCPI query command `*OPC?`, to determine when this alignment step has been completed. Ensure alignment has been completed (query returns a 1) before continuing.
8. Send the SCPI command `INST:NSEL 2`, and repeat Step-7 to align Phase-B.
9. Send the SCPI command `INST:NSEL 3`, and repeat Step-7 to align Phase-C.
10. Output Voltage AC Gain alignment, high-range AC output (333 VAC):
11. Send the SCPI command `INST:NSEL 1`, to select Phase-A.
12. Apply an external sine wave AC voltage of 10.000 V(PK) ±0.005 V at 60 Hz.
13. Perform the output voltage AC gain alignment with the SCPI command `CAL:SOUR:EXT:FSC<numeric value>`. The numeric value is in the range of 0 to 4095. Start with a value of 1500; increasing the value would increase the output voltage. Turn on the output with the SCPI command `OUTP 1`. Adjust the numeric value with SCPI command `CAL:SOUR:EXT:FSC<numeric value>`, for the closest setting producing an output voltage of 333 Vrms.
14. Send the SCPI command `INST:NSEL 2`, and repeat Step-12 and Step-13 to align Phase-B.
15. Send the SCPI command `INST:NSEL 3`, and repeat Step-12 and Step-13 to align Phase-C.
16. ADC-RMS Full-Scale alignment, high-range AC output (333 VAC):
17. Send the following SCPI command to select Phase-A: `INST:NSEL 1`.
18. Apply an external programming sine wave AC voltage of 10.000 V(PK)± 0.005 V at 60 Hz.
19. Perform the ADC-RMS gain alignment with the SCPI command `CAL:MEAS:EXT:FSC 333`. Send the SCPI query command `*OPC?`, to determine when this alignment step has been completed. Ensure alignment has been completed (query returns a 1) before continuing. Verify the ADC- RMS measurement with the SCPI command `MEAS:VOLT:EXT?`, and ensure that the returned output voltage value, 333 Vrms, is within specification limits.
20. Send the SCPI command `INST:NSEL 2`, and repeat Step-18 and Step-19 to align Phase-B.
21. Send the SCPI command `INST:NSEL 3`, and repeat Step-18 and Step-19 to align Phase-C.

10.2.27 Source Mode: External Signal Input Calibration

The external analog programming signals for setting the output voltage amplitude (RPV) are available in the External Analog Control signal connector: Phase-A signal input at Pin-1; Phase-B signal input at Pin-2; Phase-C signal input at Pin-3; signal return at Pin-4 (refer to Section 3.8.4). These signal inputs have a dual function, and for this alignment is selected for amplitude programming (RPV) using the SCPI command `VOLT:REF RPV`. The alignment is performed with an AC input: for example, a 0-10 VAC (7.07 rms sinewave) signal would produce a DC output voltage that would vary from zero to full-scale of the selected output voltage range.

Note: If the function generator is unable to source the sufficient current, use an Op-Amp voltage follower circuit, also observe the function generator output signal through DSO.

1. Connect the signal inputs for Phase-A (Pin-1), Phase-B (Pin-2), and Phase-C (Pin-3) together for connection to the same function generator output in Step-2.
2. Connect a DC reference voltage to the External Analog Control signal connector in-1/Pin-2/Pin-3 (signal) and Pin-4 (signal return); refer to Section 3.8.4.
3. Apply an External Input signal of 0 Vpk volts.

4. Send the following SCPI commands to the power source (333 VAC range selected; ALC is off; do not turn on the output at this time).
```
VOLT:ALC OFF
OUTP OFF
VOLT:RANG 333
CURR 5
VOLT:REF EXT
```
5. Enter the calibration password with the SCPI command `CAL:PASS "5000"`.
6. Send the following SCPI command to select Phase-A: `INST:NSEL 1`.
7. Perform the DC offset alignment for the selected phase with the SCPI command `CAL:MEAS:EXT:OFFS:DC 0`, with the output off and the external analog input at 0 VDC. Send the SCPI query command `*OPC?`, to determine when this alignment step has been completed; the query will return a 1 to indicate completion. Ensure alignment has been completed (query returns a 1) before continuing.
8. Send the SCPI command `INST:NSEL 2`, and repeat Step-7 to align Phase-B.
9. Send the SCPI command `INST:NSEL 3`, and repeat Step-7 to align Phase-C.
10. Apply an External Input signal of 10.0 Vpk ± 0.005 V (AC Signal with 7.07 rms sinewave). Send the commands OUTP 1.
11. Perform the output voltage DC gain alignment with the SCPI command `CAL:SOUR:EXT:FSC<numeric value>`. The numeric value is in the range of 0 to 4095. Start with a value of 1500; increasing the value would increase the output voltage. Turn on the output with the SCPI command `OUTP 1`. Adjust the numeric value for the closest setting producing an output voltage of 333 VAC±1V.
12. Send the SCPI command `INST:NSEL 2`, and repeat Step-10 and Step-11 to align Phase-B.
13. Send the SCPI command `INST:NSEL 3`, and repeat Step-10 and Step-11 to align Phase-C.
14. Apply an External Input signal of 10.0 ± 0.005 V (AC Signal with 7.07 rms sinewave). Send the commands `OUTP 1`.
15. Perform the ADC-RMS gain alignment with the SCPI command `CAL:MEAS:EXT:FSC 440`. Send the SCPI query command `*OPC?`, to determine when this alignment step has been completed; the query will return a 1 to indicate completion. Ensure alignment has been completed (query returns a 1) before continuing. Verify the measurement with the SCPI command `MEAS:VOLT:EXT?`, and ensure that the returned output voltage value, 333 V, is within specification limits.
16. Send the SCPI command `INST:NSEL 2`, and repeat Step-14 and Step-15 to align Phase-B.
17. Send the SCPI command `INST:NSEL 3`, and repeat Step-14 and Step-15 to align Phase-C..

10.2.28 Alignment of External Programming Signal for Output Voltage Amplitude, DC Output

The external analog programming signals for setting the output voltage amplitude (RPV) are available in the External Analog Control signal connector: Phase-A signal input at Pin-1; Phase-B signal input at Pin-2; Phase-C signal input at Pin-3; signal return at Pin-4 (refer to Section 3.8.4). These signal inputs have a dual function, and for this alignment is selected for amplitude programming (RPV) using the SCPI command, VOLT:REF RPV. The alignment is performed with a DC input: for example, a 0-10 VDC signal would produce a DC output voltage that would vary from zero to full-scale of the selected output voltage range (166 or 333 volts in AC, 220 volts or 440 volts in DC).

1. Connect the signal inputs for Phase-A (Pin-1), Phase-B (Pin-2), and Phase-C (Pin-3) together for connection to the same function generator output in Step-2.
2. Connect a DC reference voltage to the External Analog Control signal connector in-1/Pin-2/Pin-3 (signal) and Pin-4 (signal return); refer to Section 3.8.4.

3. Send the following SCPI commands to the power source (440 VDC range selected; ALC is off; do not turn on the output at this time):
   ```
   OUTP 0
   MODE DC
   VOLT:RANG 440
   CURR 5
   VOLT:ALC OFF
   VOLT:REF RPV
   ```
4. Enter the calibration password with the SCPI command `CAL:PASS "5000"`.
5. DC Offset alignment, high-range DC output (440 VDC):
6. Send the following SCPI command to select Phase-A: `INST:NSEL 1`.
7. Perform the DC offset alignment for the selected phase with the SCPI command, `CAL:MEAS:EXT:OFFS:DC 0`, with the output off and the external analog input at 0 VDC. Send the SCPI query command `*OPC?`, to determine when this alignment step has been completed; the query will return a 1 to indicate completion. Ensure alignment has been completed (query returns a 1) before continuing.
8. Send the SCPI command `INST:NSEL 2`, and repeat Step-7 to align Phase-B.
9. Send the SCPI command `INST:NSEL 3`, and repeat Step-7 to align Phase-C.
10. DC Gain alignment, high-range DC output (440 VDC).
11. Send the following SCPI command to select Phase-A: `INST:NSEL 1`.
12. Apply an external DC voltage of 10.0 VDC ± 0.005 VDC and Send the commands OUTP ON.
13. Perform the output voltage DC gain alignment with the SCPI command `CAL:SOUR:EXT:FSC<numeric value>`. The numeric value is in the range of 0 to 4095. Start with a value of 1000; increasing the value would increase the output voltage. Turn on the output with the SCPI command `OUTP 1`. Adjust the numeric value for the closest setting producing an output voltage of 440 VDC±1 V.
14. Send the SCPI command `INST:NSEL 2`, and repeat Step-12 and Step-13 to align Phase-B.
15. Send the SCPI command `INST:NSEL 3`, and repeat Step-12 and Step-13 to align Phase-C.
16. ADC-RMS Full-Scale alignment, high-range DC output (440 VDC).
17. Send the following SCPI command to select Phase-A: `INST:NSEL 1`.
18. Apply an external programming DC voltage of 10.0 VDC ± 0.005 VDC and Send the commands OUTP ON.
19. Perform the ADC-RMS gain alignment with the SCPI command `CAL:MEAS:EXT:FSC 440`. Send the SCPI query command `*OPC?`, to determine when this alignment step has been completed; the query will return a 1 to indicate completion. Ensure alignment has been completed (query returns a 1) before continuing. Verify the measurement with the SCPI command `MEAS:VOLT:EXT?`, and ensure that the returned output voltage value, 440 VDC ±1 V, is within specification limits.
20. Send the SCPI command `INST:NSEL 2`, and repeat Step-18 and Step-19 to align Phase-B.
21. Send the SCPI command `INST:NSEL 3`, and repeat Step-18 and Step-19 to align Phase-C.

