GENESYS Series Programmable AC Power Source

Built-in Interface: LAN, USB, RS-232, and RS-485

Optional Interface: GPIB (IEEE488.2)

USER MANUAL

dataTec
Mess- und Prüftechnik. Die Experten.

Ihr Ansprechpartner /
Your Partner:

dataTec AG
E-Mail: info@datatec.eu
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NOTE

Starting from firmware version 001.008.000, the voltage rating has been changed as follows:

350Vac to 360Vac, 500Vdc to 510Vdc, and -500Vdc to -510Vdc.

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INTRODUCTION

This manual provides instructions for the installation and operation of the Genesys Series Programmable AC Power Source, which can be used standalone or mounted in a test rack.

Refer to the **TDK-Lambda Product Center** for updated documentation and user manuals:

https://product.tdk.com/en/search/power/switching-power/prg-ac-power/tec_data/ps_system_genesys_ac

Drivers and GUIs are updated periodically to support new features. Refer to the **TDK-Lambda Product Center** for updated drivers and GUIs:

https://product.tdk.com/en/products/power/switching-power/prg-power/designtool/software_vcp.html

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WARRANTY

This TDK-Lambda product is warranted against defects in material and workmanship for a period of five years from the date of shipment.

Limitation of Warranty

During the warranty period, TDK-Lambda, at its option, will either repair or replace the products that prove to be defective.

The warranty **shall not apply** to defects or damages caused by the following:

- improper or inadequate usage or maintenance of the product by the buyer
- other equipment, circuitry, or interfaces used by the buyer
- unauthorized modifications of the product
- operation exceeding the environmental specifications of the product
- the QA seal on the product has been removed or altered by anyone other than authorized TDK-Lambda personnel

No other warranty is expressed or implied.

Warranty Service

This product must be returned to an authorized TDK-Lambda service facility for repairs or other services. For the service of products that are under warranty, the buyer shall prepay the shipping charges to TDK-Lambda, and TDK-Lambda shall pay the shipping charges to return the product to the buyer. Refer to **Section 3.4: Repacking for Shipment.**

DISCLAIMER

The information contained in this document is subject to change without notice.

TDK-Lambda shall not be liable for errors contained in this document or for incidental or consequential damages in connection with the furnishing or use of this material.

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PRODUCT TEST RESULTS

As part of TDK-Lambda's efforts to protect the global environment and as part of TDK's Sustainability Vision, we are happy to notify you that we have launched an online product test results database.

To reduce paper waste, starting in September 2022, TDK-Lambda Ltd. will stop printing individual product test results which used to be included in a unit's package. Test results are available online on a dedicated page on our website, starting with all products manufactured as of April 2021.

To view your product's test results, enter the serial number and part number printed on your power source's label on the following webpage:

https://orders.tdk-lambda.co.il/company-products

We encourage you to avoid printing test results and instead store a digital copy in your ERP system.

GENERAL SAFETY INFORMATION

READ SAFETY INSTRUCTIONS

Safety precautions must be observed during all phases of operation, service, and repair of this equipment. Failure to comply with the safety precautions, **WARNING**, or **CAUTION** presented in this document will violate the safety standards of design and manufacture and the intended use of this equipment and may impair the built-in protection. TDK-Lambda shall not be liable for the user's failure to comply with these requirements.

SYMBOLS AND MARKING ON THE EQUIPMENT

	**Warning**: There is a risk of danger. It is important to consult the user manual to preserve the safe operation of the equipment and avoid any potential injury or hazard.
	**Earth (ground) terminal**: This symbol indicates that the terminal provides Earth potential for functional purposes other than safety.
	**Protective conductor (ground) terminal**: This is the terminal, which is intended for connection to an external conductor for protection against electric shock in case of a fault.
	Switch ON position: Powers the power source ON.
	**Switch OFF position**: Powers the power source OFF. **IMPORTANT**: This is **not** the main disconnect device of the equipment. Refer to **Section 7.4: AC Input Power Connection**, to learn more about the main disconnect device.
	**Alternate Current (AC)**: Indicates that this symbol and the value next to it are of AC nature.

WARNING, CAUTION, AND NOTE

WARNING	A **WARNING** sign denotes a hazard and must not be skipped. All indicated conditions must be fully met and understood. Failure to follow the procedures or conditions correctly could result in potential injury or hazard.
CAUTION	A **CAUTION** sign denotes a hazard and must not be skipped. All indicated conditions must be fully met and understood. Failure to follow an essential operating or maintenance procedure could result in damage to the equipment.
NOTE	Indicates a necessary operating or maintenance procedure.

PRODUCT SAFETY INSTRUCTIONS

AC Input



This equipment must be operated within the input parameters stated in this manual. To avoid electric shock hazards, the means of connecting this equipment to the AC mains must be according to the instructions specified in this manual only.

The Genesys Series Programmable AC Power Source is designed for use in TN and TT power distribution systems. It can be connected to Star or Y power distribution systems. The Delta power distribution system is not supported.

Do not use an AC supply that exceeds the input voltage and frequency rating of this equipment. The nominal input voltage and frequency rating of this series are **100–240Vac, 50–60Hz for 1-phase models; 190–240Vac, 50–60Hz for 3-phase 200V models; and 380–480Vac, 50–60Hz for 3-phase 480V models.**

For safety reasons, fluctuations in the AC supply voltage should not exceed **+/-10%** of the nominal input voltage. Ensure that, under heavy loads, the AC voltage supplied to the equipment does not fall below the specifications.

Energy Hazard



This equipment can generate hazardous energy. Therefore, the output and other connections must not be user-accessible. The customer's final equipment needs to provide adequate protection for service personnel against inadvertent contact with the output wires and other hazardous signals.

Grounding



CLASS I WARNING: This product is a Safety Class I equipment.

To avoid electric shock hazards, this equipment must be reliably earthed and professionally installed. The instrument chassis must be connected to an electrical ground.

Any interruption of the protective ground conductor or disconnection of the protective earth terminal will cause a potential shock hazard that might cause personal injury or hazard.



For equipment designed to be hard-wired to the AC mains, the protective earth terminal must be connected to the safety electrical ground before any other connection is made.

Part Substitution and Modifications

WARNING

Dangerous voltages are present within the equipment. To avoid electric shock hazards, disconnect power, discharge circuits, remove external voltage sources, and wait for two minutes before removing the cover and touching the components.

Never replace components with a power cable connected.

This equipment is not customer-serviceable. Part substitutions and modifications must be carried out by authorized TDK-Lambda service personnel only. For repairs or modifications, the equipment must be returned to one of the TDK-Lambda service facilities.

Fuses

WARNING

MULTI-POLE FUSING

The equipment has internal fuses on all supply conductors, which protect the equipment.

Dangerous voltages are present within the equipment. To avoid electric shock hazards, disconnect power, discharge circuits, remove external voltage sources, and wait for two minutes before removing the cover and touching the components.

Never replace components with a power cable connected.

For continued protection against the risk of fire, replace the fuses with the same type and rating only.

Fuses should not be replaced by the user and must be replaced by authorized TDK-Lambda service personnel only.

Internal fuses are sized for fault protection, and an open fuse indicates that service is required. For changing the fuse, the equipment must be returned to one of the TDK-Lambda service facilities.

Product Usage

WARNING

This product is designed for use as standalone or rack-mount equipment within the limits described in this manual.

This product is not designed for general home or consumer use and is designed for indoor use only.

Moving the Equipment

WARNING

Moving the equipment with the power on can cause electric shock or instrument damage.

Moving the equipment with cables connected can cause wires to break and cause electric shock.

SAFETY AND EMC APPROVALS

UL 61010-1 and CAN/CSA-22.2 No. 61010-1-12 - cTUVus

IEC 61010-1 - CB Test Report and Certificate

EN 61010-1 - TUV Mark, CE Mark

IEC/EN 61326-1 - Industrial Environment

Marking of the CE symbol indicates compliance to the EMC Directive, the Low Voltage Directive (LVD), and the RoHS Directive of the European Union.

A CE “Declaration of Conformity” in accordance with the preceding directives and standards is available on file at our EU representative: TDK-Lambda Europe GmbH, Karl-Bold-Str. 40, Achern.

A UKCA marking, when applied to a product covered by this handbook, indicates compliance with the Electrical Equipment (Safety) Regulations 2016, the Electromagnetic Compatibility Regulations 2016, and the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulation 2012.

A UKCA “Declaration of Conformity” in accordance with the preceding directives and standards is available on file at our UK representative: TDK-Lambda UK Limited, Kingsley Avenue, Ilfracombe, Devon EX34 8ES.

Refer to the **TDK-Lambda Product Center** for the declarations:

https://product.tdk.com/en/search/power/switching-power/prg-ac-power/tec_data/ps_system_genesys_ac

NOTES

This equipment is designed for an industrial environment. It may cause radio interference in a residential, commercial, or light industrial environment. The user may be required to take adequate measures to reduce this interference.

This equipment is professional equipment and is not intended for sale to the public.

FCC Notice

This equipment complies with Part 15 of the FCC rules. The operation is subject to the following two conditions:

- This equipment may not cause harmful interference.
- This equipment must accept any interference received, including interference that may cause undesired operation.

NOTES

This equipment has been tested and found to comply with the limits for a Class A digital device pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment.

This equipment generates, uses, and can radiate radio frequency energy. It may cause harmful interference to radio communications if it is not installed and used in accordance with this manual.

Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user is required to correct the interference at their own expense.

Modifications not expressly approved by the party responsible for compliance could void the user’s authority to operate the equipment under FCC rules.

ENVIRONMENTAL APPROVALS

TDK-Lambda recognizes its duties and responsibilities towards promoting a sustainable environment. Our policy is to comply with applicable global legislation and to follow the TDK Corporation Environmental Policy, which goes beyond mandatory international laws.

Refer to the **TDK-Lambda environmental compliance** webpage for additional information:

https://www.emea.lambda.tdk.com/environment_policy

This webpage contains the environmental regulations and directives with which TDK-Lambda complies, and other environmental information not included in this document.

CHINA ROHS



产品 / Product: GAC Series

Date: 11 Dec 2025

产品中有害物质的名称及含有信息表

Information on the Name and Content of Hazardous Substances in Products

部件名称/ Part Name	有害物质 / Hazardous Substances									
	Pb	Hg	Cd	Cr6+	PBB	PBDE	DBP	DIBP	BBP	DEHP
電路組件/PCB Assembly	X	O	X	O	O	O	O	O	O	O
配件/Accessories	X	O	O	O	O	O	O	O	O	O

注1:	O：表示该有害物质在该部件所有均质材料中的含量均不超出电器电子产品有害物质限制使用国家标准要求。 X：表示该有害物质至少在该部件的某一均质材料中含量超出电器电子产品有害物质限制使用国家标准要求。
注2:	以上未列出的部件，表明其有害物质含量均不超出电器电子产品有害物质限制使用国家标准要求。
Note 1:	O: Indicates that the content of the hazardous substance in all homogeneous materials of the component does not exceed the national standard requirements for the restriction of the use of hazardous substances in electrical and electronic products. X: Indicates that the content of the hazardous substance in at least one homogeneous material of the component exceeds the national standard requirements for the restriction of the use of hazardous substances in electrical and electronic products.
Note 2:	For components not listed above, it means that the content of their hazardous substances does not exceed the national standard requirements for the restriction of the use of hazardous substances in electrical and electronic products.

Waste Electrical and Electronic Equipment (WEEE)

The WEEE mark (crossed-out wheeled bin symbol) on the product indicates that this equipment shall not be disposed of with unsorted municipal waste. For customers in the European Union, the product shall be collected separately and disposed of through an authorized WEEE collection, recovery, or recycling system in accordance with applicable local regulations. Proper disposal helps conserve natural resources and prevents potential adverse effects on the environment and human health.

Please contact your local take-back scheme, waste management provider, or TDK-Lambda Europe GmbH for available collection options.

OVERVOLTAGE CATEGORY AND ENVIRONMENTAL CONDITIONS

WARNING

Do not store or operate this product in locations where flammable gases or ignitable substances are present.

These products are IP20; chemicals, solvents, cleaning agents, and other liquids must not be used.

While installing the product in environments where conductive foreign dust and liquid that may cause malfunction may be present, install filters to avoid penetration of these foreign materials into the product.

Do not use this product under unusual conditions such as emission of smoke or abnormal smell or sound. Stop using it immediately and shut off the product.

These products have been assigned to Overvoltage category II.

These products are intended for use in the following operating conditions:

- **Use**: indoor
- **Pollution Degree**: 2
- **Maximum Operational Altitude**: 2000m above sea level
- **Ambient Temperature**: 0°C–40°C
- **Humidity**: 20%RH– 90%RH (no condensation)

LONG-TERM STORAGE METHOD AND LONG-TERM STORAGE PERIOD

- Keep the product in its carton box.
- Do not apply excessive vibration, shock, or mechanical stress to the product.
- Keep the product away from direct sunlight.
- Use the following storage conditions as a guideline:
    - **Temperature range**: 5°C–30°C
    - **Humidity range**: 40%RH–60%RH
- Keep the product away from places where temperature and humidity can change drastically. It can cause condensation on the product or deterioration of the product.
- There is a tendency that the leakage current of an aluminum electrolytic capacitor may increase when not used for a long time. This phenomenon can be improved by applying voltage to the aluminum electrolytic capacitor to reduce the leakage current through the self-recovery effect of the electrolyte.

  For reference, before using products that have been stored for 1 year or longer, it is recommended to turn on the product using the following conditions:
    - **Input voltage**: nominal
    - **Load**: 0A (no load condition)
    - **Ambient temperature**: normal temperature
    - **Time**: 30 minutes or more

CLEANING THE UNIT



Dangerous voltages are present within the unit. Some components inside the unit are at AC voltage even when the ON/OFF switch is in the OFF position. To avoid electric shock hazard, disconnect the AC cord and load, discharge circuits, remove external voltage sources, and wait for 2 minutes before cleaning the unit.

- Use a brush to remove any dust from the unit.
- Clean the outside with a lint-free cloth damp with water. Apply water to the cloth, not directly to the unit.
- Do not use any detergents or solvents. Use plain water only.
- Ensure that water does not enter the unit.
- While cleaning the rear panel, ensure that water or moisture does not reach the connectors.
- Ensure that the unit is completely dry before operating it.

CHAPTER 1: GENERAL INFORMATION

1.1 Introduction

This manual provides instructions for the installation and operation of the Genesys 2kVA–60kVA Programmable AC Power Source Series. These instructions refer to the standard and blank panel units, which include the built-in RS232/485, USB, and LAN interfaces, and may include the optional GPIB interface. For information related to operation with the built-in interfaces and the optional GPIB interface, refer to respective sections in this manual. This manual also provides instructions for the installation of the 9kVA PWR and 12kVA PWR booster units which can be used to increase the total output power. The PWR unit has a plain front panel with no LEDs, touchscreen, or ON/OFF switch. The built-in RS232/485 and LAN interfaces, and the optional GPIB interface are not applicable for the PWR units. The PWR units **CANNOT** be used as standalone and **MUST** be assembled along with a master unit in a parallel system.

1.2 Key Features

The Genesys Series Programmable AC Power Source is a wide output range, high-performance power source. It is power-factor corrected and operates from a worldwide AC input voltage range.
The front panel includes a graphical touch-screen display (not applicable for the blank front panel unit and the PWR unit) that allows the user to program, control, and view the power source output. The rear panel includes the necessary connectors to program, control, and monitor the power source with remote analog signals or with built-in RS232/485, USB, and LAN interfaces. Built-in interfaces (except USB) are not applicable for PWR units.
The Waveform Generator can generate standard sine, triangle, and square waves and accurate, time-controlled sequencing profiles.
The Transient Generator can simulate AC or DC signals by combining accurate, time-controlled sequences of voltage and frequency. Different AVIONICS Test routines can also be generated.
The Virtual Control Panel (VCP) program provides a graphical user interface.

Some of the key features of the power source series are:

- **Rated Output Power**: 2kVA–60kVA.
- **Input Voltage Range**: 85–265V_{ac} 1-phase, 170–265V_{ac} 3-phase, and 342–528V_{ac} 3-phase
- **Rated Output Voltage**: 360V_{rms} / ±510V_{dc}
- **Rated Output Current**: 20A_{rms}–450A_{rms}
- **Output Phase**: single-phase or multi-phase (maximum of 3 phases)
- **Phase Angle Range**: 0–359.9
- **Output Frequency Range**: 16–5000Hz / 16–1200Hz
- **Crest Factor**: 4:1–6:1

Refer to **CHAPTER 2: SPECIFICATIONS** and the ordering code for more details.

1.3 Control via Front Panel and Communication Ports

Some basic parameters that can be controlled via the front panel and communication ports are:

- Output ON/OFF
- Output voltage and current
- Over-Voltage, Under-Voltage, and Over-Power Protection
- Start-up mode
- Foldback Protection
- Slew Rate
- Frequency
- Phase
- Phase Angle

1.4 Analog Programming and Monitoring

Analog inputs and outputs are provided at the rear panel for analog control of the power source, and they can be used for the following:

- programming and monitoring the output voltage
- monitoring the output current
- remote setting of the output to ON or OFF
- monitor the operation of the power source

1.5 Parallel Operation

The parallel configuration of the power source consists of power sources configured to single or various phases. Several power sources may share a phase in parallel, or each power source may be on a separate phase. When two or more power sources are connected in parallel, they use the parallel cable to transmit the data. In parallel mode, the power source can be configured in the following configuration:

- Single-phase
- Multi-phase (maximum of 3 phases)

CHAPTER 2: SPECIFICATIONS

Unless otherwise noted, specifications are relative to rated values, warranted over the ambient temperature range of 0°C to 40°C.

Models			2kVA 1200Hz 2kVA 5000Hz	3kVA 1200Hz 3kVA 5000Hz	4kVA 1200Hz 4kVA 5000Hz
Programming (*38)					
AC output voltage (*1)					
Output phase configuration		-	1 phase		
Rated output RMS voltage		V	360 Line-Neutral		
Setting range (*3)		V	0 – 360.2		
Programming resolution		V	≤0.02		
Programming accuracy	16 – 1200Hz	%	≤0.2		
	1200.1 – 5000Hz	%	≤0.4		
AC output current					
Rated output RMS current	1 phase	A	20	30	
	3 phase (per phase)		-		
Setting range (*5)	1 phase	A	0 – 20.2	0 – 30.2	
	3 phase (per phase)		-		
Programming resolution		mA	≤5		
Programming accuracy		%	≤1	≤0.6	
AC output power					
Rated output apparent power	1 phase	VA	2000	3000	4000
	3 phase (per phase)		-		
Load power factor		-	0 – 1 (leading or lagging)		
Frequency					
Range	1200Hz models	Hz	16 – 1200		
	5000Hz models	Hz	16 – 5000		
Programming resolution	16 – 1200Hz	Hz	0.01		
	1200.1 – 5000Hz	Hz	0.1		
Programming accuracy		%	≤0.01		
DC output voltage					
Rated output DC voltage		V_{DC}	±510		
DC voltage setting range (*6)		V_{DC}	0 – ±510.2		
Programming resolution		V_{DC}	≤0.02		
Programming accuracy		%	≤0.15		
DC output current					
Rated output DC current		A_{DC}	20	30	
Setting range (*7)		A_{DC}	0 – 20.2	0 – 30.2	
Programming resolution		mA	≤5		
Programming accuracy		%	≤1	≤0.6	
DC output power					
Rated output power		W	2000	3000	4000
Measurement					
Output voltage					
AC voltage resolution		V	≤0.02		
AC voltage accuracy	16 – 1200Hz	%	≤0.2		
	1200.1 – 5000Hz	%	≤0.4		
DC voltage resolution		V_{DC}	≤0.02		
DC voltage accuracy		%	≤0.2		
Output current					
RMS current resolution		mA	≤5		
RMS current accuracy		%	≤1	≤0.6	
DC current resolution		mA_{DC}	≤5		
DC current accuracy		%	≤1	≤0.6	
Peak current resolution		mA_{PK}	≤5		
Peak current accuracy (*25)		%	≤1.5		
Output power					
Active (real) power resolution		W	≤0.2		
Active (real) power accuracy		%	AC: ≤2.25; DC: ≤3	AC: ≤1.5; DC: ≤3	
Apparent power resolution		VA	≤0.2		
Apparent power accuracy		%	≤2.25	≤1.5	
Frequency (*4)					
Resolution	16 – 1200Hz	Hz	0.01		
	1200.1 – 5000Hz	Hz	0.1		
Accuracy (*8)		%	≤0.1		

Models			2kVA 1200Hz 2kVA 5000Hz	3kVA 1200Hz 3kVA 5000Hz	4kVA 1200Hz 4kVA 5000Hz
Supplemental					
Crest factor / Maximum peak current		-	6:1 (6 times the rated RMS output current) / 120A	4:1 (4 times the rated RMS output current) / 120A	
Ripple RMS (*11)		mV_{RMS}	≤500		
Transient response time (*12)		µs	≤40		
Response speed T_{rise}, T_{fall} (*13)		µs	1200Hz models: ≤120; 5000Hz models: ≤40		
Voltage slew rate (typical)		V/µs	1200Hz models: 4.4; 5000Hz models: 16.34		
DC offset voltage (typical)		mV_{DC}	≤35		
Remote sense compensation		-	AC, AC+DC mode: $35V_{RMS}$, $50V_{PK}$; DC Mode: $35V_{DC}$		
Start-up delay		-	Less than 7 seconds		
Parallel operation (*50)		-	Possible. Form 3-phase system or increase 1-phase output power		
AC input					
Voltage nominal	1-Phase (*14)	V	100 – 240		-
	3-Phase 200		190 – 240		
	3-Phase 480		380 – 480		
Voltage variation	1-Phase (*14)	V	85 – 265		-
	3-Phase 200		170 – 265		
	3-Phase 480		342 – 528		
Maximum input current	1-Phase	A	13.5 @ 200VAC	18.5 @ 200VAC	-
	3-Phase 200		7.5 @ 200VAC	11.2 @ 200VAC	15 @ 200VAC
	3-Phase 480		4 @ 380VAC	6 @ 380VAC	8 @ 380VAC
Frequency nominal		Hz	50 – 60		
Frequency variation		Hz	47 – 63		
Power factor (*15)	1-Phase	-	0.96	0.98	-
	3-Phase 200 and 480	-	0.92	0.94	
Efficiency (*15)	1-Phase	%	78	81.5	-
	3-Phase 200		79	82.5	84
	3-Phase 480		79	82.5	84
Hold-up time (*15)		ms	≥10		
Inrush peak current (*16)		A	Less than 52		
Mechanical					
Cooling		-	Forced air cooling by internal fans. Airflow direction: From front panel to power source rear		
Weight		Kg	≤8		≤8.5
Dimensions	Without strain relief	mm	W: 423, H: 43.6, D: 544.5		
	With strain relief		W: 423, H: 43.6, D: 640.5		
Vibration		-	MIL-PRF-28800F, Class 3; 5-500 Hz per Paragraph 4.5.5.3.1 MIL-STD-810G:08, Method 514.6, procedure I		
Shock		-	MIL-PRF-28800F, Class 3; 30G half-sine with 11ms duration per 4.5.5.4.1		
Transportation integrity		-	ISTA 1A		
Regulatory compliance (safety / EMC)					
Safety (*18)		-	IEC/UL/EN 61010-1 Ed. 3 (cTUVus, T-Mark, CE/UKCA)		
Interface classification (*29) (*31)		-	Hazardous: Input, Output (including Sense), J9 and J10 Non-hazardous: J1~J8		
Withstand voltage (*29) (*31)		V_{DC} 1min	Input – Output (including sense), J1~J10: 4000 Output (including sense), J9 and J10 – J1~J8: 3850 Output (including sense), J9 and J10 – Ground: 3060 Input – Ground: 2835		
Isolation resistance (*48)		MΩ	>100		
Isolation to ground		V	360VAC, 510VDC		
EMC (*19)	General	-	EN 61326-1:2021		
	Immunity	-	EN 61000-4-2, EN 61000-4-3, EN 61000-4-4, EN 61000-4-5, EN 61000-4-6, EN 61000-4-8, EN 61000-4-11		
	Conducted emissions	-	CISPR11 Class A		
	Radiated emissions	-	CISPR11 Class A		

Protective functions		
Foldback protection	Output shutdown when power source changes mode from CV to CC mode or from CC to CV mode	
Output overvoltage protection (OVP)	Output shutdown when overvoltage is sensed on the output Programming range: 385VAC, +/-550VDC; Accuracy: ≤0.5%	
Output overvoltage protection (OVP) type	RMS – Shutdown when RMS voltage exceeds OVP RMS setting Peak – Shutdown when peak voltage exceeds OVP Peak setting	
Overtemperature protection (OTP)	Output shutdown when ambient temperature sensor or internal temperature sensors thresholds exceed	
Overcurrent protection (OCP)	Output shutdown when peak overcurrent is sensed on the output	
Overcurrent protection (OCP) range	A_{PK}	±0.5 – ±130
AC input protection	Fuse on each phase, two fuses in 1-Phase input, three fuses in 3-Phase input. Not user accessible	
Output undervoltage limit (UVL)	Prevents from adjusting output voltage below limit	
Output undervoltage protection (UVP)	Output shutdown when undervoltage is sensed on the output	

Models			6kVA 1200Hz 6kVA 5000Hz	9kVA 1200Hz (*30) 9kVA 5000Hz (*30)	12kVA 1200Hz (*30) 12kVA 5000Hz (*30)
Programming (*38)					
AC output voltage (*1)					
Output phase configuration		-	1/3 phase		
Rated output RMS voltage		V	360 Line-Neutral		
Setting range (*3)		V	0 – 360.2		
Programming resolution		V	≤0.02		
Programming accuracy	16 – 1200Hz	%	≤0.2		
	1200.1 – 5000Hz	%	≤0.4		
AC output current					
Rated output RMS current	1 phase	A	60	90	
	3 phase (per phase)		20	30	
Setting range (*5)	1 phase	A	0 – 60.6	0 – 90.6	
	3 phase (per phase)		0 – 20.2	0 – 30.2	
Programming resolution		mA	≤5		
Programming accuracy		%	≤1	≤0.6	
AC output power					
Rated output apparent power	1 phase	VA	6000	9000	12000
	3 phase (per phase)		2000	3000	4000
Load power factor		-	0 – 1 (leading or lagging)		
Frequency					
Range	1200Hz models	Hz	16 – 1200		
	5000Hz models	Hz	16 – 5000		
Programming resolution	16 – 1200Hz	Hz	0.01		
	1200.1 – 5000Hz	Hz	0.1		
Programming accuracy		%	≤0.01		
DC output voltage					
Rated output DC voltage		V_{DC}	±510		
DC voltage setting range (*6)		V_{DC}	0 – ±510.2		
Programming resolution		V_{DC}	≤0.02		
Programming accuracy		%	≤0.15		
DC output current					
Rated output DC current		A_{DC}	60	90	
Setting range (*7)		A_{DC}	0 – 60.6	0 – 90.6	
Programming resolution		mA	≤5		
Programming accuracy		%	≤1	≤0.6	
DC output power					
Rated output power		W	6000	9000	12000
Measurement					
Output voltage					
AC voltage resolution		V	≤0.02		
AC voltage accuracy	16 – 1200Hz	%	≤0.2		
	1200.1 – 5000Hz	%	≤0.4		
DC voltage resolution		V_{DC}	≤0.02		
DC voltage accuracy		%	≤0.2		
Output current					
RMS current resolution		mA	≤5		
RMS current accuracy		%	≤1	≤0.6	
DC current resolution		mA_{DC}	≤5		
DC current accuracy		%	≤1	≤0.6	
Peak current resolution		mA_{PK}	≤5		
Peak current accuracy (*25)		%	≤1.5		
Output power					
Active (real) power resolution		W	≤0.2		
Active (real) power accuracy		%	AC: ≤2.25; DC: ≤3	AC: ≤1.5; DC: ≤3	
Apparent power resolution		VA	≤0.2		
Apparent power accuracy		%	≤2.25	≤1.5	
Frequency (*4)					
Resolution	16 – 1200Hz	Hz	0.01		
	1200.1 – 5000Hz	Hz	0.1		
Accuracy (*8)		%	≤0.1		

Models			6kVA 1200Hz 6kVA 5000Hz	9kVA 1200Hz (*30) 9kVA 5000Hz (*30)	12kVA 1200Hz (*30) 12kVA 5000Hz (*30)
Supplemental					
Crest factor / Maximum peak current		-	6:1 (6 times the rated RMS output current) / 360A	4:1 (4 times the rated RMS output current) / 360A	
Ripple RMS (*11)		mV_{RMS}	≤500		
Transient response time (*12)		µs	≤40		
Response speed T_{rise}, T_{fall} (*13)		µs	1200Hz models: ≤120; 5000Hz models: ≤40		
Voltage slew rate (typical)		V/µs	1200Hz models: 4.4; 5000Hz models: 16.34		
DC offset voltage (typical)		mV_{DC}	≤35		
Remote sense compensation		-	AC, AC+DC mode: $35V_{RMS}$, $50V_{PK}$; DC Mode: $35V_{DC}$		
Start-up delay		-	Less than 7 seconds		
Parallel operation (*50)		-	Possible. Form 3-phase system or increase 1-phase output power		
AC input					
Voltage nominal	3-Phase 200	V	190 – 240		
	3-Phase 480		380 – 480		
Voltage variation	3-Phase 200	V	170 – 265		
	3-Phase 480		342 – 528		
Maximum input current	3-Phase 200	A	22.4 @ 200VAC	33.6 @ 200VAC	45 @ 200VAC
	3-Phase 480		12 @ 380VAC	18 @ 380VAC	24 @ 380VAC
Frequency nominal		Hz	50 – 60		
Frequency variation		Hz	47 – 63		
Power factor(*15)	3-Phase 200 and 480	-	0.92	0.94	
Efficiency (*15)	3-Phase 200	%	79	82.5	84
	3-Phase 480		79	82.5	84
Hold-up time (*15)		ms	≥10		
Inrush peak current (*17)		A	Less than 156		
Mechanical					
Cooling		-	Forced air cooling by internal fans. Airflow direction: From front panel to power source rear		
Weight		Kg	≤25		≤26
Dimensions	Without strain relief	mm	W: 423, H:132.5, D: 649.7		
	With strain relief		W: 423, H: 132.5, D: 755.5		
Vibration		-	MIL-PRF-28800F, Class 3; 5-500 Hz per Paragraph 4.5.5.3.1 MIL-STD-810G:08, Method 514.6, procedure I		
Shock		-	MIL-PRF-28800F, Class 3; 30G half-sine with 11ms duration per 4.5.5.4.1		
Transportation integrity		-	ISTA 1A		
Regulatory compliance (safety / EMC)					
Safety (*18)		-	IEC/UL/EN 61010-1 Ed. 3 (cTUVus, T-Mark, CE/UKCA)		
Interface classification (*29) (*31) (*46)		-	Hazardous: Input, Output, Sense, J9 and J10 Non-hazardous: J1~J8 and Service Port (including J4-1, J4-2, J6-1, J6-2, J7-1 and J7-2)		
Withstand voltage (*29) (*31) (*46)		V_{DC} 1min	Input – Output, Sense, J1~J10 and Service Port (including J4-1, J4-2, J6-1, J6-2, J7-1 and J7-2): 4000 Output, Sense, J9 and J10 – J1~J8 and Service Port (including J4-1, J4-2, J6-1, J6-2, J7-1 and J7-2): 3850 Output, Sense, J9 and J10 – Ground: 3060 Input – Ground: 2835		
Isolation resistance (*48)		MΩ	>60		
Isolation to ground		V	360VAC, 510VDC		
EMC (*19)	General	-	EN 61326-1:2021		
	Immunity	-	EN 61000-4-2, EN 61000-4-3, EN 61000-4-4, EN 61000-4-5, EN 61000-4-6, EN 61000-4-8, EN 61000-4-11		
	Conducted emissions	-	CISPR11 Class A		
	Radiated emissions	-	CISPR11 Class A		
Protective functions					
Foldback protection		Output shutdown when power source changes mode from CV to CC mode or from CC to CV mode			
Output overvoltage protection (OVP)		Output shutdown when overvoltage is sensed on the output Programming range: 385VAC, +/-550VDC; Accuracy: ≤0.5%			
Output overvoltage protection (OVP) type		RMS – Shutdown when RMS voltage exceeds OVP RMS setting Peak – Shutdown when peak voltage exceeds OVP Peak setting			
Overtemperature protection (OTP)		Output shutdown when ambient temperature sensor or internal temperature sensors thresholds exceed			
Overcurrent protection (OCP)		Output shutdown when peak overcurrent is sensed on the output			
Overcurrent protection (OCP) range		A_{PK}	±1.5 – ±390		
AC input protection		Three fuses, fuse on each phase. Not user accessible			
Output undervoltage limit (UVL)		Prevents from adjusting output voltage below limit			
Output undervoltage protection (UVP)		Output shutdown when undervoltage is sensed on the output			

Models			18kVA 1200Hz (*34) 18kVA 5000Hz (*34)	24kVA 1200Hz (*34) 24kVA 5000Hz (*34)	27kVA 1200Hz (*34) 27kVA 5000Hz (*34)
Programming (*38)					
AC output voltage (*1)					
Output phase configuration (*2)		-	1/3 phase		
Rated output RMS voltage		V	360 Line-Neutral		
Setting range (*3)		V	0 – 360.2		
Programming resolution		V	≤0.02		
Programming accuracy	16 – 1200Hz	%	≤0.2		
	1200.1 – 5000Hz	%	≤0.4		
AC output current					
Rated output RMS current	1 phase	A	180		270
	3 phase (per phase)		60		90
Setting range (*5)	1 phase	A	0 – 181.2		0 – 271.8
	3 phase (per phase)		0 – 60.4		0 – 90.6
Programming resolution		mA	≤5		
Programming accuracy		%	≤0.6		
AC output power					
Rated output apparent power	1 phase	VA	18000	24000	27000
	3 phase (per phase)		6000	8000	9000
Load power factor		-	0 – 1 (leading or lagging)		
Frequency					
Range	1200Hz models	Hz	16 – 1200		
	5000Hz models	Hz	16 – 5000		
Programming resolution	16 – 1200Hz	Hz	0.01		
	1200.1 – 5000Hz	Hz	0.1		
Programming accuracy		%	≤0.01		
DC output voltage					
Rated output DC voltage		V_{DC}	±510		
DC voltage setting range (*6)		V_{DC}	0 – ±510.2		
Programming resolution		V_{DC}	≤0.02		
Programming accuracy		%	≤0.15		
DC output current					
Rated output DC current		A_{DC}	180		270
Setting range (*7)		A_{DC}	0 – 181.2		0 – 271.8
Programming resolution		mA	≤5		
Programming accuracy		%	≤0.6		
DC output power					
Rated output power		W	18000	24000	27000
Measurement					
Output voltage					
AC voltage resolution		V	≤0.02		
AC voltage accuracy	16 – 1200Hz	%	≤0.2		
	1200.1 – 5000Hz	%	≤0.4		
DC voltage resolution		V_{DC}	≤0.02		
DC voltage accuracy		%	≤0.2		
Output current					
RMS current resolution		mA	≤5		
RMS current accuracy		%	≤0.6		
DC current resolution		mA_{DC}	≤5		
DC current accuracy		%	≤0.6		
Peak current resolution		mA_{PK}	≤5		
Peak current accuracy (*25)		%	≤1.5		
Output power					
Active (real) power resolution		W	≤0.2		
Active (real) power accuracy		%	AC: ≤1.5; DC: ≤3		AC: ≤2.25; DC: ≤3
Apparent power resolution		VA	≤0.2		
Apparent power accuracy		%	≤1.5		≤2.25
Frequency (*4)					
Resolution	16 – 1200Hz	Hz	0.01		
	1200.1 – 5000Hz	Hz	0.1		
Accuracy (*8)		%	≤0.1		

Models			18kVA 1200Hz (*34) 18kVA 5000Hz (*34)	24kVA 1200Hz (*34) 24kVA 5000Hz (*34)	27kVA 1200Hz (*34) 27kVA 5000Hz (*34)
Supplemental					
Crest factor / Maximum peak current		-	4:1 (4 times the rated RMS output current) / 720A		4:1 (4 times the rated RMS output current) / 1080A
Ripple RMS (*11)		mV_{DC}	≤500		
Transient response time (*12)		µs	≤40		
Response speed T_{rise}, T_{fall} (*13)		µs	1200Hz models: ≤120; 5000Hz models: ≤40		
Voltage slew rate (typical)		V/µs	1200Hz models: 4.4; 5000Hz models: 16.34		
DC offset voltage (typical)		mV_{DC}	≤60		
Remote sense compensation		-	AC, AC+DC mode: $35V_{RMS}$, $50V_{PK}$; DC Mode: $35V_{DC}$		
Start-up delay		-	Less than 7 seconds		
Parallel operation (*50)		-	Possible. Form 3-phase system or increase 1-phase output power		
AC input					
Voltage nominal	3-Phase 200	V	190 – 240		
	3-Phase 480		380 – 480		
Voltage variation	3-Phase 200	V	170 – 265		
	3-Phase 480		342 – 528		
Maximum input current	3-Phase 200	A	67.2 @ 200VAC	89.6 @ 200VAC	100.8 @ 200VAC
	3-Phase 480		36 @ 380VAC	48 @ 380VAC	54 @ 380VAC
Frequency nominal		Hz	50 – 60		
Frequency variation		Hz	47 – 63		
Power factor(*15)	3-Phase 200 and 480	-	0.92		
Efficiency (*15)	3-Phase 200	%	82.5	84	82.5
	3-Phase 480		82.5	84	82.5
Hold-up time (*15)		ms	≥10		
Inrush peak current (*17)		A	Less than 312		Less than 468
Mechanical					
Cooling		-	Forced air cooling by internal fans. Airflow direction: From front panel to power source rear		
Weight	Field assembly (*49)	Kg	≤50	≤52	≤75
	Component (*49)		≤52	≤54	-
Dimensions	Without strain relief (*49)	mm	Field assembly - W: 423, H: 265, D: 649.7 Component - W: 423, H: 283.9, D: 745.3		W: 423, H: 399, D: 649.7
	With strain relief (*47)		W: 423, H: 265, D: 755.5		W: 423, H: 399, D: 755.5
Vibration		-	MIL-PRF-28800F, Class 3; 5-500 Hz per Paragraph 4.5.5.3.1 MIL-STD-810G:08, Method 514.6, procedure I		
Shock		-	MIL-PRF-28800F, Class 3; 30G half-sine with 11ms duration per 4.5.5.4.1		
Transportation integrity		-	ISTA 1A		
Regulatory compliance (safety / EMC)					
Safety (*18) (*35)		-	IEC/UL/EN 61010-1 Ed. 3 (cTUVus, T-Mark, CE/UKCA)		
Interface classification (*29) (*31) (*46)		-	Hazardous: Input, Output, Sense, J9 and J10 Non-hazardous: J1~J8 and Service Port (including J4-1, J4-2, J4-3, J4-4, J4-5 J6-1, J6-2, J6-3, J6-4, J6-5, J7-1, J7-2, J7-3, J7-4 and J7-5)		
Withstand voltage (*29) (*31) (*46)		V_{DC} 1min	Input – Output, Sense, J1~J10 and Service Port (including J4-1, J4-2, J4-3, J4-4, J4-5, J6-1, J6-2, J6-3, J6-4, J6-5, J7-1 and J7-2, J7-3, J7-4, J7-5): 4000 Output, Sense, J9 and J10 – J1~J8 and Service Port (including J4-1, J4-2, J4-3, J4-4, J4-5, J6-1, J6-2, J6-3, J6-4, J6-5, J7-1 and J7-2, J7-3, J7-4, J7-5): 3850 Output, Sense, J9 and J10 – Ground: 3060 Input – Ground: 2835		
Isolation resistance (*48)		MΩ	>30		>20
Isolation to ground		V	360VAC, 510VDC		
EMC (*19) (*35)	General	-	EN 61326-1:2021		
	Immunity	-	EN 61000-4-2, EN 61000-4-3, EN 61000-4-4, EN 61000-4-5, EN 61000-4-6, EN 61000-4-8, EN 61000-4-11		
	Conducted emissions	-	CISPR11 Class A		
	Radiated emissions	-	CISPR11 Class A		
Protective functions					
Foldback protection		Output shutdown when power source changes mode from CV to CC mode or from CC to CV mode			
Output overvoltage protection (OVP)		Output shutdown when overvoltage is sensed on the output Programming range: 385VAC, +/-550VDC; Accuracy: ≤0.5%			
Output overvoltage protection (OVP) type		RMS – Shutdown when RMS voltage exceeds OVP RMS setting Peak – Shutdown when peak voltage exceeds OVP Peak setting			
Overtemperature protection (OTP)		Output shutdown when ambient temperature sensor or internal temperature sensors thresholds exceed			
Overcurrent protection (OCP)		Output shutdown when peak overcurrent is sensed on the output			
Overcurrent protection (OCP) range		A_{PK}	±3 – ±780	±3 – ±780	±4.5 – ±1170
AC input protection		Three fuses, fuse on each phase. Not user accessible			
Output undervoltage limit (UVL)		Prevents from adjusting output voltage below limit			
Output undervoltage protection (UVP)		Output shutdown when undervoltage is sensed on the output			

Models			36kVA 1200Hz (*34) 36kVA 5000Hz (*34)	45kVA 1200Hz (*34) 45kVA 5000Hz (*34)
Programming (*38)				
AC output voltage (*1)				
Output phase configuration (*2)		-	1/3 phase	
Rated output RMS voltage		V	360 Line-Neutral	
Setting range (*3)		V	0 – 360.2	
Programming resolution		V	≤0.02	
Programming accuracy	16 – 1200Hz	%	≤0.2	
	1200.1 – 5000Hz	%	≤0.4	
AC output current				
Rated output RMS current	1 phase	A	360	450
	3 phase (per phase)		120	150
Setting range (*5)	1 phase	A	0 – 362.4	0 – 453
	3 phase (per phase)		0 – 120.8	0 – 151
Programming resolution		mA	≤5	
Programming accuracy		%	≤0.6	
AC output power				
Rated output apparent power	1 phase	VA	36000	45000
	3 phase (per phase)		12000	15000
Load power factor		-	0 – 1 (leading or lagging)	
Frequency				
Range	1200Hz models	Hz	16 – 1200	
	5000Hz models	Hz	16 – 5000	
Programming resolution	16 – 1200Hz	Hz	0.01	
	1200.1 – 5000Hz	Hz	0.1	
Programming accuracy		%	≤0.01	
DC output voltage				
Rated output DC voltage		V_{DC}	±510	
DC voltage setting range (*6)		V_{DC}	0 – ±510.2	
Programming resolution		V_{DC}	≤0.02	
Programming accuracy		%	≤0.15	
DC output current				
Rated output DC current		A_{DC}	360	450
Setting range (*7)		A_{DC}	0 – 362.4	0 – 453
Programming resolution		mA	≤5	
Programming accuracy		%	≤0.6	
DC output power				
Rated output power		W	36000	45000
Measurement				
Output voltage				
AC voltage resolution		V	≤0.02	
AC voltage accuracy	16 – 1200Hz	%	≤0.2	
	1200.1 – 5000Hz	%	≤0.4	
DC voltage resolution		V_{DC}	≤0.02	
DC voltage accuracy		%	≤0.2	
Output current				
RMS current resolution		mA	≤5	
RMS current accuracy		%	≤0.6	
DC current resolution		mA_{DC}	≤5	
DC current accuracy		%	≤0.6	
Peak current resolution		mA_{PK}	≤5	
Peak current accuracy (*25)		%	≤1.5	
Output power				
Active (real) power resolution		W	≤0.2	
Active (real) power accuracy		%	AC: ≤2.25; DC: ≤3	
Apparent power resolution		VA	≤0.2	
Apparent power accuracy		%	≤2.25	
Frequency (*4)				
Resolution	16 – 1200Hz	Hz	0.01	
	1200.1 – 5000Hz	Hz	0.1	
Accuracy (*8)		%	≤0.1	

Models			36kVA 1200Hz (*34) 36kVA 5000Hz (*34)	45kVA 1200Hz (*34) 45kVA 5000Hz (*34)
Supplemental				
Crest factor / Maximum peak current		-	4:1 (4 times the rated RMS output current) / 1440A	4:1 (4 times the rated RMS output current) / 1800A
Ripple RMS (*11)		mV_{DC}	≤500	
Transient response time (*12)		µs	≤40	
Response speed T_{rise}, T_{fall} (*13)		µs	1200Hz models: ≤120; 5000Hz models: ≤40	
Voltage slew rate (typical)		V/µs	1200Hz models: 4.4; 5000Hz models: 16.34	
DC offset voltage (typical)		mV_{DC}	≤60	
Remote sense compensation		-	AC, AC+DC mode: $35V_{RMS}$, $50V_{PK}$; DC Mode: $35V_{DC}$	
Start-up delay		-	Less than 7 seconds	
Parallel operation (*50)		-	Possible. Form 3-phase system or increase 1-phase output power	
AC input				
Voltage nominal	3-Phase 200	V	190 – 240	
	3-Phase 480		380 – 480	
Voltage variation	3-Phase 200	V	170 – 265	
	3-Phase 480		342 – 528	
Maximum input current	3-Phase 200	A	134.4 @ 200VAC	168 @ 200VAC
	3-Phase 480		72 @ 380VAC	90 @ 380VAC
Frequency nominal		Hz	50 – 60	
Frequency variation		Hz	47 – 63	
Power factor(*15)	3-Phase 200 and 480	-	0.92	
Efficiency (*15)	3-Phase 200	%	82.5	
	3-Phase 480		82.5	
Hold-up time (*15)		ms	≥10	
Inrush peak current (*17)		A	Less than 624	Less than 780
Mechanical				
Cooling		-	Forced air cooling by internal fans. Airflow direction: From front panel to power source rear	
Weight		Kg	≤100	≤125
Dimensions	Without strain relief	mm	W: 423, H: 532, D: 649.7	W: 423, H: 665, D: 649.7
	With strain relief		W: 423, H: 532, D: 755.5	W: 423, H: 665, D: 755.5
Vibration		-	MIL-PRF-28800F, Class 3; 5-500 Hz per Paragraph 4.5.5.3.1 MIL-STD-810G:08, Method 514.6, procedure I	
Shock		-	MIL-PRF-28800F, Class 3; 30G half-sine with 11ms duration per 4.5.5.4.1	
Transportation integrity		-	ISTA 1A	
Regulatory compliance (safety / EMC)				
Safety (*18) (*35)		-	IEC/UL/EN 61010-1 Ed. 3 (cTUVus, T-Mark, CE/UKCA)	
Interface classification (*29) (*31) (*46)		-	Hazardous: Input, Output, Sense, J9 and J10 Non-hazardous: J1~J8 and Service Port (including J4-1, J4-2, J6-1, J6-2, J7-1 and J7-2)	
Withstand voltage (*29) (*31) (*46)		V_{DC} 1min	Input – Output, Sense, J1~J10 and Service Port (including J4-1, J4-2, J6-1, J6-2, J7-1 and J7-2): 4000 Output, Sense, J9 and J10 – J1~J8 and Service Port (including J4-1, J4-2, J6-1, J6-2, J7-1 and J7-2): 3850 Output, Sense, J9 and J10 – Ground: 3060 Input – Ground: 2835	
Isolation resistance (*48)		MΩ	>15	>12
Isolation to ground		V	360VAC, 510VDC	
EMC (*19) (*35)	General	-	EN 61326-1:2021	
	Immunity	-	EN 61000-4-2, EN 61000-4-3, EN 61000-4-4, EN 61000-4-5, EN 61000-4-6, EN 61000-4-8, EN 61000-4-11	
	Conducted emissions	-	CISPR11 Class A	
	Radiated emissions	-	CISPR11 Class A	
Protective functions				
Foldback protection		Output shutdown when power source changes mode from CV to CC mode or from CC to CV mode		
Output overvoltage protection (OVP)		Output shutdown when overvoltage is sensed on the output Programming range: 385VAC, +/-550VDC; Accuracy: ≤0.5%		
Output overvoltage protection (OVP) type		RMS – Shutdown when RMS voltage exceeds OVP RMS setting Peak – Shutdown when peak voltage exceeds OVP Peak setting		
Overtemperature protection (OTP)		Output shutdown when ambient temperature sensor or internal temperature sensors thresholds exceed		
Overcurrent protection (OCP)		Output shutdown when peak overcurrent is sensed on the output		
Overcurrent protection (OCP) range		A_{PK}	±6 – ±1560	±7.5 – ±1950
AC input protection		Three fuses, fuse on each phase. Not user accessible		
Output undervoltage limit (UVL)		Prevents from adjusting output voltage below limit		
Output undervoltage protection (UVP)		Output shutdown when undervoltage is sensed on the output		

Models			48kVA 1200Hz (*34) 48kVA 5000Hz (*34)	60kVA 1200Hz (*34) 60kVA 5000Hz (*34)
Programming (*38)				
AC output voltage (*1)				
Output phase configuration (*2)		-	1/3 phase	
Rated output RMS voltage		V	360 Line-Neutral	
Setting range (*3)		V	0 – 360.2	
Programming resolution		V	≤0.02	
Programming accuracy	16 – 1200Hz	%	≤0.2	
	1200.1 – 5000Hz	%	≤0.4	
AC output current				
Rated output RMS current	1 phase	A	360	450
	3 phase (per phase)		120	150
Setting range (*5)	1 phase	A	0 – 362.4	0 – 453
	3 phase (per phase)		0 – 120.8	0 – 151
Programming resolution		mA	≤5	
Programming accuracy		%	≤0.6	
AC output power				
Rated output apparent power	1 phase	VA	48000	60000
	3 phase (per phase)		16000	20000
Load power factor		-	0 – 1 (leading or lagging)	
Frequency				
Range	1200Hz models	Hz	16 – 1200	
	5000Hz models	Hz	16 – 5000	
Programming resolution	16 – 1200Hz	Hz	0.01	
	1200.1 – 5000Hz	Hz	0.1	
Programming accuracy		%	≤0.01	
DC output voltage				
Rated output DC voltage		V_{DC}	±510	
DC voltage setting range (*6)		V_{DC}	0 – ±510.2	
Programming resolution		V_{DC}	≤0.02	
Programming accuracy		%	≤0.15	
DC output current				
Rated output DC current		A_{DC}	360	450
Setting range (*7)		A_{DC}	0 – 362.4	0 – 453
Programming resolution		mA	≤5	
Programming accuracy		%	≤0.6	
DC output power				
Rated output power		W	48000	60000
Measurement				
Output voltage				
AC voltage resolution		V	≤0.02	
AC voltage accuracy	16 – 1200Hz	%	≤0.2	
	1200.1 – 5000Hz	%	≤0.4	
DC voltage resolution		V_{DC}	≤0.02	
DC voltage accuracy		%	≤0.2	
Output current				
RMS current resolution		mA	≤5	
RMS current accuracy		%	≤0.6	
DC current resolution		mA_{DC}	≤5	
DC current accuracy		%	≤0.6	
Peak current resolution		mA_{PK}	≤5	
Peak current accuracy (*25)		%	≤1.5	
Output power				
Active (real) power resolution		W	≤0.2	
Active (real) power accuracy		%	AC: ≤2.25; DC: ≤3	
Apparent power resolution		VA	≤0.2	
Apparent power accuracy		%	≤2.25	
Frequency (*4)				
Resolution	16 – 1200Hz	Hz	0.01	
	1200.1 – 5000Hz	Hz	0.1	
Accuracy (*8)		%	≤0.1	

Models			48kVA 1200Hz (*34) 48kVA 5000Hz (*34)	60kVA 1200Hz (*34) 60kVA 5000Hz (*34)
Supplemental				
Crest factor / Maximum peak current		-	4:1 (4 times the rated RMS output current) / 1440A	4:1 (4 times the rated RMS output current) / 1800A
Ripple RMS (*11)		mV_{DC}	≤500	
Transient response time (*12)		µs	≤40	
Response speed Trise, Tfall (*13)		µs	1200Hz models: ≤120; 5000Hz models: ≤40	
Voltage slew rate (typical)		V/µs	1200Hz models: 4.4; 5000Hz models: 16.34	
DC offset voltage (typical)		mV_{DC}	≤60	
Remote sense compensation		-	AC, AC+DC mode: 35VRMS, 50VPK; DC Mode: 35VDC	
Start-up delay		-	Less than 7 seconds	
Parallel operation (*50)		-	Possible. Form 3-phase system or increase 1-phase output power	
AC input				
Voltage nominal	3-Phase 200	V	190 – 240	
	3-Phase 480		380 – 480	
Voltage variation	3-Phase 200	V	170 – 265	
	3-Phase 480		342 – 528	
Maximum input current	3-Phase 200	A	179.2 @ 200VAC	224 @ 200VAC
	3-Phase 480		96 @ 380VAC	120 @ 380VAC
Frequency nominal		Hz	50 – 60	
Frequency variation		Hz	47 – 63	
Power factor(*15)	3-Phase 200 and 480	-	0.92	
Efficiency (*15)	3-Phase 200	%	84	
	3-Phase 480		84	
Hold-up time (*15)		ms	≥10	
Inrush peak current (*17)		A	Less than 624	Less than 780
Mechanical				
Cooling		-	Forced air cooling by internal fans. Airflow direction: From front panel to power source rear	
Weight		Kg	≤104	≤130
Dimensions	Without strain relief	mm	W: 423, H: 532, D: 649.7	W: 423, H: 665, D: 649.7
	With strain relief		W: 423, H: 532, D: 755.5	W: 423, H: 665, D: 755.5
Vibration		-	MIL-PRF-28800F, Class 3; 5-500 Hz per Paragraph 4.5.5.3.1 MIL-STD-810G:08, Method 514.6, procedure I	
Shock		-	MIL-PRF-28800F, Class 3; 30G half-sine with 11ms duration per 4.5.5.4.1	
Transportation integrity		-	ISTA 1A	
Regulatory compliance (safety / EMC)				
Safety (*18) (*35)		-	IEC/UL/EN 61010-1 Ed. 3 (cTUVus, T-Mark, CE/UKCA)	
Interface classification (*29) (*31) (*46)		-	Hazardous: Input, Output, Sense, J9 and J10 Non-hazardous: J1~J8 and Service Port (including J4-1, J4-2, J6-1, J6-2, J7-1 and J7-2)	
Withstand voltage (*29) (*31) (*46)		V_{DC} 1min	Input – Output, Sense, J1~J10 and Service Port (including J4-1, J4-2, J6-1, J6-2, J7-1 and J7-2): 4000 Output, Sense, J9 and J10 – J1~J8 and Service Port (including J4-1, J4-2, J6-1, J6-2, J7-1 and J7-2): 3850 Output, Sense, J9 and J10 – Ground: 3060 Input – Ground: 2835	
Isolation resistance (*48)		MΩ	>15	>12
Isolation to ground		V	360VAC, 510VDC	
EMC (*19) (*35)	General	-	EN 61326-1:2021	
	Immunity	-	EN 61000-4-2, EN 61000-4-3, EN 61000-4-4, EN 61000-4-5, EN 61000-4-6, EN 61000-4-8, EN 61000-4-11	
	Conducted emissions	-	CISPR11 Class A	
	Radiated emissions	-	CISPR11 Class A	
Protective functions				
Foldback protection		Output shutdown when power source changes mode from CV to CC mode or from CC to CV mode		
Output overvoltage protection (OVP)		Output shutdown when overvoltage is sensed on the output Programming range: 385VAC, +/-550VDC; Accuracy: ≤0.5%		
Output overvoltage protection (OVP) type		RMS – Shutdown when RMS voltage exceeds OVP RMS setting Peak – Shutdown when peak voltage exceeds OVP Peak setting		
Overtemperature protection (OTP)		Output shutdown when ambient temperature sensor or internal temperature sensors thresholds exceed		
Overcurrent protection (OCP)		Output shutdown when peak overcurrent is sensed on the output		
Overcurrent protection (OCP) range		A_{PK}	±6 – ±1560	±7.5 – ±1950
AC input protection		Three fuses, fuse on each phase. Not user accessible		
Output undervoltage limit (UVL)		Prevents from adjusting output voltage below limit		
Output undervoltage protection (UVP)		Output shutdown when undervoltage is sensed on the output		

Models			All models
Harmonics measurement			
Fundamental frequency		Hz	16 – 1000
Harmonic frequency / harmonic #		Hz	32 – 50000 / 2 – 50
Measurement items		-	RMS Voltage, RMS current, phase angle and THD
Stability			
Line regulation		%	≤0.02
Load regulation (*9)		%	≤0.03
Total harmonic distortion (THD) (*9)	16 – 500	%	≤0.4
	501 – 1200		≤0.7
	1201 – 5000		≤1
Temperature coefficient (*10)		ppm/°C	50
Temperature stability (voltage)		%	±0.05 of FS over 8 hours. Constant line, load, and temperature. Remote sense
Warm-up drift (voltage)		%	Less than 0.05 of rated output voltage over 30 minutes following power on
Environmental conditions			
Operating temperature		°C / °F	0 – 40 / 32 – 104
Storage temperature		°C / °F	-30 – 85 / -22 – 185
Operating environment		-	Overvoltage category II, Indoor use
Operating humidity		%	20 – 90 RH (no condensation)
Storage humidity		%	10 – 95 RH (no condensation
Altitude (*26) (41 – *45)		m / feet	Operating: 2000 / 6562; Non-operating: 12000 / 39370
Remote control interfaces (isolated from the output) (*32)			
USB			2.0, Full Speed, Virtual COM Port, Type B high retention connector
RS232			Up to 921.6kbps with optional handshake (RTS/CTS), DB9 connector
RS485			Up to 921.6kbps, full duplex (4-wire), DB9 connector (shared with RS232)
LAN			10/100Mbps, Auto-MDIX, Auto-Negotiation, built-in web server
GPIB (optional interface)			IEEE488.1, IEEE488.2 compliant
Signals and controls (isolated from the output)			
Constant voltage / Constant current monitor			Open collector. CC mode: On (0 – 0.6V); CV mode: Off. Maximum voltage: 30V. Maximum sink current: 10mA
Power source OK #2 monitor (*32)			Push pull. Output on: 4.5 – 5.5V; Output off: 0 – 0.6V. Maximum source / sink current: 10mA
Power source OK #1 monitor (*32)			Open collector. Output on: On (0 – 0.6V); Output off: Off. Maximum voltage: 30V. Maximum sink current: 10mA
Trigger in signals (*32)			Maximum low level input voltage: 0.8V. Minimum high level input voltage: 2.5V. Maximum high level input: 5V Positive edge trigger width: 10us minimum. Maximum Tr,Tf: 1us. Minimum delay between 2 pulses: 1ms
Trigger out signals			Maximum low level output voltage: 0.6V. Minimum high level output voltage: 4.5V. Maximum high level output voltage: 5V. Maximum source / sink current: 10mA. Minimum pulse width:100us
Local / Remote analog programming monitor			Open collector. Remote: On (0 – 0.6V); Local: Off. Maximum Voltage: 30V. Maximum sink current: 10mA
Local / Remote analog programming enable			Enable / Disable analog programming control by electrical signal or dry contact. Remote: On (0 – 0.6V) or short; Local: Off (2 – 30V) or open
Enable / Disable (ENA) power source output (*32)			Enable / Disable power source output by electrical signal or dry contact. Voltage levels: 0 – 0.6V or short, 2 – 30V or open. User selectable output on / off logic
Interlock (ILC) inhibit power source output (*32)			Enable / Disable power source output by electrical signal or dry contact. Output on: 0 – 0.6V or short; Output OFF: 2 – 30V or open
Programmed signals			Two open drain programmable signals. Maximum voltage: 25V. Maximum sink current: 100mA
AC input voltage OK monitor			Open collector. AC input voltage OK: 0 – 0.6V; AC input voltage not OK: Off. Maximum voltage: 30V. Maximum sink current: 10mA
Alarm (fault) monitor			Open collector. No faults: 0 – 0.6V; Power source fault: Off. Maximum voltage: 30V. Maximum sink current: 10mA
Emergency power off (EPO) (*32)			Enable / Disable power source output by electrical signal or dry contact. Output on: 0 – 0.6V or short; Output OFF: 2 – 30V or open

Models	All models
Analog programming and monitoring (isolated from the output)	
Output voltage programming (*21)	Full mode range: ±0 – 10V. RMS mode range: 0 – 10V. User selectable range: ±2.5 – 10V. Accuracy: 0.3%
Output voltage monitoring (*21)	Full mode range: ±0 – 10V. RMS mode range: 0 – 10V. User selectable range: ±2.5 – 10V. Accuracy: 0.4%
Output current monitoring (*21)	Full mode range: ±0 – 10V. RMS mode range: 0 – 10V. User selectable range: ±2.5 – 10V. Accuracy 2kVA/6kVA: ≤1.3%. Accuracy 3kVA/4kVA/9kVA/12kVA/18KVA/24kVA/27kVA/36KVA/45KVA/48kVA/60kVA: ≤0.9%
Software / Firmware test sequences (*20) (*33)	
RTCA/DO 160 (*22)	Environmental conditions and test procedures for airborne equipment
MIL-STD 704 (*22)	Aircraft electric power characteristics
A350 (Airbus ABD100.1.8.1) (*22)	Electric characteristics of A350 AC and DC equipment
MIL-STD-1399-300 PART 1 (*22)	Low voltage electric power, alternating current
IEC61000-4-11 (*23)	Voltage dips, short interruptions and voltage variations immunity
IEC61000-4-13 (*23)	Harmonics and interharmonics including mains signalling at a.c. power port
IEC61000-4-14 (*24)	Voltage fluctuation immunity test for equipment with input current not exceeding 16 A per phase
IEC61000-4-17 (*24)	Ripple on d.c. input power port immunity
IEC61000-4-27 (*24)	Unbalance, immunity test for equipment with input current not exceeding 16 A per phase
IEC61000-4-28 (*24)	Variation of power frequency, immunity test for equipment with input current not exceeding 16 A per phase
IEC61000-4-29 (*24)	Voltage dips, short interruptions and voltage variations on d.c. input power port immunity tests
IEC61000-4-34 (*24)	Voltage dips, short interruptions and voltage variations immunity tests for equipment with mains current more than 16 A per phase
Output characteristics	

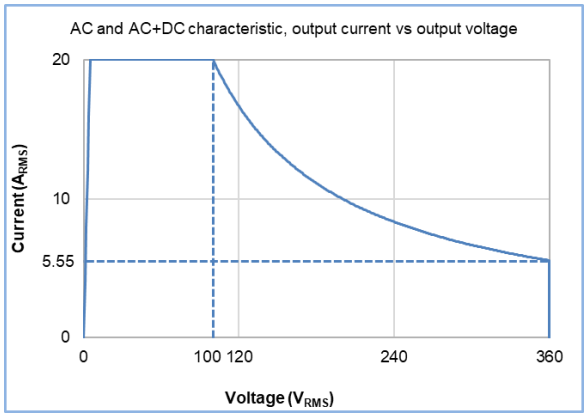


Figure 1: 2kVA AC and AC+DC characteristic

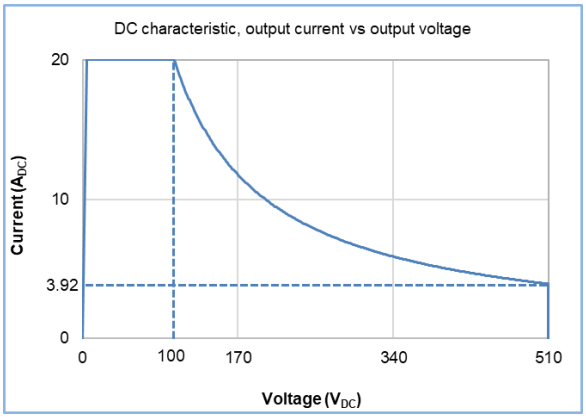


Figure 2: 2kW DC characteristic

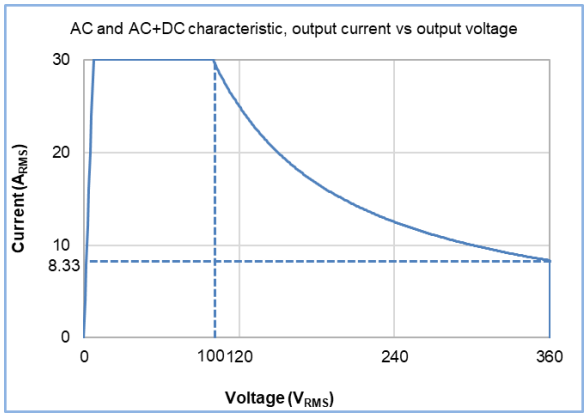


Figure 3: 3kVA AC and AC+DC characteristic (*27)

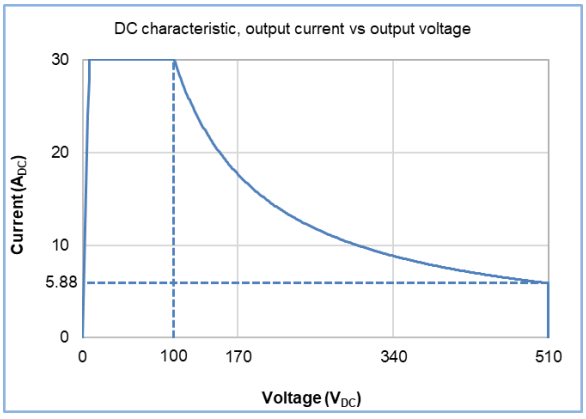


Figure 4: 3kW DC characteristic

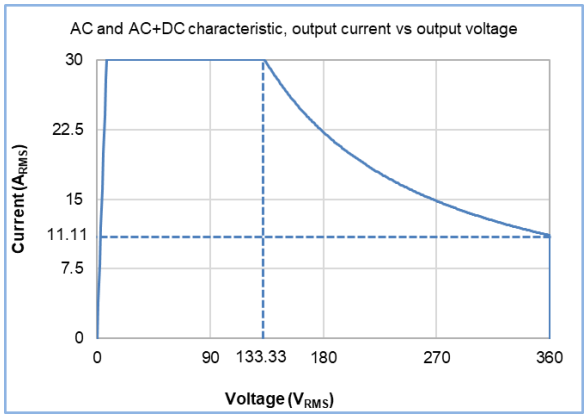


Figure 5: 4kVA AC and AC+DC characteristic (*41)

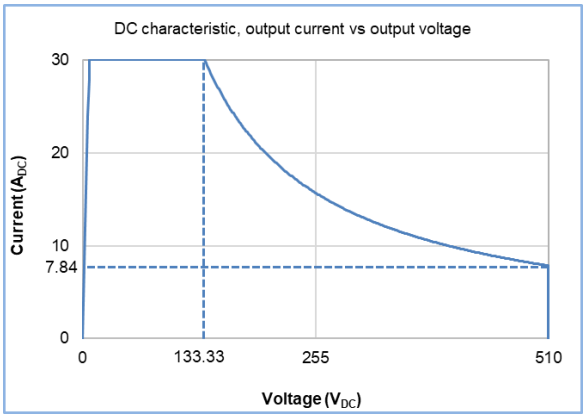


Figure 6: 4kW DC characteristic

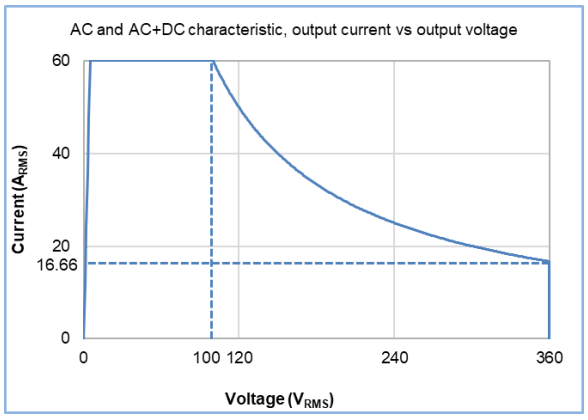


Figure 7: 6kVA AC and AC+DC characteristic

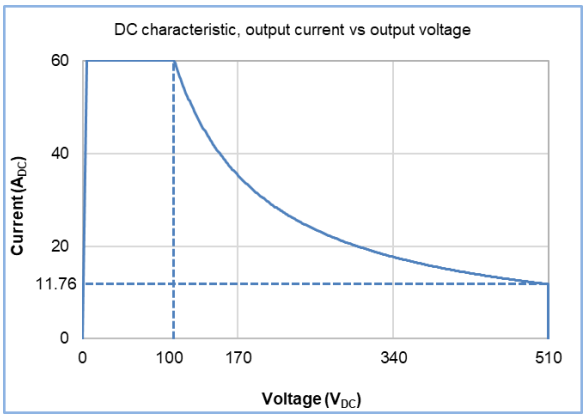


Figure 8: 6kW DC characteristic

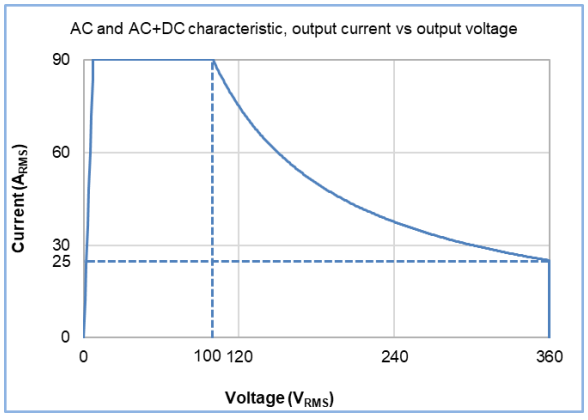


Figure 9: 9kVA AC and AC+DC characteristic (*28)

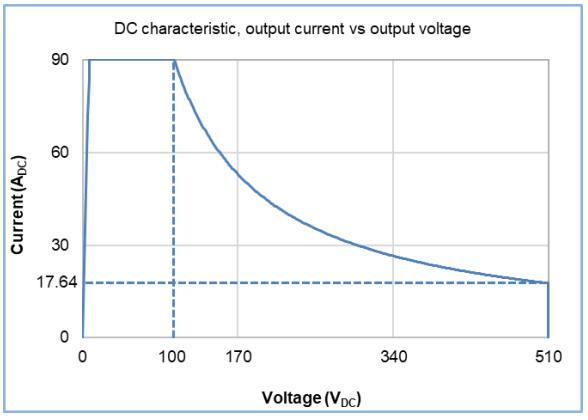


Figure 10: 9kW DC characteristic

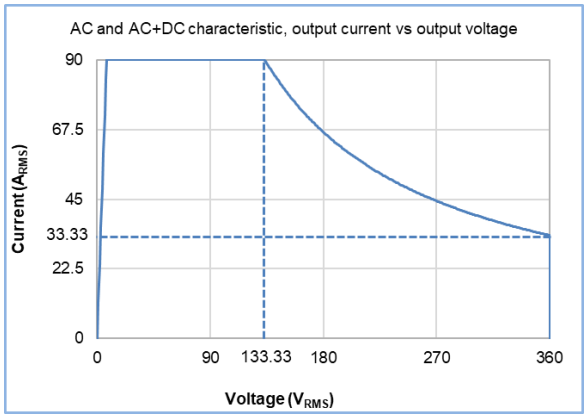


Figure 11: 12kVA AC and AC+DC characteristic (*42)

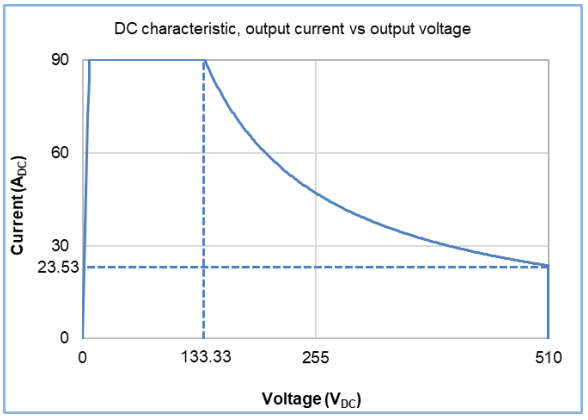


Figure 12: 12kW DC characteristic

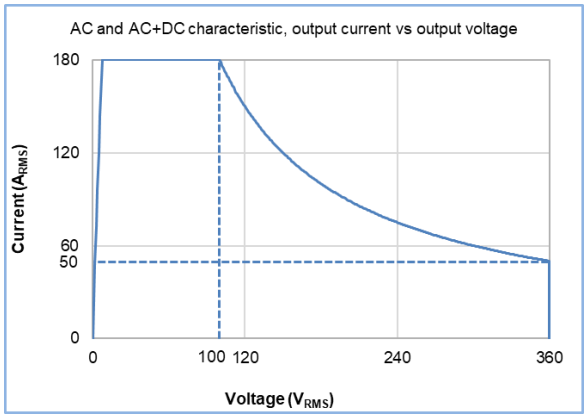


Figure 13: 18kVA AC and AC+DC characteristic (*36)

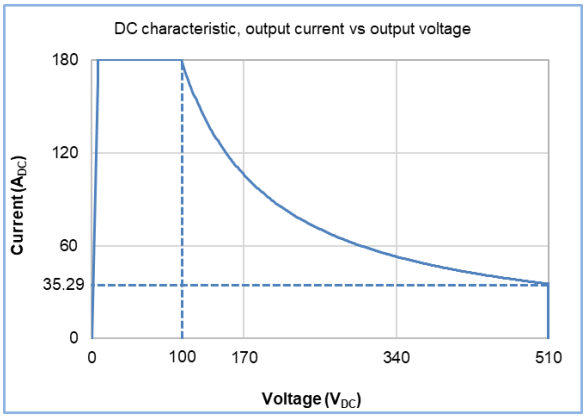


Figure 14: 18kW DC characteristic

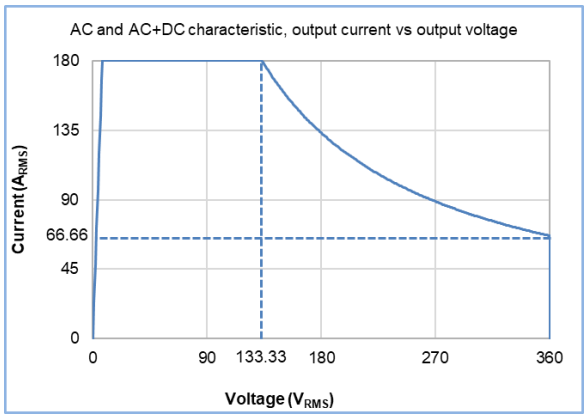


Figure 15: 24kVA AC and AC+DC characteristic (*43)

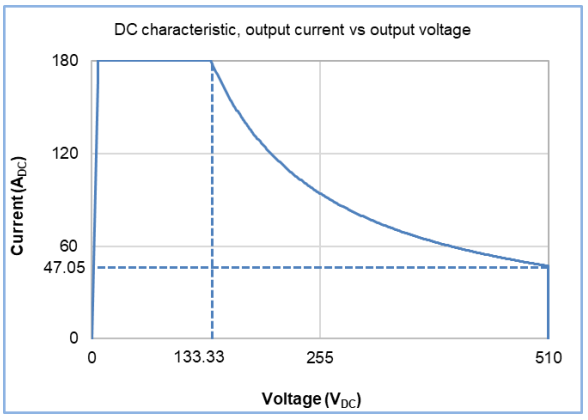


Figure 16: 24kW DC characteristic

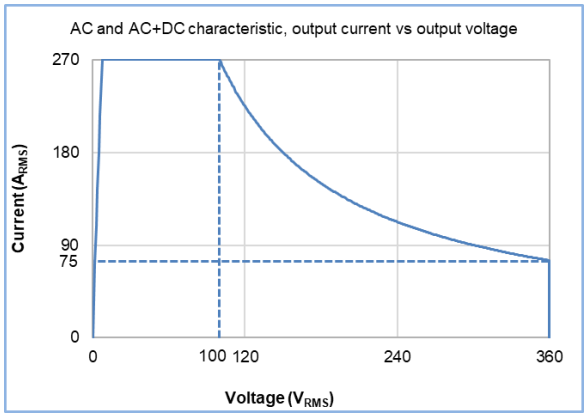


Figure 17: 27kVA AC and AC+DC characteristic (*39)

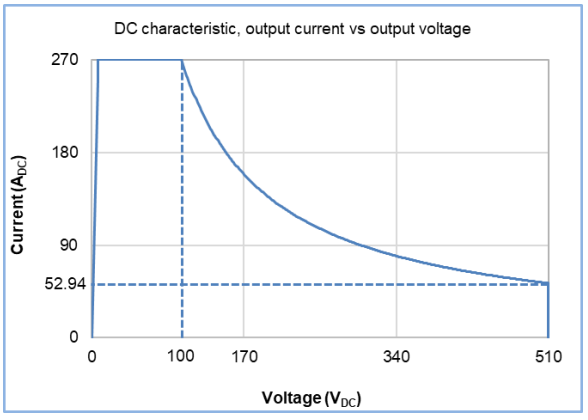


Figure 18: 27kW DC characteristic

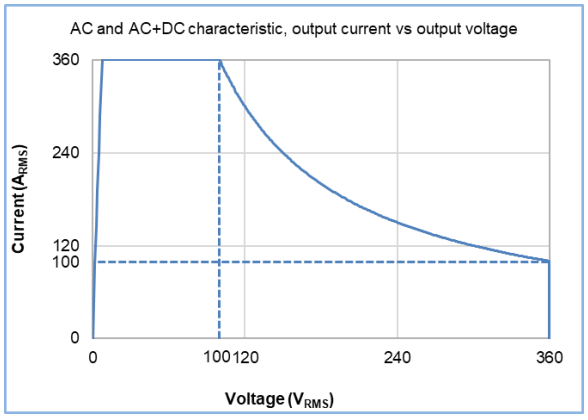


Figure 19: 36kVA AC and AC+DC characteristic (*40)

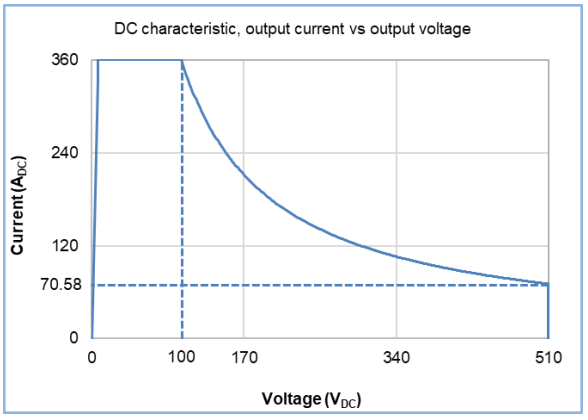


Figure 20: 36kW DC characteristic

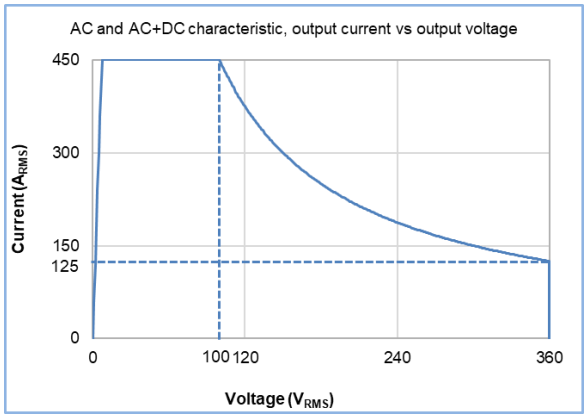


Figure 21: 45kVA AC and AC+DC characteristic (*37)

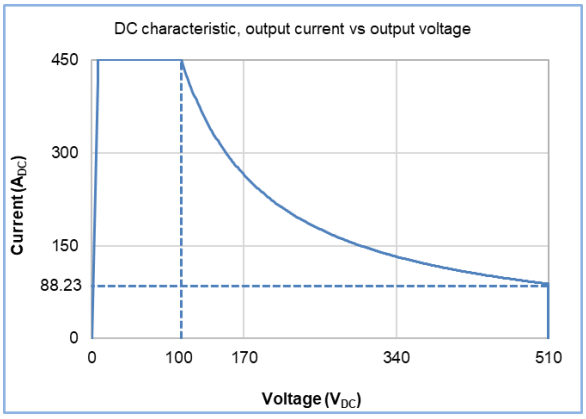


Figure 22: 45kW DC characteristic

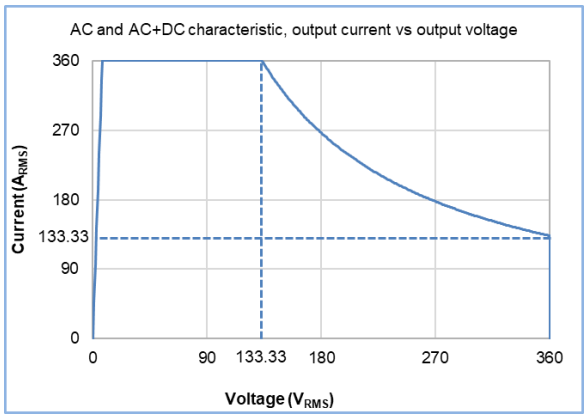


Figure 23: 48kVA AC and AC+DC characteristic (*44)

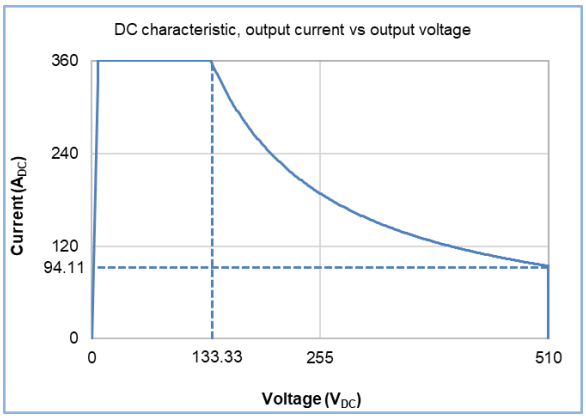


Figure 24: 48kW DC characteristic

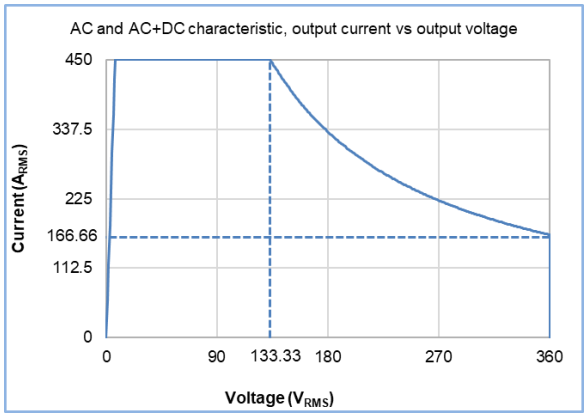


Figure 25: 60kVA AC and AC+DC characteristic (*45)

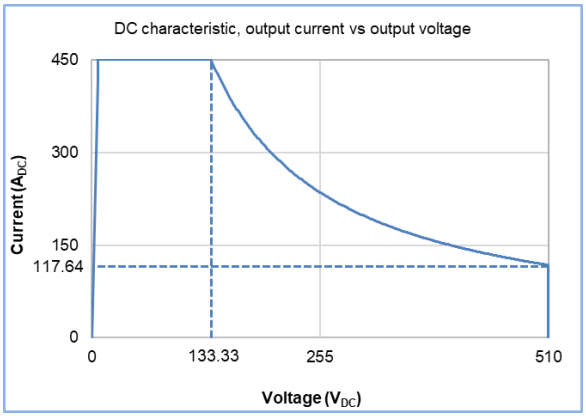


Figure 26: 60kW DC characteristic

NOTES:

*1: Combined with AC and DC output, the peak voltage must be between -510V to +510V.

*2: 18kVA, 24KVA, 36kVA and 48KVA models support 2-Phase output configuration.

*3: Maximum RMS voltage setting range is associated with the output current setting. When the output current setting is above 5.55A for 2kVA, 8.33A for 3kVA, 11.11A for 4kVA, 16.66A for 6kVA, 25A for 9kVA, 33.33A for 12kVA, 50A for 18kVA, 66.66A for 24kVA, 75A for 27kVA, 100A for 36kVA, 125A for 45kVA, 133.33A for 48kVA or 166.66A for 60kVA the output voltage setting is limited to rated output power.
Refer to Figure 1, Figure 3, Figure 5, Figure 7, Figure 9, Figure 11, Figure 13, Figure 15, Figure 17, Figure 19, Figure 21 or Figure 23.
Maximum RMS current setting is adjusted automatically to the maximum allowed value according to the rated output power when the RMS voltage is set.

*4: Frequency measurements are available above 10VAC in AC Mode, 17.5VAC in AC+DC Mode.

*5: Maximum RMS current setting range is associated with the output voltage setting.

*6: Maximum DC voltage setting range is associated with the output current setting. When the output current setting is above 3.92A for 2kW, 5.88A for 3kW, 7.84A for 4kW, 11.76A for 6kW, 17.64A for 9kW, 23.53A for 12kW, 35.29A for 18kW, 47.05 for 24kW, 52.94A for 27kW, 70.58A for 36kW, 88.23A for 45kW, 94.11A for 48kW or 117.64A for 60kW the output voltage setting is limited to rated output power.
Refer to Figure 2, Figure 4, Figure 6, Figure 8, Figure 10, Figure 12, Figure 14, Figure 16, Figure 18, Figure 20, Figure 22 or Figure 24.
Maximum DC current setting is adjusted automatically to the maximum allowed value according to the rated output power when the DC voltage is set.

*7: Maximum DC current setting range is associated with the output voltage setting.

*8: Accuracy is guaranteed above 5% of rated output voltage.

*9: Load power factor is 1. Measured on the sensing point. Regulation is guaranteed above 5% of rated output voltage. THD is guaranteed above 15% of rated output voltage.

*10: ppm/°C of rated output voltage, following 30 minutes warm-up.

*11: The ripple is measured at 10 – 100% of rated output voltage and rated output current. B.W 5Hz – 1MHz, load power factor is 1.

*12: Time for output voltage to recover within 1% of its rated output for a load change 10~90% of rated output current. Output set point: 10 – 100%, local sense, load power factor is 1, at rated output voltage.

*13: At 10% to 90% of the output voltage, at rated output voltage.

*14: Output power is limited to 1500W or 1500VA at input voltage below 170VAC.

*15: Typical at rated output power, rated output current, DC mode or sine wave, load power factor is 1. 1-Phase models at 230VAC input voltage, 3-Phase 200V models at 200VAC input voltage, 3-Phase 480V at 380Vac input voltage.

*16: Not including the EMI filter inrush current, less than 0.2mSec. 1-Ph Input, at Input line ≥ 240Vac, less than 70A.

*17: Not including the EMI filter inrush current, less than 0.2mSec.

*18: Class I; Pollution Degree 2.

*19: All cables' length except LAN must be less than 3 meters.