10.2.29 Alignment of External Programming Signal for Output Voltage Amplitude, AC output

The external analog programming signals for setting the output voltage amplitude (RPV) are available in the External Analog Control signal connector: Phase-A signal input at Pin-1; Phase-B signal input at Pin-2; Phase-C signal input at Pin-3; signal return at Pin-4 (refer to Section 3.8.4). This signal input has a dual function, and for this alignment is selected for amplitude programming using the SCPI command `VOLT:REF RPV`. The alignment is performed with a DC input: for example, a 0-10 VDC signal would control the AC output voltage amplitude from zero to full-scale of the selected output voltage range, while the AC output waveform is programmed through the internal reference generator.

1. Connect the signal inputs for Phase-A (Pin-1), Phase-B (Pin-2), and Phase-C (Pin-3) together for connection to the same function generator output in Step-2.
2. Connect a DC reference voltage to external Analog Control signal connector Pin-1, Pin-2, and Pin-3 (signal) and Pin-4 (signal return (refer to Section 3.8.4).
3. Send the following SCPI commands to the power source (333 VAC range selected; ALC off; do not turn on the output at this time):
   ```
   OUTP 0
   MODE AC
   VOLT:RANG 333
   FREQ 60
   VOLT:ALC OFF
   CURR 5
   VOLT:REF RPV
   ```
4. Enter the calibration password with the SCPI command `CAL:PASS "5000"`.
5. DC Offset alignment, high-range AC output (333 VAC).
6. Send the following SCPI command to select Phase-A: `INST:NSEL 1`.
7. Perform the DC offset alignment with the SCPI command `CAL:MEAS:EXT:OFFS:DC 0`, with the output off and the external analog input at 0 VDC. Send the SCPI query command `*OPC?`, to determine when this alignment step has been completed; the query will return a 1 to indicate completion. Ensure alignment has been completed (query returns a 1) before continuing.
8. Send the SCPI command `INST:NSEL 2`, and repeat Step-7 to align Phase-B.
9. Send the SCPI command `INST:NSEL 3`, and repeat Step-7 to align Phase-C.
10. AC Gain alignment, high-range AC output (333 VAC):
11. Send the following SCPI command to select Phase-A: `INST:NSEL 1`.
12. Apply an external programming DC voltage of 10.0 VDC, ± 0.005 VDC.
13. Perform the output voltage AC gain alignment with the SCPI command `CAL:SOUR:EXT:FSC<numeric value>`. The numeric value is in the range of 0 to 4095. Start with a value of 1000; increasing the value would increase the output voltage. Turn on the output with the SCPI command `OUTP 1`. Adjust the numeric value for the closest setting producing an output voltage of 333 Vrms and verify the measured value is in 333±1 V.
14. Send the SCPI command `INST:NSEL 2`, and repeat Step-12 and Step-13 to align Phase-B.
15. Send the SCPI command `INST:NSEL 3`, and repeat Step-12 and Step-13 to align Phase-C.
16. ADC-RMS Full-Scale alignment, high-range AC output (333 VAC):
17. Send the following SCPI command to select Phase-A: `INST:NSEL 1`.
18. Apply an external programming DC voltage of 10.0 VDC, ± 0.005 VDC and Send the commands OUTP ON.
19. Perform the ADC RMS gain alignment with the SCPI command `CAL:MEAS:EXT:FSC 333`. Send the SCPI query command `*OPC?`, to determine when this alignment step has been completed; the query will return a 1 to indicate completion. Ensure alignment has been completed (query returns a 1) before continuing. Verify the measurement with the SCPI command `MEAS:VOLT:EXT?`, and ensure that the returned output voltage value, 333 Vrms, is within specification limits.
20. Send the SCPI command `INST:NSEL 2`, and repeat Step-18 and Step-19 to align Phase-B.
21. Send the SCPI command `INST:NSEL 3`, and repeat Step-18 and Step-19 to align Phase-C.

10.2.30 Alignment of Output Voltage Monitor, DC output

The Isolated Output Voltage Monitor for getting the scaled-down output voltage is available in the rear panel external analog control signal connector: Phase-A Voltage monitor (VMON) signal output will be obtained at Pin-11; Phase-B monitor signal input at Pin-12; Phase-C signal input at Pin-13; signal return at Pin-14 (refer to Section 3.8.4). The alignment is performed for 0 V to full-scale output voltage (220 volts or 440 volts in DC) for a 0-7.07 Vrms monitor signal range.

1. Ensure that there is no load connected to the output of the power source.
2. With the external DVM set for AC, monitor the output voltage monitor (VMON) signal at the external analog control signal connector pin (Pin-11 for Phase A, Pin-12 for Phase B and Pin 13 for Phase C) with respect to Pin-14.
3. Enter the calibration password with the SCPI command, `CAL:PASS "5000"`.
4. Send the following SCPI command to select Phase-A: `INST:NSEL 1`.
5. Send the following SCPI commands to the power source (220 VAC range selected; ALC OFF):
```
VOLT:ALC OFF
MODE AC
VOLT:RANG 220
VOLT 0
FREQ 60
OUTP 1
```
6. Perform the adjustment using the command `CAL:MON:VOLT:ZERO <numeric value>`. The numeric value is in the range of 0 to 255. Adjust until the phase A voltage monitor output reading is 0 Vrms +/-5 mV, where the output voltage is 0 V.
7. Send the SCPI command `INST:NSEL 2`, and repeat Step-2 through Step-6 to align Phase-B.
8. Send the SCPI command `INST:NSEL 3`, and repeat Step-2 through Step-6 to align Phase-C.
9. Send the following SCPI command to select Phase-A: `INST:NSEL 1`.
10. Send the following SCPI commands to the power source (220 VAC range selected; ALC ON) `VOLT 220`.
11. Perform the adjustment using the command `CAL:MON:VOLT:FSC <numeric value>`. The numeric value is in the range of 0 to 255. Adjust until the phase A voltage monitor output reading is 7.07 Vrms +/-10 mV, where the output voltage is 220 V.
12. Send the SCPI command `INST:NSEL 2`, and repeat Step-10 and Step-11 to align Phase-B.
13. Send the SCPI command `INST:NSEL 3`, and repeat Step-10 and Step-11 to align Phase-C.
14. Send the following SCPI command to select Phase-A: `INST:NSEL 1`.
15. Send the following SCPI commands to the power source (440 VAC range selected; ALC ON):
```
OUTP 0
VOLT:ALC ON
MODE AC
VOLT:RANG 440
VOLT 440
FREQ 60
OUTP 1
```
16. Perform the adjustment using the command `CAL:MON:VOLT:FSC <numeric value>`. The numeric value is in the range of 0 to 255. Adjust until the phase A voltage monitor output reading is 7.07 Vrms +/-10 mV, where the output voltage is 440 V.
17. Send the SCPI command `INST:NSEL 2`, and repeat Step-15 through Step-16 to align Phase-B.
18. Send the SCPI command `INST:NSEL 3`, and repeat Step-15 through Step-16 to align Phase-C.

10.2.31 Alignment of Output Voltage Monitor, AC output

The Isolated Output Voltage Monitor for getting the scaled-down output voltage is available in the rear panel external analog control signal connector: Phase-A Voltage monitor (VMON) signal output will be obtained at Pin-11; Phase-B Voltage monitor signal input at Pin-12; Phase-C voltage signal input at Pin-13; signal return at Pin-14 (refer to Section 3.8.4). The alignment is performed for 0 V to the full-scale output voltage (166 or 333 volts in AC) for 0-7.07 Vrms monitor signal range.