*20: Software / Firmware test sequences must be acquired. Require Virtual Control Panel (VCP) software via RS232, RS485, USB, LAN or GPIB.
Wave Generator & Harmonic Analysis: Built-in in Genesys AC Pro Series. Must be acquired in Genesys AC Series.
IEC61000-4-17 and IEC61000-4-29: Built-in in Genesys AC Pro Series (not available in Genesys AC models without DC capability).
For details and limitations on test sequences, see Virtual Control Panel (VCP) Installation and Applications Guide (IA761-04-03).

*21: RMS mode, programming and monitoring.

*22: Available in Genesys AC Pro (must be acquired).

*23: Available in Genesys AC and Genesys AC Pro (must be acquired).

*24: Available in Genesys AC and Genesys AC Pro. Wave Generator & Harmonic Analysis must be acquired in Genesys AC.

*25: Minimum peak current duration - 10µsec.

*26: AC operating mode, frequency below 40Hz:
3kVA: Derate output power linearly from 3000VA to 2700VA starting at 500 meters (maximum allowed output power is 2700VA at 2000 meters).
4kVA: Derate output power linearly from 4000VA to 3600VA starting at 500 meters (maximum allowed output power is 3600VA at 2000 meters).
9kVA: Derate output power linearly from 9000VA to 8100VA starting at 500 meters (maximum allowed output power is 8100VA at 2000 meters).
12kVA: Derate output power linearly from 12000VA to 10800VA starting at 500 meters (maximum allowed output power is 10800VA at 2000 meters).
18kVA: Derate output power linearly from 18000VA to 16200VA starting at 500 meters (maximum allowed output power is 16200VA at 2000 meters).
24kVA: Derate output power linearly from 24000VA to 21600VA starting at 500 meters (maximum allowed output power is 21600VA at 2000 meters).
27kVA: Derate output power linearly from 27000VA to 24300VA starting at 500 meters (maximum allowed output power is 24300VA at 2000 meters).
36kVA: Derate output power linearly from 36000VA to 32400VA starting at 500 meters (maximum allowed output power is 32400VA at 2000 meters).
45kVA: Derate output power linearly from 45000VA to 40500VA starting at 500 meters (maximum allowed output power is 40500VA at 2000 meters).
48kVA: Derate output power linearly from 48000VA to 43200VA starting at 500 meters (maximum allowed output power is 43200VA at 2000 meters).
60kVA: Derate output power linearly from 60000VA to 54000VA starting at 500 meters (maximum allowed output power is 54000VA at 2000 meters).

*27: Maximum allowed output power in AC+DC mode: 2kVA at output frequency <30Hz, 2.5kVA at output frequency ≥30Hz and <100Hz, 3kVA at output frequency ≥100Hz.

*28: Maximum allowed output power in AC+DC mode: 6kVA at output frequency <30Hz, 7.5kVA at output frequency ≥30Hz and <100Hz, 9kVA at output frequency ≥100Hz.

*29: J1 – RS232 and RS485, J2 – USB, J3 – LAN, J4, J4-1, J4-2, J4-3, J4-4, J4-5 – Remote Programming, J5 – Emergency Power Off, J6, J6-1, J6-2, J6-3, J6-4, J6-5 – Trigger Out, J7, J7-1, J7-2, J7-3, J7-4, J7-5 – Voltage Monitor, J8 – Optional Interface slot, J9 – Parallel Master, J10 – Parallel Slave.

*30: Including GAC-PWR, except items marked by *31, *32 and *33.

*31: J1, J2, J3, J5 and J8 are not available in GAC-PWR.

*32: Not applicable to GAC-PWR. Controlled by the Master unit via parallel connection.

*33: Not applicable to GAC-PWR. Software / Firmware test sequences are defined by the Master unit.

*34: 18kVA unit specifications cover GAC-18, GAC-PRO-18 or a field assembly of a GAC-09/GAC-PRO-09 unit and a GAC-PWR-09 unit.
24kVA unit specifications cover GAC-24, GAC-PRO-24 or a field assembly of a GAC-12/GAC-PRO-12 unit and a GAC-PWR-12 unit.
The 27kVA unit consists of a GAC-09/GAC-PRO-09 unit and two GAC-PWR-09 units.
The 36kVA unit consists of a GAC-09/GAC-PRO-09 unit and three GAC-PWR-09 units.
The 45kVA unit consists of a GAC-09/GAC-PRO-09 unit and four GAC-PWR-09 units.
The 48kVA unit consists of a GAC-12/GAC-PRO-12 unit and three GAC-PWR-12 units.
The 60kVA unit consists of a GAC-12/GAC-PRO-12 unit and four GAC-PWR-12 units.

*35: The 18kVA, 27kVA, 36kVA and 45kVA approval is based on each 9kVA unit approval.
The 24kVA, 48kVA and 60kVA approval is based on each 12kVA unit approval.

*36: Maximum allowed output power in AC+DC mode: 12kVA at output frequency <30Hz, 15kVA at output frequency ≥30Hz and <100Hz, 18kVA at output frequency ≥100Hz.

*37: Maximum allowed output power in AC+DC mode: 30kVA at output frequency <30Hz, 37.5kVA at output frequency ≥30Hz and <100Hz, 45kVA at output frequency ≥100Hz.

*38: Starting from firmware 001.008.000:
Maximum programming voltage (rated voltage) range is extended from 350VAC / ±500VDC to 360VAC / ±510VDC.
Minimum programming current range is extended from 5% of rated current to 0 Amperes.

*39: Maximum allowed output power in AC+DC mode: 18kVA at output frequency <30Hz, 22.5kVA at output frequency ≥30Hz and <100Hz, 27kVA at output frequency ≥100Hz.

*40: Maximum allowed output power in AC+DC mode: 24kVA at output frequency <30Hz, 30kVA at output frequency ≥30Hz and <100Hz, 36kVA at output frequency ≥100Hz.

*41: Maximum allowed output power in AC+DC mode: 3kVA at output frequency <30Hz, 3.3kVA at output frequency ≥30Hz and <100Hz.
For output frequencies ≥100Hz, the maximum permitted output power is 4.0kVA at an altitude of 500m, with linear derating to 3.6kVA at 2000m.

*42: Maximum allowed output power in AC+DC mode: 9kVA at output frequency <30Hz, 9.9kVA at output frequency ≥30Hz and <100Hz.
For output frequencies ≥100Hz, the maximum permitted output power is 12kVA at an altitude of 500m, with linear derating to 10.8kVA at 2000m.

*43: Maximum allowed output power in AC+DC mode: 18kVA at output frequency <30Hz, 19.8kVA at output frequency ≥30Hz and <100Hz.
For output frequencies ≥100Hz, the maximum permitted output power is 24kVA at an altitude of 500m, with linear derating to 21.6kVA at 2000m.

*44: Maximum allowed output power in AC+DC mode: 36kVA at output frequency <30Hz, 39.6kVA at output frequency ≥30Hz and <100Hz.
For output frequencies ≥100Hz, the maximum permitted output power is 24kVA at an altitude of 500m, with linear derating to 43.2kVA at 2000m.

*45: Maximum allowed output power in AC+DC mode: 45kVA at output frequency <30Hz, 49.5kVA at output frequency ≥30Hz and <100Hz.
For output frequencies ≥100Hz, the maximum permitted output power is 24kVA at an altitude of 500m, with linear derating to 54kVA at 2000m.

*46: J4-1, J4-2, J6-1, J6-2, J7-1, J7-2 are available in GAC-06, GAC-PRO-06, GAC-09, GAC-PRO-09, GAC-PWR-09, GAC-12, GAC-PRO-12, GAC-PWR-12, GAC-18, GAC-PRO-18, GAC-24, GAC-PRO-24 only.
J4-3, J4-4, J4-5, J6-3, J6-4, J6-5, J7-3, J7-4, J7-5 are available in GAC-18, GAC-PRO-18, GAC-24, GAC-PRO-24 only.

*47; Strain relief is not applicable to GAC-18, GAC-PRO-18, GAC-24, GAC-PRO-24 (applicable to GAC/GAC-PRO-06, GAC/GAC-PRO-09 and GAC-PWR-09 or GAC/GAC-PRO-12 and GAC-PWR-12 only).

*48: At 25°C, 70%RH, 500VDC output to ground

*49; Field assembly - Relates to GAC/GAC-PRO-09 and GAC-PWR-09 or GAC/GAC-PRO-12 and GAC-PWR-12.
Component - Relates to GAC-18, GAC-PRO-18, GAC-24, GAC-PRO-24 factory assembled.

*50: Parallel connection of even number of units allows 2-Phase output configuration.

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3.1 Unpacking and Initial Inspection

WARNING

To avoid potential personal injury, handling, lifting, and carrying of the equipment shall be done only according to the instructions specified in this section.

The equipment handles are designed for adjustments in a 19-inch rack or equipment, and they are not intended for lifting and carrying the equipment.

NOTE

The product was inspected before shipment and found to be free of mechanical or electrical defects.

WARNING

6kVA, 9kVA, 9kVA PWR, 12kVA, and 12kVA PWR units weigh around 30kg. 18kVA and 24kVA units weigh around 55kg. Do not attempt to lift or carry the unit alone; at least two people are required to do so.

1. Carefully open the packing box and remove the accessories box.
2. Gently remove the top foam covers. The top foam covers in the PWR units also include the Parallel Kit box.

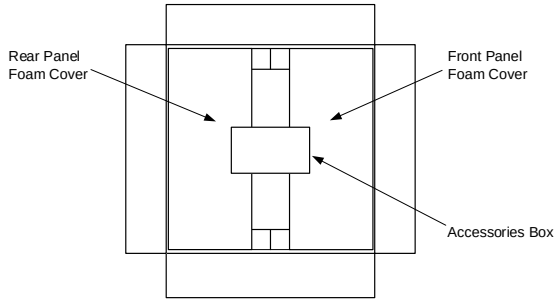


Figure 3-1: Unpacking the Power Source—2kVA, 3kVA, and 4kVA

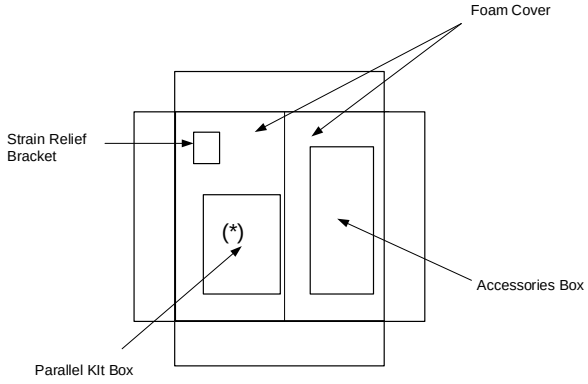


Figure 3-2: Unpacking the Power Source—6kVA, 9kVA, 9kVA PWR, 12kVA, and 12kVA PWR

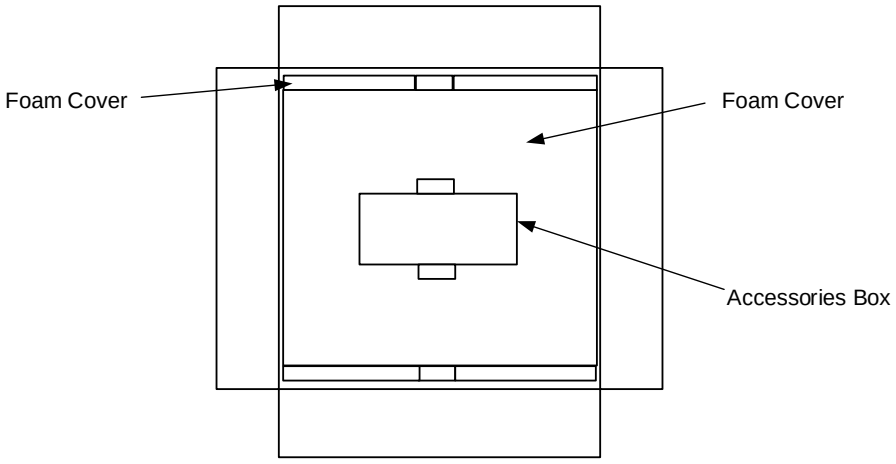


Figure 3-3: Unpacking the Power Source— 18kVA and 24kVA

NOTES

(*) The slot is filled for the 9kVA PWR and 12kVA PWR unit only. If another parallel kit is required for the 6kVA, 9kVA, 12kVA, 18kVA, or 24kVA unit, use Order Code: GAC/P.

The foam cover in the packing box for 6kVA, 9kVA, 9kVA PWR, 12kVA, and 12kVA PWR power source includes the Strain Relief Bracket.

3. Insert your hands into the side recesses (lift slots) and lift the power source parallel to the ground surface. To avoid damage, **do not** tilt the power source against the foam covers. Keep it parallel to the ground until it is totally out of the foam covers. **Do not** use the front panel handles to remove the unit.

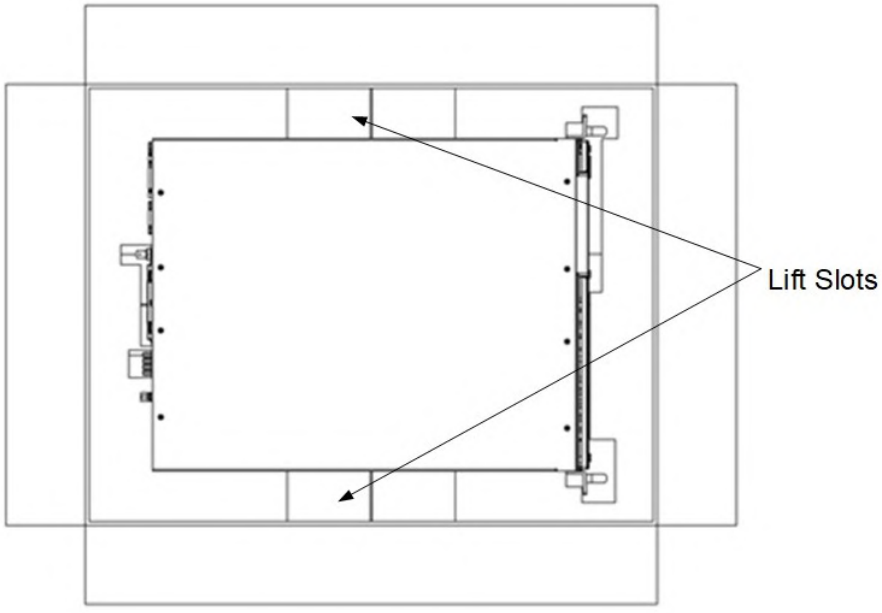


Figure 3-4: Removing the Power Source—2kVA, 3kVA, and 4kVA

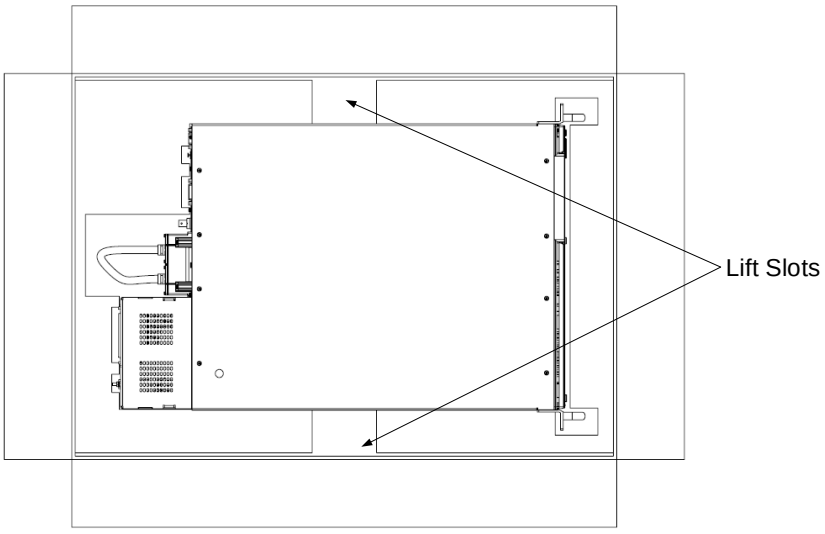


Figure 3-5: Removing the Power Source—6kVA, 9kVA, 9kVA PWR, 12kVA, and 12kVA PWR

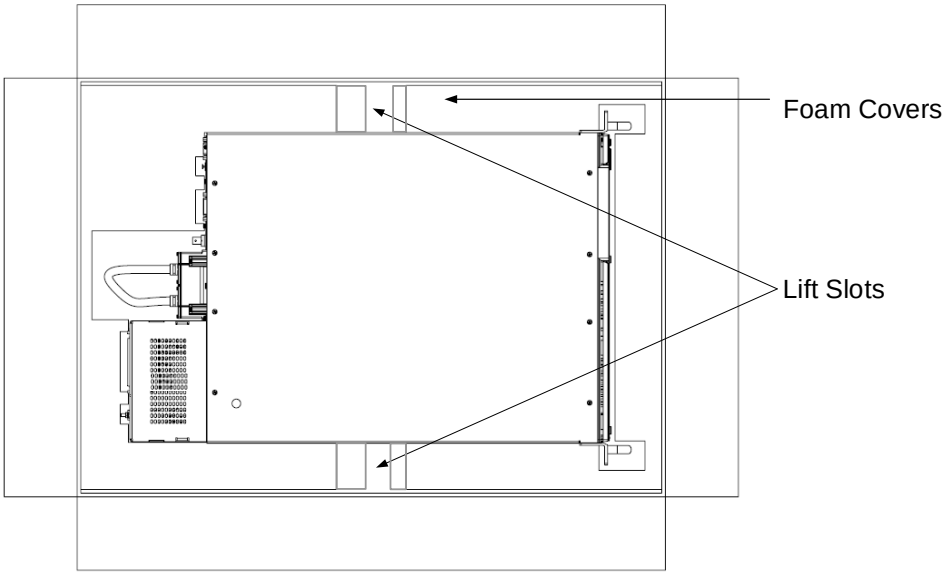


Figure 3-6: Removing the Power Source—18kVA and 24kVA

As soon as the product is unpacked, inspect it for any damage that may have occurred during transit. The inspection should confirm that there is no exterior damage, such as broken connectors, scratched or cracked front panel or meter faces. If any damage is detected, file a claim with the carrier and notify the nearest TDK-Lambda sales or service facility.

3.2 Items Provided with the Power Source

WARNING

Only items that meet the manufacturer's specifications must be used. For identification of the items and instructions for connecting them, refer to this manual.

3.2.1 2kVA, 3kVA, and 4kVA Power Source

Item	Catalog No.	Manufacturer	Quantity
			2kVA, 3kVA, and 4kVA
AC Input Plug: for 3-phase 200 and 3-phase 480 (sticker included) (*)	PC 5 / 4-STCL1-7,62	PHOENIX CONTACT	1
AC Input Plug: for 1-phase (sticker included) (*)	PC 5/ 3-STCL1-7,62	PHOENIX CONTACT	1
Output Plug (sticker included)	IPC 5/ 4-STF-7,62	PHOENIX CONTACT	1
Output Cover Base	-	-	1
Output Cover Cap	-	-	1
Screw for plastic cover 30x8mm	WN1412(KA30X8)	-	2
DB-26 Connector	10090769-P264ALF	FCI	1
DB-15 Backshell	86303638BLF	FCI	1
Strain Relief Washer	8216	AGRO	1
Bellmouth Cable Gland	5301 5440	LAPP KABEL	1
SEMS Screw	M3X8 Fe Ni	-	4
Strain Relief Bracket Assembly	-	-	1
E-STOP	MC 1,5/ 2-ST-3,81	PHOENIX CONTACT	1
Safety Note Paper	-	-	1

(*) Depending on the model (3-phase or 1-phase), the appropriate AC input plug is supplied.

Table 3-1: Items Provided with the Power Source—2kVA, 3kVA, and 4kVA

3.2.2 6kVA, 9kVA, 9kVA PWR, 12kVA, and 12kVA PWR Power Source

Item	Catalog No.	Manufacturer	Quantity	
			6kVA, 9kVA, and 12kVA	9kVA PWR and 12kVA PWR
AC Input Plug: for 3-phase 200 and 3-phase 480 (sticker included)	PC 16 / 4-ST-10,16	PHOENIX CONTACT	1	1
Output Plug (sticker included)	IPC 16/ 6-STF-10,16	PHOENIX CONTACT	1	1
Sense Plug (sticker included)	PC 5/ 6-STF1-7,62	PHOENIX CONTACT	1	1
Output Cover Base	-	-	1	1
Output Cover Cap	-	-	1	1
Sense Cover Base	-	-	1	1
Sense Cover Cap	-	-	1	1
Screw for plastic cover 30x8mm	WN1412(KA30X8)	-	4	4
DB-26 Connector	10090769-P264ALF	FCI	3	3
DB-15 Backshell	86303638BLF	FCI	3	3
Strain Relief Washer (3-phase 200) (*)	8229	AGRO	1	1
Strain Relief Washer (3-phase 480) (*)	8225	AGRO	1	1
Bellmouth Cable Gland (3-phase 200) (*)	5301 8060	LAPP KABEL	1	1

Item	Catalog No.	Manufacturer	Quantity	
			6kVA, 9kVA, and 12kVA	9kVA PWR and 12kVA PWR
Bellmouth Cable Gland (3-phase 480) (*)	F7022500	SCHLEMMER	1	1
SEMS Screw	M3X8 Fe Ni	-	4	4
Strain Relief Bracket Assembly	-	-	1	1
E-STOP	MC 1,5/ 2-ST-3,81	PHOENIX CONTACT	1	1
Safety Note Paper	-	-	1	1
Parallel Kit	GAC/P	-	-	1

(*) Depending on the model (3-phase 200 or 3-phase 480), the appropriate Strain Relief Washer and Cable Gland are supplied.

Table 3-2: Items Provided with the Power Source—6kVA, 9kVA, 9kVA PWR, and 12kVA

3.2.3 18kVA and 24kVA Power Source

Item	Catalog No.	Manufacturer	Quantity
			18kVA and 24kVA
Sense Plug (sticker included)	PC 5/ 6-STF1-7,62	PHOENIX CONTACT	1
DB-26 Connector	10090769-P264ALF	FCI	6
DB-15 Backshell	86303638BLF	FCI	6
E-STOP	MC 1,5/ 2-ST-3,81	PHOENIX CONTACT	1
Safety Note Paper	-	-	1

Table 3-3: Items Provided with the Power Source—18kVA and 24kVA

NOTE

If any of the item in **Table 3-1**, **Table 3-2**, or **Table 3-3** is missing, notify the nearest TDK-Lambda sales or service facility.

3.3 Optional Accessories

- **Parallel Cable**

  Order Code: GAC/P.

- **Rack Mount Slides**

  Refer to **Section 7.3.2: Rack Mount Slides (Optional)**.

3.4 Repacking for Shipment

To ensure safe transportation of the equipment, contact the nearest TDK-Lambda sales or service facility for return authorization and shipping information. Attach a tag to the equipment describing the problem and specifying the model's name, the name of the owner, and the serial number of the equipment.

CHAPTER 4: FRONT PANEL DISPLAY, CONTROLS, AND INDICATORS

4.1 Introduction

The Genesys Series Programmable AC Power Source includes a graphical touch-screen display and a full set of controls and indicators on the front panel that allow the user to setup, program, and control the unit. The touch screen display and controls are not applicable for blank panel and PWR units. Indicators are not applicable for PWR units.

4.2 Front Panel Display, Controls, and Indicators

Refer to **Figure 4-1, Figure 4-2, Figure 4-3,** and **Table 4-1** for a brief description of the Front Panel Display, Controls, and Indicators.



Figure 4-1: Front Panel Display, Controls, and Indicators—2kVA, 3kVA, and 4kVA

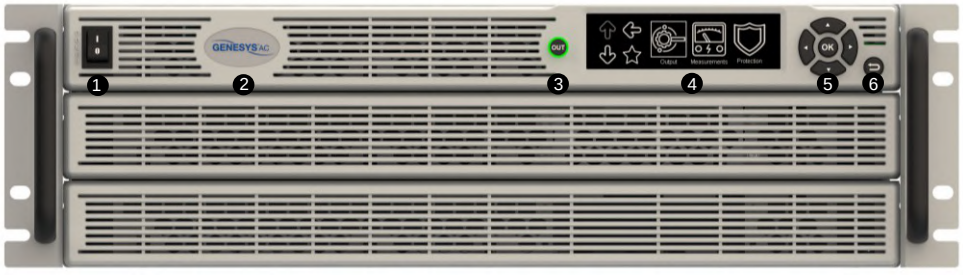


Figure 4-2: Front Panel Display, Controls, and Indicators—6kVA, 9kVA, and 12kVA

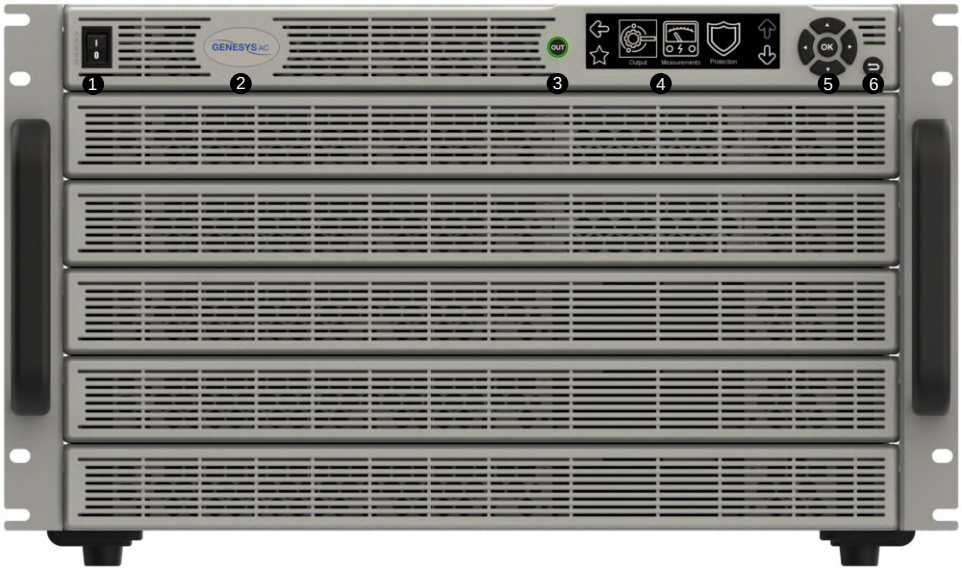


Figure 4-3: Front Panel Display, Controls, and Indicators—18kVA and 24kVA

No.	Control/Indicator	Description
1	Power Switch (*)	POWER ON/OFF control.
2	Power Source Model	Company logo, model name, and output rating.
3	OUT Button/LEDs	Output ON/OFF control. Turns the output ON or OFF. A green LED lights up when the output is enabled. A red LED blinks in the case of an alarm. The green and red LEDs are integrated into the OUT button.
4	Display Panel	3.9" TFT touch-screen display with backlight. Refer to **CHAPTER 9: FRONT PANEL DISPLAY, BUTTONS, AND NAVIGATION** for a detailed explanation of the display panel.
5	Navigation	Used to navigate between and within the menus/sub-menus. The **OK** button makes the selection. Refer to **CHAPTER 9: FRONT PANEL DISPLAY, BUTTONS, AND NAVIGATION** for a detailed explanation of the navigation panel.
6	Return Button	Returns one step back in menu navigation mode.

Table 4-1: Front Panel Display, Controls, and Indicators

WARNING

(*) The power switch is **not** the main disconnect device and **does not** completely disconnect all the circuits from the AC mains. The power switch is added to shut down certain circuits inside the power source.

4.3 Blank Front Panel Indicators

Refer to **Figure 4-4**, **Figure 4-5**, **Figure 4-6**, and **Table 4-2** for the description of the Blank Front Panel Indicators.



Figure 4-4: Blank Front Panel Indicators—2kVA, 3kVA, and 4kVA

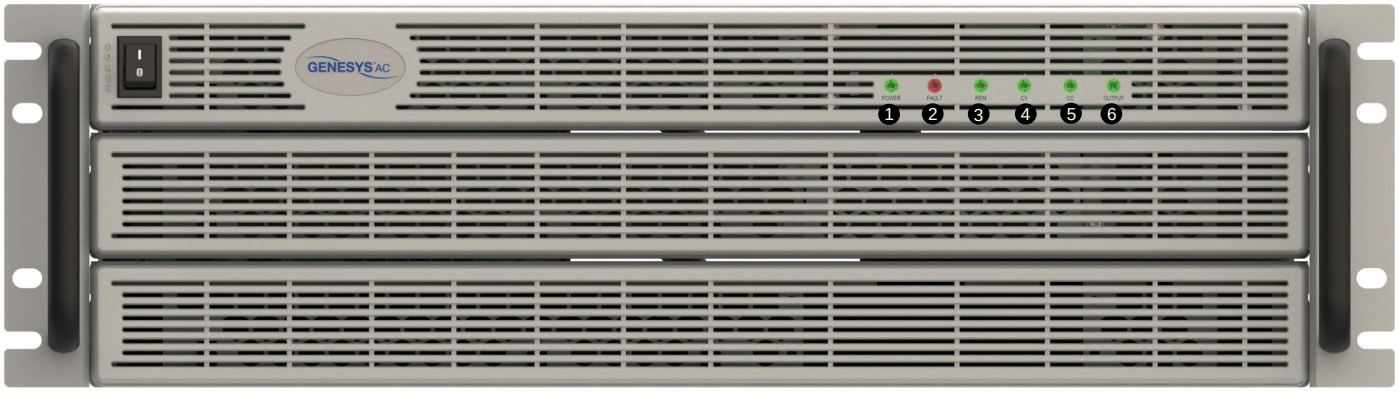


Figure 4-5: Blank Front Panel Indicators—6kVA, 9kVA, and 12kVA

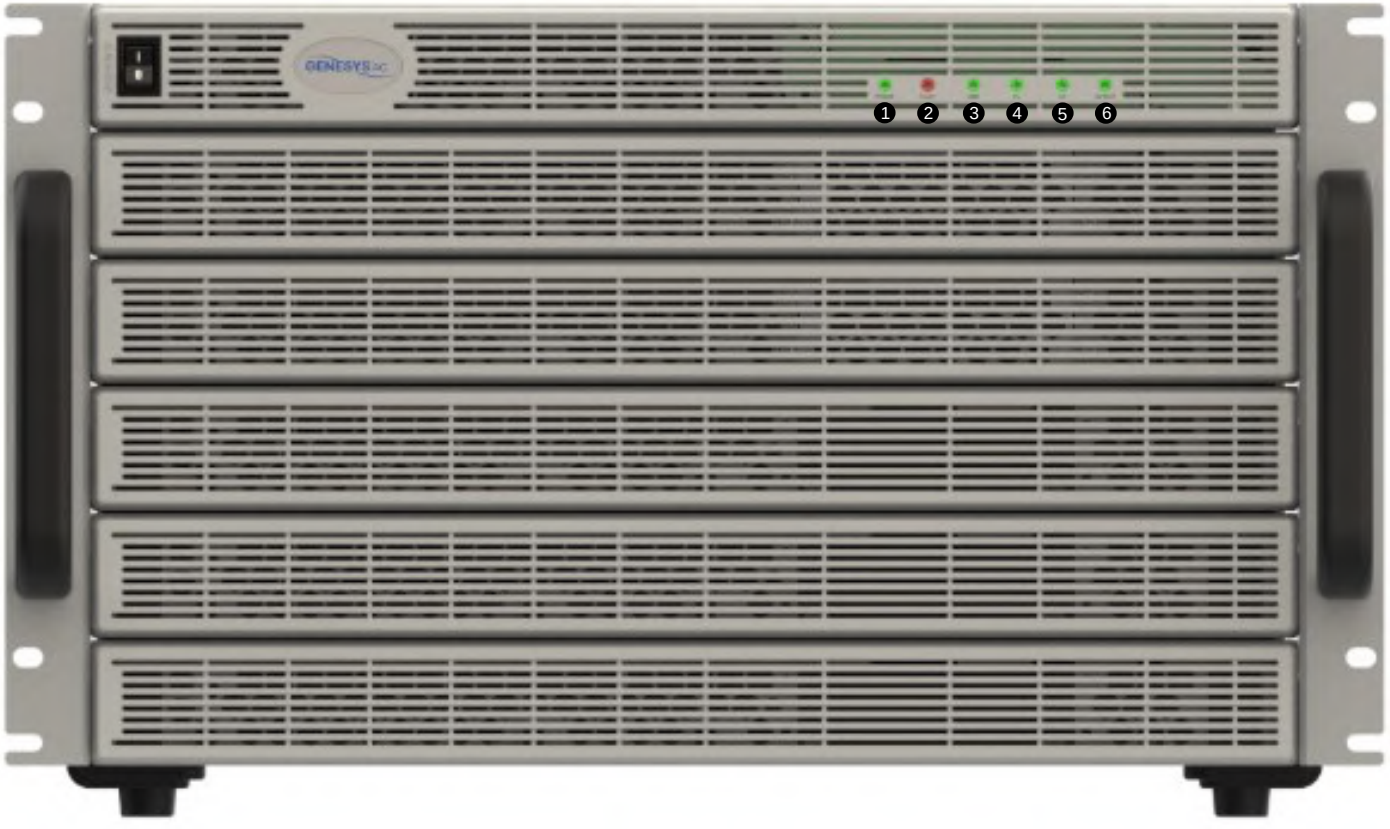


Figure 4-6: Blank Front Panel Indicators—18kVA and 24kVA

No.	LED Indicator (*)	Description
1	POWER	Green when the power switch is in the ON position.
2	FAULT	Blinking red when a fault occurs.
3	REM	Green when the power source is controlled via remote communication: RS232, RS485, USB, LAN, or optional GPIB.
4	CV	Green when the power source is operating in Constant Voltage mode.
5	CC	Green when the power source is operating in Constant Current mode.
6	OUTPUT	Green when the output is enabled.

Table 4-2: Blank Front Panel Indicators

NOTE

(*) All LEDs in the figures are lit for illustration purposes only.

4.4 Front Panel-9kVA PWR and 12kVA PWR Unit

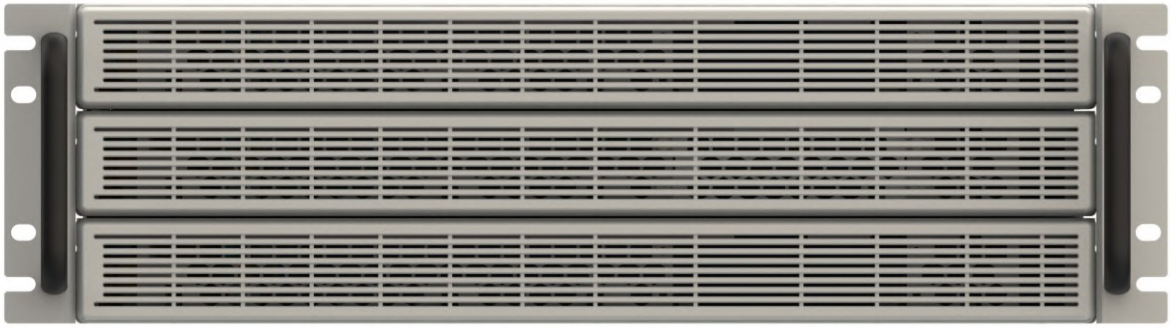


Figure 4-7: Front Panel—9kVA PWR and 12kVA PWR Unit

The PWR unit has a plain front panel with no LEDs, touchscreen, or ON/OFF switch.

NOTE

The PWR units **CANNOT** be used as standalone and **MUST** be assembled along with a master unit in a parallel system.

5.1 Introduction

The Genesys Series Programmable AC Power Source has built-in RS232/RS485, USB, and LAN interfaces and a full set of remote analog signals on the rear panel that allow the user to setup and control the unit. The built-in RS232/485 and LAN interfaces, and the optional GPIB interface are not applicable for the PWR units. The Power Source may also contain an optional GPIB interface.

5.2 Rear Panel Controls and Connectors

Refer to **Figure 5-1, Figure 5-2, Figure 5-3, Figure 5-4,** and **Table 5-1** for the description of the Rear Panel Controls and Connectors.



Figure 5-1: Rear Panel Controls and Connectors—2kVA, 3kVA, and 4kVA

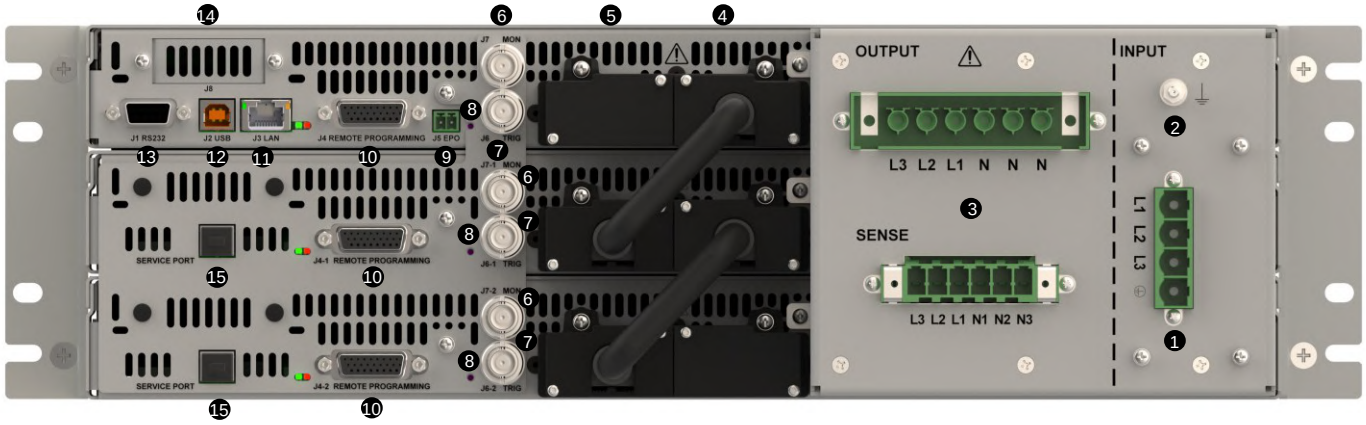


Figure 5-2: Rear Panel Controls and Connectors—6kVA, 9kVA, and 12kVA

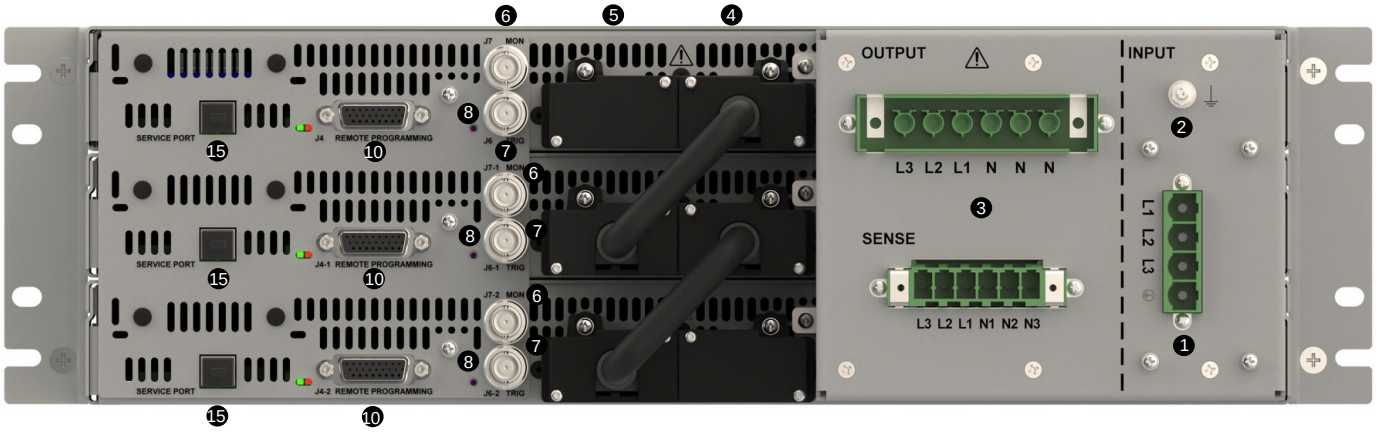


Figure 5-3: Rear Panel Controls and Connectors—9kVA PWR and 12kVA PWR

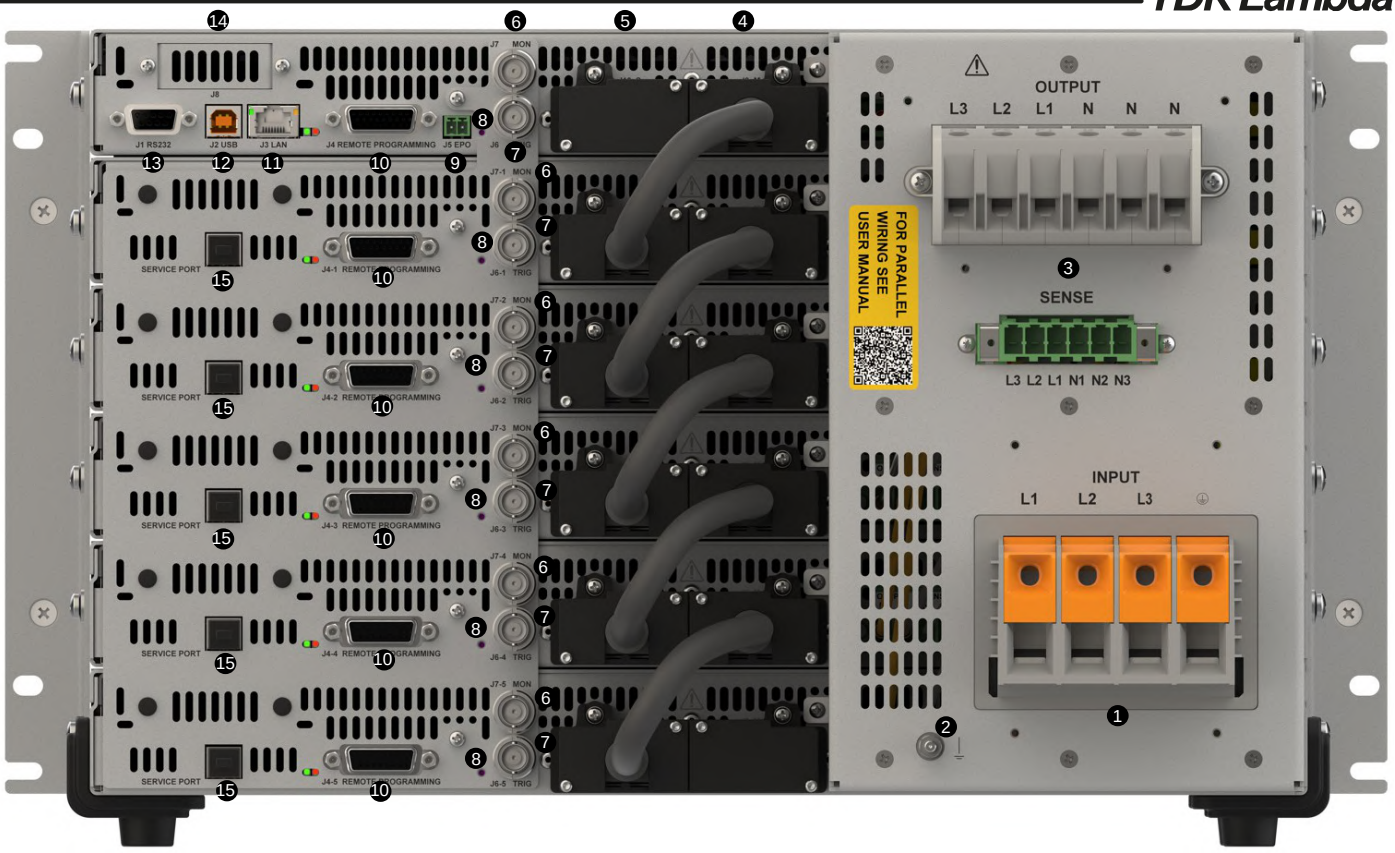


Figure 5-4: Rear Panel Controls and Connectors—18kVA and 24kVA

No.	Connection	Description
1	AC Input Connector	**For 2kVA, 3kVA, and 4kVA:** **1-phase**: PC 5/ 3-G-7,62 PHOENIX CONTACT **3-phase 200 and 3-phase 480**: PC 5/ 4-G-7,62 PHOENIX CONTACT. **Figure 5-1** shows a 3-phase unit. **For 6kVA, 9kVA, 9kVA PWR, 12kVA, and 12kVA PWR:** **3-phase 200 and 3-phase 480**: DFK-PC 16/ 4-ST-10,16 PHOENIX CONTACT **For 18kVA and 24kVA:** **3-phase 200 and 3-phase 480:** TW 50/ 4-CL PHOENIX CONTACT Refer to **Section 7.4: AC Input Power Connection** for detailed information on the connection of the AC input.
2	Ground Stud	Functional ground connection. M4x15 Stud
3	Output and Sense Connector	**For 2kVA, 3kVA, and 4kVA:** IPC 5/ 4-GF-7,62 PHOENIX CONTACT **For 6kVA, 9kVA, 9kVA PWR, 12kVA, and 12kVA PWR:** Output Connector: DFK-IPC 16/ 6-STF-10,16 PHOENIX CONTACT Sense Connector: DFK-PC 5/ 6-STF-7,62 PHOENIX CONTACT **For 18kVA and 24kVA:** Output Connector: UW 16-POT/S PHOENIX CONTACT Sense Connector: DFK-PC 5/ 6-STF-7,62 PHOENIX CONTACT Refer to **Section 7.6: Connecting the Load** for detailed information on the connection of the output.

No.	Connection	Description
4	Advanced Paralleling Connector: Master (J9) (*1)	Female D-Sub type DB26 connector for parallel operation. It is provided with a protective cover.
5	Advanced Paralleling Connector: Slave (J10) (*1)	Female D-Sub type DB26 connector for parallel operation. It is provided with a protective cover.
6	Voltage Monitor (J7, J7-1, and J7-2)	BNC-type connector for monitoring the output voltage.
7	Trigger Out (J6, J6-1, and J6-2)	BNC-type connector for outputting a trigger.
8	Reset Button	Sets the factory default settings of the power source.
9	Emergency Power OFF (EPO) (J5) (*2)	Enables or disables the output. The signal can be used during emergencies.
10	Remote Programming and Logic Control Connector (J4, J4-1, and J4-2)	Female D-Sub type DB26HD connector for Isolated Analog programming, logic signals, and controls.
11	LAN Connector and Indicators (J3) (*3)	RJ-45 type LAN connector.
12	USB Connector (J2)	Type-B USB connector.
13	Single RS232 and RS485 Connector (J1)	Female D-Sub type DB9 connector for connecting to a RS232 or RS485 port of a computer for the purpose of remote control.
14	GPIB Interface Slot (J8)	Slot for an optional GPIB communication interface.
15	Service Port	Service port for factory use. Type-B USB connector.

Table 5-1: Rear Panel Controls and Connectors

Refer to **Table 18-1** and **Table 18-2** for the configuration of J1–J8 connectors, J4 connector pins, and the Reset button depending on the configuration of the unit.

(*1) The output of these connectors can generate hazardous energy. In single units, the protective covers are not to be removed. If a parallel setup is prepared, the GAC/P parallel kit must be used, and a cable connection must be made between the master (J9) and the slave (J10) unit.

(*1) Parallel connection must be done using the GAC/P parallel kit only. The cable included in the kit must be used and it must be covered with the plastic parts included in the kit.

WARNING

(*2) The Emergency Power OFF (EPO) signal disconnects the output only and does not disconnect the unit from the AC mains.

NOTE

(*3) All LEDs in the figures are lit for illustration purposes only.

CHAPTER 6: OUTLINE

NOTES

Only the standard unit is shown as an example, but the dimensions of the blank panel unit are the same as the standard unit.

The dimensions of the 9kVA PWR and the 12kVA PWR unit are the same as the 9kVA/12kVA standard unit.

All dimensions are in mm.

Front View

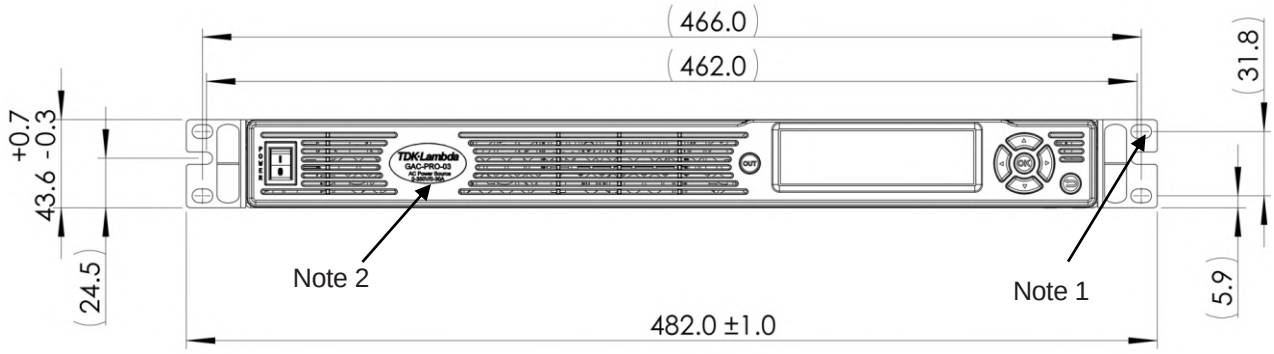


Figure 6-1: Front View—2kVA, 3kVA, and 4kVA

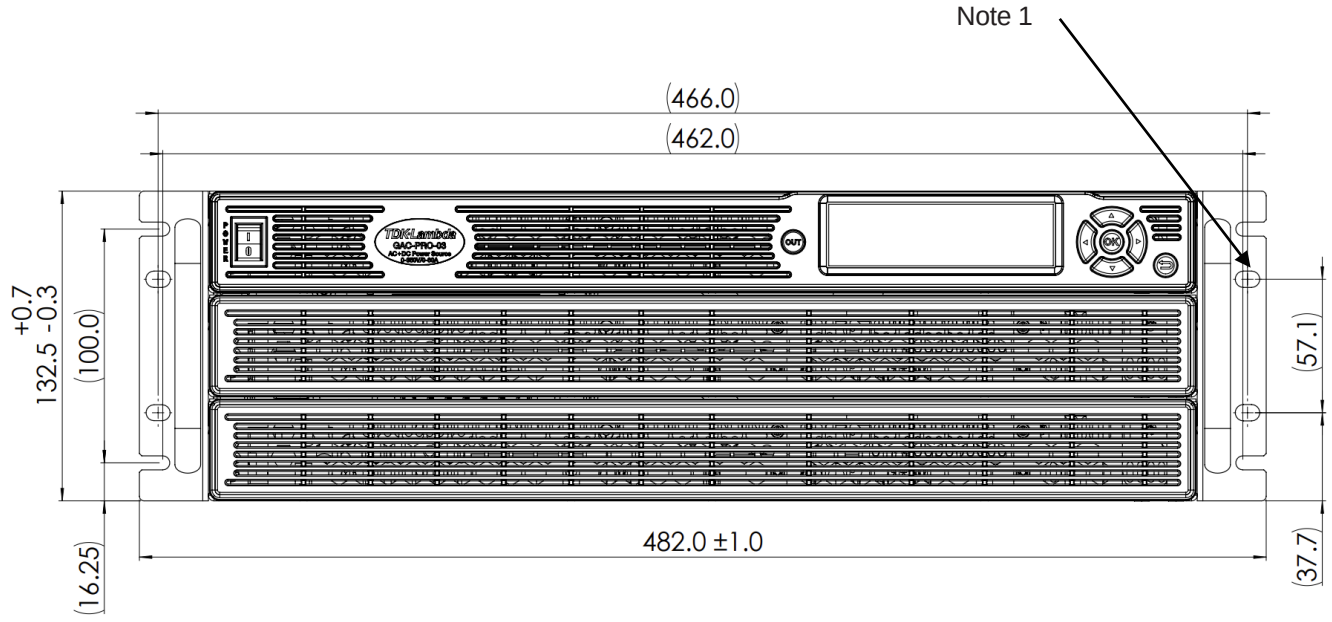


Figure 6-2: Front View—6kVA, 9kVA, and 12kVA

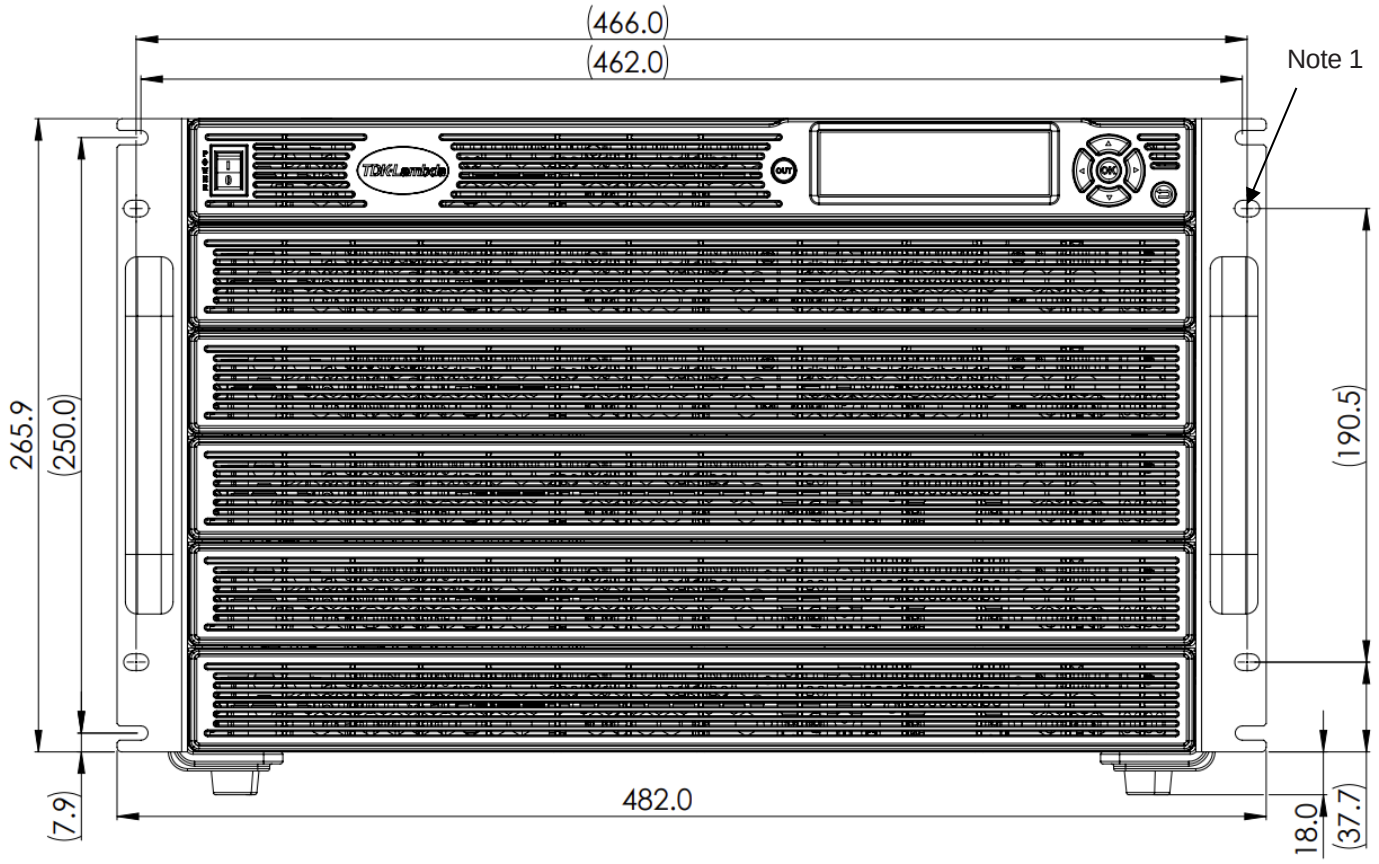
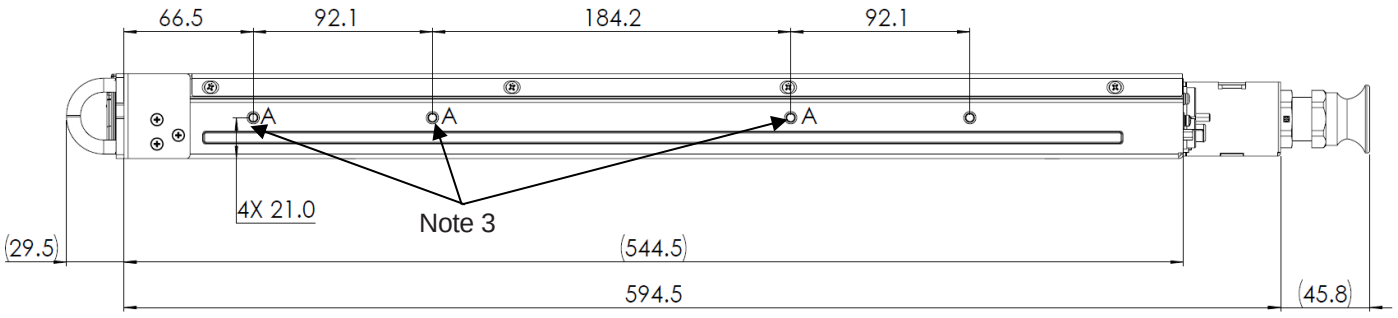


Figure 6-3: Front View—18kVA and 24kVA

Side View



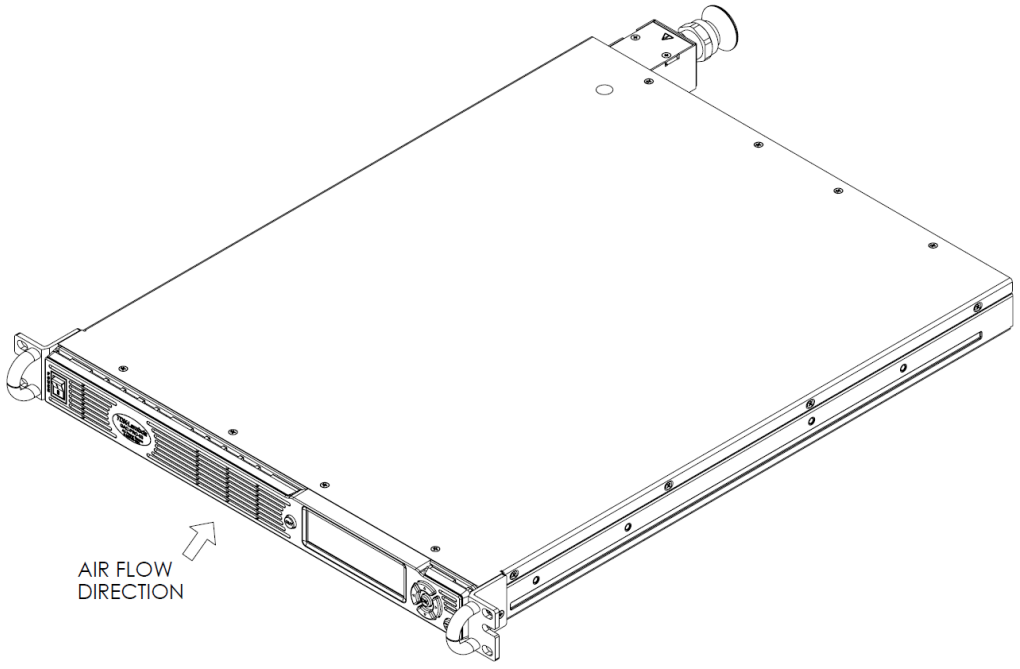


Figure 6-4: Side View—2kVA, 3kVA, and 4kVA

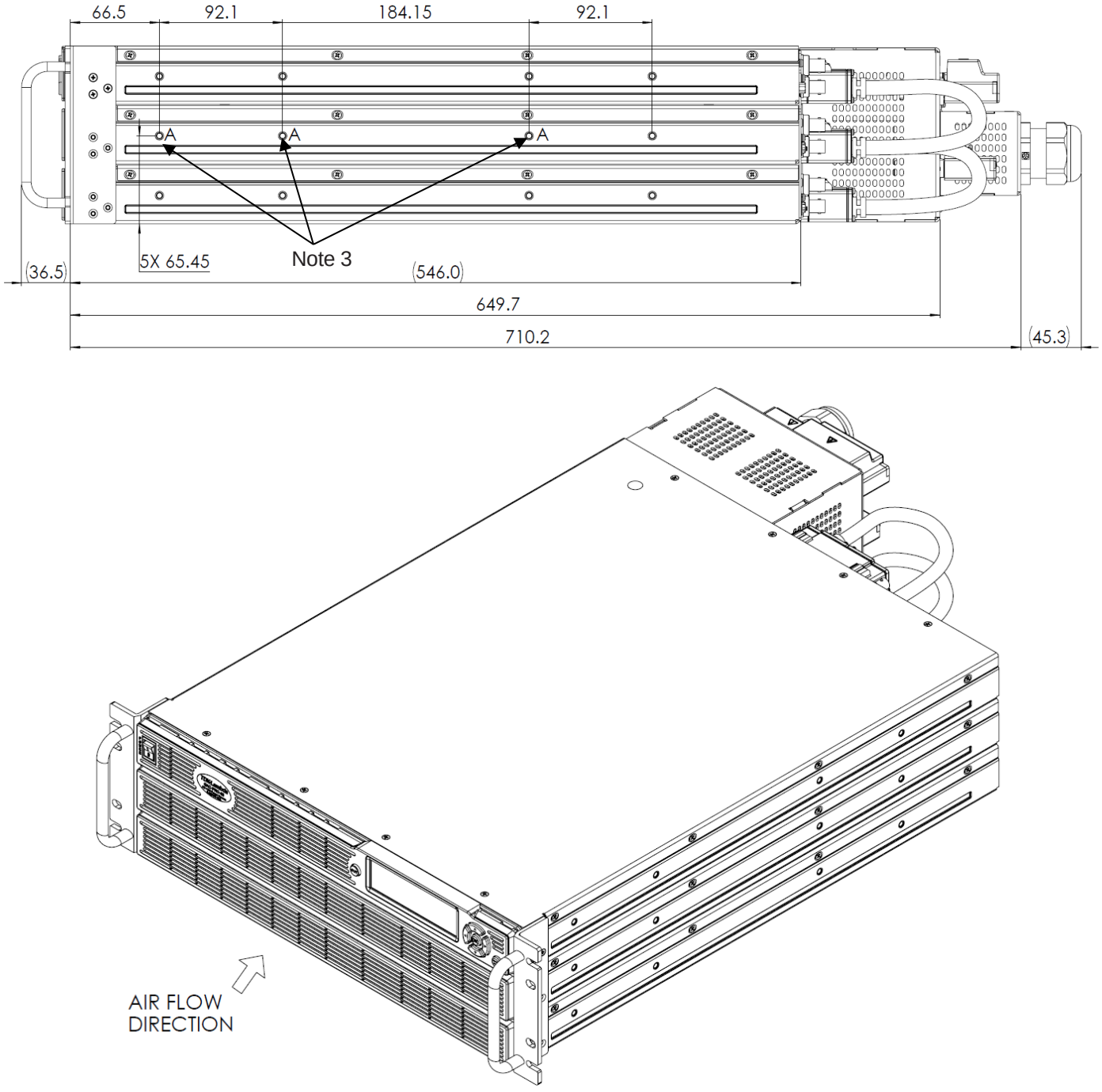
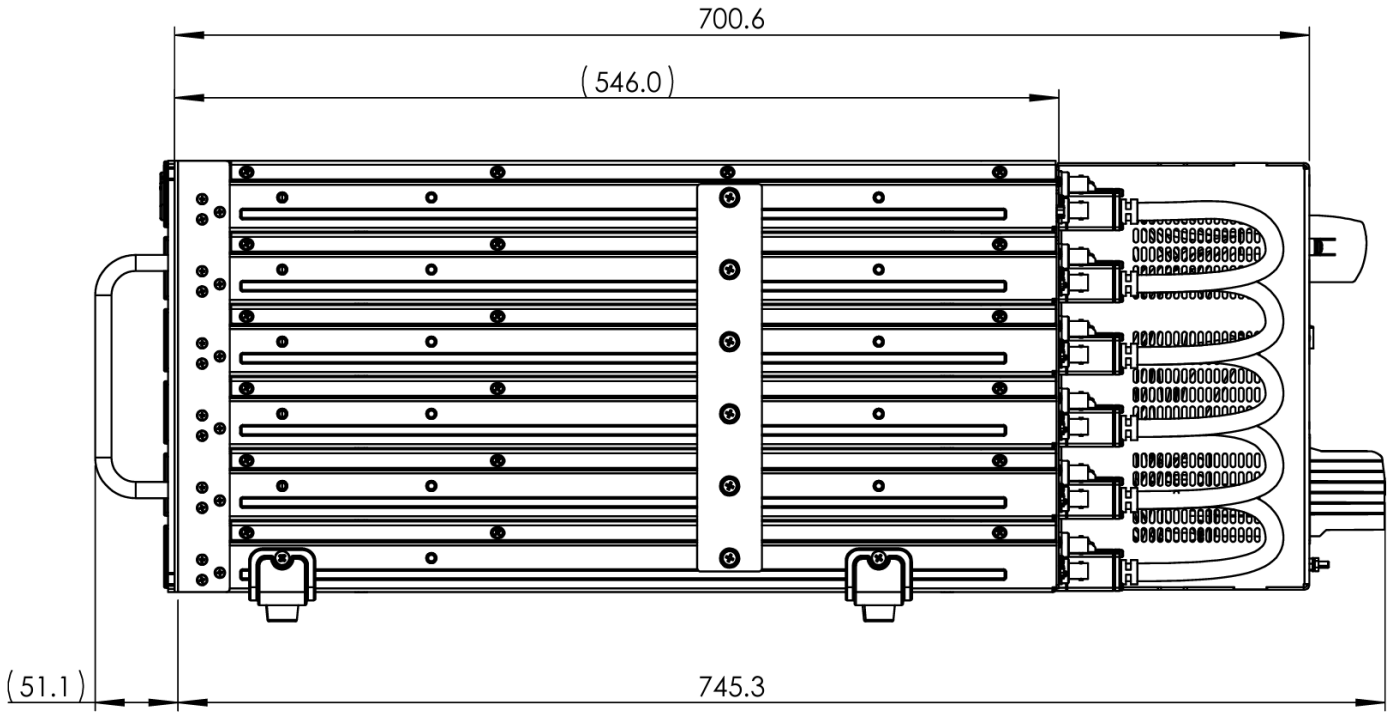


Figure 6-5: Side View—6kVA, 9kVA, and 12kVA



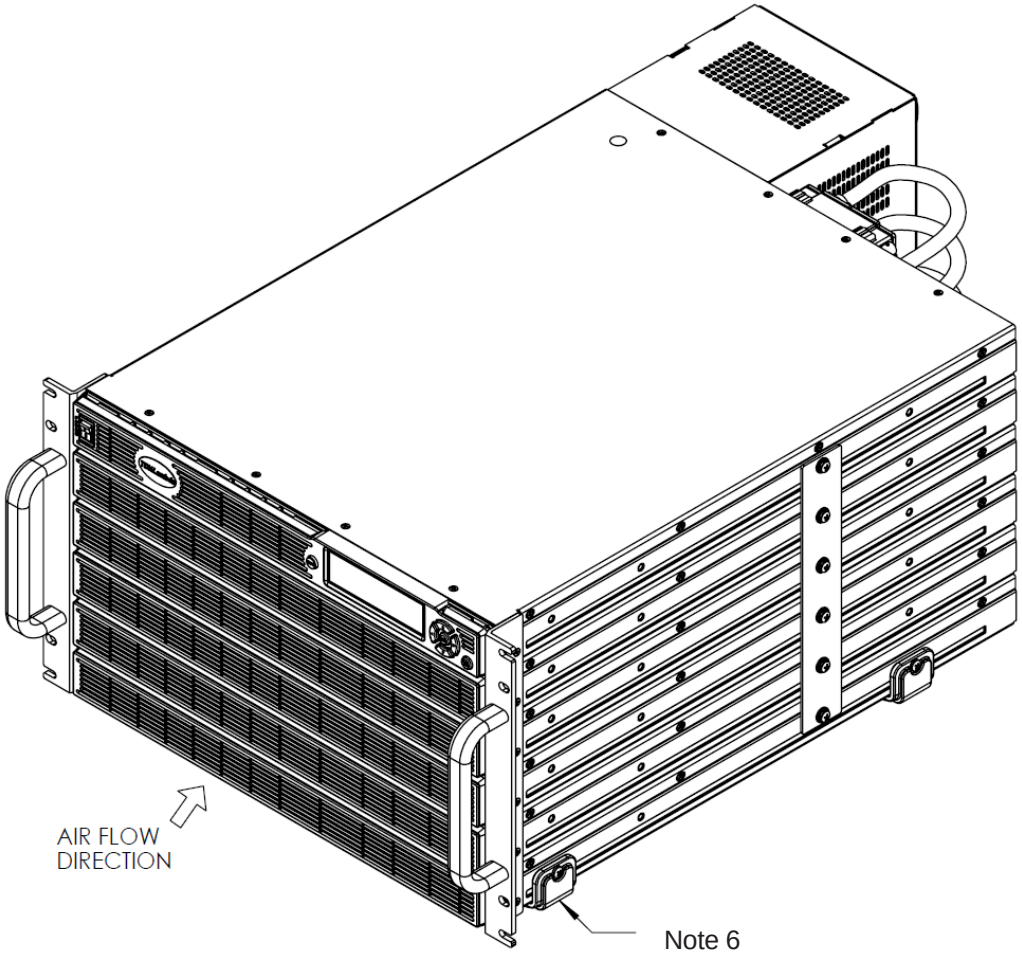


Figure 6-6: Side View—18kVA and 24kVA

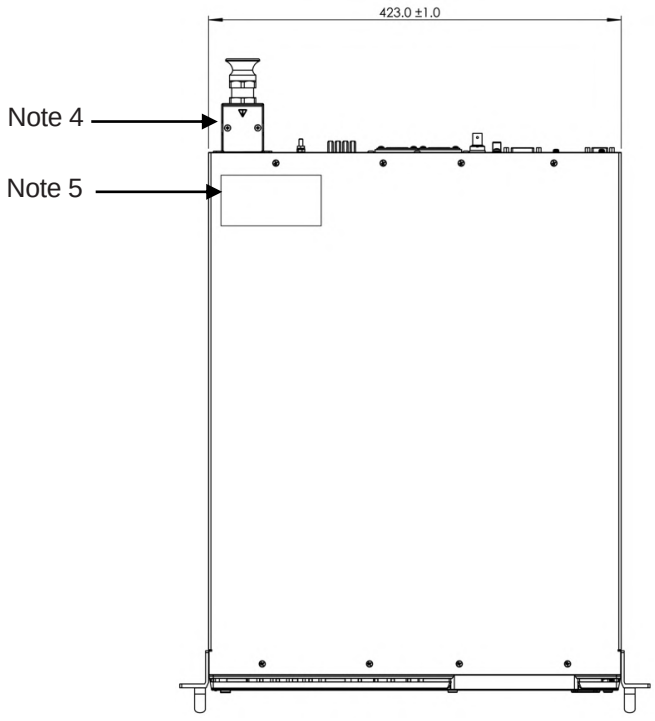


Figure 6-7: Top View—2kVA, 3kVA, and 4kVA

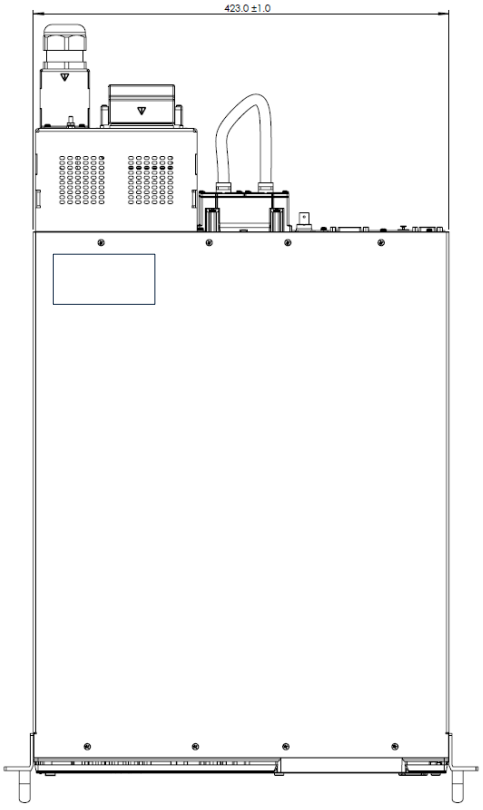


Figure 6-8: Top View—6kVA, 9kVA, and 12kVA

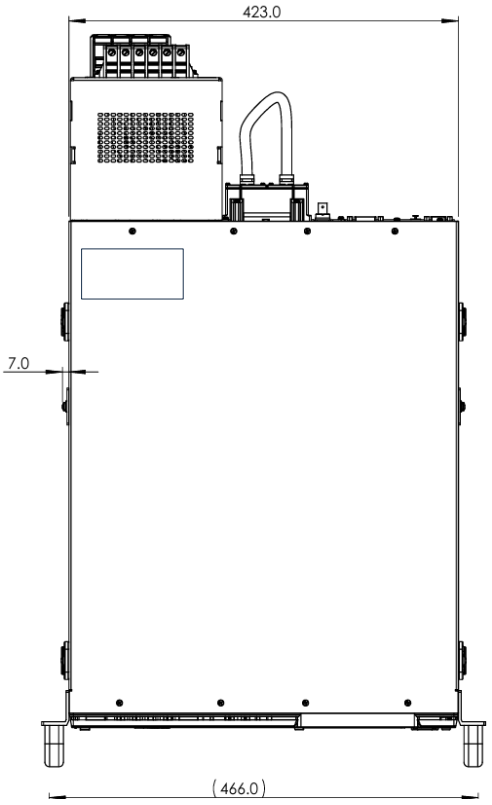


Figure 6-9: Top View—18kVA and 24kVA

NOTES:

1. Mounting holes for 19” rack. Refer to **Section 7.3.3: Installing the Power Source in a Rack**.
2. Company logo, model name, and output rating are shown here according to the specifications.
3. Mounting holes for chassis slides.
   - Use #10-32x0.38” (maximum) x 3 screws on each side in positions marked with A. For 6kVA, 9kVA, 9kVA PWR, 12kVA, and 12kVA PWR units, the chassis slides must be attached to the middle unit only. The chassis slides cannot be used with 18kVA and 24kVA units.
   - Ensure that the screws **do not** penetrate more than 6.0 mm into the unit.

   Refer to **Section 7.3.2: Rack Mount Slides (Optional)**.
4. AC cable gland and strain relief bracket assembly.
5. AC input rating and safety approval symbols are shown according to the specifications.
6. Remove the feet (4 in total) before rack mounting. Store them for future use. They may be required if the product is removed from the rack.

CHAPTER 7: INSTALLATION

WARNING

This equipment must be installed and put into operation by qualified personnel only. Protective measures must be implemented to prevent unauthorized people from accessing the equipment.

WARNING

The installation of the equipment or the system incorporating the equipment must be in accordance with the installation instructions provided. The safety of any system incorporating the equipment is the responsibility of the system assembler.

CAUTION

Observe all torque guidelines within this manual. Over-torque may damage the equipment or the accessories. Such damage is not covered under the warranty.

CAUTION

Do not use this unit if it was dropped or subjected to impact.

NOTE

This product generates magnetic fields, which might affect the operation of other equipment. If your equipment is susceptible to magnetic fields, **do not** position it adjacent to this product.

7.1 Preparation for Use

To be operational, the power source must be connected to appropriate AC mains. **Do not** apply power before reading the safety instructions and **Section 7.4: AC Input Power Connection**.



Before starting the installation, confirm that the AC mains meets the equipment's nominal input rating.

Follow the instructions in the sequence given in **Table 7-1** to prepare the unit for use.

Step No.	Section	Description	Reference
1	Location and Cooling	Placing the power source, ensuring adequate ventilation	Section 7.2
2	Mounting	Stand-alone or rack mounting	Section 7.3
3	AC Input Power Connection	AC mains requirements	Section 7.4
4	Turn-On Check Procedure	Procedure to test the unit after turn-on	Section 7.5
5	Connecting the Load	Selection of wire size Local and remote sensing	Section 7.6 Section 7.7

Table 7-1: Preparing the Unit

7.2 Location and Cooling

This equipment is fan cooled. The air intake is at the front, and the exhaust is at the rear of the equipment.

CAUTION

The ventilation openings in this equipment must not be covered. Allow a minimum of 10 cm (4”) of unrestricted air space at the front and rear of the equipment. The equipment should be used in an area where the ambient temperature **does not** exceed +40°C. Refer to **CHAPTER 2: SPECIFICATIONS** for operating conditions.

7.3 Mounting

This equipment is designed for bench-top and rackmount applications. It can be used as a stand-alone unit or rack-mounted using the optional mounting accessories.

7.3.1 Rack Mounting

This equipment is designed to fit in a standard 19” equipment rack.

CAUTION

The operating ambient temperature of the rack environment may be greater than the room ambient temperature if installed in a closed or multi-unit rack assembly. Therefore, consideration must be given to installing the equipment in an environment compatible with the maximum ambient temperature (Ta) specified.

The installation of the equipment in a rack should be such that there is enough air flow required for the safe operation of the equipment.

The mounting of the equipment in the rack should be such that a hazardous condition is not achieved due to uneven mechanical loading.

Consideration should be given to the connection of the equipment to the supply circuit and the effect that overloading of the circuits might have on overcurrent protection and supply wiring. Appropriate consideration of equipment nameplate ratings should be used when addressing this concern.



Reliable earthing of rack-mounted equipment should be maintained. Attention should be given to supply connections other than direct connections to the branch circuit (e.g., use of power strips).

7.3.2 Rack Mount Slides (Optional)

To install the equipment into a standard 19" rack, use the accessories from **Table 7-2** and follow **Figure 7-1** and **Figure 7-2**.

Item	Catalog No.	Manufacturer	Quantity
Rack-mount Slides	Part/Drawing number- CC3001-00-0160	General Devices	2
Screws	#10-32x0.38" (maximum)	-	6 (3 on each side)

Table 7-2: Rack Mount Slides

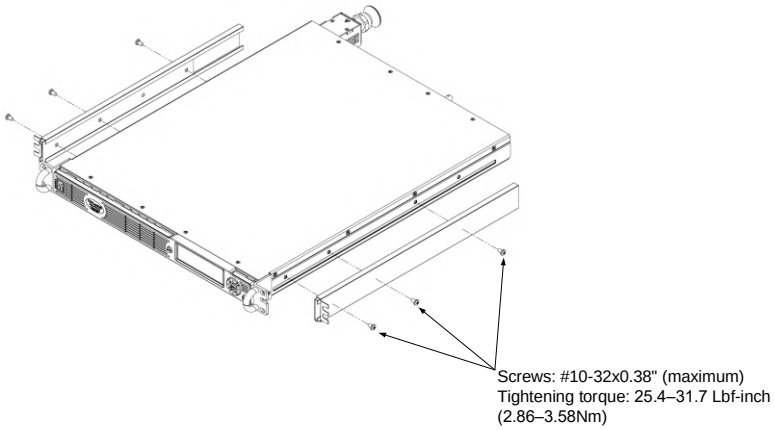


Figure 7-1: Rack Mounting—2kVA, 3kVA, and 4kVA

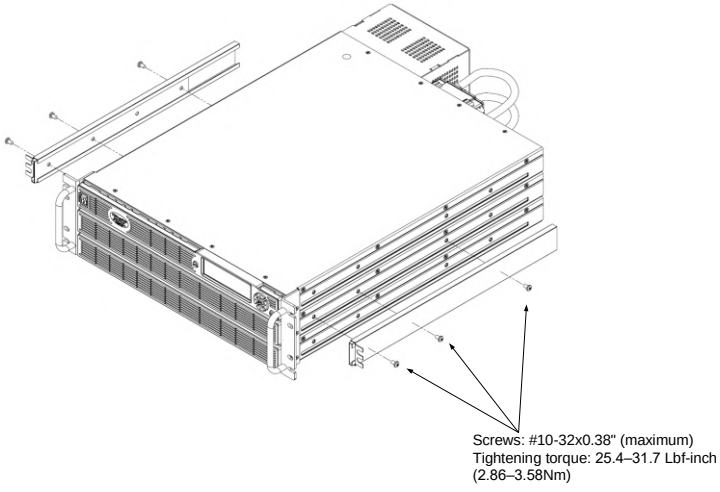


Figure 7-2: Rack Mounting—6kVA, 9kVA, 9kVA PWR, 12kVA, and 12kVA PWR (6KVA/9kVA/12kVA shown)

CAUTION

Ensure that the screws **do not** penetrate more than 6.0 mm into the unit.

To prevent internal damage to the equipment, use the specified screw length only.

NOTE

For 6kVA, 9KVA, 9kVA PWR, 12kVA, and 12kVA PWR units, the chassis slides must be attached to the middle unit only. The chassis slides cannot be used with 18kVA and 24kVA units.

7.3.3 Installing the Power Source in a Rack

Use the right and left brackets on the front panel to install the equipment into the rack. Use M6x16 screws to fix the unit to the rack. Use a torque of 42 lbf-inch (4.8Nm).

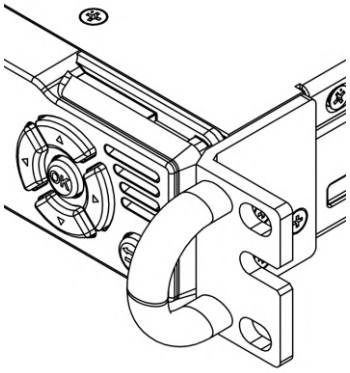


Figure 7-3: Installing the Power Source in a Rack—2kVA, 3kVA, and 4kVA

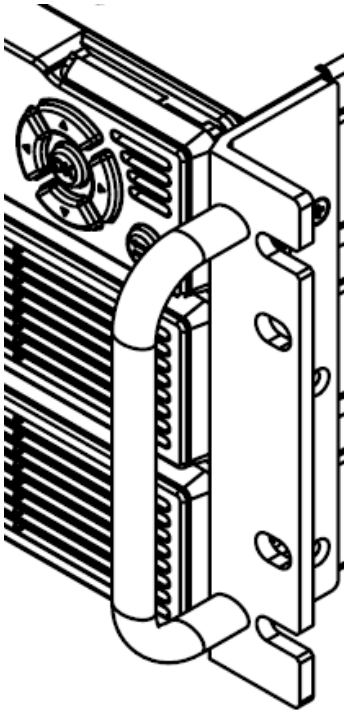


Figure 7-4: Installing the Power Source in a Rack—6kVA, 9kVA, 9kVA PWR, 12kVA, and 12kVA PWR (6kVA shown)

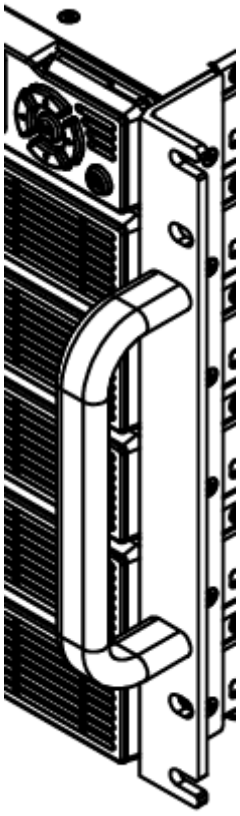


Figure 7-5: Installing the Power Source in a Rack—18kVA and 24VA

7.4 AC Input Power Connection



An appropriately rated disconnect device, such as a building circuit breaker or fuse, that reliably shuts off the power source from the AC mains, shall be provided in the final installation. The disconnect device should be selected according to local regulations and power source specifications.

For single-phase equipment, if the cord used is not part of a permanent connection and can be easily unplugged, then that cord's plug may be used as the disconnect device.

The positioning of the equipment must not make the operation of the disconnect device difficult. The disconnect device must be marked as the disconnecting device for the equipment.

The disconnect device must disconnect all the line conductors simultaneously.

The power source must be connected to the AC mains via a protective device (e.g., circuit breaker, fuses) which disconnect each current-carrying conductor. The recommended current rating of this protective device is as follows:

- **2kVA, 3kVA, and 4kVA:** 30A for 1-phase, 16A for 3-phase 200V and 3-phase 480V
- **6kVA:** 32A for 3-phase 200V and 16A for 3-phase 480V
- **9kVA and 9kVA PWR:** 40A for 3-phase 200V and 25A for 3-phase 480V
- **12kVA and 12kVA PWR**: 50A for 3-phase 200V and 32A for 3-phase 480V
- **18kVA:** 80A for 3-phase 200 and 50A for 3-phase 480
- **24kVA:** 120A for 3-phase 200 and 63A for 3-phase 480

AC input cables are not provided with the power source. For recommended AC input cables, refer to **Table 7-3, Table 7-4, Table 7-5**, and **Table 7-6**.

AC Input Range	AC Input Cable
100–240Vac, one phase	Minimum 3 X 2.5 mm^2 (two wires plus safety ground), stranded copper, 300V, 105°C minimum, 3 m maximum length, outer diameter 10–14 mm
190–240Vac, three phase	Minimum 4 X 2.5 mm^2 (three wires plus safety ground), stranded copper, 300V, 105°C minimum, 3 m maximum length, outer diameter 10–14 mm
380–480Vac, three phase	Minimum 4 X 1.5 mm^2 (three wires plus safety ground), stranded copper, 600V, 105°C minimum, 3 m maximum length, outer diameter 10–14 mm

Table 7-3: Recommended AC Input Cables–2kVA, 3kVA, and 4kVA

AC Input Range	AC Input Cable
190–240Vac, three phase	Minimum 4 X 4 mm^2 (three wires plus safety ground), stranded copper, 300V, 105°C minimum, 3 m maximum length, outer diameter 14–32 mm
380–480Vac, three phase	Minimum 4 X 2.5 mm^2 (three wires plus safety ground), stranded copper, 600V, 105°C minimum, 3 m maximum length, outer diameter 9–18 mm

Table 7-4: Recommended AC Input Cables–6kVA

AC Input Range	AC Input Cable
190–240Vac, three phase	Minimum 4 X 10 mm^2 (three wires plus safety ground), stranded copper, 300V, 105°C minimum, 3 m maximum length, outer diameter 18–32 mm
380–480Vac, three phase	Minimum 4 X 4 mm^2 (three wires plus safety ground), stranded copper, 600V, 105°C minimum, 3 m maximum length, outer diameter 9–18 mm

Table 7-5: Recommended AC Input Cables–9kVA, 9kVA PWR, 12kVA, and 12kVA PWR

AC Input Range	AC Input Cable
190–240Vac, three phase	Minimum 4 X 25 mm^2 (three wires plus safety ground), stranded copper, 300V, 105°C minimum, 3 m maximum length, outer diameter typically 39mm
380–480Vac, three phase	Minimum 4 X 10 mm^2 (three wires plus safety ground), stranded copper, 600V, 105°C minimum, 3 m maximum length, outer diameter typically 21mm

Table 7-6: Recommended AC Input Cables–18kVA and 24kVA



Dangerous voltages are present within the unit. Some components inside the unit are at AC voltage even when the ON/OFF switch is in the OFF position. To avoid electric shock hazard, disconnect the AC cord and load, discharge circuits, remove external voltage sources, and wait for 2 minutes before making any rear panel connections.