1. Ensure that there is no load connected to the output of the power source.
2. With the external DMM set for AC, monitor the output voltage monitor (VMON) signal at the external analog control signal connector pin (Pin-11 for Phase A, Pin-12 for Phase B, and Pin 13 for Phase C) with respect to Pin-14.
3. Enter the calibration password with the SCPI command `CAL:PASS "5000"`.
4. Send the following SCPI command to select Phase-A: `INST:NSEL 1`.
5. Send the following SCPI commands to the power source (166 VAC range selected; ALC ON):
```
VOLT:ALC ON
MODE AC
VOLT:RANG 166
VOLT 0
CURR 10
OUTP 1
```
6. Perform the adjustment using the command `CAL:MON:VOLT:FSC <numeric value>`. The numeric value is in the range of 0 to 255. Adjust until the phase A voltage monitor output reading is 0 VDC +/- 25 mV, where the output voltage is 166 V.
7. Send the SCPI command, `INST:NSEL 2`, and repeat Step-5 and Step-6 to align Phase-B.
8. Send the SCPI command, `INST:NSEL 3`, and repeat Step-5 and Step-6 align Phase-C.
9. Send the following SCPI command to select Phase-A: `INST:NSEL 1`.
10. Send the following SCPI commands to the power source (166 VAC range selected; ALC ON):
```
VOLT:ALC ON
MODE AC VOLT:RANG 166
VOLT 166
CURR 10
FREQ 60
OUTP 1
```
11. Query the monitor coefficient using command `CAL:MON:VOLT:FSC?`, Perform the adjustment using the command `CAL:MON:VOLT:FSC <numeric value>`. The numeric value in the range of 0 to 255. Adjust until the phase A voltage monitor output reading is 7.07 VDC +/-10 mV, where the output voltage is 166 V.
12. Send the SCPI command `INST:NSEL 2`, and repeat Step-10 and Step-11 to align Phase-B.
13. Send the SCPI command `INST:NSEL 3`, and repeat Step-10 and Step-11 to align Phase-C.
14. Enter the calibration password with the SCPI command `CAL:PASS "5000"`.
15. Send the following SCPI command to select Phase-A: `INST:NSEL 1`.
16. Send the following SCPI commands to the power source (333 VAC range selected; ALC ON):
```
VOLT:ALC ON
MODE AC
VOLT:RANG 333
VOLT 0
CURR 10
```

```
OUTP 1
```

17. Perform the adjustment using the command `CAL:MON:VOLT:ZERO <numeric value>`. The numeric value in the range of 0 to 255. The default value is 127. Adjust until the phase A voltage monitor output reading is 0 VDC +/- 25 mV.
18. Send the SCPI command `INST:NSEL 2`, and repeat Step-16 and Step-17 to align Phase-B.
19. Send the SCPI command `INST:NSEL 3`, and repeat Step-16 and Step-17 to align Phase-C.
20. Send the following SCPI commands to the power source (333 VAC range selected; ALC ON):

```
OUTP 0
VOLT:ALC ON
MODE AC
VOLT:RANG 333
VOLT 333
CURR 15
FREQ 60
OUTP 1
```

21. Query the monitor coefficient using command `CAL:MON:VOLT:FSC?`, Perform the adjustment using the command `CAL:MON:VOLT:FSC <numeric value>`. The numeric value in the range of 0 to 255. Adjust until the phase A voltage monitor output reading is 7.07 VDC +/-10 mV, where the output voltage is 333 V.
22. Send the SCPI command `INST:NSEL 2`, and repeat Step-3 through Step-16 to align Phase-B.
23. Send the SCPI command `INST:NSEL 3`, and repeat Step-20 and Step-21 to align Phase-C.

10.2.32 Alignment of Output Current Monitor, DC output

The Isolated Output Current Monitor for getting the scaled down output current are available in the rear panel external analog control signal connector: Phase-A current monitor (IMON) signal output will be obtained at Pin-6; Phase-B current monitor signal input at Pin-7; Phase-C current signal input at Pin-8; signal return at Pin-9 (refer to Section 3.8.4). The alignment is performed for 0 V to full-scale output current for 0-7.07 VDC monitor signal range.

1. With the external DMM set for AC, monitor the output current monitor (IMON) signal at the external analog control signal connector pin (Pin-6 for Phase A, Pin-7 for Phase B and Pin 8 for Phase C) with respect to Pin- 9.
2. Enter the calibration password with the SCPI command `CAL:PASS "5000"`.
3. Send the following SCPI command to select Phase-A: `INST:NSEL 1`.

1. Send the following SCPI commands to the power source (220 VAC range selected; ALC ON):

```
VOLT:ALC ON
CURR:PROT OFF
MODE DC
VOLT:RANG 220
VOLT 0
CURR 0
VOLT 100
FREQ 60
OUTP 1
```

4. Ensure that the load is connected to the output of the power source and set the load resistance: *R = (100*0.90)V / FSC*
5. Perform the adjustment using the command `CAL:MON:CURR:ZERO <numeric value>`. The numeric value in the range of 0 to 255. The default value is 127. Adjust until the phase A current monitor output reading to 0 VDC +/- 25 mV.

6. Send the SCPI command `INST:NSEL 2`, and repeat Step-6 to align Phase-B.
7. Send the SCPI command `INST:NSEL 3`, and repeat Step-6 to align Phase-C
8. Send the following SCPI command to select Phase-A: `INST:NSEL 1`
9. Send the following SCPI commands to the power source (220 VAC range selected; ALC ON):

```
VOLT:ALC ON
CURR:PROT OFF
MODE DC
VOLT:RANG 220
VOLT 100
CURR <Full-Scale>
VOLT 100
FREQ 60
OUTP 1
```

10. Perform the adjustment using the command `CAL:MON:CURR:FSC <numeric value>`. The numeric value in the range of 0 to 255. The default value is 127. Adjust until the phase A current monitor output reading to 7.07 VDC +/- 10 mV, where the output current is FSC.
11. Send the SCPI command `INST:NSEL 2`, and repeat Step-10 and Step-11 to align Phase-B.
12. Send the SCPI command `INST:NSEL 3`, and repeat Step-10 and Step-11 to align Phase-C.
13. Send the following SCPI command to select Phase-A: `INST:NSEL 1`.
14. Perform the adjustment using the command `CAL:MON:CURR:ZERO <numeric value>`. The numeric value in the range of 0 to 255. The default value is 127. Adjust until the phase A current monitor output reading to 0 VDC +/- 25 mV.
15. Send the SCPI command `INST:NSEL 2`, and repeat Step-15 to align Phase-B.
16. Send the SCPI command `INST:NSEL 3`, and repeat Step-15 to align Phase-C.
17. Send the following SCPI commands to the power source (220 VAC range selected; ALC ON):

```
MODE DC
VOLT:ALC ON
CURR:PROT OFF
VOLT:RANGE 440
VOLT 200
CURR <Full-Scale>
OUTP 1
```

18. Ensure that the load is connected to the output of the power source and set the load resistance: *R = (200*0.90)V / FSC*
19. Enter the calibration password with SCPI command `CAL:PASS "5000"`.
20. Perform the adjustment using the command `CAL:MON:CURR:FSC <numeric value>`. The numeric value in the range of 0 to 255. The default value is 127. Adjust until the phase A current monitor output reading to 7.07 VDC +/- 10 mV, where the output current is FSC.
21. Send the SCPI command `INST:NSEL 2`, and repeat Step-21 to align Phase-B.
22. Send the SCPI command `INST:NSEL 3`, and repeat Step-21 to align Phase-C.

10.2.33 Alignment of Output Current Monitor, AC output

1. The Isolated Output Current Monitor for getting the scaled-down output current is available in the rear panel external analog control signal connector: Phase-A current monitor signal output will be obtained at Pin-6; Phase-B current monitor signal input at Pin-7; Phase-C current signal input at Pin-8; signal return at Pin-9 (refer to Section 3.8.4). The alignment is performed for 0V to full-scale output current for 0-7.07 VDC monitor signal range.

2. With the external DMM set for AC, monitor the output current monitor (IMON) signal at the external analog control signal connector pin (Pin- 6 for Phase A, Pin-7 for Phase B, and Pin 8 for Phase C) with respect to Pin- 9.
3. Enter the calibration password with the SCPI command `CAL:PASS "5000"`.
4. Send the following SCPI command to select Phase-A: `INST:NSEL 1`.
5. Send the following SCPI commands to the power source (166 VAC range selected; ALC ON):
```
VOLT:ALC ON
CURR:PROT OFF
MODE AC
VOLT:RANG 166
VOLT 166
FREQ 60
VOLT 0
CURR 0
```
6. Ensure that the load is connected to the output of the power source and set the load resistance: *R = (100*0.90)V / FSC*
7. Perform the adjustment using the command `CAL:MON:CURR:ZERO <numeric value>`. The numeric value in the range of 0 to 255. The default value is 127. Adjust until the phase A current monitor output reading to 0 VDC +/- 25 mV.
8. Send the SCPI command `INST:NSEL 2`, and repeat Step-6 to align Phase-B.
9. Send the SCPI command `INST:NSEL 3`, and repeat Step-6 to align Phase-C.
10. Send the following SCPI command to select Phase-A: `INST:NSEL 1`.
11. Send the following SCPI commands to the power source (166 VAC range selected; ALC ON):
```
VOLT:ALC ON
CURR:PROT OFF
MODE AC
VOLT:RANG 166
FREQ 60
VOLT 100,
CURR <Full-Scale>
```
12. Enter the calibration password with `CAL:PASS "5000"`.
13. Enable output `OUTP 1`. Perform the adjustment using the command `CAL:MON:CURR:FSC <numeric value>`. The numeric value in the range of 0 to 255. The default value is 127. Adjust until the phase A current monitor output reading to 7.07 VDC +/- 10 mV, where the output current is FSC.
14. Send the SCPI command `INST:NSEL 2`, and repeat Step-11 to align Phase-B.
15. Send the SCPI command `INST:NSEL 3`, and repeat Step-11 to align Phase-C.
16. Send the following SCPI command to select Phase-A: `INST:NSEL 1`.
17. Send the following SCPI commands to the power source (333 VAC range selected; ALC ON):
```
VOLT:ALC ON
CURR:PROT OFF
MODE AC
VOLT:RANG 333
VOLT 333
FREQ 60
VOLT 0,
CURR 0
```
18. Ensure that the load is connected to the output of the power source and set the load resistance:

*R = (100*0.90)V / FSC*

19. Enter the calibration password with `CAL:PASS "5000"`.
20. Enable output OUTP 1. Perform the adjustment using the command `CAL:MON:CURR:ZERO <numeric value>`. The numeric value in the range of 0 to 255. The default value is 127. Adjust until the phase A current monitor output reading to 0 VDC +/- 25 mV.
21. Send the SCPI command `INST:NSEL 2`, and repeat Step-18 to align Phase-B.
22. Send the SCPI command `INST:NSEL 3`, and repeat Step-18 to align Phase-C.
23. Enter the calibration password with the SCPI command `CAL:PASS "5000"`.
24. Send the following SCPI command to select Phase-A: `INST:NSEL 1`.
25. Send the following SCPI commands to the power source (333 VAC range selected; ALC ON):
```
VOLT:ALC ON
CURR:PROT OFF
MODE AC
VOLT:RANG 333
FREQ 60
VOLT 100,
CURR <Full-Scale>
```
26. Ensure that the load is connected to the output of the power source and set the load resistance:
*R = (200*0.90)V / FSC*
27. Enter the calibration password with `CAL:PASS "5000"`.
28. Enable output `OUTP 1`. Perform the adjustment using the command `CAL:MON:CURR:FSC <numeric value>`. The numeric value in the range of 0 to 255. The default value is 127. Adjust until the phase A current monitor output reading to 7.07 VDC +/- 10 mV, where the output current is FSC.
29. Send the SCPI command `INST:NSEL 2`, and repeat Step-26 to align Phase-B.
30. Send the SCPI command `INST:NSEL 3`, and repeat Step-26 to align Phase-C.
31. Cycle the AC input power off and then on when calibration has been completed to terminate the alignment routines and have the calibration take effect.

10.3 Electronic-LOAD Mode Calibration Procedures

10.3.1 Preparation for Calibration

WARNING!

Hazardous voltages exist at the rear of the power source. Care must be taken to avoid contact with the AC input and AC/DC output terminals. Only authorized personnel should perform these procedures.

Only technically trained personnel, who understand the operation of the power source, can take accurate readings and follow the procedure steps, should perform calibration. The calibration procedures require precision instrumentation to measure voltage and current; when substituting for the recommended test equipment, ensure that the accuracy is adequate so that excessive error is not incurred, compared to the specifications of the parameters that are to be calibrated. To set up the alignment procedures, perform the following initial steps:

1. Disconnect AC mains power when making setup connections.
2. Connect the test equipment and any desired remote-control inputs of the Sequoia Series AC Source.
3. Connect the voltage source Input to the output of the Sequoia Unit.
4. Allow a 30-minute warm-up period for the power source and test equipment before conducting the calibration procedure.

CAUTION!

The AC input power must be cycled off and then on when calibration has been completed to terminate the alignment routines and have calibration take effect. This is necessary also if only subsections of the calibration procedure are performed.

10.3.2 Procedure For Three-Phase AC Synchronization.

1. Use any AC power supply as Source. Set the voltage, Current, phase sequence & frequency for the Source. Ensure the programmed current limit of the Source must be higher than the set current of the Sequoia unit. Make sure the Voltage Source and Sequoia unit voltage ranges are the same.
2. Make the phase sequence of the voltage source to 0°, 240°, 120°.
3. Use the below commands for setting the Sequoia unit.

   SYNC:VOLT <numeric value > (numeric value is same as the set voltage of the Voltage Source)

   SYNC:FREQ <numeric value > (numeric value is same as the set frequency of the Voltage Source)

   Note: Voltage and frequency values are to be programmed as per the respective test cases.
4. Select the individual Phase 1, 2, and 3, and set the phase sequence value as 0°, 240°, and 120° by sending the below command:

```
INST:NSEL 1
SYNC:PHASE 0
INST:NSEL 2
SYNC:PHASE 240
INST:NSEL 3
SYNC:PHASE 120
```

5. Turn ON the output of the Source (AC power supply).
6. Query the below command for getting the status of the Sequoia unit. `SYNC:STAT?` This should give a response as IDLE. Synchronize the Sequoia unit with the Voltage Source by sending the below command or pressing the Sync button from the front panel, refer to the Figure 10-1.

   `SYNC:START`

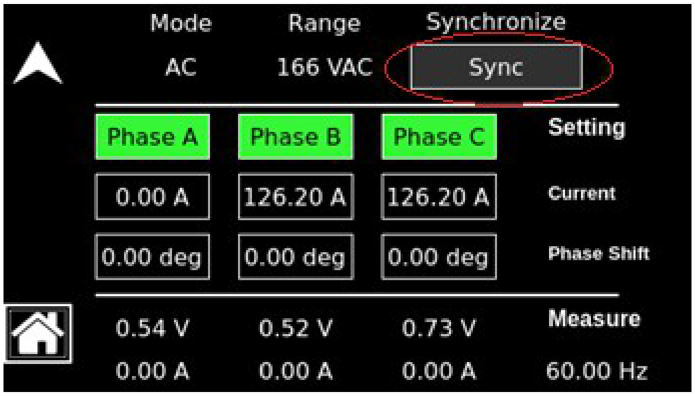


Figure 10-1: Dashboard Screen–Electronic load

7. Verify the status using the SCPI command `SYNC:STAT?`. This should give a response as SYNCED.

10.3.3 Procedure For DC Synchronization.

1. Change the operating mode of Source to DC. Set the voltage and Current limit for the Source. **Ensure the programmed current limit of the Source must be higher than the set current of the Sequoia unit. Make sure the Voltage Source and Sequoia unit voltage ranges are the same.**
2. Use the below SCPI command for setting the Sequoia unit.

   `SYNC:VOLT <numeric value >` (numeric value is same as the set voltage of the Voltage Source)

   Note: Voltage values are to be programmed as per the respective test cases.
3. Turn ON the output of the Source (Voltage source).
4. Query the below SCPI command `SYNC:STAT?`, for getting the status of the Sequoia unit.

   This should give a response as IDLE.

   Synchronize the Sequoia unit with the Voltage Source by sending the command `SYNC:START` or pressing Sync button from the front panel, refer to Figure 10-1.
5. Verify the status using the SCPI command `SYNC:STAT?`. This should give a response as SYNCED.

10.3.4 AC Function DC Current Zero Alignment, AC-Mode

1. Cycle the AC input power to the Sequoia unit off and then on.
2. Set Voltage Source (connected at Sequoia unit load side) Mode AC, voltage to 150 V, frequency 60 Hz, and current limit 20 A.
3. With the Power Analyzer, monitor the current at the Sequoia unit output.
4. Enter the calibration password with the SCPI command `CAL:PASS "5000"`.
5. Send the following SCPI command to select Phase-A: `INST:NSEL 1`.

6. Send the following SCPI commands to the power source; the ALC can be either on or off (166 VAC range selected):
```
VOLT:RANGE 166
CURR:ALC OFF
MODE AC
SYNC:FREQ 60
SYNC:VOLT 150
CURR:PHASE 0
CURR 0
```
7. Perform the synchronization procedure section 9.3.2 and enable the output of the unit using SCPI command `OUTP 1`.
8. Perform the AC function DC zero alignment using the SCPI command `CAL:CURR:AC:LRAN:OFF <numeric value>`. The numeric value is in the range of +/- 3000. Align for the lowest AC output voltage reading of the selected phase, but at least < 20 mA.
9. Send the SCPI command `INST:NSEL 2`, and repeat Step-6 through Step-8 to align Phase-B.
10. Send the SCPI command `INST:NSEL 3`, and repeat Step-6 through Step-8 to align Phase-C.

10.3.5 AC Function AC Current Zero Alignment, AC-Mode

1. Set Voltage Source (connected at Sequoia unit load side) Mode AC, voltage to 150 V, frequency 60 Hz, and current limit 20 A.
2. With the Power Analyzer, monitor the current at the unit output.
3. Enter the calibration password with the SCPI command `CAL:PASS "5000"`.
4. Send the following SCPI command to select Phase-A: `INST:NSEL 1`.
5. Send the following SCPI commands to the power source; the ALC can be either on or off (166 VAC range selected):
```
VOLT:ALC OFF
VOLT:RANGE 166
SYNC:VOLT 150
CURR:ALC OFF
CURR 0
CURR:PHASE 0
MODE AC
SYNC:FREQ 60
```
6. Perform the synchronization procedure section 9.3.2 and enable the output of the unit using SCPI command `OUTP 1`.
7. Perform the AC zero alignment using the SCPI command `CAL:VOLT:LRAN:ZERO <numeric value>`. The numeric value is in the range of 0 to 255; the default value is 127. Align for the lowest AC output current reading of the selected phase, but at least < 625 mA.
8. Send the SCPI command `INST:NSEL 2`, and repeat Step-5 through Step-7 to align Phase-B.
9. Send the SCPI command `INST:NSEL 3`, and repeat Step-5 through Step-7 to align Phase-C.