The connection of the power source to the AC mains must be made by an electrician or other qualified personnel in accordance with local electricity standards, rules, and regulations.



This product is an IEC Safety Class I equipment. Be sure to ground (earth) the unit.



This equipment must be connected to the AC mains through a three-conductor power cable (L, N, PE) or through a four-conductor power cable (L1, L2, L3, PE) with the ground (PE) wire firmly connected to an electrical ground (safety ground) at the power outlet.



Use cables with the appropriate voltage and temperature ratings to ensure safe, reliable operation.

The AC mains cord must be protected against abrasion and sharp bends at the point where the cord enters the end equipment. The connecting points of the AC mains cord conductors must be relieved of strain.

If the input connection is made by a jacketed cord, the PE/Ground wire must be at least 10 mm longer than all the other MAINS current-carrying conductors connected to the equipment to prevent inadvertent disconnection of the PE/Ground wire. If the input connection is made by separate wires, then an appropriate conduit in accordance with local electricity standards, rules, and regulations that stretches from the MAINS outlet supply source up to the entry of the power source must be used.

There is a potential electrical shock hazard when using the power source without input protection. **Do not** connect the power source to the AC mains without the input protection properly assembled.

There is a potential shock hazard if the power source chassis (with cover in place) is not connected to an electrical safety ground via the safety ground terminal in the AC input connector.

CAUTION

It is forbidden to solder the conductors. The solder tin yields and fractures under high pressure. The result is an increase in contact resistance and an excessive temperature rise. In addition, corrosion caused by pickling or fluxes has been observed on soldered conductor ends. Notch fractures at the transition point from the rigid to the flexible conductor area are also possible.

NOTE

AC Input Wires No Conductor Pretreatment: All kinds of copper conductors can be clamped without pretreatment (solid, flexible, with ferrule, with or without plastic sleeve).

7.4.1 AC Input Wire Connection for 2kVA, 3kVA, and 4kVA

1. Ensure that the power source is turned OFF and the AC cable is disconnected from any electrical potential before making any connection.
2. Insert the cable gland into the strain relief bracket assembly as shown in **Figure 7-6**.
3. Tighten the plastic nut onto the cable gland within the strain relief bracket assembly. Use manual force only.

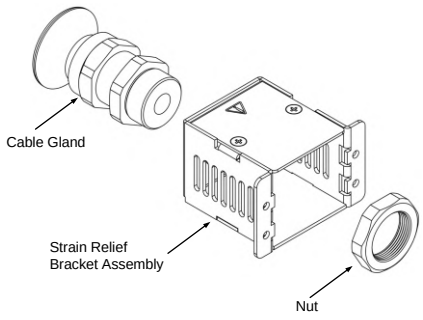


Figure 7-6: Insertion of the Plastic Nut into the Cable Gland

4. Loosen the conical part of the cable gland until it is possible to insert the AC cable.
5. Strip about 5 cm of the outside insulation of the AC cable. Trim the wires so that the ground wire is 10 mm longer than the other wires. Strip 10 mm of the insulation from each wire.
6. Insert the AC cable through the cable gland and the strain relief bracket assembly as shown in **Figure 7-7** (applicable for 4-wire 3-phase and 3-wire 1-phase; 1-phase shown).

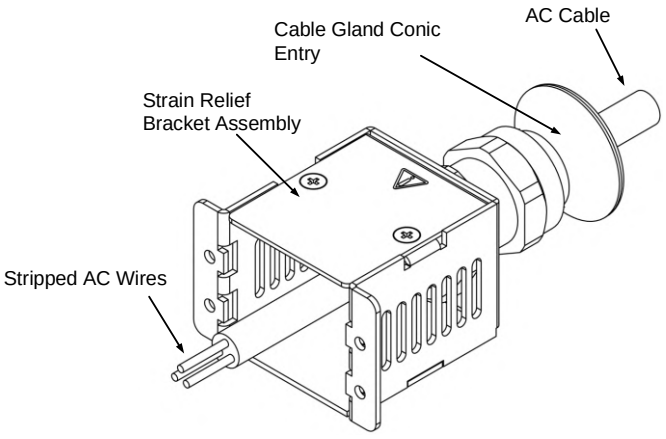


Figure 7-7: Insertion of the AC Cable through the Cable Gland and Strain Relief Bracket Assembly

7. Insert the AC wires into the AC input connector as shown in **Figure 7-8**.

NOTE

It is recommended to add ferrules to the AC input conductors so that there is no possibility of contact between the conductors.

8. Tighten the screws on the AC input connector using a tightening torque of 6.2–7.1 Lbf-inch (0.7–0.8Nm).

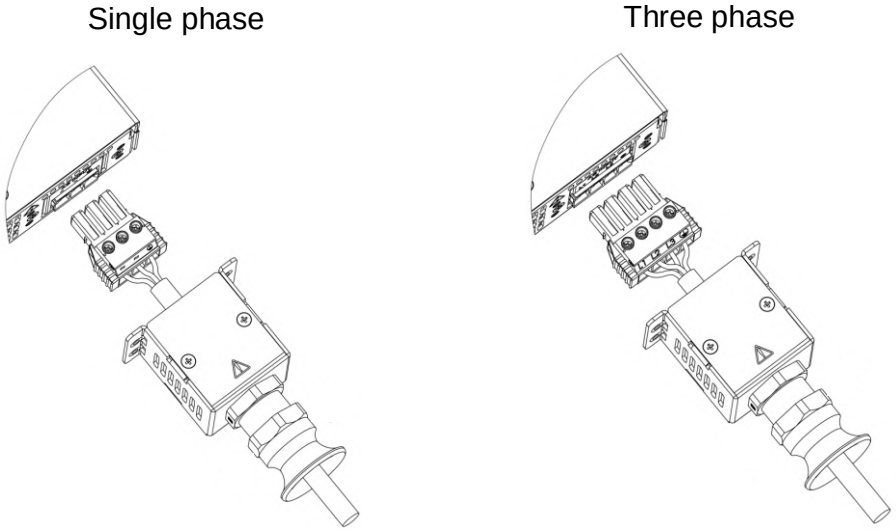


Figure 7-8: AC Wires fixed to the AC Connector

9. Insert the AC input connector into the power source.

10. Fix the strain relief bracket assembly to the rear panel with four SEMS screws as shown in **Figure 7-9** using a tightening torque of 4.7–5.7 Lbf-inch (0.53–0.64Nm).
11. After fixing the strain relief bracket assembly, tighten the conical part of the cable gland until the AC cable is well tightened. Use manual force only. **Do not** apply excessive force.

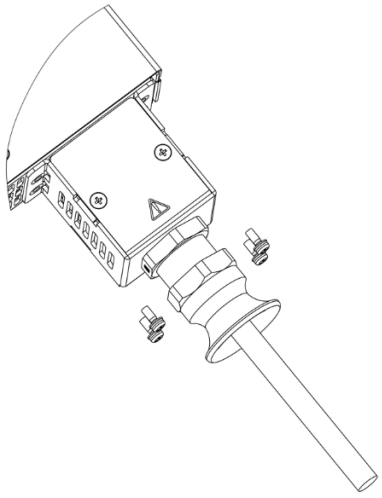


Figure 7-9: Strain Relief Bracket Assembled to Power Source Rear Panel

7.4.2 AC Input Wire Connection for 6kVA, 9kVA, 9kVA PWR, 12kVA, and 12kVA PWR

1. Ensure that the power source is turned OFF and the AC cable is disconnected from any electrical potential before making any connection.
2. Insert the cable gland into the strain relief bracket assembly as shown in **Figure 7-10**.
3. Tighten the plastic nut onto the cable gland within the strain relief bracket assembly. Use manual force only.

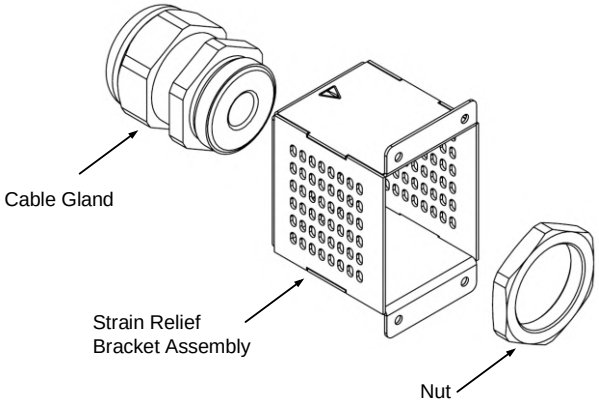


Figure 7-10: Insertion of the Plastic Nut into the Cable Gland

4. Loosen the conical part of the cable gland until it is possible to insert the AC cable.
5. Strip about 5 cm of the outside insulation of the AC cable. Trim the wires so that the ground wire is 10 mm longer than the other wires. Strip 10 mm of the insulation from each wire.

6. Insert the AC cable through the cable gland and the strain relief bracket assembly as shown in **Figure 7-11**.

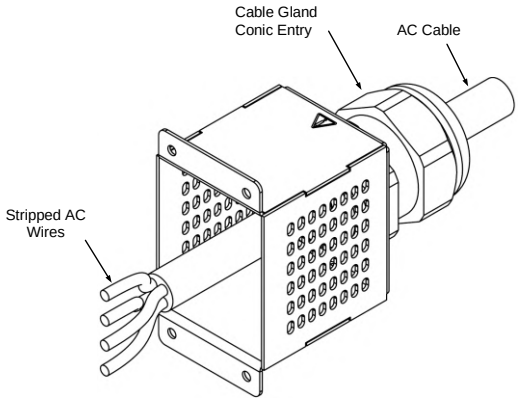


Figure 7-11: Insertion of the AC Cable through the Cable Gland and Strain Relief Bracket Assembly

7. Insert the AC wires into the AC input connector as shown in **Figure 7-12** and tighten the screws using a tightening torque of 15–16 Lbf-inch (1.7–1.8Nm).

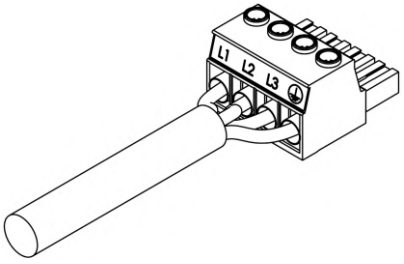


Figure 7-12: AC Wires fixed to the AC Connector

NOTE

It is recommended to add ferrules to the AC input conductors so that there is no possibility of contact between the conductors.

8. Insert the AC input connector into the power source as shown in **Figure 7-13**.

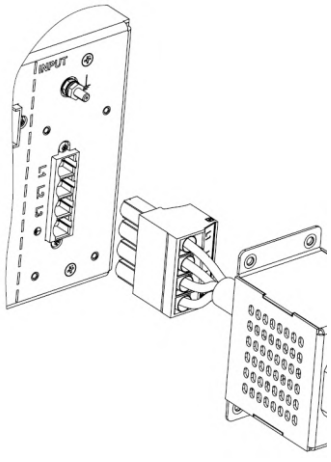


Figure 7-13: Inserting the AC Cable

9. Fix the strain relief bracket assembly to the rear panel with four SEMS screws as shown in **Figure 7-14** using a tightening torque of 4.7–5.7 Lbf-inch (0.53–0.64Nm).

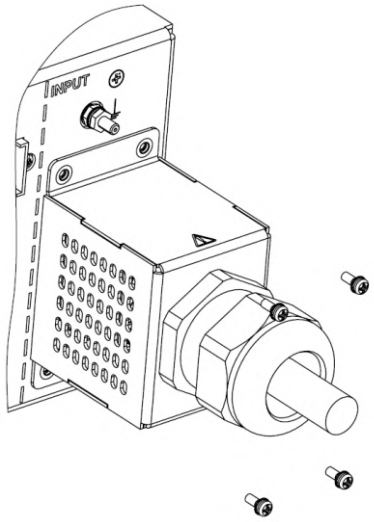


Figure 7-14: Fixing the Strain Relief Bracket

10. After fixing the strain relief bracket assembly, tighten the conical part of the cable gland until the AC cable is well tightened. Use manual force only. **Do not** apply excessive force.

7.4.3 AC Input Wire Connection for 18kVA and 24kVA

1. Ensure that the power source is turned OFF and the AC cable is disconnected from any electrical potential before making any connection.
2. Insert a screwdriver into the round opening of the orange cover caps and lift the caps as shown in **Figure 7-15**.

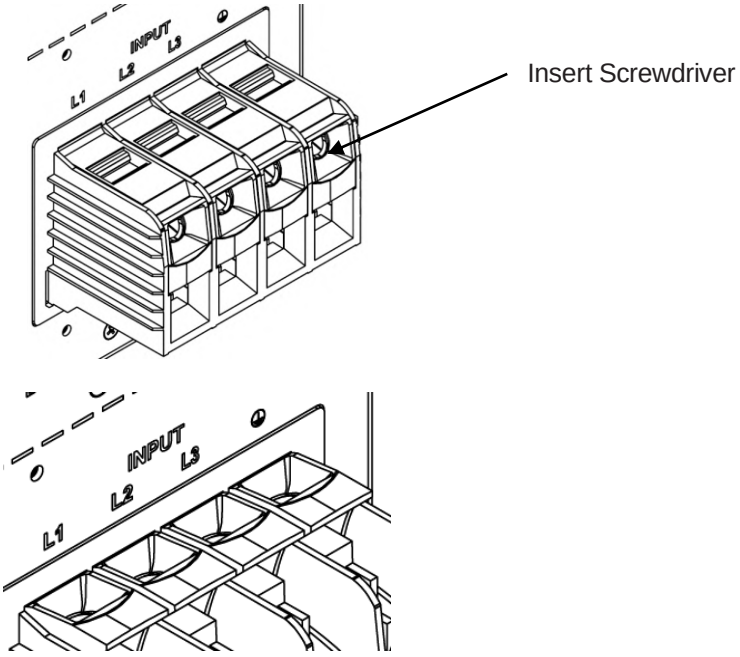


Figure 7-15: Opening the Cap

3. Strip about 5 cm of the outside insulation of the AC cable. Trim the wires so that the ground wire is 10 mm longer than the other wires. Strip 10 mm of the insulation from each wire.
4. Place the conductor into the terminal block from above as shown in **Figure 7-16** and then push them down as shown in **Figure 7-17**.

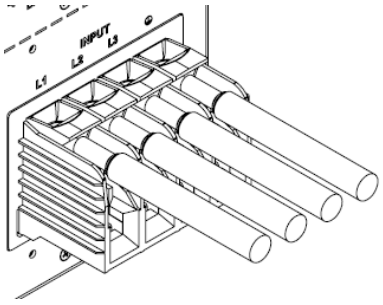


Figure 7-16: Placing the Conductor

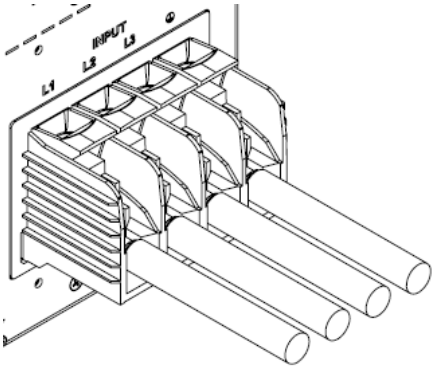


Figure 7-17: Pushing the Conductor

NOTE

To protect the terminal block from mechanical stress, do not insert the conductor into it from the front.

5. Close the caps by pushing them down using the screwdriver as shown in **Figure 7-18**.

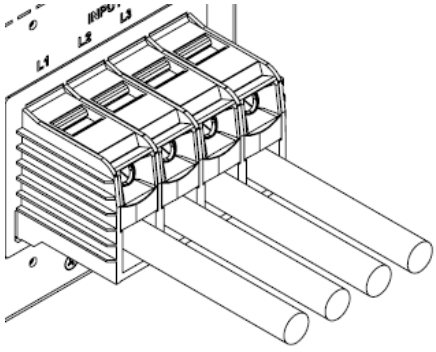


Figure 7-18: Closing the Cap

7.5 Turn-On Check Procedure

WARNING

This equipment must be operated by qualified personnel who understand the warning and safety instructions in this manual. The personnel must use the designated and recommended safety equipment. When the equipment is operated by unqualified personnel, qualified personnel must supervise them.

CAUTION

The identification and description of operating controls and their use in all operating modes are stated in this manual. The operation of the equipment is explained in detail in this manual.

7.5.1 General

The following procedures can be used as a basic incoming inspection check that ensures that the unit is operational. Refer to **Figure 4-1, Figure 4-2, Figure 4-3, Figure 5-1, Figure 5-2, Figure 5-4** for the location of the controls indicated in the procedure. For the blank panel units, the parameter settings and status reading can be made using the communication interface only.

7.5.2 Before Operation

1. Ensure that the power switch is OFF and that the unit is disconnected from the AC mains.
2. Ensure that the protection for the input terminals is mounted and properly assembled.
3. Connect the unit to the AC mains.
4. Connect a DVM with appropriate cables for the rated voltage to the output terminals.
5. Turn ON the power switch.
6. Confirm that the power source is configured to the default setting; refer to **Section 13.2: Default Setting or Factory Reset.**
7. The display shows **OUTPUT OFF** (not applicable for blank panel unit).

7.5.3 Constant Voltage Check (Standard Power Source)

1. Select AC mode and set the output voltage to 50Vrms; refer to **Section 9.4.1: Output Settings Menu**.
2. Turn ON the output by pressing the **OUT** button; the **OUT** LED illuminates.
3. Confirm the DVM reading with the front panel voltage reading to verify the accuracy of the voltage display.
4. Confirm that **CV** is indicated on the front panel.
5. Turn OFF the power switch.

7.5.4 Constant Voltage Check (Blank Panel Power Source)

1. Connect a USB cable from a PC to USB connector (J2); refer to **Figure 5-1, Figure 5-2**, and **Figure 5-4**.
2. Turn ON the power switch.
3. Run any terminal communication software and send the following commands:
    1. MODE AC (select AC mode)
    2. VOLT 60 (set output to 60Vrms)
    3. OUTP 1 (turn ON the output); the **OUT** LED illuminates.

4. Send MEAS:VOLT? to read the output voltage. Confirm the DVM reading with the readback voltage to verify the accuracy of the voltage readback.
5. Confirm that the **CV** LED illuminates.
6. Turn OFF the power switch.

7.6 Connecting the Load

7.6.1 Output Connections

The output and sense connector provides terminals for output and remote sense connections to the load. A functional ground connection is available next to the connector for terminating cable shields. Either the line (L) or the neutral (N) terminal may be grounded (although it is not recommended to connect the line (L) terminal to ground), or the output may be floated. The unit must not float outputs more than +/- 510Vdc above/below chassis ground.
Local or remote sense connections may be used.



Dangerous voltages are present within the unit. Some components inside the unit are at AC voltage even when the ON/OFF switch is in the OFF position. To avoid potential shock hazard, disconnect the AC cord and load, discharge circuits, remove external voltage sources, and wait for 2 minutes before making any rear panel connections.



Use cables with the appropriate voltage and temperature ratings to ensure safe, reliable operation.

WARNING

The output power taken from the equipment must not exceed the rating stated on the product label, except otherwise stated in this manual.

7.6.2 Load Wiring

The following considerations should be made when selecting wiring for connecting the load to the power source:

- current carrying capacity of the wire; refer to **Section 7.6.3: Current Carrying Capacity**.
- insulation rating of the wire should be equal to or greater than the maximum output voltage of the power source.
- appropriate temperature rating of the wire.
- maximum wire length and voltage drop; refer to **Section 7.6.3: Current Carrying Capacity**.
- noise and impedance effects of the load wiring; refer to **Section 7.6.5: Noise and Impedance Effects**.

7.6.3 Current Carrying Capacity

Two factors must be considered when selecting the wire size:

- To prevent overheating, wires should have enough current carrying capacity while carrying the load current at the rated load or the load current that would flow in the event the load wires were shorted, whichever is greater.
- Ensure that the voltage drop on the load wires does not exceed (typically) 35Vrms/50Vpk in AC and ACDC mode, or 35Vdc in DC mode to prevent excessive output power consumption from the power source and poor dynamic response to load changes. Refer to **Table 7-7, Table 7-8, Table 7-9**, and **Table 7-10** for the recommended wire in American and European dimensions, respectively, to limit the voltage drop.

Output Current	Recommended Wires (Stranded Copper) (Ferrules with Plastic Sleeves)		Connector
	(mm^2)	(AWG)	
0A–30A	6 (per conductor)	10 (per conductor)	Phoenix contact IPC 5/ 4-STF-7,62

Table 7-7: Recommended Wire Size—2kVA, 3kVA, and 4kVA

Output Current	Recommended Wires (Stranded Copper) (Ferrules with Plastic Sleeves)		Connector
	(mm^2)	(AWG)	
0A–60A	6 (per conductor)	10 (per conductor)	Phoenix contact IPC 16/ 6-STF-10,16

Table 7-8: Recommended Wire Size—6kVA

Output Current	Recommended Wires (Stranded Copper) (Ferrules with Plastic Sleeves)		Connector
	(mm^2)	(AWG)	
0A–90A	6 (per conductor)	10 (per conductor)	Phoenix contact IPC 16/ 6-STF-10,16

Table 7-9: Recommended Wire Size—9kVA, 9kVA PWR, 12kVA, and 12kVA PWR

Output Current	Recommended Wires (Stranded Copper) (Ferrules with Plastic Sleeves)	
	(mm^2)	(AWG)
0A–180A	10 (per conductor)	8 (per conductor)

Table 7-10: Recommended Wire Size—18kVA and 24kVA

7.6.4 Wire Termination

The wires should be properly terminated with terminals securely attached. **Do not** use non-terminated wires for load connections.

7.6.5 Noise and Impedance Effects

To minimize the noise pickup or radiation, the load wires and remote sense wires should be twisted in pairs to the shortest possible length. Shielding sense leads may be necessary in high-noise environments. Where shielding is used, connect the shield to the chassis via a rear panel ground screw. Even if noise is not an issue, the load and remote sense wires should be twisted in pairs to reduce coupling. Untwisted pairs might impact the stability of the power source. The sense leads should be separated from the power leads.

7.6.6 Inductive Loads

Inductive load can produce high voltage spikes. To reduce the effect of inductive loads on the output of the power source, various slew functions available with this power source can be used.

7.6.7 Making the Load Connections

Hazardous voltages exist at the output terminals. Load wires should have a minimum insulation rating equal to or greater than the maximum output voltage of the power source. Ensure appropriate temperature rating of the wires.

Ensure that the connections at the load end are shielded to prevent accidental contact with the hazardous voltages.

To protect personnel against accidental contact with the hazardous voltages, ensure that the load and its connections have no accessible live parts.

Ensure that the protection of the output connector is properly assembled.

CAUTION

Ensure that the load wiring mounting hardware **does not** short the output terminals. Heavy cables must have some form of strain relief to prevent loosening of the connections.

CAUTION

It is forbidden to solder the conductors. The solder tin yields and fractures under high pressure. The result is an increased contact resistance and an excessive temperature rise. In addition, corrosion caused by pickling or fluxes has been observed on soldered conductor ends. Notch fractures at the transition point from the rigid to the flexible conductor area are also possible.

NOTE

Output Wires No Conductor Pretreatment: All kinds of copper conductors can be clamped without pretreatment (solid, flexible, with ferrule, with or without plastic sleeve).

7.6.7.1 Load Connection for 2kVA, 3kVA, and 4kVA

Refer to **Figure 7-19** for a view of the output and sense connector.

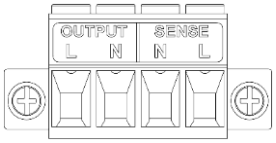


Figure 7-19: Output and Sense Connector

1. Prepare suitable wires and connector according to the recommendations in **Table 7-7.**
2. Ensure that the power source is turned OFF and the AC cable is disconnected from any electrical potential before making any connection.
3. Strip approximately 10 mm of insulation from each wire.

4. Attach ferrules to each of the stripped wires.

NOTE

It is recommended to add ferrules to the output and sense conductors so that there is no possibility of contact between the conductors.

5. Insert the wires into the terminals as shown in **Figure 7-20** and tighten the terminal screws securely using a tightening torque of 6.2–7.1 lbf-inch (0.7–0.8Nm).

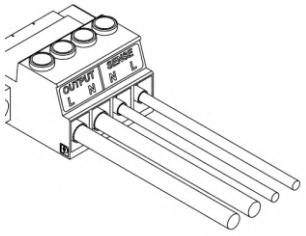


Figure 7-20: Inserting the Wires

NOTE

The wires connected to the sense terminals are for illustration purpose only and should only be used for remote sense. Refer to **Section 7.7: Local and Remote Sensing**.

6. Tighten the connector to the power source rear panel as shown in **Figure 7-21** using a tightening torque of 3–6 lbf-inch (0.3–0.7Nm).

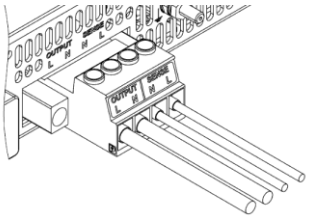


Figure 7-21: Tightening the Connector to the Power Source

7. Fix the output cover using 2 screws (WN1412(KA30X8)) provided with the power source; refer to **Figure 7-22**. Use a tightening torque of 5.2 lbf-inch (0.58Nm).



Figure 7-22: Fixing the Output Cover

8. Ensure that all connections are securely tightened.

CAUTION

For high current outputs, it is particularly important to make the output connections properly and follow the instructions. Improper connections may result in excessive temperature rise or power source going into protection mode.

7.6.7.2 Load Connection for 6kVA, 9kVA, 9kVA PWR, 12kVA, and 12kVA PWR

Refer to **Figure 7-23** for a view of the output connector.

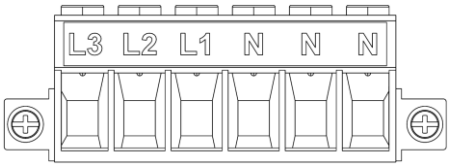


Figure 7-23: Output Connector

1. Prepare suitable wires and connector according to the recommendations in **Table 7-8** or **Table 7-9**.
2. Ensure that the power source is turned OFF and the AC cable is disconnected from any electrical potential before making any connection.
3. Strip approximately 10 mm of insulation from each wire.
4. Attach ferrules to each of the stripped wires.

NOTE

It is recommended to add ferrules to the output conductors so that there is no possibility of contact between the conductors.

5. Insert the wires into the terminals as shown in **Figure 7-24** and tighten the terminal screws securely using a tightening torque of 15–16 Lbf-inch (1.7–1.8Nm).

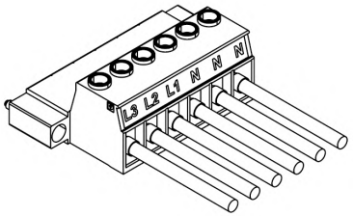


Figure 7-24: Inserting the Load Wires

6. Tighten the connector to the power source rear panel as shown in **Figure 7-25** using a tightening torque of 2.6 Lbf-inch (0.3Nm).

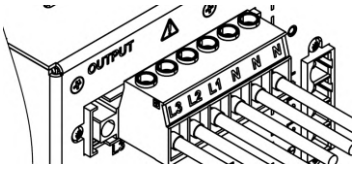


Figure 7-25: Tightening the Connector to the Power Source

7. Fix the output covers using 2 screws (WN1412(KA30X8)) provided with the power source; refer to **Figure 7-26**. Use a tightening torque of 5.2lbf-inch (0.58Nm). Refer to **Figure 7-27** for the final assembly.

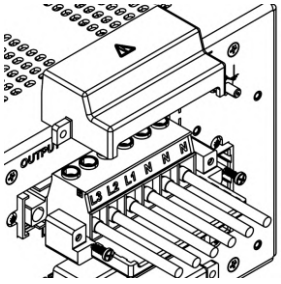


Figure 7-26: Fixing the Output Cover

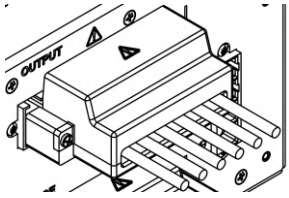


Figure 7-27: Final Assembly

8. Ensure that all connections are securely tightened.

CAUTION

For high current outputs, it is particularly important to make the output connections properly and follow the instructions. Improper connections may result in excessive temperature rise or power source going into protection mode.

7.6.7.3 Load Connection for 18kVA and 24kVA

Refer to **Figure 7-28** for a view of the output connector.

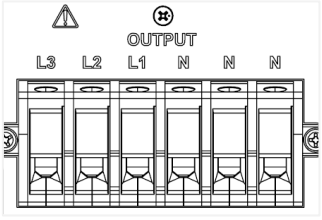


Figure 7-28: Output Connector

1. Prepare suitable wires and connector according to the recommendations in **Table 7-10**.
2. Ensure that the power source is turned OFF and the AC cable is disconnected from any electrical potential before making any connection.
3. Strip approximately 10 mm of insulation from each wire.
4. Attach ferrules to each of the stripped wires.

NOTE

It is recommended to add ferrules to the output conductors so that there is no possibility of contact between the conductors.

5. Insert the wires into the terminals as shown in **Figure 7-29** and tighten the terminal screws securely using a tightening torque of 18–20.5 Lbf-inch (2–2.3Nm).

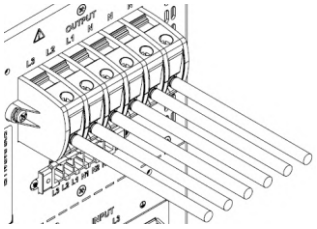


Figure 7-29: Inserting the Load Wires

CAUTION

For high current outputs, it is particularly important to make the output connections properly and follow the instructions. Improper connections may result in excessive temperature rise or power source going into protection mode.

7.6.8 Grounding Outputs

Either the Line (L) or Neutral (N) terminal may be grounded (although it is not recommended to connect the Line (L) terminal to ground).To avoid noise problems caused by common-mode current flowing from the load to ground, it is recommended to ground the output terminal as close as possible to the power source chassis ground. Always use two wires to connect the load to the power source, regardless of how the system is grounded. **Do not** rely on the ground to power the load.

7.7 Local and Remote Sensing

Dangerous voltages are present within the unit. Some components inside the unit are at AC voltage even when the ON/OFF switch is in the OFF position. To avoid potential shock hazard, disconnect the AC cord and load, discharge circuits, remove external voltage sources, and wait for 2 minutes before making any rear panel connections.

Use cables with the appropriate voltage and temperature ratings to ensure safe, reliable operation.

Hazardous voltages exist at the sense terminals. Remote sense wires should have a minimum insulation rating equal to or greater than the maximum output voltage of the power source.

Ensure that the connections at the sense end are shielded to prevent accidental contact with the hazardous voltages.

To protect personnel against accidental contact with the hazardous voltages, ensure that the sense and its connections have no accessible live parts.

Ensure that the protection of the sense connector is properly assembled.

CAUTION

Ensure that the sense wiring mounting hardware **does not** short the sense terminals. Cables must have some form of strain relief to prevent loosening of the connections.

CAUTION

It is forbidden to solder the conductors. The solder tin yields and fractures under high pressure. The result is an increased contact resistance and an excessive temperature rise. In addition, corrosion caused by pickling or fluxes has been observed on soldered conductor ends. Notch fractures at the transition point from the rigid to the flexible conductor area are also possible.

NOTE

Output Wires No Conductor Pretreatment: All kinds of copper conductors can be clamped without pretreatment (solid, flexible, with ferrule, with or without plastic sleeve).

7.7.1 Local Sensing

The power source is shipped with a local-sense configuration. In this configuration, the unit is sensing the output voltage at the output terminals. This method does not compensate for the voltage drop on the load wires. Therefore, this configuration is recommended only for low-load current applications or where the load regulation is less critical.

7.7.2 Remote Sensing

Use remote sense where the load regulation at the load end is critical. In remote sense, the unit compensates for voltage drop on the load wires. Ensure that the voltage drop on the load wires does not exceed (typically) 35Vrms/50Vpk in AC and ACDC mode, or 35Vdc in DC mode. The voltage drop is subtracted from the total voltage available at the output.

7.7.3 Sense Wires

CAUTION

Reversing the sense wires might cause damage to the power source.

When using shielded sense wires, ground the shield in one place only. The location can be the unit chassis or one of the output terminals if either of the output terminals is grounded.

NOTE

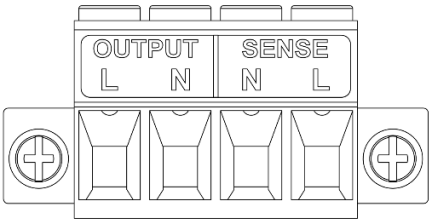
To ensure correct operation in remote sense mode, ensure that the voltage drop on the load wires meets product specifications.

Recommended Wires (Stranded Copper) (Ferrules with Plastic Sleeves)	
(mm^2)	**(AWG)**
1.5 (per conductor)	16 (per conductor)

Table 7-11: Recommended Wire Size—Sense

7.7.4 Sense Connection (2kVA, 3kVA, and 4kVA)

The two right terminals in the output connector can be used for remote sensing of the output voltage.



1. Prepare suitable wires according to the recommendation in **Table 7-11**.
2. Follow steps 2 to 6 indicated in **Section 7.6.7.1: Load Connection for 2kVA, 3kVA, and 4kVA**.
3. Connect Sense line (SENSE L) from the power source to Sense line of the load.
4. Connect Neutral line (SENSE N) from the power source to Neutral line of the load.
5. Fix the output cover using 2 screws (WN1412(KA30X8)) provided with the power source; refer to **Figure 7-22**. Use a tightening torque of 5.2 lbf-inch (0.58Nm).
6. Ensure that all connections are securely tightened.
7. Turn ON the power source.
8. Set voltage sense setting to remote sense via front panel or communication.

7.7.5 Sense connection (6kVA, 9kVA, 9kVA PWR, 12kVA, 12kVA PWR, 18kVA, and 24kVA)

Refer to **Figure 7-30** for a view of the sense connector.

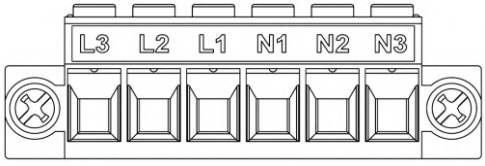


Figure 7-30: Sense Connector

1. Prepare suitable wires according to the recommendation in **Table 7-11**.
2. Ensure that the power source is turned OFF and the AC cable is disconnected from any electrical potential before making any connection.
3. Strip approximately 10 mm of insulation from each wire.
4. Attach ferrules to each of the stripped wires.

NOTE

It is recommended to add ferrules to the sense conductors so that there is no possibility of contact between the conductors.

5. Insert the wires into the terminals as shown in **Figure 7-31** and tighten the terminal screws securely using a tightening torque of 6.2–7.1 lbf-inch (0.7–0.8Nm).

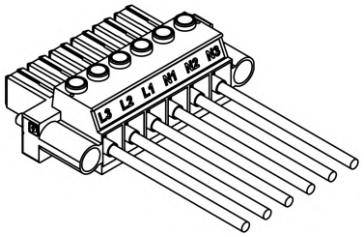


Figure 7-31: Inserting the Sense Wires

6. Tighten the connector to the power source rear panel as shown in **Figure 7-32** using a tightening torque of 3–6 Lbf (0.3–0.7Nm). 6kVA is shown as an example.

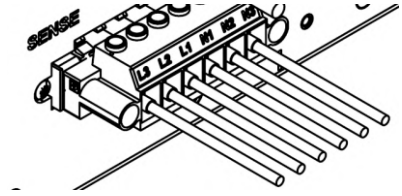


Figure 7-32: Tightening the Connector to the Power Source

7. Connect Sense line (SENSE L) from the power source to Sense line of the load.
8. Connect Neutral line (SENSE N) from the power source to Neutral line of the load.
9. **For 6kVA / 9kVA / 9kVA PWR / 12kVA / 12kVA PWR only**: Fix the output cover using 2 screws (WN1412(KA30X8)) provided with the power source; refer to **Figure 7-33**. Use a tightening torque of 5.2 lbf-inch (0.58Nm). Refer to **Figure 7-34** for the final assembly.

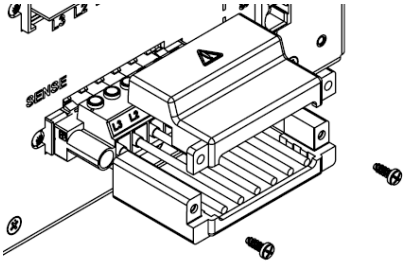


Figure 7-33: Fixing the Sense Cover

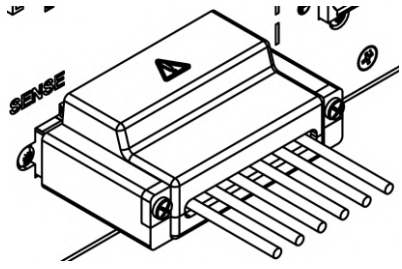


Figure 7-34: Final Assembly

10. Ensure that all connections are securely tightened.

11. Turn ON the power source.
12. Set voltage sense setting to remote sense via front panel or communication.

7.7.6 Load Connection Options (2kVA, 3kVA, and 4kVA)

7.7.6.1 Single Load, Local Sense (Default)

Figure 7-35 shows recommended load connection for a single load. This connection is for local sensing mode. Therefore, this configuration is recommended only for low-load current applications or where the load regulation is less critical.

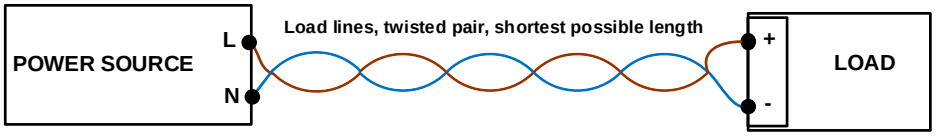


Figure 7-35: Single Load, Local Sensing

7.7.6.2 Single Load, Remote Sense

Figure 7-36 shows recommended remote sensing connection for single loads. Remote sensing is used when the load regulation is important at the load terminals. Use twisted or shielded wires to minimize noise pick-up. If shielded wires are used, the shield should be connected to the ground at one point, either at the power source chassis or the load ground. The optimal point for the shield ground should be determined by experimentation.

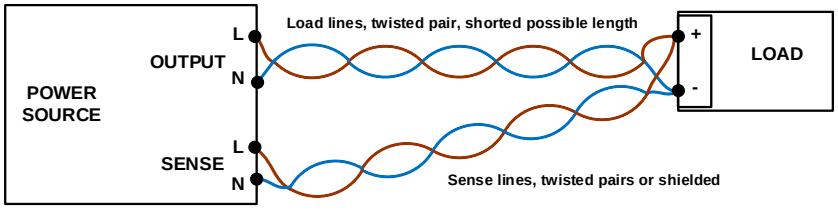


Figure 7-36: Single Load, Remote Sensing

7.7.6.3 Multiple Loads, Radial Distribution, Local Sense

Figure 7-37 shows multiple loads connected to one power source. Each load should be connected to the power source output terminals using separate pairs of wires. It is recommended that each pair of wires be as short as possible and twisted or shielded to minimize noise pick-up and radiation.

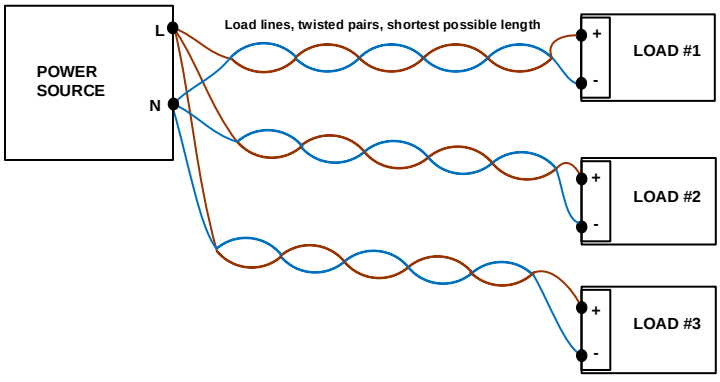


Figure 7-37: Multiple Loads, Radial Distribution

7.7.6.4 Multiple Loads, Distribution Terminals

If remotely located output distribution terminals are used, the power source output terminals should be connected to the distribution terminals by a pair of twisted and/or shielded wires. Each load should be separately connected to the remote distribution terminals (refer to **Figure 7-38**).

If remote sensing is required, the sensing wires should be connected to the distribution terminals or at the most critical load.

In remote sense, the power source compensates for voltage drop on the load wires.

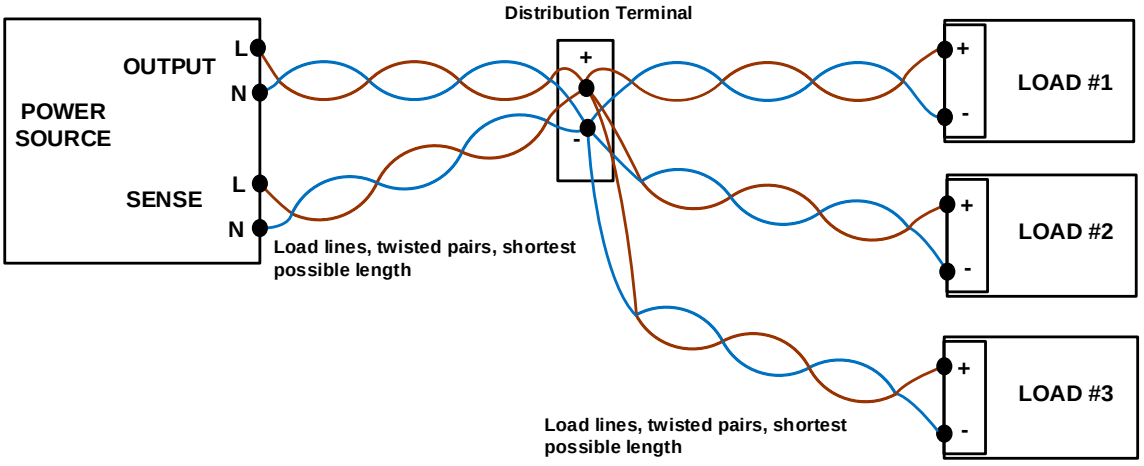


Figure 7-38: Multiple Loads, Distribution Terminals

7.7.7 Load Connection Options (6kVA, 9kVA, 9kVA PWR, 12kVA, 12kVA PWR, 18kVA, and 24kVA)

7.7.7.1 Single Phase, Local Sense

Figure 7-39 shows recommended load connection for a single-phase configuration. This configuration is for local sensing mode only. Therefore, this configuration is recommended only for low-load current applications or where the load regulation is less critical.

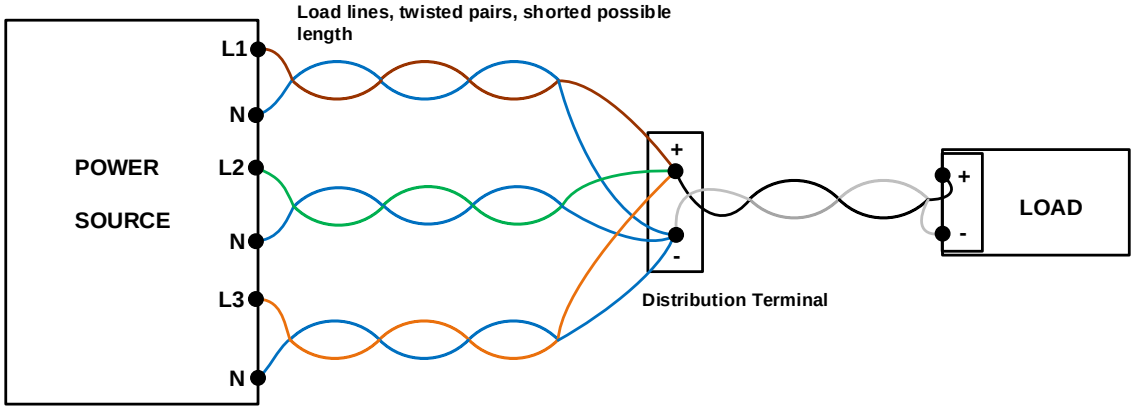


Figure 7-39: Single Phase, Local Sense

7.7.7.2 Three Phase, Local Sense

Figure 7-40 shows recommended load connection for a three-phase configuration. This configuration is for local sensing mode only and hence is recommended only for low-load current applications, or where the load regulation is less critical.

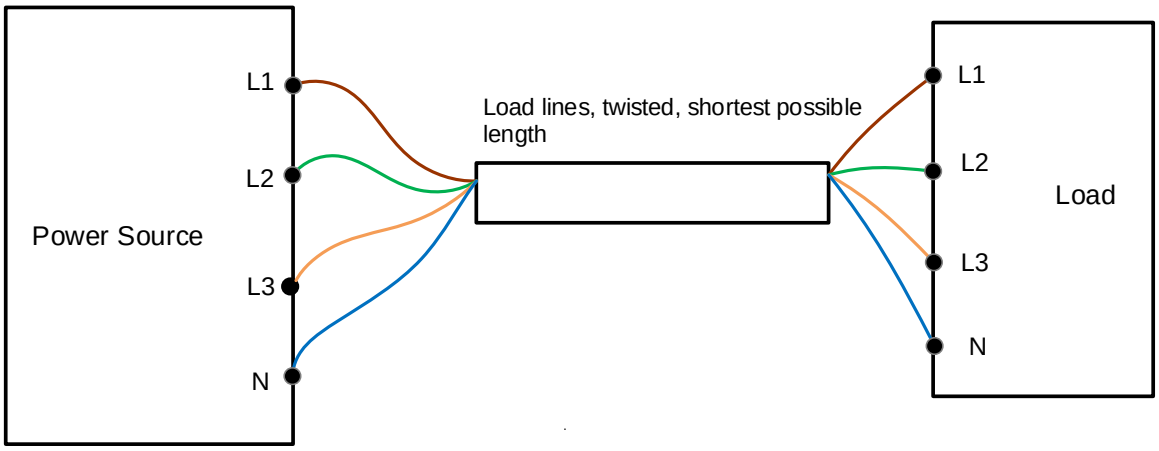


Figure 7-40: Three Phase, Local Sense

7.7.7.3 Single Phase, Remote Sense

Figure 7-41 shows recommended remote sensing connection for single loads. Remote sensing is used when the load regulation is important at the load terminals. Use twisted or shielded wires to minimize noise pick-up. If shielded wires are used, the shield should be connected to the ground at one point, either at the power source chassis or the load ground. The optimal point for the shield ground should be determined by experimentation.

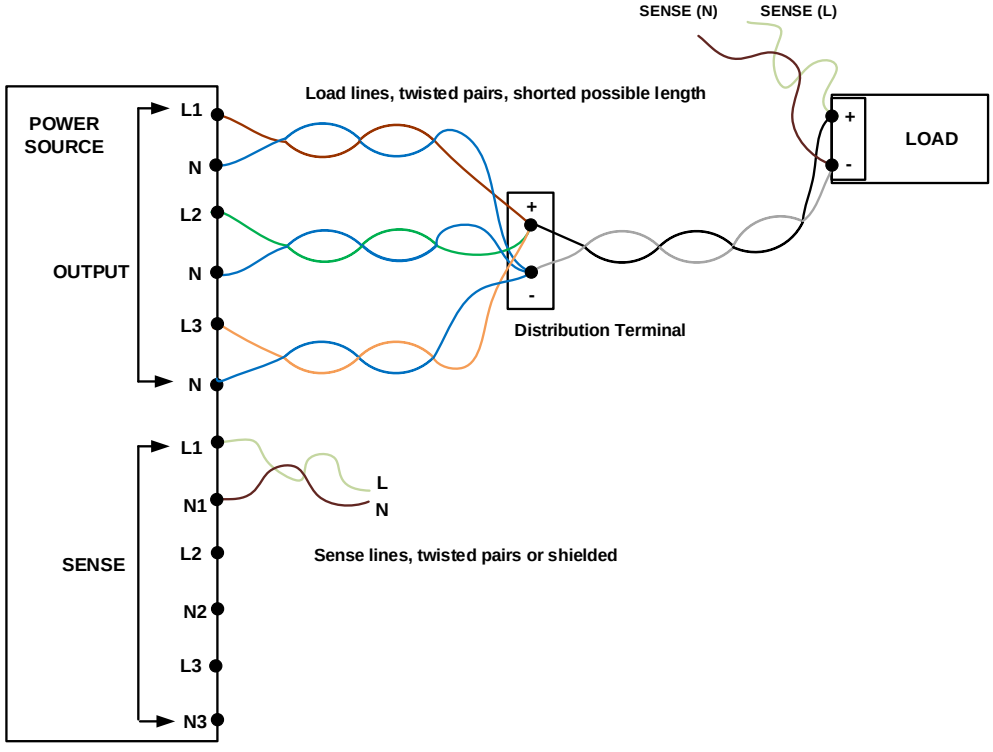


Figure 7-41: Single Phase, Remote Sense

CHAPTER 8: REAR PANEL CONNECTORS

8.1 Serial RS232 and RS485 Connector (J1)

RS232 and RS485 communications can be performed through a single RS232 and RS485 connector on the rear panel. The connector type is female D-Sub type DB9, and it is referenced to COMMON.
RS232 configuration allows optional Request to Send (RTS) and Clear to Send (CTS) Hardware Flow Control.
RS485 configuration allows for full-duplex communication, and 485 termination can be enabled or disabled.



Figure 8-1: RS-232 and RS-485 Connector

Refer to **Table 8-1** for the pinout of the RS232 part and **Table 8-2** for the pinout of the RS485 part.

Pin no.	Name	Signal Name
1	NC	Not Connected
2	Tx	Transmit Data
3	Rx	Receive Data
4	NC	Not Connected
5	COMMON	COMMON
6	NC	Not Connected
7	CTS	Clear to Send
8	RTS	Request to Send
9	NC	Not Connected

Table 8-1: Pinout of the RS232 Connector

Pin no.	Name	Signal Name
1	TxD+	Transmit Data (+)
2	NC	Not Connected
3	NC	Not Connected
4	RxD-	Receive Data (-)
5	COMMON	COMMON
6	TxD-	Transmit Data (-)
7	NC	Not Connected
8	NC	Not Connected
9	RxD+	Receive Data (+)

Table 8-2: Pinout of the RS-485 Connector

NOTE

Combined 232 and 485 connection can also be done on the same connector.

Refer to **Section 10.2: Programming with RS232 and RS485 Communication** for setting up the RS232 and RS485 communication.

8.2 USB Connector (J2)

USB communication can be performed through the USB connector on the rear panel.
The connector type is type-B, and it is referenced to COMMON.



Figure 8-2: USB Connector

The USB communication supports USB 2.0 (Full Speed).
Refer to **Section 10.3: Programming with USB** to install the USB driver and set up USB communication.

8.3 LAN Connector (J3)

8.3.1 Introduction

LAN communication can be performed through the LAN connector on the rear panel. The connector type is RJ-45, and it is referenced to COMMON.
A computer web browser can be used to operate the power source through a built-in web server. For applications, including factory and test automation, communication is made using several standard network protocols and instrument commands.
Refer to **Section 10.4: Programming with LAN** for the specifications and setting up the LAN communication.

8.3.2 LAN Connector Features

- Ethernet RJ-45 type (standard 8-pin)
- Green and Amber LEDs on the connector

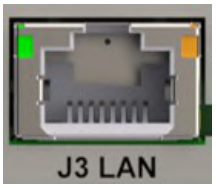


Figure 8-3: LAN Connector

8.3.3 LAN Connector Electrical Specifications

Ethernet	Meets IEEE 802.3u specifications.
Auto-MDIX	Accepts a patch or a cross-over cable connection.
Auto-Negotiate	Supports half and full duplex operation. Selects the fastest of 10Base-T or 100Base-T networks. (10 or 100 Megabits per second).

8.4 Remote Programming and Logic Control Connector (J4)

A female D-Sub DB26HD connector is located on the rear panel for remote programming and logic controls. Refer to **Figure 8-4** and **Table 8-3** for the pinout of the connector.



Figure 8-4: Remote Programming and Logic Control Connector

Pin no.	Signal Name	Signal Function
1	CV/CC Signal	Open collector output signal for indicating the operating mode: Constant Voltage or Constant Current
2	Power Source OK Signal #2	Push-pull output signal to indicate the output status: ON or OFF
3	Power Source OK Signal #1	Open collector output signal to indicate the output status: ON or OFF
4	Trigger In #1	Trigger input to start triggered sequencer operations
5	Local/Remote Analog Monitor	Output signal for indicating the operating mode: local (digital) or remote (analog)
6	Local/Remote Analog Enable	Input signal for selecting the programming mode: local (digital) or remote (analog)
7	Trigger Out #2	Captured measurement data is ready
8	Voltage Monitor	Output signal for monitoring the output voltage
9	Voltage Programming	Input signal for programming the output voltage
10	ENABLE IN	Enables or disables the output through dry contact or an external voltage source
11	COMMON	COMMON. Return for all signals.
12	COMMON	COMMON. Return for all signals.
13	COMMON	COMMON. Return for all signals.
14	NC	Not Connected
15	NC	Not Connected
16	NC	Not Connected
17	COMMON	COMMON. Return for all signals.
18	COMMON	COMMON. Return for all signals.
19	INTERLOCK IN	Enables or disables the output through dry contact or an external voltage source
20	Programmable Pin #2	General purpose open drain port
21	Programmable Pin #1	General purpose open drain port
22	Trigger In #2	Trigger input to start triggered measurements
23	Trigger Out #1	Trigger output to trigger other equipment
24	AC-OK Signal	Open collector output signal for indicating the status of the AC input
25	Alarm Signal	Open collector output signal for indicating that a fault has occurred
26	Current Monitor	Output signal for monitoring the output current

Table 8-3: Remote Programming and Logic Control Connector

CAUTION

It is prohibited to connect any of the NC (Not Connected) pins to any of the signals or to any potential.

NOTE

All signals (except NC (Not Connected) pins) on the J4 connector are referenced to COMMON.

CAUTION

To prevent ground loops and to maintain the isolation of the power source when programming from J4, it is recommended to use an ungrounded programming source only.

Refer to **CHAPTER 11: CONFIGURING THE J4 CONNECTOR** for detailed explanation of the pins and setting them up for their operation.

8.5 Emergency Power OFF (EPO) Connector (J5)

The Emergency Power OFF (EPO) signal, also known as ESTOP, quickly disconnects the output from the power source. This protects the end equipment in the event of an emergency. This connector is referenced to COMMON.



Figure 8-5: Emergency Power OFF (EPO) Connector

WARNING

The Emergency Power OFF (EPO) signal disconnects only the output and does not disconnect the unit from the AC mains.

The power source output can be enabled or disabled through a dry contact or an electrical signal.
Refer to **Section 9.4.3: Protection Menu** to enable or disable the EPO function from the front panel.
Refer to **Section 14.13.5: Output Subsystem** to enable or disable the EPO function with a communication command.

EPO Function	Connector Pin	Power Source Output
0/OFF (disabled)	Open or Short	ON
1/ON (enabled)	Open or 2–30V	OFF
	Short or 0–0.6V	ON

Table 8-4: Emergency Power OFF (EPO) Settings

NOTE

If the EPO function is disabled, the connection has no effect, and the output always remains ON.

8.6 Trigger Out Connector (J6)

A BNC-type connector is located on the rear panel for the trigger out signal. This signal can be used to trigger other equipment. This signal is user selectable, and there are four trigger out modes.
The connector is referenced to COMMON.



Figure 8-6: Trigger Out Connector

This connector provides the same function as the J4-23 pin on the J4 connector.

8.7 Voltage Monitor Connector (J7)

A BNC-type connector is located on the rear panel for output voltage monitoring.
The connector is referenced to COMMON.



Figure 8-7: Voltage Monitor Connector

This connector provides the same function as the J4-8 pin on the J4 connector**.**

8.8 GPIB Interface Connector (J8)



Figure 8-8: GPIB Interface Connector

General Purpose Interface Bus (GPIB, also referred as IEEE), factory installed as an option, allows operation of the power source from a controller or computer via IEEE-488.
Communication over the GPIB interface is compliant with the IEEE 488.2 standard for Programmable Instrumentation (SCPI).

8.9 Parallel Connectors (J9 and J10)

These connectors can be used to increase the output power per phase and can also be used to setup a multi-phase system.



Figure 8-9: Parallel Connectors

The output of these connectors can generate hazardous energy. In standalone units, the protective covers are not to be removed. If a parallel setup is prepared, the GAC/P parallel kit must be used, and a cable connection must be made between the master (J9) and slave (J10) unit.

Parallel connection must be made using the GAC/P parallel kit only. The cable included in the kit must be used, and it must also be covered with the plastic parts included in the kit. Refer to **Section 18.3.1: System Assembly**.

8.10 Reset Button

The Reset button resets the power source to its default settings.
Refer to **Table 13-1** for the default values.
Press and hold the **Reset** button for up to 5 seconds to perform the reset and restore default settings (Reset column in the table).
Press and hold the **Reset** button for 5 to 10 seconds to perform the reset and restore factory default settings with communication set to USB (Factory Reset column in the table).

NOTE

The power source ON/OFF switch must be set to the ON position for the reset function to operate.

CHAPTER 9: FRONT PANEL DISPLAY, BUTTONS, AND NAVIGATION

9.1 Introduction

This chapter explains how to navigate the front panel of the Genesys Series Programmable AC Power Source. The front panel is one of the ways to control the power source. Controlling, setting, and monitoring can be done through either the touch-screen display or the set of buttons to the right of the display. The touch screen display and buttons are not applicable for blank panel units and PWR units.

CAUTION

Do not apply excessive pressure or use sharp objects while working with the front panel. It may damage the touch-screen display.

9.2 The Dashboard Screen

At power-on, the display shows the **TDK-LAMBDA** logo as the opening screen, followed by the dashboard screen. The details on the dashboard screen may vary depending on the condition and settings of the power source.



Figure 9-1: Opening Screen

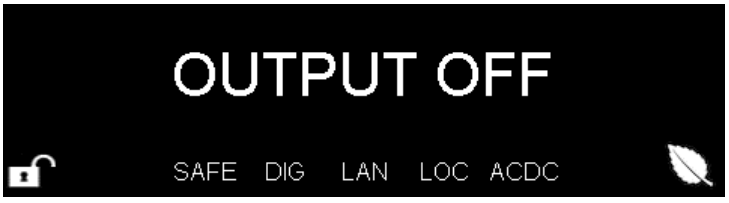


Figure 9-2: Dashboard—Output OFF



Figure 9-3: Dashboard—Output ON (Single Phase)

As an example, the screen in **Figure 9-3** displays the voltage, current, and frequency, and indicates the following modes of operation: Constant-Voltage, safe, digital control (front panel or communication), LAN communication, local, and ACDC. It also indicates that the front panel is in locked mode.

Considering a three-phase unit, the screen in **Figure 9-4** displays the voltage, current, and frequency of Phase 1 (#1), Phase 2 (#2) and Phase 3 (#3).



Figure 9-4: Dashboard—Output ON (Three Phase) (System Master Unit)

The dashboard screen offers an alternate method for changing some operating parameters.
The parameters can be changed by tapping on the icons shown in **Table 9-1**.

Icon	Mode	Reference
	Front Panel Lock/Unlock	Refer to **Section 9.4.7: Display Menu**.
	ECO Mode	Refer to **Section 9.4.6: System Menu**.
	Safe/Auto Start Mode	Refer to **Section 9.4.3: Protection Menu**.
	External Control Mode	Refer to **Section 9.4.5: Configuration Menu**.
	Communication Mode	Refer to **Section 9.4.4: Interface Menu**.
	Local/Remote Mode	Refer to **Section 9.4.7: Display Menu**.
	Operation Mode	Refer to **Section 9.4.1: Output Settings Menu**.

Table 9-1: Front Panel Icons

9.3 Menu Navigation

When the dashboard is displayed, the HOME screen opens by tapping the dashboard or clicking any button on the right side of the touch-screen display. It is made up of three pages, as shown in **Figure 9-5,** and contains a total of nine main menus.

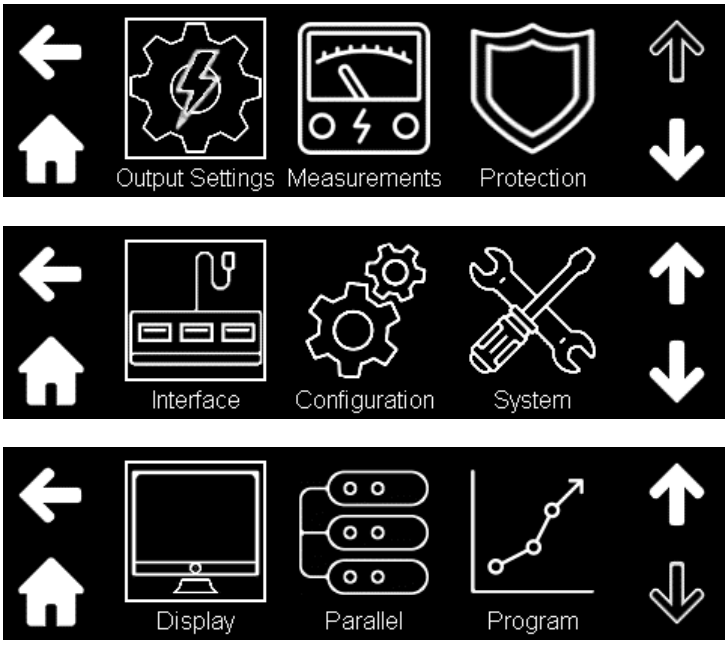


Figure 9-5: Main Menus

NOTE

Main menu **Parallel** is displayed only when a parallel setup is present.

Each main menu may contain various levels of sub-menus. The main menus and sub-menus can be navigated using either the touch-screen display or the set of buttons on the right side of the display.
A square selection box always highlights the menu and sub-menu. In **Figure 9-6,** the selection box can be seen around **Output Settings** menu**.** In **Figure 9-7**, the selection box can be seen around **Voltage** which is a sub-menu under **Output Settings** menu**.**

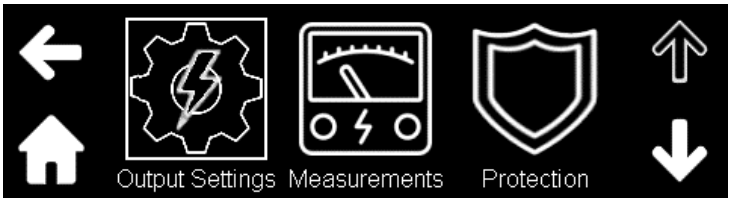


Figure 9-6: Highlighted Main Menu

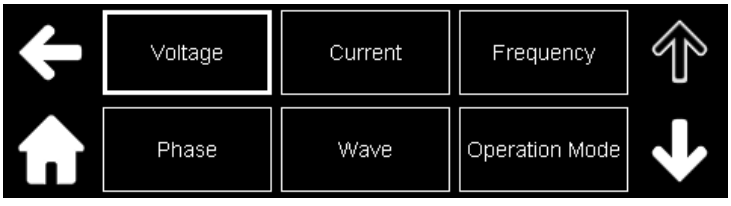


Figure 9-7: Highlighted Sub-Menu

9.3.1 Representation of Buttons and Icons

Table 9-2 and **Table 9-3** describes how the buttons and icons on the front panel are represented in the sections to follow.

Button	Representation
	**RETURN**
	**OUT**
	**NAVIGATION PANEL**
	**LEFT, RIGHT, UP, and DOWN buttons on the NAVIGATION PANEL. RIGHT button is shown as an example.**

Table 9-2: Representation of Front Panel Buttons

Icon	Representation
	**UP**
	**DOWN**
	**LEFT**
	**HOME**
	**BACK**
	**ENTER**
	**LOCK/UNLOCK**
All icons on the menus and sub-menus - Ex - 	**Represented in text (bold).** **Example** - Click **Voltage**

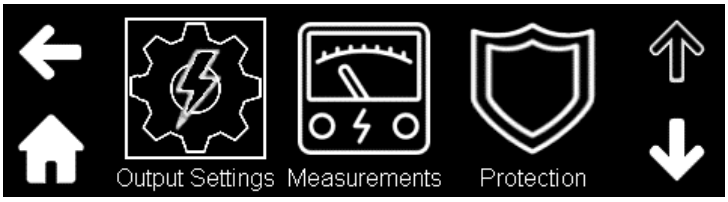
Table 9-3: Representation of Touch-Screen Display Icons

9.3.2 Navigation using the Touch-Screen Display

The touch-screen display allows the user to configure and operate the unit using various menus and sub-menus.

By tapping anywhere on the dashboard, the HOME screen is displayed. The pages on this screen are indicated with a **UP** and a **DOWN** icon. The highlighted **UP** or the **DOWN** icon indicates that there are additional pages. An un-highlighted icon indicates the end of the pages.

Each of these pages has main menus. One of the pages is shown below.



All pages on the HOME screen also have the following:

LEFT icon and **HOME** icon. These icons allows the user to go back to the dashboard.

Tap on any main menu to enter the sub-menu screen. The sub-menu of **Output Settings** is shown below.

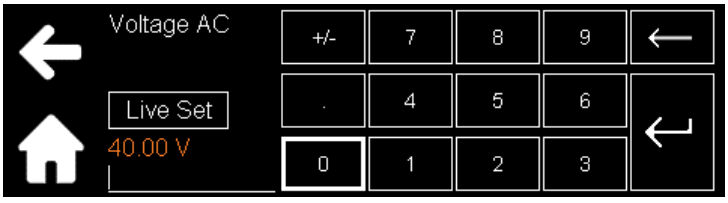




Some sub-menus have button and/or box icons for selecting the parameters, while others have entry fields. For sub-menus with button or box icons, tap on the required parameter for its selection. The parameters of **Operation Mode** with button icon is shown below.



For sub-menus that have entry fields, a keypad can be used to enter numerical values, decimal points, and polarity keys. The keypad for setting **Voltage** is shown below.



The **BACK** icon erases the last entry. The **ENTER** icon selects the entry.

These type of sub-menus also have the following:

LEFT icon: This button allows the user to go back one screen.

HOME icon: This button allows the user to return to the dashboard.

9.3.3 Navigation using the Front Panel Buttons

Alternatively, the buttons on the right of the touch-screen display can also be used to configure and operate the unit.

From the dashboard, the HOME screen can be accessed by clicking any button on the right of the touch-screen display. Use the **NAVIGATION PANEL** to move across the pages and across the main menus/sub-menus and select the main menu/sub-menus by clicking **OK**.

For selecting the required parameter under the sub-menus that have button and/or box icons, move to the required parameter using the **NAVIGATION PANEL,** and select it by clicking **OK**.

For sub-menus that have entry fields, move to the required numerical values, decimal point, and polarity keys using the **NAVIGATION PANEL** and select them with **OK**. Multiple selections of the same value can be achieved by re-pressing **OK**. The final selection is done by moving to the **ENTER** icon and pressing **OK** on the **NAVIGATION PANEL**.

RETURN allows to go back one screen.

9.3.4 Main Menu and Sub-menu Structure

Table 9-4 provides a short explanation of the different menus and sub-menus available on the front panel display. Detailed explanation is further available in different sections that follow.

Page No.	Menu	Sub-Menus
Page-1	Output Settings	Setting of the AC voltage, DC voltage, current limit, and frequency Setting of the phase ON and phase OFF angle of the output waveform Selection of the type of waveform Selection of the operating mode Selection of the turn-on priority mode (CV/CC)
	Measurements	Measurements: • Output voltage, current, their harmonics, and their Total Harmonic Distortion (THD) • Maximum and minimum instantaneous current, and Crest Factor • Frequency • Real, Apparent, and Reactive Power, and Power Factor Display the triggered measurements of harmonics of output voltage and current as per the trigger settings Displays the real-time waveform of output voltage and current
	Protection	Setting the protection levels: • Over-Voltage Protection (OVP) and Under-Voltage Protection (UVP) • Over-Current Protection (OCP) and Over-Power Protection (OPP) Selection of the start-up mode Setting of the foldback mode and delay Setting of Enable (ENA), Interlock (ILC), and Emergency Power OFF (EPO) functions Setting of the drop on wire for remote sense

Page No.	Menu	Sub-Menus
Page-2	Interface	Selection of the communication type and its configuration: • USB • LAN • RS232 • RS485 • GPIB Display the working parameters of the selected communication type
	Configuration	Create and load waveforms based on the built-in waveforms Setting of the slew rate of AC, DC, and frequency Selection of different types of external programming and monitoring, and monitoring range Setting of the programmable external pins Balancing of the output voltage Setting of the trigger out signals Setting the PS_OK (Power Source OK) delay
	System	Display the power source information Selection of the sense type Save and recall working profiles Select the power-saving mode Allow factory reset and basic reset Set the startup profile
Page-3	Display	Setting of the display brightness, dimming brightness, and dimming delay Selection of the display mode Selection of the on-screen language Setting of the time taken to return from the menus and submenus to the dashboard if no activity takes place Lock/unlock the front panel Enabling or disabling the touch screen Testing and flashing the display
	Parallel	Selection of the number of phases Setting the phase shift angle between the phases
	Program	Programming different types of AC, ACDC, and DC sequencers Selecting the trigger source and trigger delay for triggering the sequencers Storing the sequencer values in the memory. Loading the sequencer values from the memory Aborting the sequencers to a user defined state Setting the phase shift angle during sequencer operation

Table 9-4: Menu and Sub-Menus Screen

9.4 Menu Diagrams and Description

Table 9-5 indicates the different icons that are used in the front panel menu diagrams.

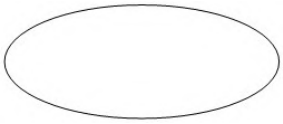
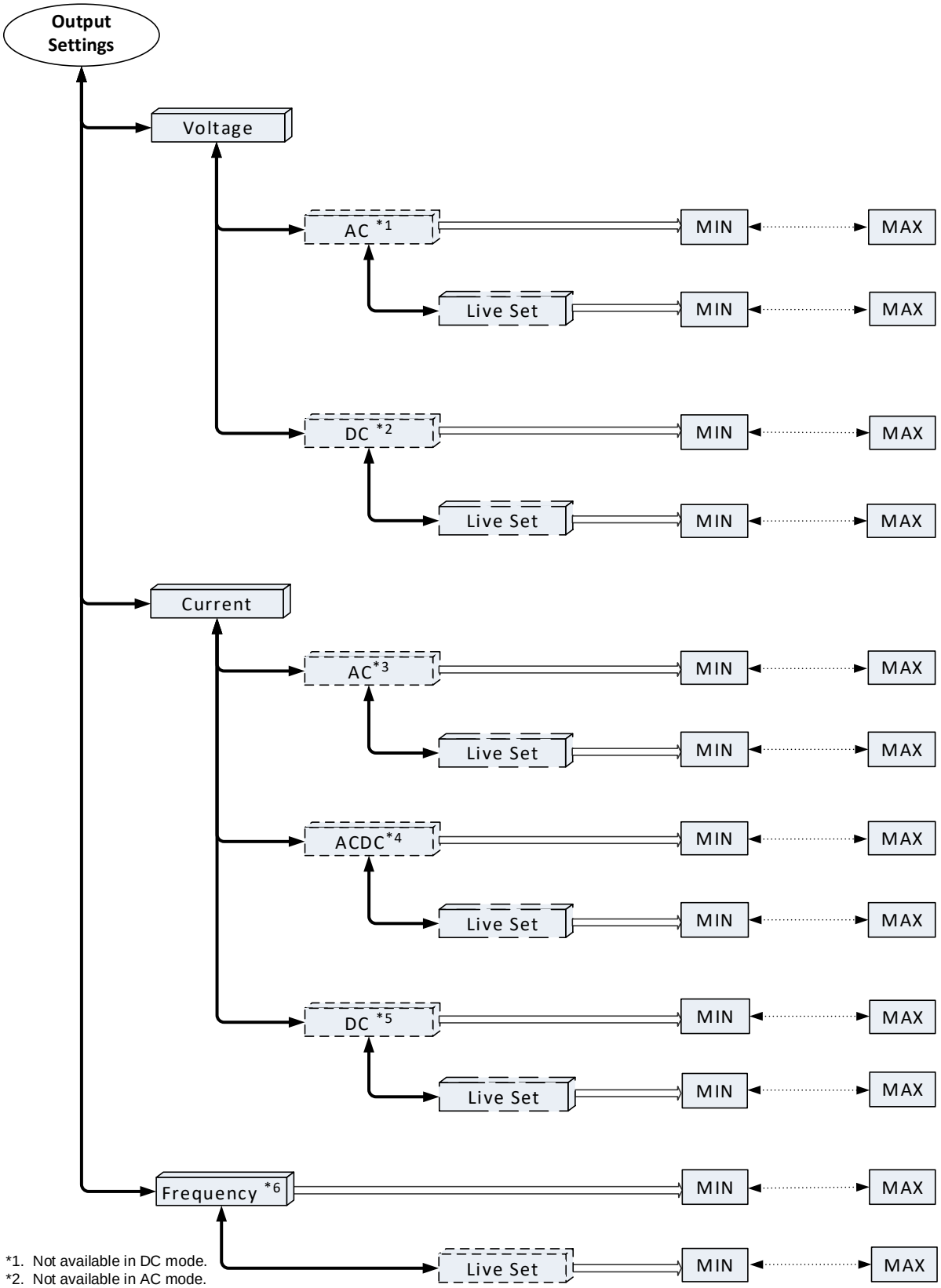
	**Main Menu**
	**Sub-menu (Level 1)**
	**Sub-menu (Level 2)**
	**Sub-menu (Level 3)**
	**Sub-menu (Level 4)**
	Sub-menu (Level 5)
	**Enter Values**
	**Select Parameters**
	**View/Read**

Table 9-5: Icons used in the Front Panel Menu Diagrams

Each main menu can be accessed from the HOME screen in two ways:

- Using the **UP** or **DOWN** icon on the touch-screen display and tapping on the required menu.
- Using the **NAVIGATION PANEL** to move to the required menu and clicking **OK**.

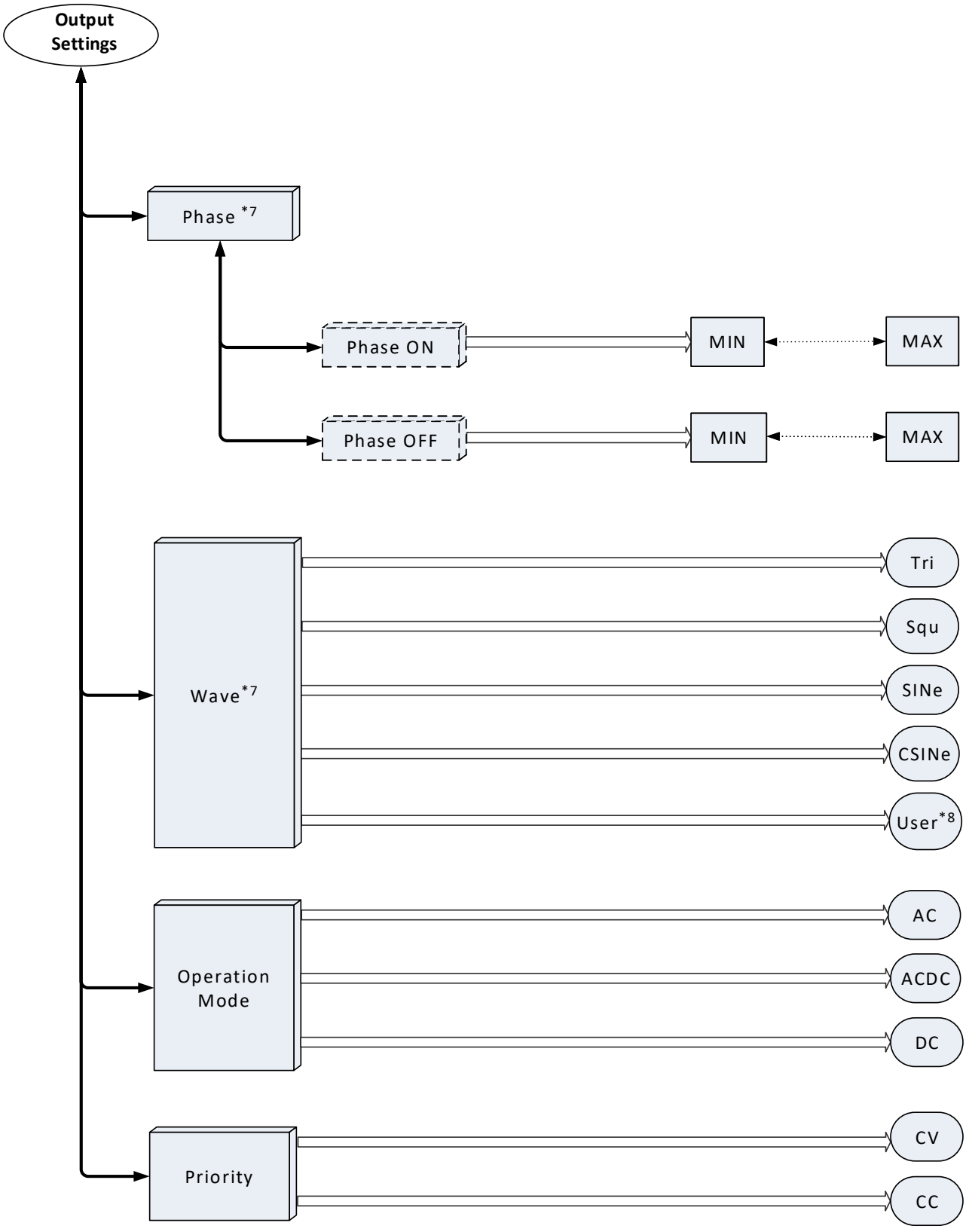
9.4.1 Output Settings Menu



*1. Not available in DC mode.
*2. Not available in AC mode.
*3 Not available in ACDC and DC mode.
*4. Not available in AC and DC mode.
*5. Not available in ACDC and AC mode.
*6. Not available in DC mode.

NOTE: All sub-menus under Voltage and Current sub-menus also have a Phase selection button if a multi-phase unit is set up.

OUTPUT SETTINGS - CONTINUED



*7. Not available in DC mode.
*8 Multiple waveforms.
NOTE: Wave sub-menu also has a Phase selection button if a multi-phase unit is set up.

After selecting **Output Settings**, the sub-menus appear. The windows for a power source in AC and ACDC mode are shown below.





NOTES

Refer to **Table 14-10** for the programming parameters of voltage, current, and frequency.

Refer to **Section 14.13.5: Output Subsystem** for the programming parameters of phase angle.

NOTE

Frequency programming, phase angle programming, and wave selection are not available in DC mode.

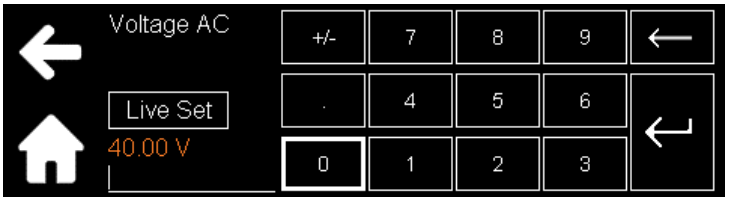
Voltage

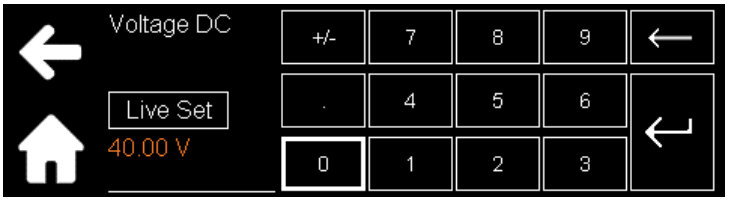
Click **Voltage**.

The window for voltage programming in ACDC mode is shown below.



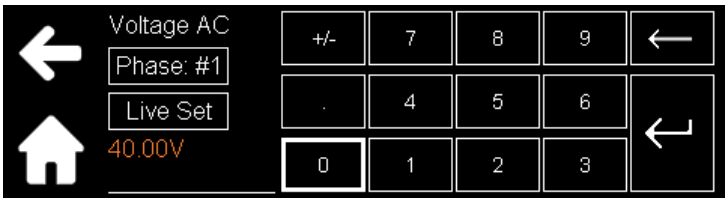
Click **AC** to program the AC component of the output voltage and/or **DC** to program the DC offset of the output voltage.





The DC offset can be set to a positive or negative value.

If a multi-phase unit is set up, the programming window for sub-menus under **Voltage** also includes a phase selection button. The window with the phase selection button for voltage programming in AC mode is shown below.



Phase: #1: By clicking **Phase: #1**, a screen opens that allows the user to select the phase.

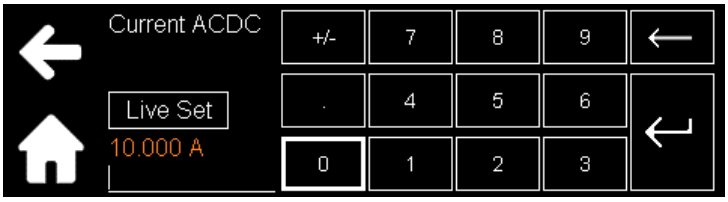


The value can be applied to each phase individually or to all phases simultaneously.

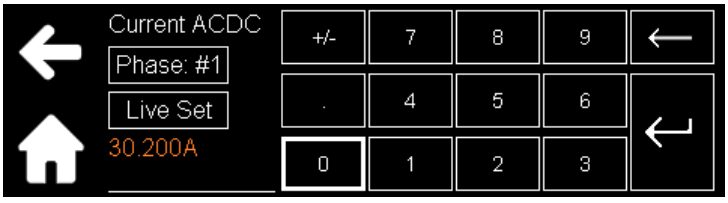
Current

Click **Current**.

The window for current programming in ACDC mode is shown below.

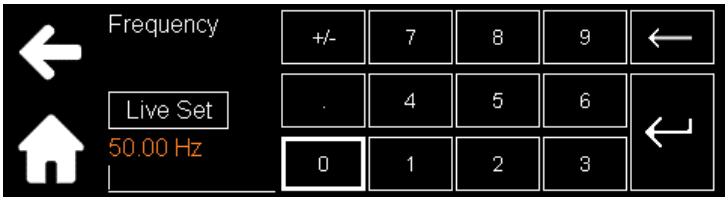


If a multi-phase unit is set up, the programming window for sub-menu under **Current** also includes a phase selection button. The window with the phase selection button for current programming in ACDC mode is shown below.



Frequency

Click **Frequency**.



The programming window for sub menus under **Voltage** as well as the programming window for **Current** and **Frequency** also include the following setup option:

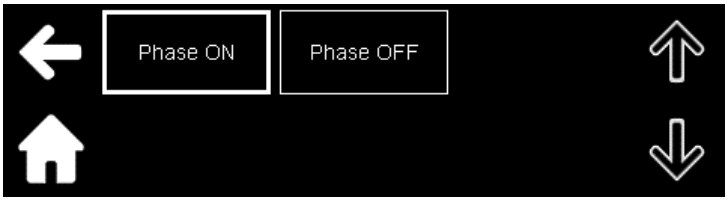
Live Set: By clicking **Live Set**, a screen opens that allows the user immediate value changes.



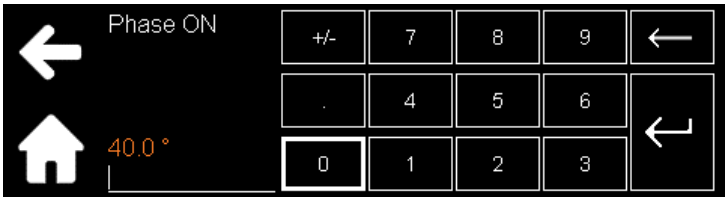
This screen allows the user to change the value per digit. Use the **LEFT** or **RIGHT** button on the **NAVIGATION PANEL** to move to the required digit. Press the **UP** or **DOWN** button on the **NAVIGATION PANEL** once to change the value in single steps, or hold it down to scroll continuously.

Phase

Click **Phase**.



The window to set the phase ON angle is shown below.



Wave

Displays the names of the built-in waveforms (TRIangle, SQUare, SINe, and CSINe) and all the waveforms that were created by the user using function name (FnName) as a parameter; refer to **Section 14.13.6: Function Subsystem**.

Click **Wave**.



The names displayed depend on the waveform region selected; refer to **Section 9.4.5: Configuration Menu** or to [FUNCtion:]WAVeform:REGion <NR1> in **Section 14.13.6: Function Subsystem**. TRIANGLE, SQUARE, SINE, and CSINE are available in all regions.

If a multi-phase unit is set up, the programming window for **Wave** also includes a phase selection button.



Operation Mode

Three operation modes are available: AC, DC, and ACDC.



NOTES

If the operation mode is changed while the output is ON, an **invalid command** message appears.