10.3.6 DC Function DC Current Zero Alignment, DC-Mode

1. Set Voltage Source (connected at Sequoia unit load side) Mode DC, voltage to 200 V and current limit 20 A.
2. With the Power Analyzer, monitor the current at the Sequoia unit output.
3. Enter the calibration password with the SCPI command `CAL:PASS "5000"`.
4. Send the following SCPI command to select Phase-A: `INST:NSEL 1`.

5. Send the following SCPI commands to the power source (220 VDC range selected; ALC off):
```
VOLT:ALC OFF
MODE DC
VOLT:RANGE 220
SYNC:VOLT 200
CURR:ALC OFF
CURR 0
```
6. Perform the synchronization procedure section 9.3.3 and enable the output of Sequoia unit using SCPI command `OUTP 1`.
7. Perform the alignment with the SCPI command `CAL:VOLT:DC:ZERO <numeric value>`. Start with a value of zero and increase or decrease for the lowest DC output current reading of the selected phase within the range of 0 ± 100 mA. The maximum range of this alignment is ±2000.
8. Send the SCPI command `INST:NSEL 2`, and repeat Step-5 through Step-7 to align Phase-B.
9. Send the SCPI command `INST:NSEL 3`, and repeat Step-5 through Step-7 to align Phase-C.

10.3.7 Current Gain Initial Alignment, AC-Mode, and DC-Mode

1. Set Voltage Source (connected at Sequoia unit load side) Mode AC, voltage to 150 V, frequency 60 Hz, and current maximum limit (should be greater than the Sequoia unit 80% of the AC Low range rated current).
2. With the Power Analyzer, monitor the current at the Sequoia unit output.
3. Enter the calibration password with the SCPI command, `CAL:PASS “5000”`.
4. Current Gain Initial Alignment, AC-Mode: Send the following SCPI commands to the power source (166 VAC range selected; ALC off):
```
OUTP OFF
CURR:ALC OFF
MODE AC
VOLT:RANGE 166
SYNC:VOLT 150
SYNC:FREQ 60CURR:PHASE 0
CURR <80% of the rated current>
CURR:PHASE 0
```
5. Perform the synchronization procedure section 9.3.2 and enable the output of Sequoia unit using SCPI command `OUTP 1`.
6. Send the following SCPI command to select Phase-A: `INST:NSEL 1`.
7. Verify the existing calibration coefficient by `CAL:CURR:FSC?`.
8. Perform the alignment by adjusting the output current of the selected phase to 80% of the rated current ±0.2% FSC as indicated on the Power Analyzer by using the SCPI command `CAL:CURR:FSC <numeric value>` to increase or decrease the value.
9. Send the SCPI command `INST:NSEL 2`, and repeat Step-7 and Step-8 to align Phase-B.
10. Send the SCPI command `INST:NSEL 3`, and repeat Step-7 and Step-8 to align Phase-C.
11. Current Gain Initial Alignment, DC-Mode:
12. Set Voltage Source (connected at Sequoia unit load side) Mode DC, voltage to 200V, and current limit Max value 68 A.
13. Send the following commands, which also change the voltage mode to DC:
```
OUTP OFF
MODE DC
VOLT:RANGE 220
```

```
CURR:ALC OFF
SYNC:VOLT 200
CURR <80% of the rated current>
```

14. Perform the synchronization procedure section 9.3.3 and enable the output of Sequoia unit using command `OUTP 1`.
15. Send the following SCPI command to select Phase-A: `INST:NSEL 1`.
16. Verify the existing calibration coefficient by `CAL:CURR:DC?`.
17. Perform the alignment by adjusting the output current of the selected phase to 80% of the rated current ±0.2% FSC as indicated on the Power Analyzer by using the SCPI command `CAL:CURR:DC <numeric value>` to increase or decrease the value. (where numeric value can be up to 0 to 65535).
18. Send the SCPI command `INST:NSEL 2`, and repeat Step-16 and Step-17 to align Phase-B.
19. Send the SCPI command `INST:NSEL 3`, and repeat Step-16 and Step-17 to align Phase-C.

10.3.8 Phase Shift calibration

1. Set Voltage Source (connected at Sequoia unit load side) Mode AC, voltage to 150 V, frequency 50 Hz, and current maximum limit (should be greater than the Sequoia unit).
2. Send the following SCPI commands to the power source (200 VAC range selected):

```
CURR:ALC OFF
MODE AC
VOLT:RANGE 16
SYNC:VOLT 150
SYNC:FREQ 50
CURR:PHASE 30
OUTP 0
```

3. Perform the synchronization procedure section 9.3.2 and enable the output of the unit using command `OUTP 1`.
4. Set the current to 50% of rated current by sending the command `CURR <50% of rated current>`.
5. Enter the calibration password with the SCPI command `CAL:PASS "5000"`.
6. Send the following SCPI commands to select Phase-A: `INST:NSEL 1`.
7. Perform the alignment with the SCPI command `CAL:PHASE <numeric value>`, where the numeric value is derived from phase measurement using the Power Analyzer. You may have to add or subtract 0.2 degrees to obtain a phase measurement reading of a value near zero.
8. Send the SCPI command `INST:NSEL 2`, and repeat Step-7 to align Phase-B.
9. Send the SCPI command `INST:NSEL 3`, and repeat Step-7 to align Phase-C.
10. For standard frequency of 100 Hz, repeat step-1 to Step-9 for Sync Frequency in the unit of 100 Hz.
11. For standard frequency of 200 Hz, perform step-1 to Step-9 for Sync Frequency in the unit of 200 Hz.
12. For HF and EHF options, at 550 Hz frequency repeat step-1 to Step-9 for Sync Frequency in the unit of 500 Hz, using the SCPI command `SYNC:FREQ <n>`, or the highest frequency of the power source model being aligned.
13. The calibration coefficients are verified with the SCPI query `CAL:PHASE?`. First, cycle the AC input power off then on and then send the command `CAL:PHASE?`. The command will return a command-separated number sequence of calibration coefficients with the following format:

`f1,data1,f2,data2,f3,data3,f4,data4,f5,data5,f6,data6,current-cal.`

10.3.9 Alignment of External Programming Signal for Output Current Amplitude, DC Output

The external analog programming signals for setting the output current (RPV) are available in the External Input/Output Control connector: Phase-A signal input at Pin-1; Phase-B signal input at Pin-2; Phase-C signal input at Pin-3; signal return at Pin-4 (refer to Section 3.8.4). The alignment is performed with a DC input: for example, a 0-10 VDC signal would produce a DC output current that would vary from zero to full-scale of the selected output current range.

1. Connect the signal inputs for Phase-A (Pin-1), Phase-B (Pin-2), and Phase-C (Pin-3) together for connection to the same function generator output in Step-2.
2. Connect a DC reference voltage to the external analog programming connector in Pin-1, Pin-2, and Pin-3 (signal), and Pin-4 (signal return); refer to Section 3.8.4.
3. Set Voltage Source (connected at SQ unit load side) Mode DC, voltage to 110 V, and max current limit to
68 A.
4. Send the following SCPI commands to the power source (220 VDC range selected; ALC is off; do not turn on the output at this time):
```
OUTP 0
MODE DC
VOLT:RANG 220
CURR:ALC OFF
SYNC:VOLT 110
CURR:REF RPV
```
5. Perform the synchronization procedure section 9.3.3 and enable the output of the unit using command OUTP 1.
6. Enter the calibration password with the SCPI command `CAL:PASS "5000"`.
7. DC Offset alignment, low-range DC output (220 VDC)
8. Send the following SCPI commands to select Phase-A: `INST:NSEL 1`.
9. Perform the DC offset alignment for the selected phase using SCPI command `CAL:MEAS:EXT:OFFS:DC 0`, with the output off and the external analog input at 0 VDC. Send the SCPI query command `*OPC?`, to determine when this alignment step has been completed; the query will return a 1 to indicate completion. Ensure alignment has been completed (query returns a 1) before continuing.
10. Send the SCPI command `INST:NSEL 2`, and repeat Step-7 to align Phase-B.
11. Send the SCPI command `INST:NSEL 3`, and repeat Step-7 to align Phase-C.
12. DC Gain alignment, high-range DC output (220 VDC).
13. Send the following SCPI commands to select Phase-A: `INST:NSEL 1`.
14. Apply an external DC voltage of 9 VDC, ± 0.005 V.
15. Measure the output current of Phase A with an external meter (Power Analyzer) and verify the measured output current is 90% FS (68A for SQ0045) current ±2% FSC.
16. If not Send the command `CAL:SOUR:EXT:FSC <numerical value>` . to adjust the output current by reducing or increasing the numerical value. (Where numeric value can be up to 0 to 4095).
17. Send the SCPI command `INST:NSEL 2`, and repeat Step-14 to Step-16 to align Phase-B.
18. Send the SCPI command `INST:NSEL 3`, and repeat Step-14 to Step-16 to align Phase-C.
19. ADC-RMS Full-Scale alignment, high-range DC output (220 VDC):

20. Send the following SCPI commands to select Phase-A: INST:NSEL 1.
21. Perform the ADC RMS gain alignment with the SCPI command CAL:MEAS:EXT:FSC <90% FS Current>. Send the SCPI query command *OPC?, to determine when this alignment step has been completed; the query will return a 1 to indicate completion. Ensure alignment has been completed (query returns a 1) before continuing. Verify the measurement with the SCPI command MEAS:CURR:EXT?, and ensure that the returned output current is 90% FS current ±1 A.
22. Send the SCPI command INST:NSEL 2, and repeat Step-21 to align Phase-B.
23. Send the SCPI command INST:NSEL 3, and repeat Step-21 to align Phase-C.

10.3.10 Alignment of External Programming Signal for Output Current Amplitude, AC output

The external analog programming signals for setting the output current (RPV) are available in the External Input/Output Control connector: Phase-A signal input at Pin-1; Phase-B signal input at Pin-2; Phase-C signal input at Pin-3; signal return at Pin-4 (refer to Section 3.8.4). The alignment is performed with a DC input: for example, a 0-10 VDC signal would produce a DC output current that would vary from zero to full-scale current of the selected output voltage range.

1. Connect the signal inputs for Phase-A (Pin-1), Phase-B (Pin-2), and Phase-C (Pin-3) together for connection to the same function generator output in Step-2.
2. Connect a DC reference voltage to External Input/Output Control connector Pin-1/Pin-2/Pin-3 (signal) and Pin-4 (signal return (refer to Section 3.8.4).
3. Set Voltage Source (connected at SQ unit load side) Mode AC, voltage to 100 V, frequency 60 Hz, and current maximum limit (should be greater than the SQ unit).
4. Send the following SCPI commands to the power source (166 VAC range selected; ALC off; do not turn on the output at this time):
   ```
   OUTP 0
   MODE
   CURR:ALC OFF
   VOLT:RANG AC 166
   SYNC:VOLT 100
   SYNC:FREQ 60
   CURR:PHASE 0
   CURR:REF RPV
   ```
5. Perform the synchronization procedure section 10.3.2 and enable the output of Sequoia unit using command OUTP 1.
6. Enter the calibration password with the SCPI command CAL:PASS "5000".
7. DC Offset alignment, low-range AC output (166 VAC)
8. Send the following SCPI commands to select Phase-A: INST:NSEL 1.
9. Perform the DC offset alignment with the SCPI command CAL:MEAS:EXT:OFFS:DC 0, with the output off and the external analog input at 0 VDC. Send the SCPI query command *OPC?, to determine when this alignment step has been completed; the query will return a 1 to indicate completion. Ensure alignment has been completed (query returns a 1) before continuing.
10. Send the SCPI command INST:NSEL 2, and repeat Step-9 to align Phase-B.
11. Send the SCPI command INST:NSEL 3, and repeat Step-9 to align Phase-C.
12. AC Gain alignment, low-range AC output (166 VAC):
13. Send the following SCPI commands to select Phase-A: INST:NSEL 1.
14. Apply an external programming DC voltage of 9 VDC, ± 0.005 V.

15. Measure the output current of Phase A with an external meter (Power Analyzer) and verify the measured output current is 90% FS current ±2% FSC.
16. If not Send the command `CAL:SOUR:EXT:FSC < numerical value>` . to adjust the output current by reducing or increasing the numerical value. (Where numeric value can be up to 0 to 4095).
17. Send the SCPI command `INST:NSEL 2`, and repeat Step-15 and Step-16 to align Phase-B.
18. Send the SCPI command `INST:NSEL 3`, and repeat Step-15 and Step-16 to align Phase-C.
19. ADC-RMS Full-Scale alignment, high-range AC output (166 VAC):
20. Send the SCPI command `INST:NSEL 1`, to select Phase-A.
21. Perform the ADC RMS gain alignment with the SCPI command `CAL:MEAS:EXT:FSC <90% FS Current>`. Send the SCPI query command `*OPC?`, to determine when this alignment step has been completed; the query will return a 1 to indicate completion. Ensure alignment has been completed (query returns a 1) before continuing. Verify the measurement with the SCPI command `MEAS:CURR:EXT?`, and ensure that the returned output current is 100% FS current ±1A.
22. Send the SCPI command `INST:NSEL 2`, and repeat Step-21 to align Phase-B.
23. Send the SCPI command `INST:NSEL 3`, and repeat Step-21 to align Phase-C.

11. ERROR AND STATUS MESSAGES

Errors that occur during operation, whether from the front panel or the remote digital interface, will trigger error messages. These messages are displayed on the front panel and stored in the memory allocated to the error message queue. The error messages in the queue can be read using the SCPI query command, `SYST:ERR?`. The error queue has a limited capacity. If more error messages are generated than can be stored, a queue overflow message will appear in the last location.

To clear the queue, read the error queue until the message "No Error" is displayed. Errors shown on the front panel display have a negative number and will remain visible until the user navigates to another screen. If multiple error messages occur in sequence, only the last message will be displayed. Status messages give information on the operational state of the power source. They appear on the front panel with a positive number.

The table below lists errors and status messages, along with their possible causes and suggested remedies. Refer to the Sequoia Series Programming Manual, M447353-01 and Tahoe Series Programming Manual P/N M445374-01 for more details.

Number	Message String	Cause	Remedy
0	"No error"	No errors in the queue	Normal operation
-100	"Command error"	Unable to complete the requested operation	Check command syntax and data type.
-102	"Syntax error"	SCPI command syntax incorrect, unrecognized command or data type	Correct command syntax, e.g. misspelled or unsupported commands.
-103	"Invalid separator"	SCPI command separator not recognized	Check the SCPI section of the Programming Manual.
-104	"Data type error"	Command data element invalid	Check the command for supported data types.
-108	"Parameter not allowed"	One or more additional command parameters were received	Check the Programming Manual for the correct number of parameters.
-109	"Missing parameter"	Too few command parameters were received for the requested operation	Check the Programming Manual for the correct number of parameters.
-110	"Command header error"	Command header incorrect	Check the syntax of the command.
-111	"Header separator error"	Invalid command separator used.	Ensure that a semi-colon is used to separate command headers.
-112	"Program mnemonic too long"	Command syntax error	Check the Programming Manual for correct command syntax.
-113	"Undefined header"	Command not recognized error	Check the Programming Manual for correct command syntax.
-120	"Numeric data error"	Data received is not a number	Check the Programming Manual for correct command syntax.
-121	"Invalid character in number"	The number received contains a non-numeric character(s)	Check the Programming Manual for correct command syntax.
-123	"Exponent too large"	The number exponent exceeds the limits	Check the Programming Manual for correct command syntax.
-128	"Numeric data not allowed"	The number received, but not allowed	Check the Programming Manual for correct command syntax.
-168	"Block data not allowed"	Block data received but not	Check the Programming Manual for

Number	Message String	Cause	Remedy
		allowed	correct command syntax.
-200	"Execution error"	The command could not be executed	The command might be inconsistent with the mode of operation, such as programming frequency when in DC-Mode.
-201	"Invalid while in local"	Command issued but the unit is not in the remote state	Put the instrument in the remote state before issuing SCPI commands.
-203	"Command protected"	The command is locked out	Some commands are supported by the unit but are locked out for the protection of settings and are not user accessible.
-210	"Trigger error"	Problem with the trigger system	The unit could not generate a trigger for transient execution or measurement.
-211	"Trigger ignored"	Trigger request has been ignored	The trigger setup was incorrect, or the unit was not armed when the trigger was received. Check transient system or measurement trigger system settings.
-213	"Init ignored"	The initiation request has been ignored	The unit was told to go to armed state but was unable to do so. Could be caused by an incorrect transient system or measurement acquisition setup.
-220	"Parameter error"	Parameter not allowed	Incorrect parameter or parameter value. Check the Programming Manual for allowable parameters.
-221	"Setting conflict"	Requested setting conflicts with other settings in effect	Check settings: e.g., changing mode, AC/DC/AC+DC, is not allowed with output on; setting voltage is not allowed if reference is not internal; setting frequency is not allowed if set for External SYNC or Clock/Lock.
-222	"Data out of range"	Parameter data outside of the allowable range	Check the Programming Manual for allowable parameter values.
-223	"Too much data"	More data received than expected	Check the Programming Manual for the number of parameters or data block size.
-224	"Illegal parameter value"	The parameter value is not supported	Check the Programming Manual for correct parameters.
-226	"Lists not same length"	One or more transient lists programmed had different length	All lists must be of the same length or transient cannot be compiled and executed.
-254	"Media full"	No storage space left to save settings or data	Delete other settings or data to make room.
-255	"Directory full"	Too many waveform directory entries	Delete one or more waveforms from waveform memory to make room.
-256	"File name not found"	Waveform requested is not in the directory	Check the waveform directory for the waveform names present.
-257	"File name error"	Incorrect filename	Check waveform file definition for too many or non-ASCII characters.
-283	"Illegal variable name"	Variable name illegal	Use ASCII characters only.
-300	"Device specific error"	Hardware related generic error	Check settings for proper mode or command sequence: e.g., setting DC offset is not allowed if the mode is not AC+DC; setting IEEE-488 address is not