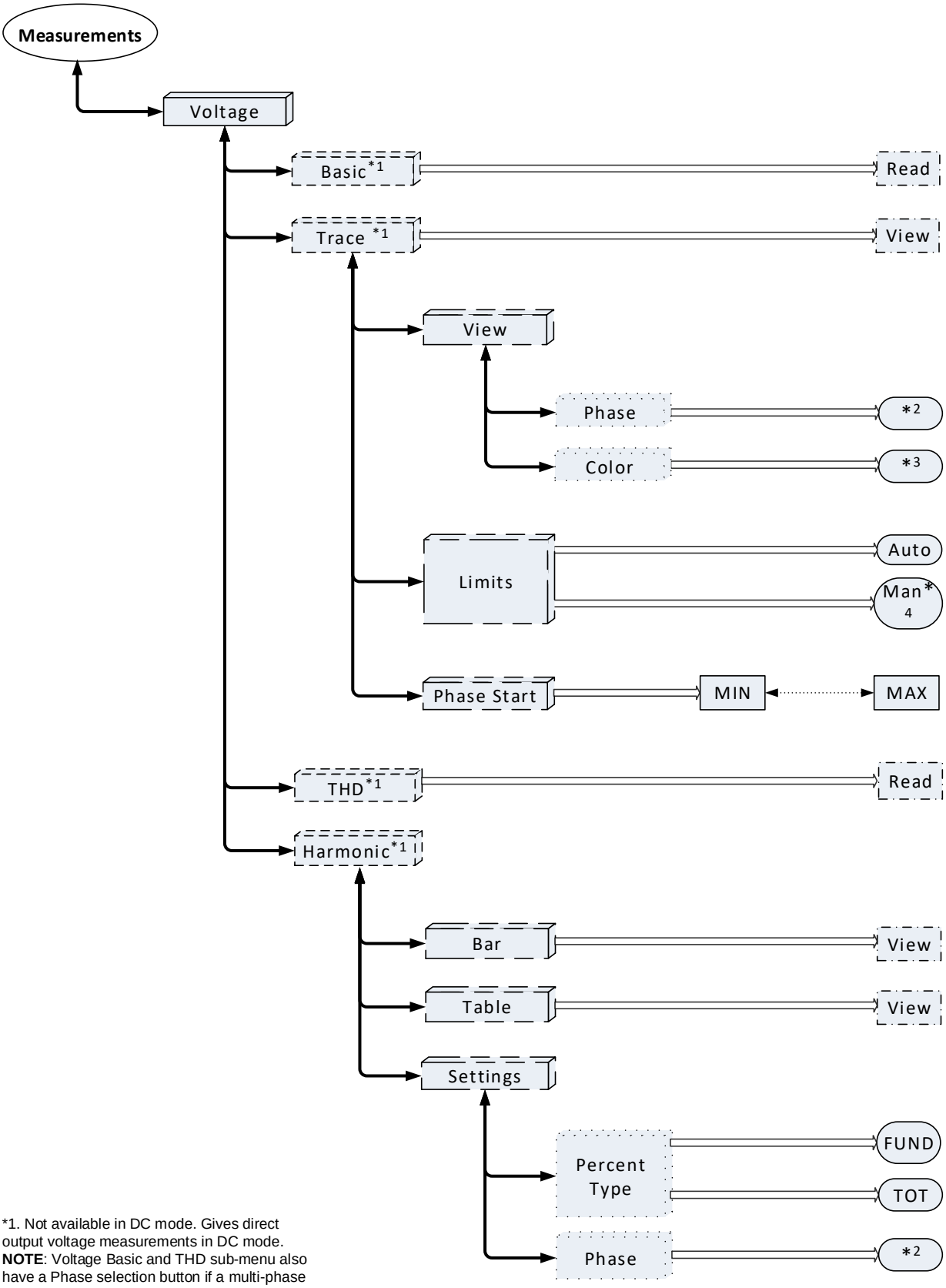
After the operating mode is changed, the dashboard screen returns.

Priority

Sets the priority of the operation mode when OUTPUT is set to ON.

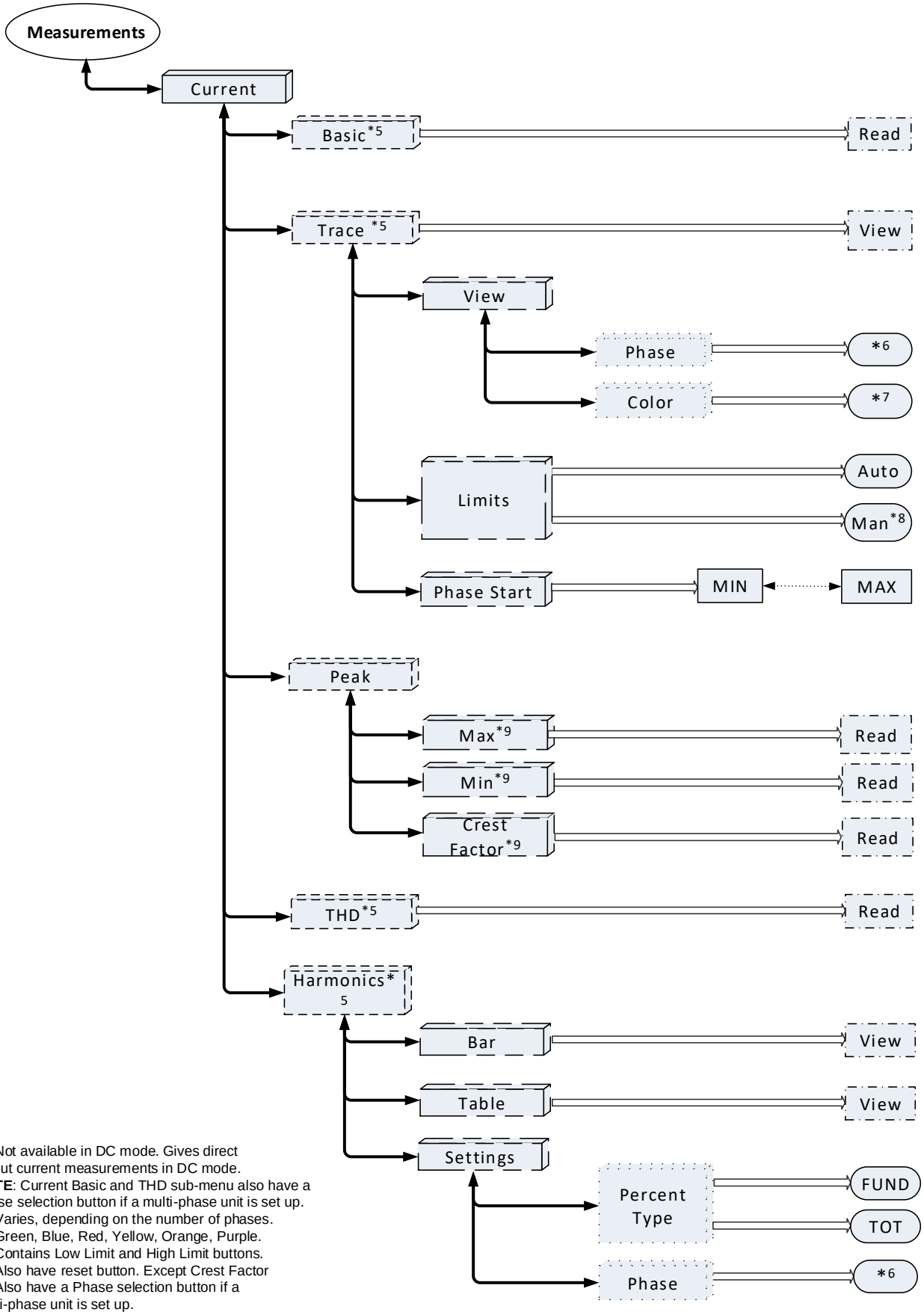


9.4.2 Measurements Menu



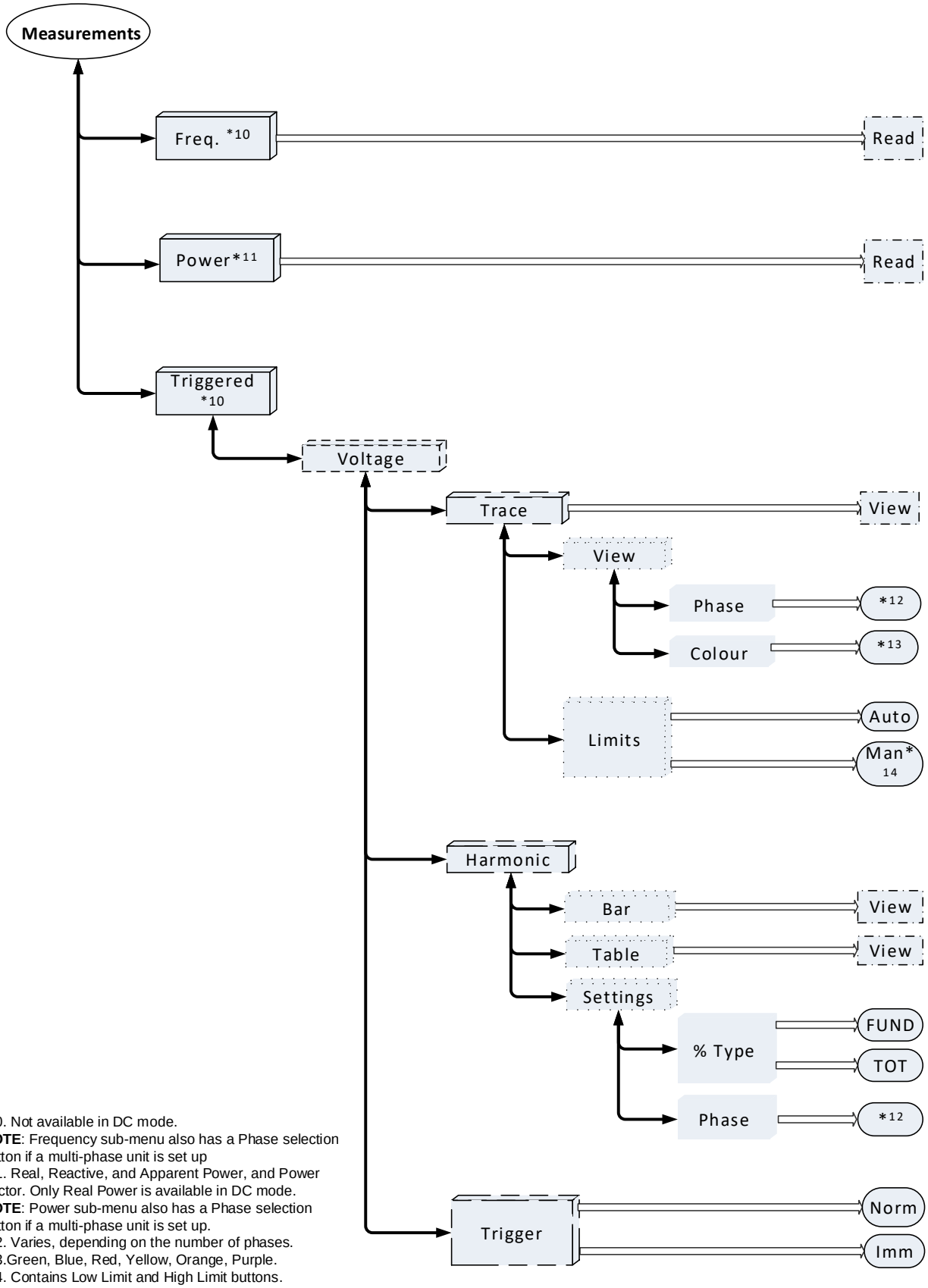
*1. Not available in DC mode. Gives direct output voltage measurements in DC mode.
NOTE: Voltage Basic and THD sub-menu also have a Phase selection button if a multi-phase unit is set up.
*2. Varies, depending on the number of phases.
*3. Green, Blue, Red, Yellow, Orange, Purple.
*4. Contains Low Limit and High Limit buttons.

MEASUREMENTS - CONTINUED



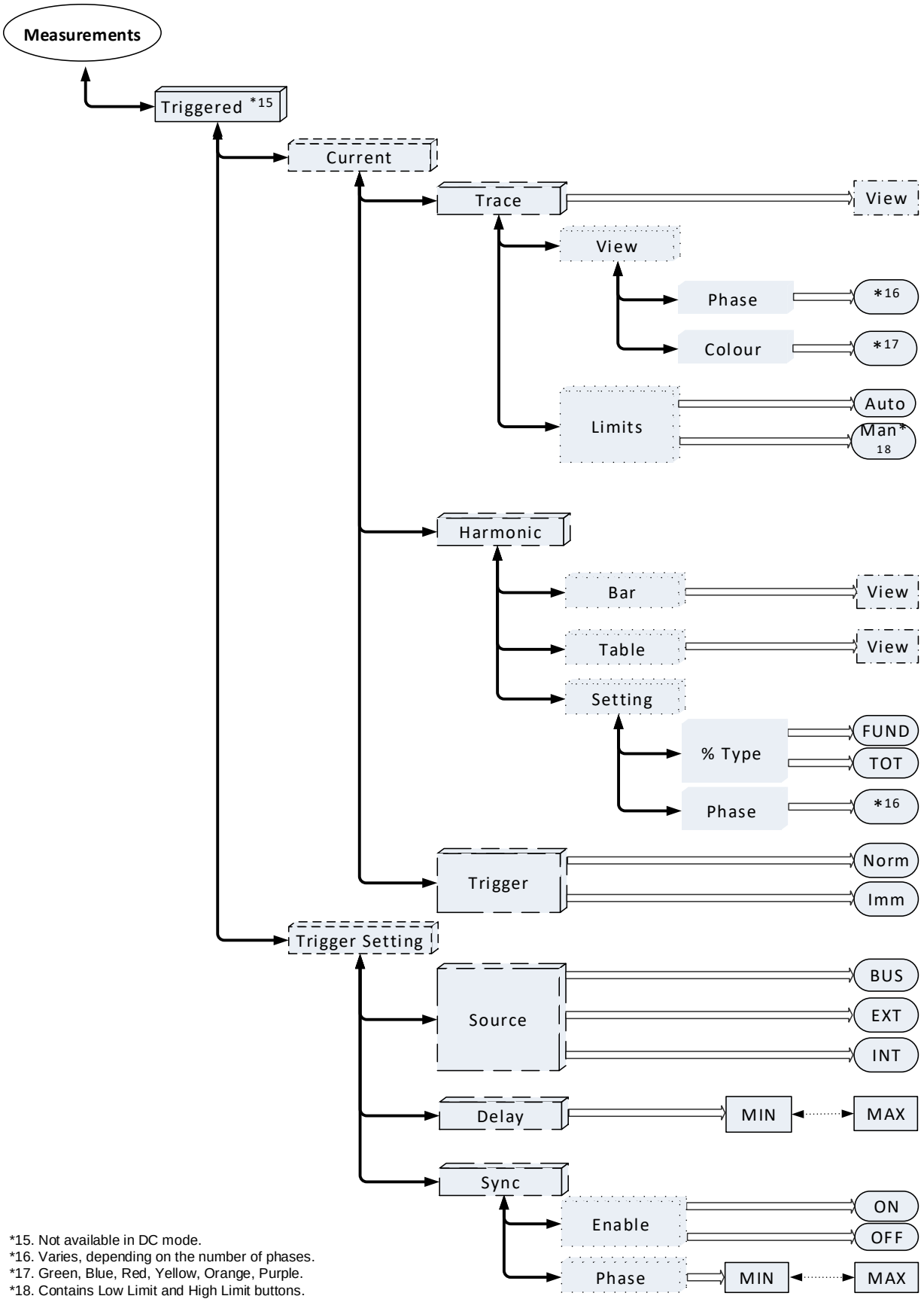
*5. Not available in DC mode. Gives direct output current measurements in DC mode.
NOTE: Current Basic and THD sub-menu also have a Phase selection button if a multi-phase unit is set up.
*6. Varies, depending on the number of phases.
*7. Green, Blue, Red, Yellow, Orange, Purple.
*8. Contains Low Limit and High Limit buttons.
*9. Also have reset button. Except Crest Factor
*9. Also have a Phase selection button if a multi-phase unit is set up.

MEASUREMENTS - CONTINUED



*10. Not available in DC mode.
NOTE: Frequency sub-menu also has a Phase selection button if a multi-phase unit is set up
*11. Real, Reactive, and Apparent Power, and Power Factor. Only Real Power is available in DC mode.
NOTE: Power sub-menu also has a Phase selection button if a multi-phase unit is set up.
*12. Varies, depending on the number of phases.
*13.Green, Blue, Red, Yellow, Orange, Purple.
*14. Contains Low Limit and High Limit buttons.

MEASUREMENTS - CONTINUED



*15. Not available in DC mode.
*16. Varies, depending on the number of phases.
*17. Green, Blue, Red, Yellow, Orange, Purple.
*18. Contains Low Limit and High Limit buttons.

After selecting **Measurements,** the sub-menus appear. The window for a power source in AC and ACDC mode is shown below.



NOTE

In DC mode, **Frequency** and **Triggered** icons are not available.

Voltage

Click **Voltage**.

The window for a power source in AC and ACDC mode is shown below.



NOTE

In DC mode, only direct measurement of the output voltage is seen, and none of the above icons are available.

Click **Basic** to read the measured values.

AC mode: Displays the rms value of the output voltage. There is no DC component in this mode.



ACDC mode: Displays the DC offset, AC component, and rms value of the output voltage.



If a multi-phase unit is set up, the window for displaying the **Voltage** also includes a phase selection button. The window with the phase selection button in ACDC mode is shown below.



Phase: #1 : By clicking **Phase: #1**, a screen opens that allows the user to select the phase.



Each phase can be selected individually.

From the **Voltage** sub-menu, click **Trace** to display the real-time waveform of the output voltage.

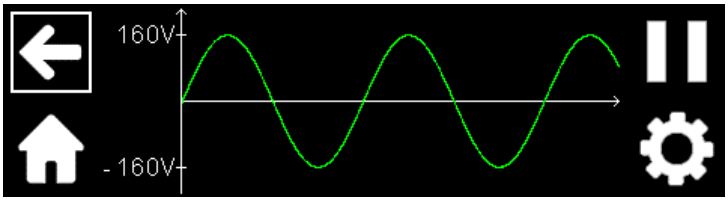


Figure 9-8: Real-Time Waveform (Single-Phase)

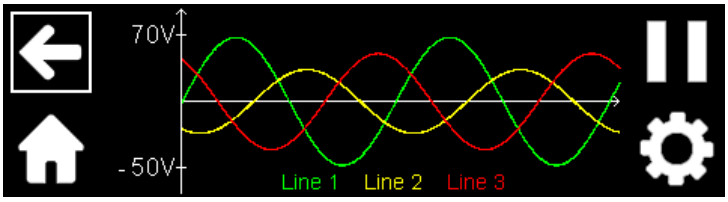
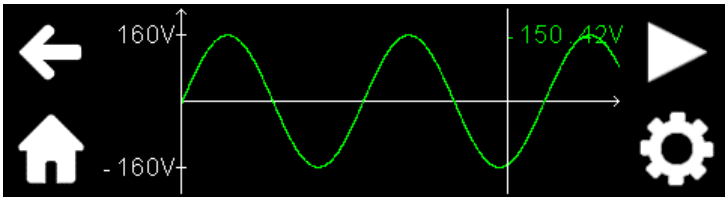


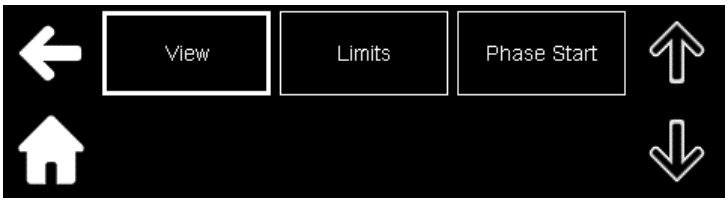
Figure 9-9: Real-Time Waveform (Three-Phase)

By tapping on ⏸, the capture can be paused. Once paused, ⏸ is replaced with ▶. The capture can be restarted by tapping on it.

By pausing the capture, followed by tapping on the screen, a vertical cursor appears. By pressing on this cursor and moving it simultaneously, it can be used to select any position on the screen to display the instantaneous value of the output voltage. Alternatively, the **NAVIGATION PANEL** can also be used after the cursor appears. The value is displayed on the top of the screen.

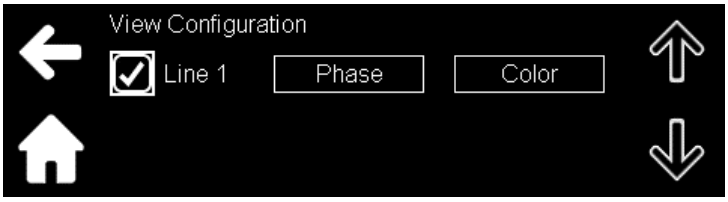


To zoom the waveform, keep the cursor pressed until it disappears. Keep on pressing the screen and move over the screen to select the portion of the waveform to be zoomed. Use to return from zoom. Tap to enter the trace options.

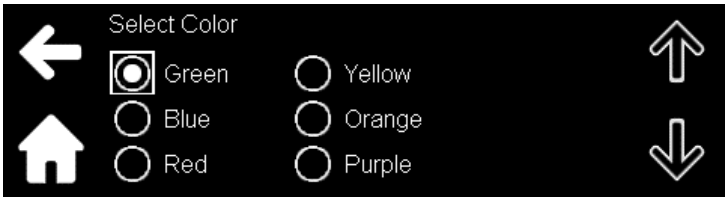


Click **View** to assign the phase and the color of the displayed waveform to the lines.

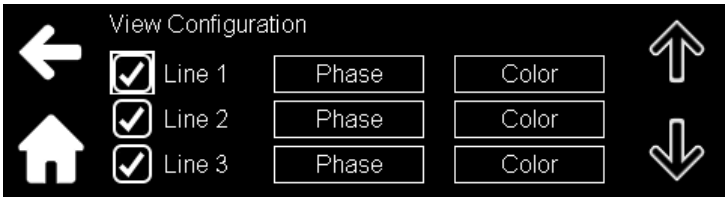
Single-Phase Unit:



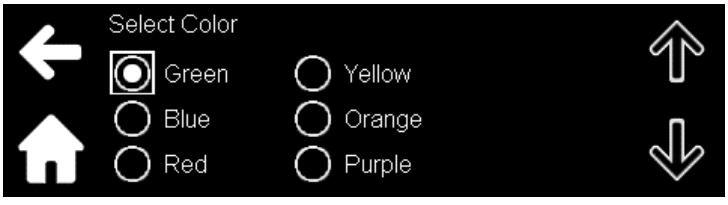




Three-Phase Unit:







The phase and color can be assigned to any line. As seen in **Figure 9-10**, Phase 1 and Green color are assigned to Line1.

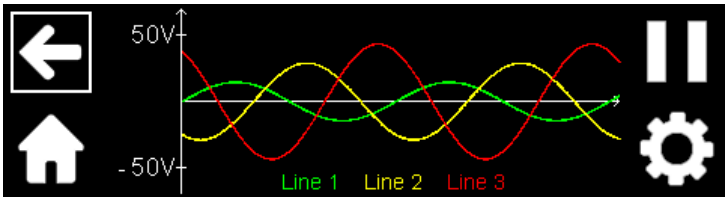
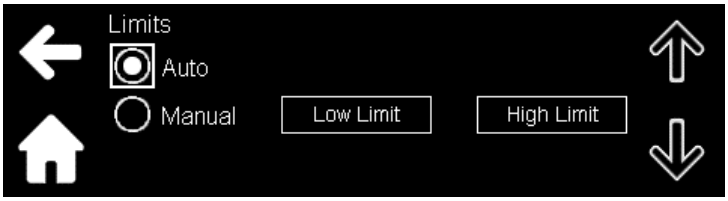


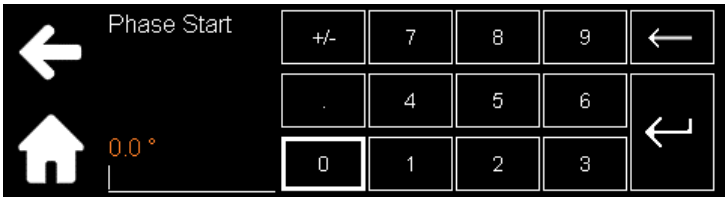
Figure 9-10: Three-Phase Trace

Click **Limits** to select the display limits.



- **Auto**: Creates limits automatically to accommodate the display of the waveform.
- **Manual**: Enter the low limit and high limit of the voltage level to be displayed.

Click **Phase Start** to set the start phase angle of the waveform to be displayed.



NOTE

In a multi-phase system, this only sets the start phase angle of Phase 1. The start phase angle of all other phases is shifted relative to the start angle of Phase 1 by the value set with [SOURce:]PHASe:SHIFt[#] <NRf> (refer to **Section 14.13.8: Source Subsystem**) or set from the front panel (refer to **Section 9.4.8: Parallel Menu**).

From the **Voltage** sub-menu, click **THD** to view the Total Harmonic Distortion of the output voltage.

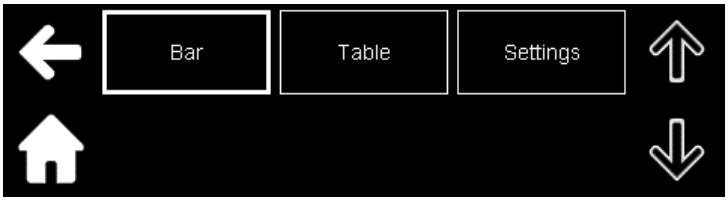


The THD is calculated using harmonics 2 to 50 and is calculated relative to the fundamental harmonic or total harmonic spectrum. Refer to MEASure:HARMonic:PERCent[:TYPE] <DSC> in **Section 14.13.4: Measure Subsystem** for an explanation of the percent type and the equation used for calculation.

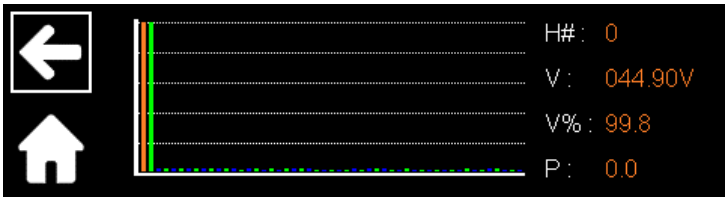
NOTE

If a multi-phase unit is set up, the window for displaying the **Voltage THD** also includes a phase selection button.

From the **Voltage** sub-menu, click **Harmonics t**o display the harmonics of the output voltage. Measurements are displayed in bar or table format.



Click **Bar** to view the harmonic details in bar format.



X-Axis:

select any harmonic number by clicking on any bar or sliding over the bars at the bottom of the screen. The bars are spread from 0 (DC component) to 50th harmonic.

Orange bar: selected harmonic number

Blue bar: even harmonic number

Green bar: odd harmonic number

Y-Axis:

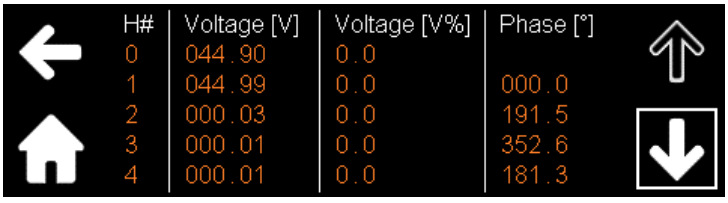
H#: the Harmonic Number

V: the rms value of the selected harmonic number

V%: harmonic value in percent

P: The phase angle of the selected harmonic number

Click **Table** to view the harmonic details in table format. The table spreads from 0 (DC component) to 50th harmonic.



H#: the Harmonic Number

V: the rms value of the harmonic number

V%: harmonic value in percent

P: the phase angle of the harmonic number

Click **Settings** to select the equation used to calculate the harmonic value in percentage.



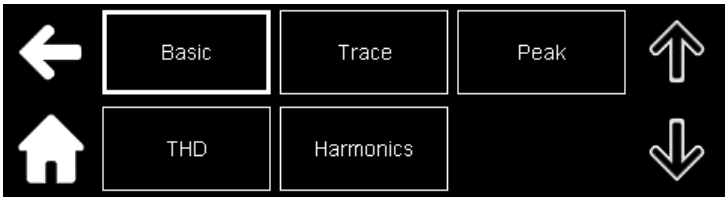
Refer to MEASure:HARMonic:PERCent[:TYPE] <DSC> in **Section 14.13.4: Measure Subsystem** for an explanation of the percent type and the equation used for calculation.

For a multi-phase unit, click **Phase** to display the harmonic details of the selected phase.

Current

Click **Current**.

The window for a power source in AC and ACDC mode is shown below.



Click **Basic** to view the measured values.

AC mode: Displays the rms value of the output current. There is no DC component in this mode.



ACDC mode: Displays the DC offset, AC component, and rms value of the output current.



If a multi-phase unit is set up, the window for displaying the **Current** also includes a phase selection button. The window with the phase button in ACDC mode is shown below.



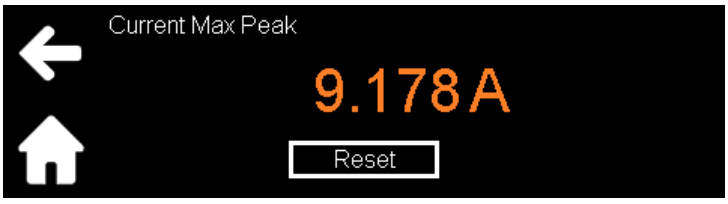
From the **Current** sub-menu, click **Trace** to display the real-time waveform of the output current.

NOTE

Follow the same procedure as explained in the **Voltage** sub-menu → **Trace** section to display the real-time waveform and to make additional settings.

From the **Current** sub-menu, click **Peak** to view the maximum and minimum measured peak value, and the Crest Factor.





The window for displaying the maximum and minimum **Peak Current** also includes a reset button to reset the measured value.



NOTE

If a multi-phase unit is set up, the window for displaying the maximum and minimum **Peak Current**, and **Crest Factor** also includes a phase selection button.

From the **Current** sub-menu, click **THD** to view the total harmonic distortion of output current.

NOTE

If a multi-phase unit is set up, the window for displaying the **Current THD** also includes a phase selection button.

From the **Current** sub-menu, click **Harmonics** to view the harmonics of the output current.

NOTE

Follow the same procedure as explained in the **Voltage** sub-menu → **Harmonics** section to display the harmonics values and to make additional settings.

Frequency

Click **Frequency**.



NOTE

The returned measured frequency is 0 if the output voltage is below 9.5V.

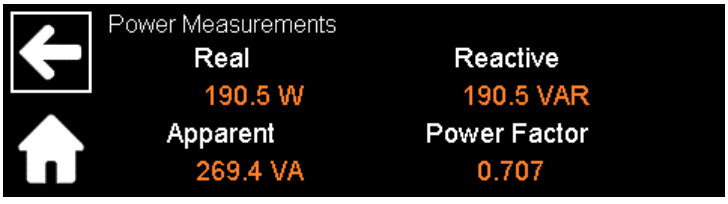
NOTE

If a multi-phase unit is set up, the window for displaying the **Frequency** also includes a phase selection button.

Power

Click **Power**.

The window for a power source in AC and ACDC mode is shown below.



NOTE

Only Real Power measurement is available in DC mode.

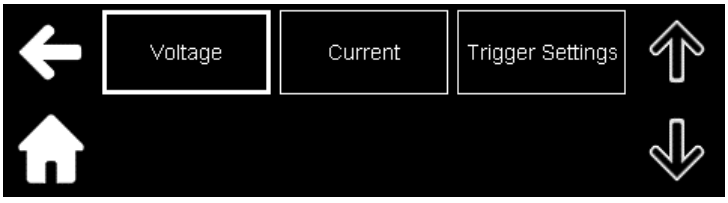
NOTE

If a multi-phase unit is set up, the window for displaying the **Power** also includes a phase selection button.

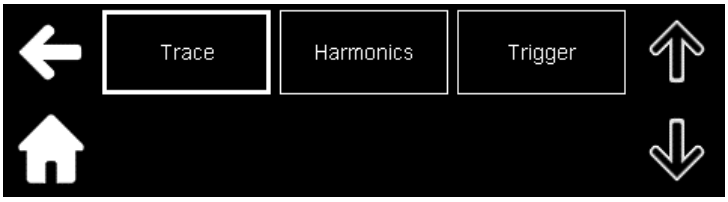
Triggered

To ensure precise data acquisition at a specific time, the measurement system is triggered in different ways. Triggered measurements are available for voltage and current values as well as for their harmonics. Triggers can also be synchronized with different phase angles and delays, and different trigger sources can be selected.

Click **Triggered**.



Click **Voltage/Current**.



Trace:

NOTE

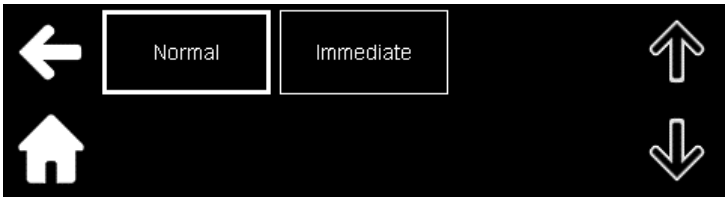
Follow the same procedure as explained in the **Voltage** sub-menu →**Trace** section to display the triggered waveform of the output voltage and to make additional settings.

Harmonics:

NOTE

Follow the same procedure as explained in the Voltage sub-menu → **Harmonics** section to display the triggered harmonic measurement of the output voltage and to make additional settings.

Trigger:



Normal: sets a trigger with a delay.
Immediate: sets a trigger without any delay.

From the **Triggered** sub-menu, click **Trigger Settings**.

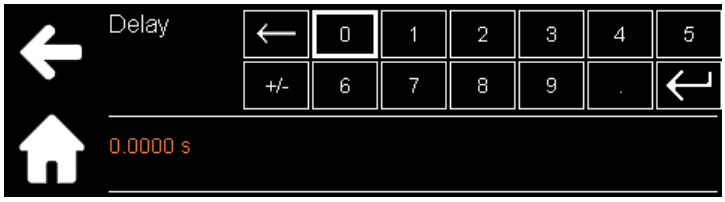


Source: selects the trigger source for measurements.



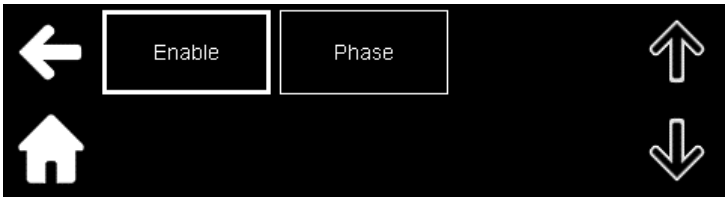
Refer to MEASure:TRIGger:SOURce <DSC> in **Section 14.13.4: Measure Subsystem.**

Delay: sets a delay for triggered measurement. It is the time between the trigger event from a specified trigger source to the start of any corresponding measurements. This is valid for all trigger sources: BUS, EXT (external), and INT (internal).



Refer to MEASure:TRIGger:DELay <NRf> in **Section 14.13.4: Measure Subsystem** for the programming parameter**.**

Sync: triggers measurements that can be synchronized with any phase angle.



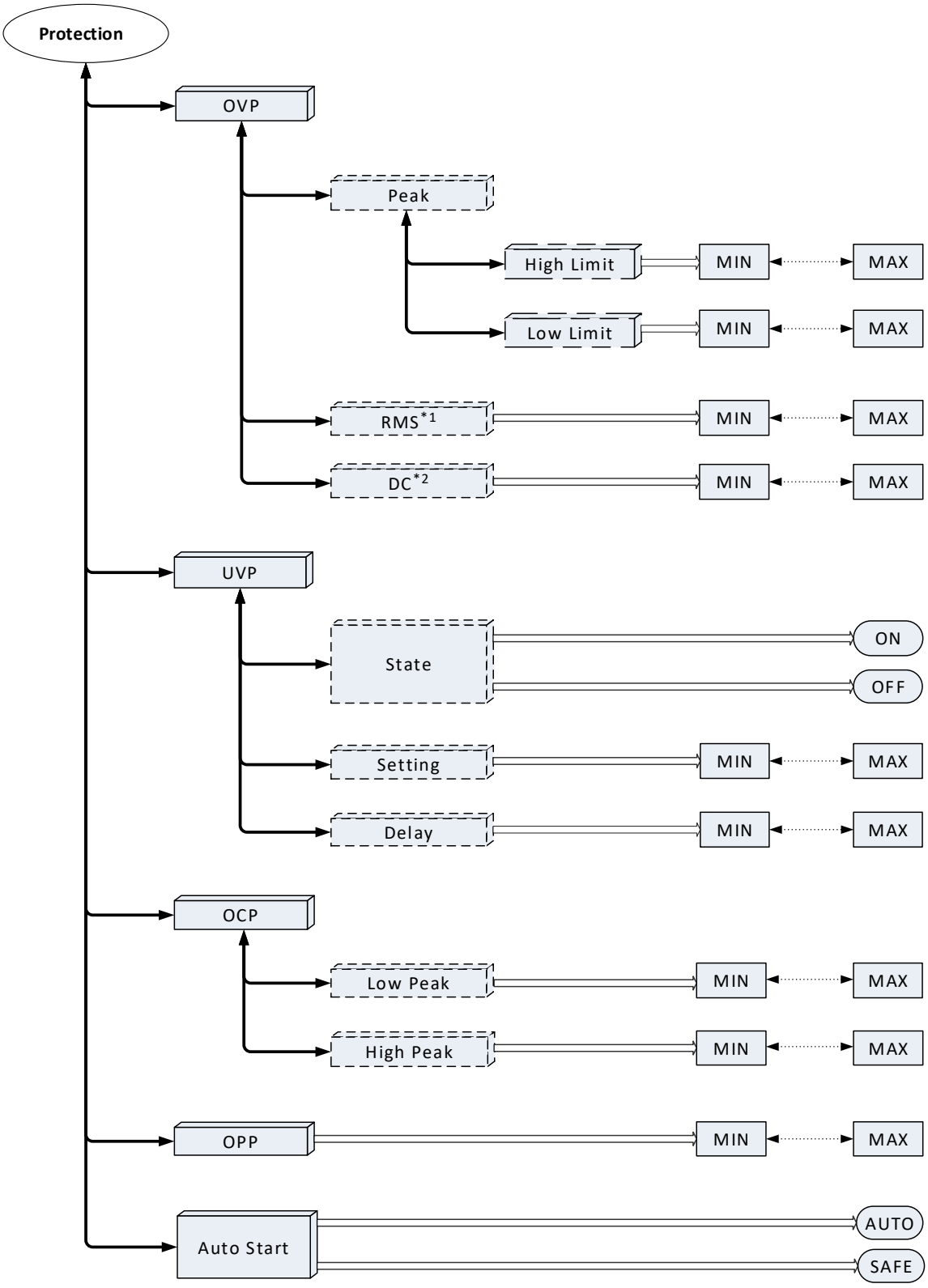
Enable: enables or disables synchronization of the measurement trigger.

Phase: sets the synchronization phase angle of the measurement trigger. Refer to MEASure:TRIGger:SYNC:PHASe <NRf> in **Section 14.13.4: Measure Subsystem**.

NOTE

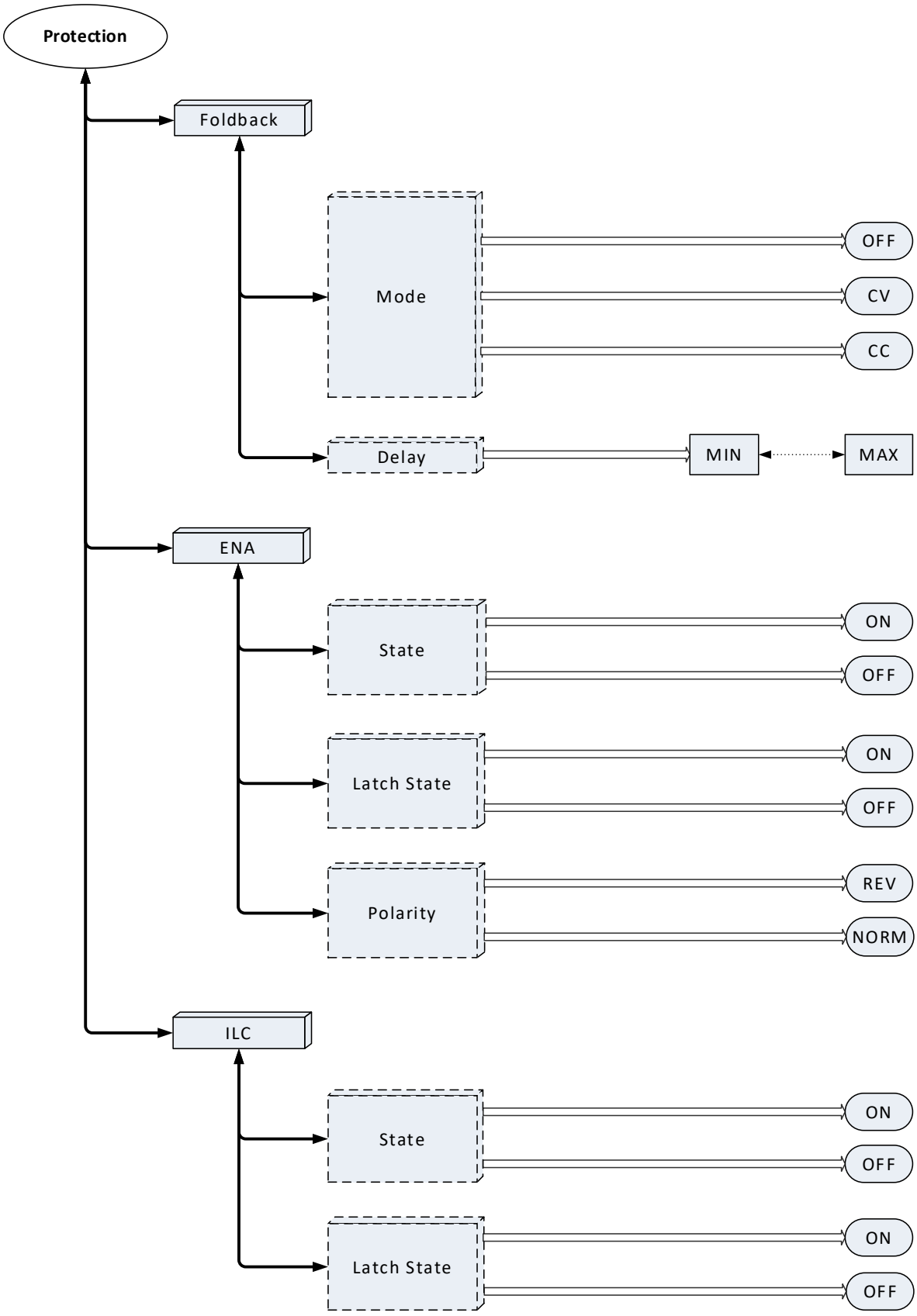
In a multi-phase system, this only sets the triggering phase angle of Phase 1. The triggering phase angle of all other phases is shifted relative to the triggering phase angle of Phase 1 by the value set with [SOURce:]PHASe:SHIFt[#] <NRf> (refer to **Section 14.13.8: Source Subsystem**) or set from the front panel (refer to **Section 9.4.8: Parallel Menu**).