Number	Message String	Cause	Remedy
			allowed if the option is not installed; setting the state to on for the 411 option if the trigger sync source is not set to internal; changing remote sense is not allowed if the output is on.
-311	"Memory error"	Waveform memory checksum error	Check for incomplete user-defined waveform downloads. Check interface and try downloading the waveform again. The successful download may clear this error condition. Alternatively, use the SCPI command, `TRAC:DEL:ALL`, to clear waveform memory.
-314	"Save/recall memory lost"	User setup register contents lost	Save the setup again in the same registers to restore content.
-315	"Configuration memory lost"	Hardware configuration settings lost	Contact AMETEK Service Department to obtain instructions on restoring configuration data.
-330	"Self-test failed"	Internal error	Contact AMETEK Service Department to troubleshoot the problem.
-350	"Queue overflow"	Message queue full	Read status using SYST:ERR query until 0; "No Error" is received indicating queue empty.
-400	"Query error"	Unable to complete query.	Check the Programming Manual for the correct query format and parameters
-410	"Query INTERRUPTED"	Query issued but response not read	Check the application program for correct flow. The response must be read after each query to avoid this error.
-420	"Query UNTERMINATED"	Query incomplete	Check for terminator after query command.
-430	"Query DEADLOCKED"	The query cannot be completed	Check the application program for multiple queries.
-440	"Query UNTERMINATED"	Query incomplete.	Check for terminator after query command.
1	"Output volt fault"	The output voltage does not match the programmed value	Reduce load or increase current setpoint. Also, the output voltage might be driven above the programmed voltage by external influence (load voltage kickback, etc.).
2	"Current limit fault"	Current limit exceeded	Load exceeds current limit (CL) programmed value; reduce the load or increase CL setting. Change to constant-current mode (CC).
4	"External sync. Error"	Could not sync to external sync signal	External sync signal missing, disconnected, or out of range.
5	"Initial memory lost"	Power-on settings could not be recalled.	Save power-on settings again to overwrite old content.
6	"Limit memory lost"	Hardware configuration settings lost	Contact AMETEK Service Department to obtain instructions on restoring configuration data.
7	"System memory lost"	Memory corrupted	Recycle power. Contact AMETEK Service Department for instructions if memory remains corrupted.

Number	Message String	Cause	Remedy
8	"Calibration memory lost"	Calibration data lost	Contact AMETEK Service Department to obtain instructions on restoring calibration data or recalibrate the unit.
9	"Start angle must be the first sequence"	Start phase angle in the wrong place	Start phase angles can only be programmed at the start of a transient list. Once a transient is in progress, the phase angle cannot be changed.
10	"Illegal for DC"	Operation is not possible in DC-Mode	Switch to AC or AC+DC mode.
13	"Missing list parameter"	One or more transient list parameters missing	Check programmed lists.
14	"Voltage peak error "	Peak voltage exceeded	This error could occur when selecting user-defined wave shapes with higher crest factors. Reduce programmed RMS value.
16	"Illegal during transient"	The operation requested is not available while the transient is running	Wait until transient execution is completed or abort transient execution first.
17	"Output relay must be closed"	Operation is not possible with an open relay	Close relay before attempting operation: e.g., transient execution requires the output relay to be closed.
18	"Trans. Duration less than 0.5 msec"	Dwell time below the minimum of 0.5 ms	Increase dwell time to at least 0.5 ms.
19	"Clock and sync must be internal"	Operation is not possible with an external clock	Switch to internal sync (default).
20	"Input buffer full"	Too much data received	Break up data into smaller blocks.
21	"Timeout error"	Controller did not receive a command from the display	Reduce remote command activity. Internal communication between the controller and display has been impacted.
22	"Waveform harmonics limit"	The harmonic content of user-defined wave shape is too high for amplifier capability	Reduce harmonic content or reduce the programmed fundamental frequency.
24	"Output relay must be open"	Attempting to change settings that expect the relay to be closed	Ensure that the output relay is open when changing settings such as range, sense, and AC/DC/AC+DC mode.
25	"Overvoltage Protection Trip"	Overvoltage limit exceeded	Ensure that OVP is programmed sufficiently above the output voltage value. Check for load inductive kickbacks or overshoot on output. Ensure that remote sense leads are connected if utilized.
29	"DC component exceeds limit"	Waveform selected contains a DC component that is not possible in the AC-Mode	Select AC+DC mode.
32	"Ac module error"	AC Module is not able to produce output power	Verify that the external ambient temperature is not greater than 40°C. Contact AMETEK Service Department for instructions pertaining to an internal hardware fault.
33	"External reference exceeds limit"	The amplitude or frequency of the external	Ensure that the external programming signal meets specification requirements.

Number	Message String	Cause	Remedy
		programming signal exceeds the allowed limits	
35	"Output DC component exceeds limit"	The high DC offset from the power source connected to the Sequoia in Electronic Load Mode	Limit the power source DC offset to prevent this error, as a high DC offset could damage the unit.
46	"Under volt protection trip"	Undervoltage limit exceeded	Ensure that UVP is programmed sufficiently below the output voltage value
47	"Sync Setting error"	Voltage, frequency, or phase sequence settings issue	Check synchronization parameters voltage, frequency, or Phase sequence settings in sequoia with UUT output settings
48	"Output Curr Fault"	The output current does not match the programmed value	Check UUT or Sequoia's current setpoints.

Table 11-1: Error and Status Messages

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12. SERVICE

This section provides information on cleaning and troubleshooting details for different modes of operation in Sequoia/Tahoe series models.

12.1 Cleaning

The power supply uses forced convection cooling, which can pull in dust from the surrounding environment. In areas with high dust concentrations, regular cleaning may be necessary to ensure the unit continues to function properly.

1. Cleaning Instructions:
2. Disconnect AC mains power to the power supply before cleaning.
3. Use a mild detergent and water solution for cleaning.
4. Apply the solution to a soft cloth, not directly to the unit's surface.
5. Do not use aromatic hydrocarbons or chlorinated solvents, as they may damage materials.
6. Periodic cleaning may be needed in dusty environments to maintain performance.

12.2 Basic Troubleshooting Common for all the Operating Modes

Refer to the following tables for possible issues related to the basic operation and connection of the power supply.

12.2.1 FAULT LED is On

Cause	Solution
ALC control error has occurred.	ALC is not able to regulate output; select REG or OFF mode; reduce output load.
Overtemperature (OTP) shutdown has occurred.	Make sure the air intake and exhaust are not blocked and verify that the ambient temperature at the power source air intake is within the specified range.

12.2.2 No Output and Front Panel Display/LEDs are Off.

Cause	Solution
Input AC mains is not connected.	Check the mains disconnect switch.
There is no input AC mains power.	Verify that mains power is available.
The AC mains voltage is inadequate.	Verify that the mains voltage is within specification limits.

12.2.3 No Output and Front Panel Display/LEDs are On

Cause	Solution
The OUTPUT switch is turned off.	Press the OUTPUT switch and ensure that the OUTPUT LED is on.

The current setpoint is low or at zero.	Program current setpoint to a higher value.
The voltage setpoint is low or at zero.	Program the correct output voltage.
REMOTE INHIBIT signal is shutting down the output.	Verify that the REMOTE INHIBIT signal is at the correct logic level to enable the output.

12.2.4 Setting of AC/DC Mode or Voltage Range is Not Accepted

Cause	Solution
The OUTPUT switch is turned on.	Press the OUTPUT switch to toggle output to off and ensure that the OUTPUT LED is off. Changes in the setting of AC/DC Mode or Voltage Range can only be performed with the output off.

12.2.5 Parallel Group Faults When Leader Output Switch is Turned On

Cause	Solution
Clock Config set to Auxiliary with Clock Mode set to SYNC.	When the Clock Config is set to Auxiliary, the Clock Mode must be set to either Internal or External.

12.3 Basic Troubleshooting in Source and Grid Simulator Modes

Refer to the following tables for problems that might arise related to basic operation and connection of the power supply in the Source or Grid simulator mode of operation.

12.3.1 FAULT LED is On

Cause	Solution
Overcurrent (OCP) shutdown has occurred.	CV/CL mode is select; change to CV/CC; If excessive load current for the current setpoint, reduce the load current

12.3.2 Excessive Output Voltage

Cause	Solution
Measurement showing set value and output will have 4% extra voltage than set voltage if External sense leads are not connected if selected in external sense mode.	Connect external sense wires to the rear panel AC/DC Output/Sense connector.
The voltage at the AC/DC Output connector is higher than that on the Sense connector.	If the External Sense is connected to the load, the voltage output on Sense lines will be higher when the output is loaded because of the output cable voltage drop.

12.3.3 Poor Output Voltage Regulation

Cause	Solution
The unit is overloaded and in constant-current mode.	Remove overload to allow constant-voltage operation.
The unit is programmed to the incorrect voltage range required for the level of load current.	Select the correct voltage range.
Remote Sense lines are not connected to the load.	Connect Remote Sense lines to the load and select Remote(external) Sense for the voltage sense method.

12.3.4 Distorted Output

Cause	Solution
Load is drawing nonlinear currents.	Reduce load or add power sources in the parallel group.
The crest factor of the load exceeds model limits.	Reduce load current peaks by reducing load or adding power sources in the parallel group.

12.3.5 Unit Shuts Down after Short Interval

Cause	Solution
The load has a high inrush current and exceeds the current setting in constant-voltage/current-limit mode.	Increase time delay for current-limit detection; add power sources in the parallel group to increase output current capability.
Output is short-circuited.	Remove output short-circuit.
Remote sense leads are connected in reverse polarity	Correct sense wiring.

12.4 Basic Troubleshooting in Electronic Load Mode

Refer to the following tables for problems that might arise related to basic operation and connection of the power supply in the Electronic Load Mode of operation.

12.4.1 Over Voltage Fault

Cause	Solution
Excess voltage applied by the UUT to the Sequoia unit	Check the voltage applied by the UUT is within the voltage range of Sequoia unit

12.4.2 Sync settings error

Cause	Solution
Voltage Magnitude, frequency or phase sequence not matching applied by the UUT to Sequoia output is not matching with the sync setting parameters entered in Sequoia unit	Verify Sync settings in the Sequoia are matching to the UUT output such as Voltage, frequency, and phase sequence.

12.4.3 Distorted Output current

Cause	Solution
Crest factor greater than 3 (or 4.5 for the SQ /TA 0030 models)	In random wave generation, make sure the crest factor is less than 3 (or 4.5 for the SQ /TA 0030 models)

12.4.4 Over Current fault in the UUT

Cause	Solution
The slew rate is programmed to a high value	Reduce slew rate by sending SCPI command `Curr:slew <value>` to limit spike.
Neutral wires of Sequoia and UUT are not connected	Make sure the Neutral wire is connected. In Electronic Load Mode neutral wire of Sequoia and UUT are connected.

ACRONYMS

This section provides definitions for the acronyms and abbreviations used in this document.

Acronym	Full form	Description
AC	Alternating Current	An electrical current that reverses direction periodically, commonly used for power distribution.
ALC	Automatic Load Control	Automatic Load Control: A function used to automatically adjust the load applied to a device under test to maintain desired operating conditions.
BNC	Bayonet Neill-Concelman	A type of connector commonly used for RF signals.
CFM	Cubic Feet per Minute	It is a unit of measurement that quantifies the volume of air or gas that flows through a system or space per minute.
CTSHL	Compliance test hardware and software	Compliance test hardware and software for specific EMC standards.
DC	Direct Current	An electrical current that flows in one direction, typically used in battery-powered devices.
dFreq	Delta Frequency	Delta Frequency refers to the difference or change in frequency between two points in time or measurements.
DSP	Digital Signal Processing	The use of digital processing techniques to manipulate signals, often in the context of improving their quality or extracting information.
DTE	Data Terminal Equipment	Data Terminal Equipment is a device that creates, receives, or processes data, typically a computer or terminal that connects to a communication network for transmitting data.
DVM	Digital Voltmeter	A Digital Voltmeter is an electronic device used to measure the voltage across two points in a circuit.
DMM	Digital Multimeter	A Digital Multimeter is a tool that measures electrical values like voltage, current, and resistance in a digital format.
EHF	Extended High Frequency	An option specifying the extended frequency range, typically for higher-frequency operation in the power supply.
EMC	Electromagnetic Compatibility	Electromagnetic Compatibility is the ability of a device or system to work properly without causing interference to other devices and resisting interference from other devices in their environment.

ESD	Electrostatic discharge	Electrostatic discharge is the release of static electricity when two objects with different electrical charges come into contact. It can damage sensitive electronic components and circuits.
EXTD	External drive	An external drive is a storage device connected to the system through an external port, used to add extra storage or back up data.
EVSE	Electric Vehicle Supply Equipment	Charging equipment for electric vehicles, such as chargers for electric cars.
FC	Frequency Control	An option for controlling the frequency output of the power supply.
FFT	Fast Fourier Transform	An algorithm to compute the Discrete Fourier Transform (DFT) of a signal in an efficient way.
FS	Full Scale	Refers to the maximum value or range for a measurement or parameter.
GPM	Gallons per Minute	It is a unit of measurement used to quantify the flow rate of liquids, specifically how many gallons of liquid pass through a system or space per minute.
GUI	Graphical User Interface	A visual interface that allows users to interact with software through graphical icons and visual indicators, as opposed to text-based commands.
Hz	Hertz	A unit of frequency, representing one cycle per second.
HIL	Hardware in the Loop	A testing methodology where real hardware is used in the loop of a simulation to test and validate a system.
IEEE-488	Institute of Electrical and Electronics Engineers 488	A standard for connecting and controlling test equipment through a bus interface, also known as GPIB (General Purpose Interface Bus).
IVI	Interchangeable Virtual Instruments	A set of software drivers that allow instruments to be easily swapped out in test systems without modifying software.
IEC	International Electrotechnical Commission	An international standards organization that prepares and publishes standards for electrical, electronic, and related technologies.
kWh	Kilowatt-Hour	A unit of energy equal to one kilowatt of power used for one hour.
kVAR	Kilovolt-Ampere Reactive	kVAR is a unit of measurement for reactive power in an electrical system.
LAN	Local Area Network	A network that connects computers and devices within a small geographic area, like a building or campus.

LKM/LKS	Load Control Modules	Optional modules for controlling load behavior, especially in varying frequency ranges.
LXI	LAN Extensions for Instrumentation	A standard for controlling instruments over Ethernet.
MIL-STD	Military Standard	A set of standards used by the U.S. Department of Defense for testing and evaluation of equipment.
NI	National Instruments	A company that provides software and hardware used for automated testing and measurement systems.
PONS	Power On Settings	Configuration settings that take effect when the power is cycled on/off (usually related to how the power supply is set up or reset during initialization).
PSID	Pounds per Square Inch Differential	It is a unit of measurement used to express pressure differential or pressure drop across a system, component, or filter.
RAH	Relative Air Humidity	Relative Air Humidity is a measure of the amount of water vapor present in the air compared to the maximum amount of water vapor the air can hold at a given temperature.
RMS	Root Mean Square	A measure of the effective value of an alternating current or voltage, representing its equivalent direct current value in terms of heating effect.
RS232C	Recommended Standard 232C	A standard for serial communication used to connect computers and other devices.
RLC	Resistor, Inductor, and Capacitor	Refers to the combination of resistive, inductive, and capacitive components used for programming load conditions.
RTCA DO-160	Radio Technical Commission for Aeronautics, Document 160	A standard for testing the environmental conditions and performance of avionics equipment.
SCPI	Standard Commands for Programmable Instruments	A standard set of commands used for controlling programmable test instruments.
SELV	Safety Extra Low Voltage	This is part of the SELV classification, emphasizing safe low-voltage systems that are electrically isolated from hazardous voltages for protection.
SQ	Sequoia	Refers to the Sequoia Series power source models (e.g., SQ0022, SQ0030, etc.).
TA	Tahoe	Refers to the Tahoe Series power source models (e.g., TA0022, TA0030, etc.).
TFT	Thin-Film Transistor	A type of LCD display technology

THD	Total Harmonic Distortion	THD is a measure of the distortion in a signal caused by harmonics, which are unwanted frequencies that are multiples of the main (fundamental) frequency. It shows how much the signal deviates from a pure sine wave.
TTL	Transistor-Transistor Logic	A logic family used in digital circuits, commonly referring to a type of input used for frequency control.
UUT	Unit Under Test	Refers to the device or system being tested or evaluated.
USB	Universal Serial Bus	A standard for connecting devices to a computer, allowing data transfer and power supply.
V2G	Vehicle to Grid	A system that allows electric vehicles to connect to the grid to provide power back to the grid.
VA	Volt-Ampere	A unit of apparent power in an AC circuit, calculated as the product of voltage and current.
VAC	Volts of Alternating Current	A unit of measurement for the voltage in an AC electrical circuit.
VDC	Volts of Direct Current	A unit of measurement for the voltage in a DC electrical circuit.
VAR	Volt-Ampere Reactive	A unit of reactive power in an AC circuit, representing the power that does no real work but is necessary for maintaining electric and magnetic fields.
Vrms	Volts Root Mean Square	The RMS value of the voltage waveform, which is a way of expressing the equivalent steady DC voltage that would produce the same power dissipation in a resistive load.
XVC	Extended Voltage Range	A specific output range option for the power supply, typically providing higher voltage capability.
µs	Microsecond	One millionth of a second.