9.4.3 Protection Menu

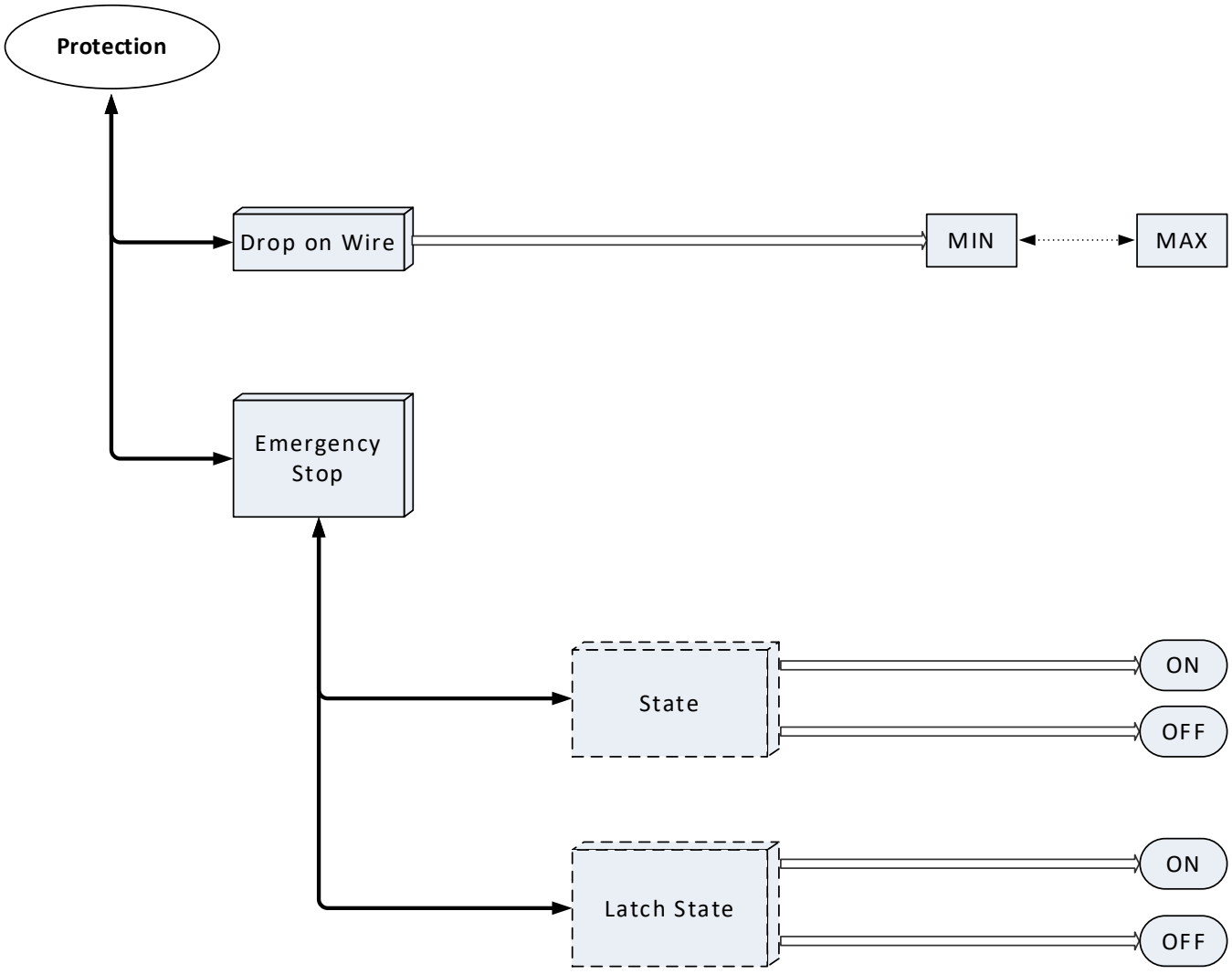


*1. Not available in DC mode.
*2. Not available in AC and ACDC mode.
NOTE: Sub-menus under OVP, UVP, OCP, and OPP sub-menus also have a Phase selection button if a multi-phase unit is setup

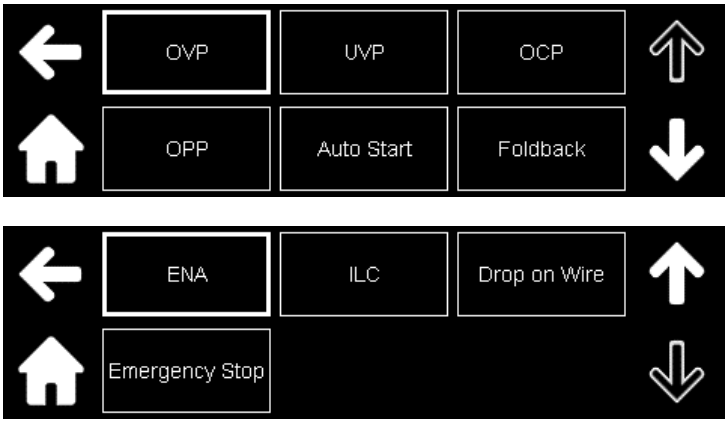
PROTECTION - CONTINUED



PROTECTION-CONTINUED



After selecting **Protection**, the sub-menus appear.



NOTES

Refer to **Section 14.13.8: Source Subsystem** for the programming parameters of OVP, UVP, OCP, OPP, and Drop on wire.

Refer to **Section 14.13.5: Output Subsystem** for the programming parameters of Foldback.

OVP

The Over-Voltage Protection (OVP) protects the customer's equipment from Over-Voltage by detecting the peak, rms, and DC values of the output voltage.

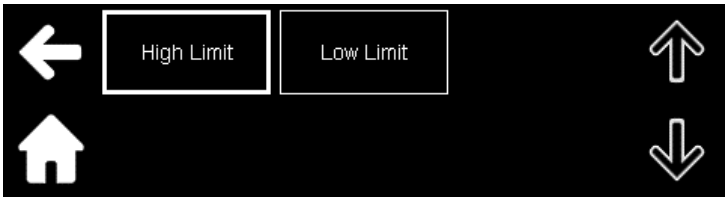
NOTE

Per-phase setting is available in firmware revision 001.010.000 and later. For older revisions, setting is global.

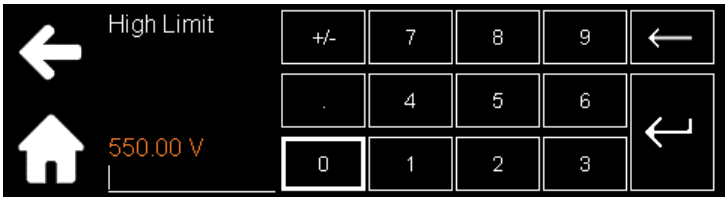
Click **OVP**.
The window for OVP setting in DC mode is shown below.



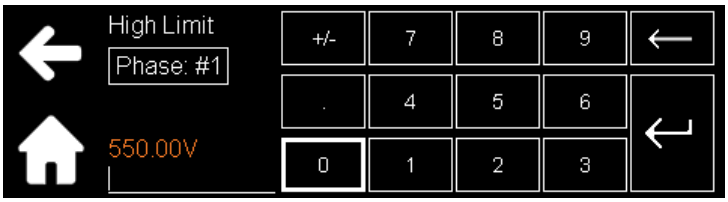
Click **Peak** to set the high limit and low limit of the peak OVP level.



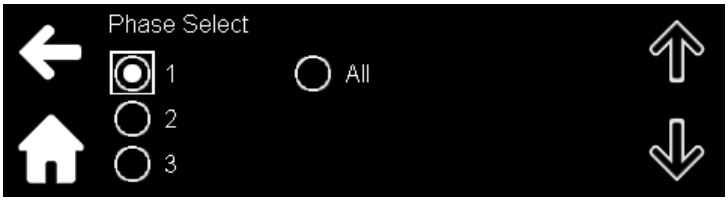
The window to set the high limit of the peak OVP level is shown below.



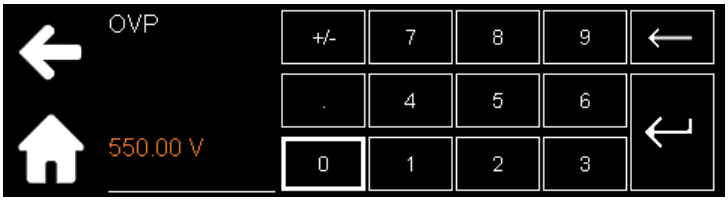
If a multi-phase unit is set up, the programming window for the **High** and **Low limits** of the peak OVP level also includes a phase selection button. The window with the phase button for programming the high limit of peak OVP level is shown below.



Phase: #1 : By clicking **Phase: #1**, a screen opens that allows the user to select the phase.



Click **DC** to set the DC OVP level.



NOTE

If a multi-phase unit is set up, the programming window for **DC OVP** level also includes a phase selection button.

UVP

The Under-Voltage Protection (UVP) protects the customer equipment from Under-Voltage.

NOTE

Per-phase setting is available in firmware revision 001.010.000 and later. For older revisions, setting is global.

Click **UVP**.



Click **State**.



- **ON**: This mode enables the UVP function and disables the output when the measured voltage reaches the UVL level.
- **OFF**: This mode disables the UVP function.

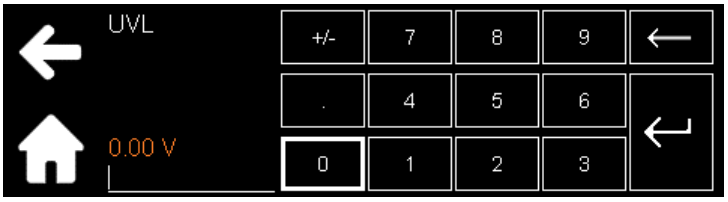
If a multi-phase unit is set up, the programming window for **State** also includes a phase selection button. The window with the phase button is shown below.



Phase: #1: By clicking **Phase: #1**, a screen opens that allows the user to select the phase.



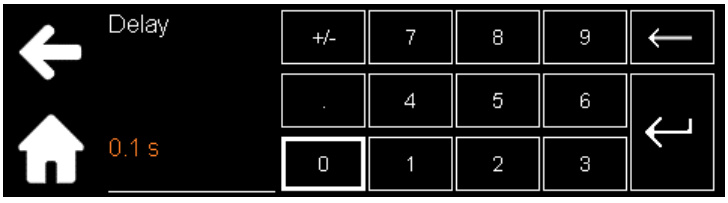
Click **Setting** to set the required Under-Voltage limit (UVL).



NOTE

If a multi-phase unit is set up, the programming window for **UVL Setting** also includes a phase selection button.

Click **Delay** to set the required Under-Voltage Protection (UVP) delay.



OCP

The Over-Current Protection (OCP) protects the customer's equipment from peak Over-Current.

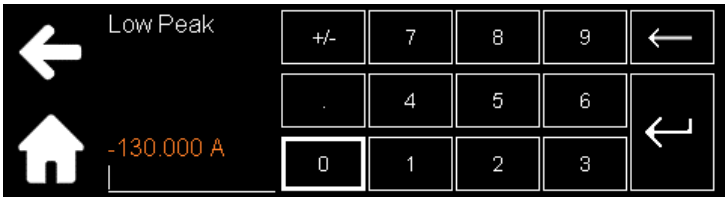
NOTE

Per-phase setting is available in firmware revision 001.010.000 and later. For older revisions, setting is global.

Click **OCP**.



The window to set the low peak limit is shown below.



NOTE

If a multi-phase unit is set up, the programming window for **Low Peak** and **High Peak** also includes a phase selection button.

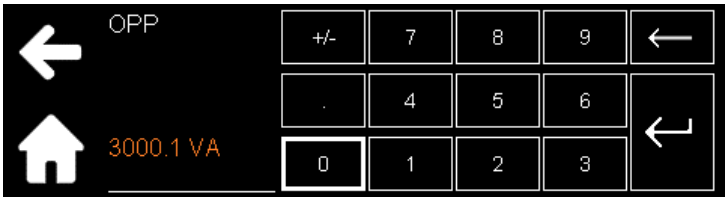
OPP

The Over-Power Protection (OPP) protects the customer equipment from Over-Power.

NOTE

Per-phase setting is available in firmware revision 001.010.000 and later. For older revisions, setting is global.

Click **OPP**.



NOTE

If a multi-phase unit is set up, the programming window for **OPP** also includes a phase selection button.

Auto Start

This defines how the power source recovers from a non-latched fault, ILC (Interlock) signal, ENA (Enable) signal, or after an AC reset.

Click **Auto Start**.



- **AUTO**: The power source recovers to the previous state before the non-latching fault, ILC (Interlock) signal, ENA (Enable) signal occurred, or to the last setting if an AC recycle was done.
- **SAFE**: The power source is restored to the last operating setting, and the output always returns to OFF.

Foldback

Foldback mode is used to disable the power source if a transition between the operating mode occurs.

This feature is useful for protecting voltage or current sensitive loads.

Click **Foldback**.

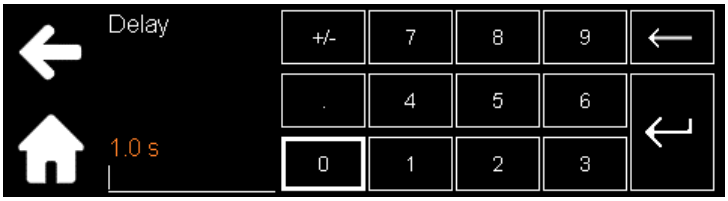


Click **Mode** to select the required foldback mode.



- **OFF**: Foldback mode is disabled.
- **CV**: Foldback is activated on CC→ CV transition.
- **CC**: Foldback is activated on CV → CC transition.

Click **Delay** to set the delay period following which foldback is activated.



ENA

The ENA signal serves as the power source enable control.

Click **ENA**.



State: enables or disables the ENA function.



Latch State: enables or disables the ENA latch function. Refer to **Section 11.10.4: ENABLE IN Latch** to recover from the latched condition.



Polarity: sets the type of polarity.

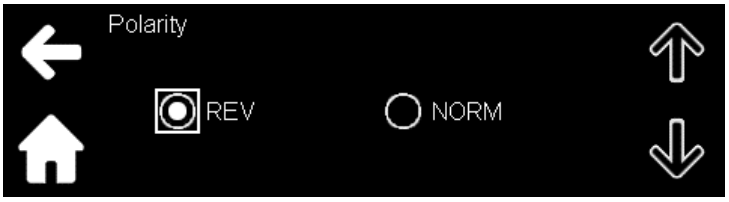


Table 11-8 shows the status of the power source output with respect to the ENA signal and its polarity.

ILC

The ILC signal serves as the power source enable control.
Click **ILC**.



State: enables or disables the ILC function.



Latch State: enables or disables the ILC latch function. Refer to **Section 11.11.3: INTERLOCK Latch** to recover from latched condition.

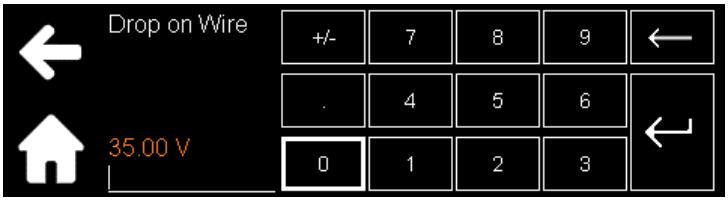


Table 11-9 shows the status of the power source output with respect to the ILC signal.

Drop on Wire

In remote sense mode, OVP protection can be activated considering the voltage drop on the wires. If the difference between the remote sense measurement and the local sense measurement is higher than the set value, an **OVP Drop on Wire** fault is activated.

Click **Drop on Wire**.



Emergency Stop (Emergency Power OFF (EPO))

The Emergency Stop signal serves as the power source enable control.

Click **Emergency Stop**.



State: enables or disables the emergency stop function.



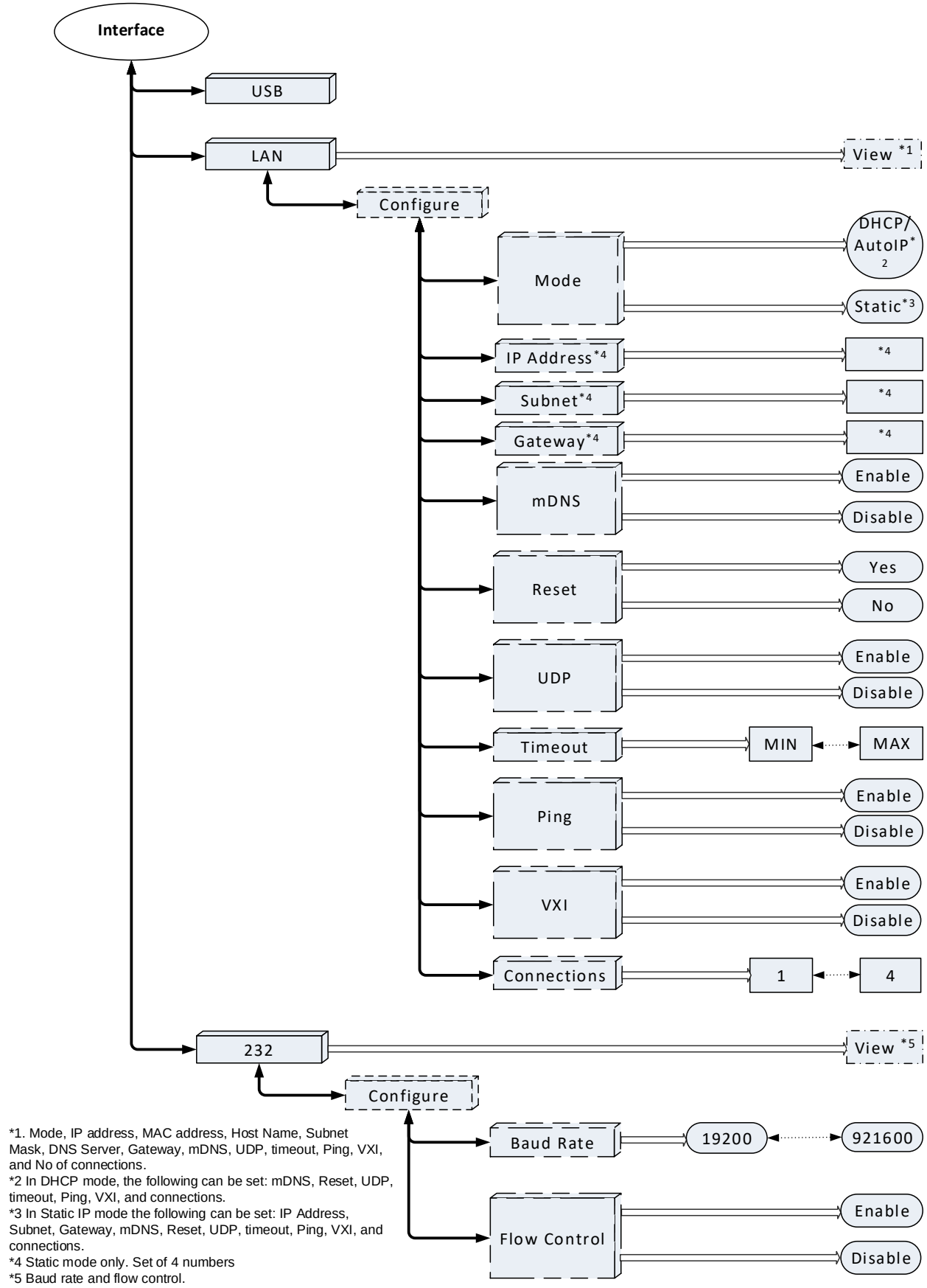
Latch State: enables or disables the emergency stop latch function.



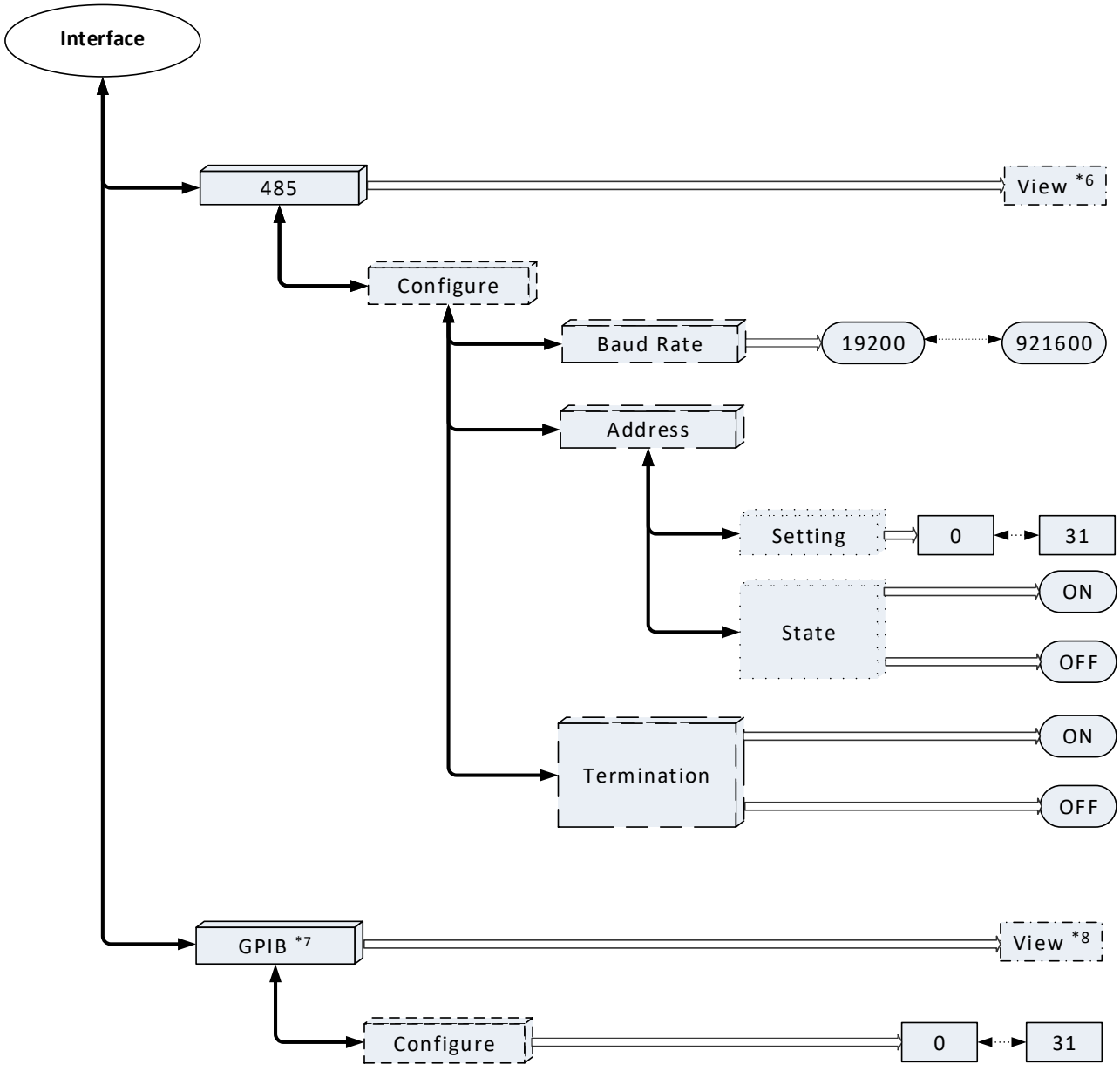
Refer to **Section 12.2: Types of Faults and Protective Functions** to recover from the latched condition.

Table 8-4 shows the status of the power source output with respect to the Emergency Stop (Emergency Power OFF (EPO)) signal.

9.4.4 Interface Menu

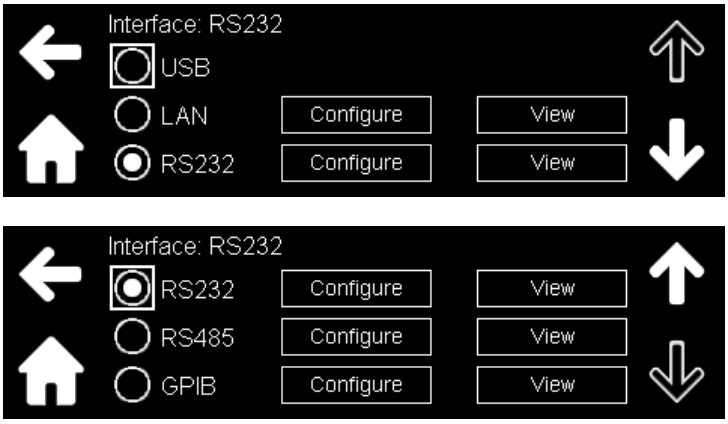


*1. Mode, IP address, MAC address, Host Name, Subnet Mask, DNS Server, Gateway, mDNS, UDP, timeout, Ping, VXI, and No of connections.
*2 In DHCP mode, the following can be set: mDNS, Reset, UDP, timeout, Ping, VXI, and connections.
*3 In Static IP mode the following can be set: IP Address, Subnet, Gateway, mDNS, Reset, UDP, timeout, Ping, VXI, and connections.
*4 Static mode only. Set of 4 numbers
*5 Baud rate and flow control.



*6. Baud rate, address, termination, state.
*7. Only when GPIB option installed.
*8. Address

After selecting **Interface**, the sub-menus appear.



USB

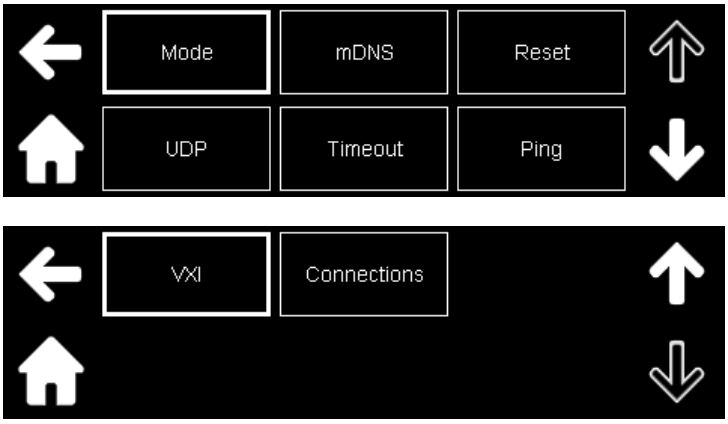
Click **USB** to select the USB interface.

LAN

Click **LAN** to select the LAN interface.

LAN →Configure

Click **Configure** to configure the LAN settings (DHCP/Auto-IP mode is shown and it is by default).

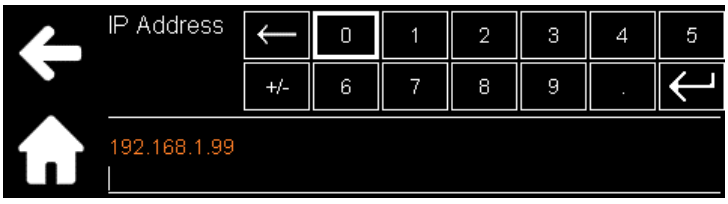


Mode: selects the LAN operating mode.



- **DHCP/Auto-IP**: In this mode, the network assigns the IP address, Subnet Mask, and Gateway.
- **STATIC**: In this mode, IP Address, Subnet Mask, and Gateway are assigned by the user. After selecting **STATIC**, move back one screen to enter the details.

The screen to set the IP Address is shown below.



mDNS (Multicast DNS): enables or disables the mDNS protocol.



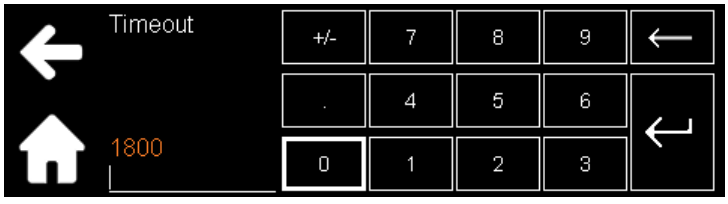
Reset: restores the LAN settings to default. Refer to **Table 10-8** for the default LAN settings.



UDP: enables or disables the UDP protocol.



Timeout: sets the timeout for TCP sockets, VISA, and Web pages. Refer to SYSTem[:COMMunicate]:LAN:TIMEout <NR1> in **Section 14.13.10: System Subsystem** for the programming parameter.



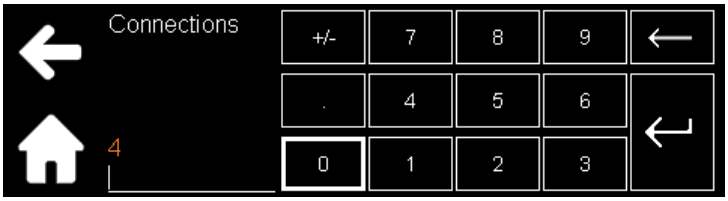
Ping: enables or disables the ping.



VXI: enables or disables the VXI discovery.

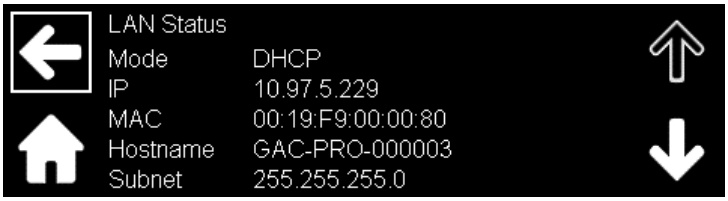


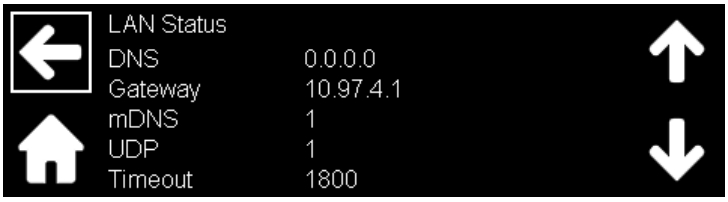
Connections: sets the number of connections allowed. Possible options are 1 to 4.



LAN→View

Click **View** to display the LAN settings.





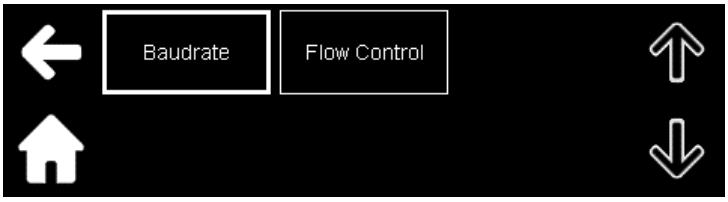


RS232

Click **RS232** to select the 232 interface.

RS232→Configure

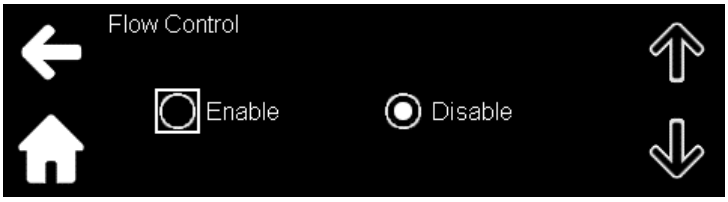
Click **Configure** to configure the RS232 interface. The settings must match the settings of the external controller.



Baudrate: selects the operating Baudrate. Options are: 19200 to 921600.



Flow Control: enables or disables the flow control. Flow Control enables or disables Request to Send (RTS)/Clear to Send (CTS) flow control.



RS232→View

Click **View** to display the RS232 settings.



RS485

Click **RS485** to select the 485 interface.

RS485→Configure

Click **Configure**.



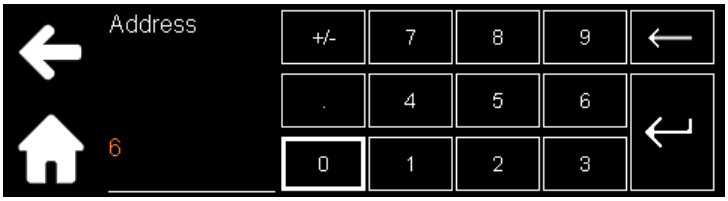
Baudrate: selects the operating Baudrate. Options are: 19200 to 921600.



Address: sets the RS485 address and enables/disables the addressing system.



Setting: sets the RS-485 address.

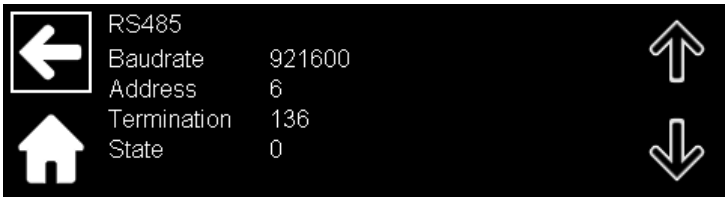


The address options are 0–31.

Termination: enables or disables the RS485 termination.

RS485->View

Click **View** to display the RS485 settings.

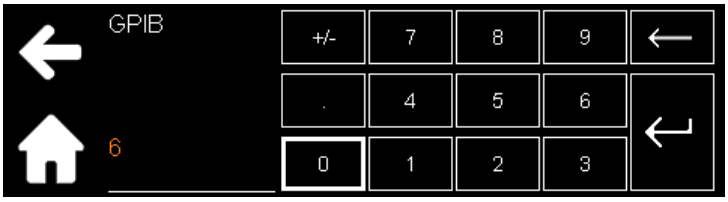


GPIB (only when GPIB option is installed)

Click **GPIB** to select the GPIB interface.

GPIB→Configure

Click **Configure** to set the GPIB address

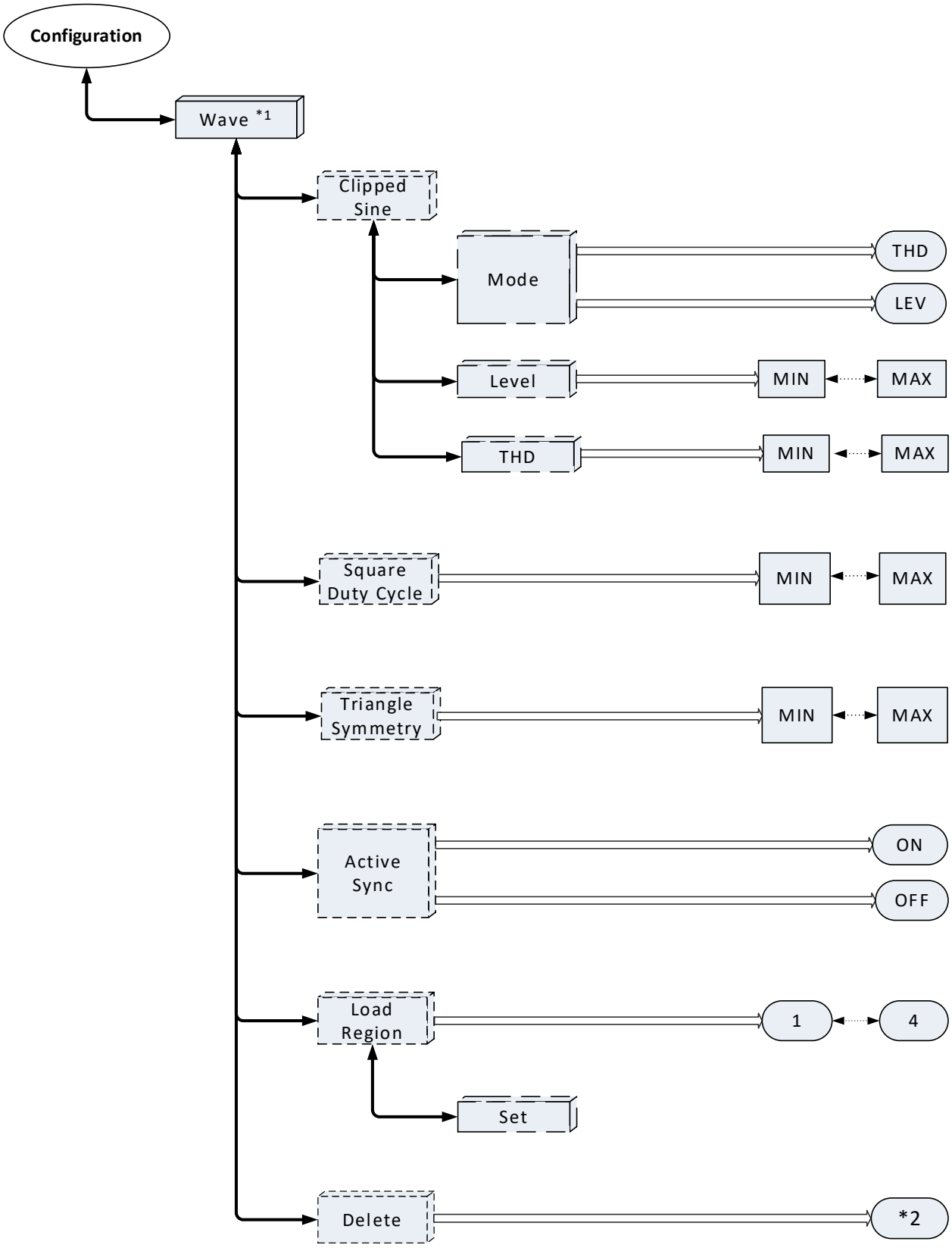


GPIB->View

Click **View** to display the GPIB settings.

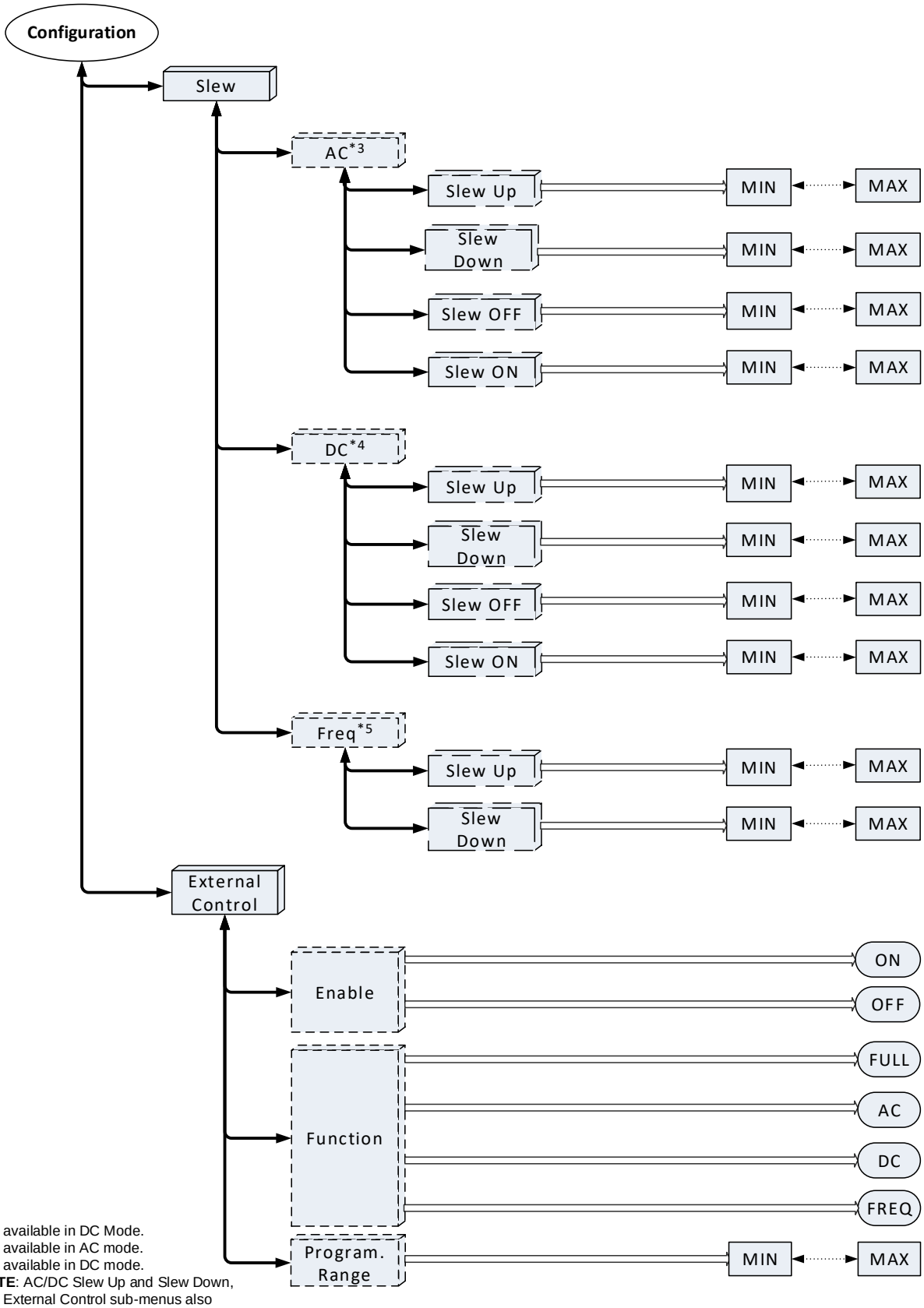


9.4.5 Configuration Menu



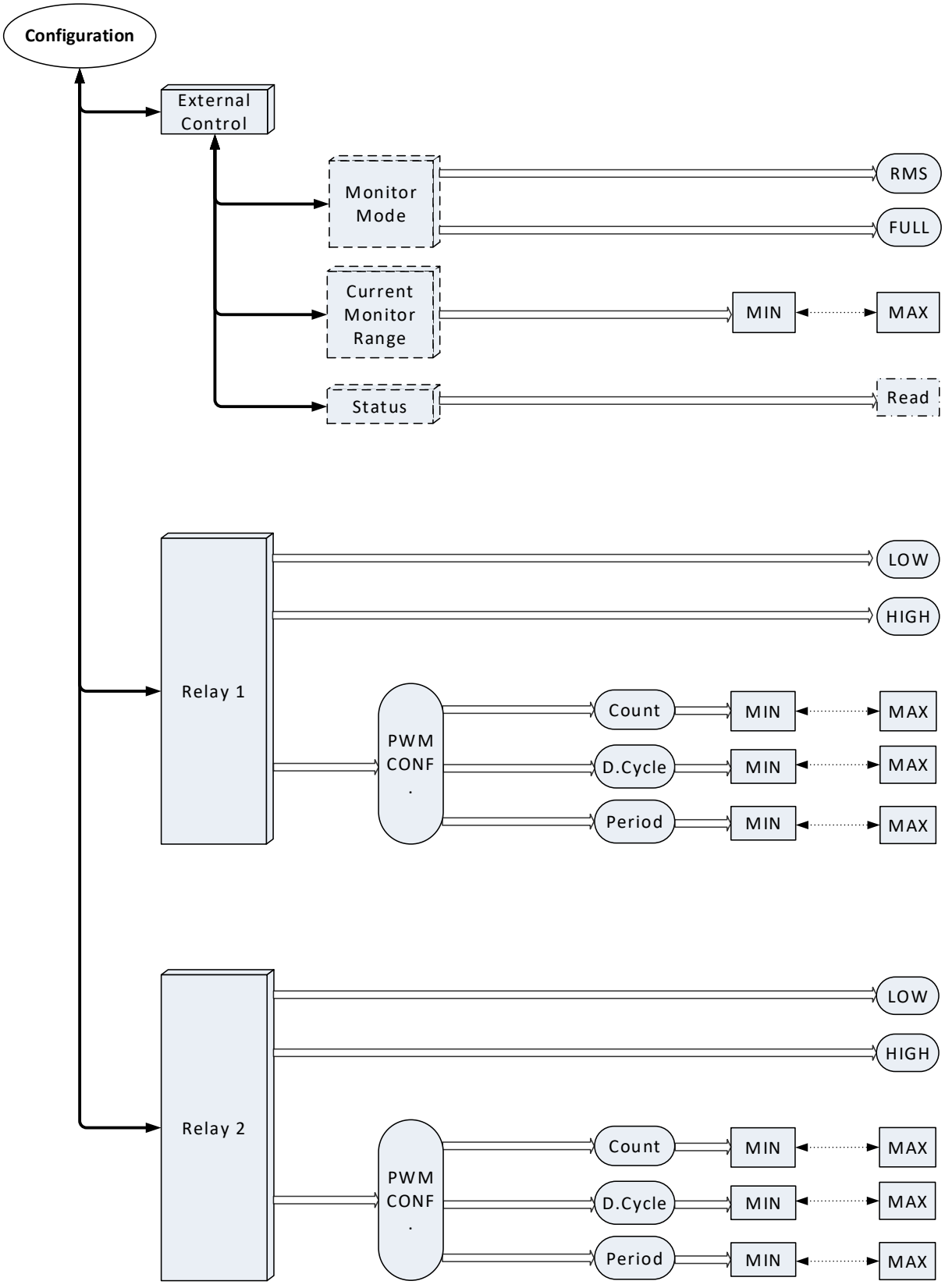
*1. Not available in DC mode.
*2. Delete User built waveforms.
NOTE: Clipped Sine, Square Duty Cycle, Triangle Symmetry, and Active Sync sub-menus also have a Phase selection button if a multi-phase unit is setup.

CONFIGURATION - CONTINUED



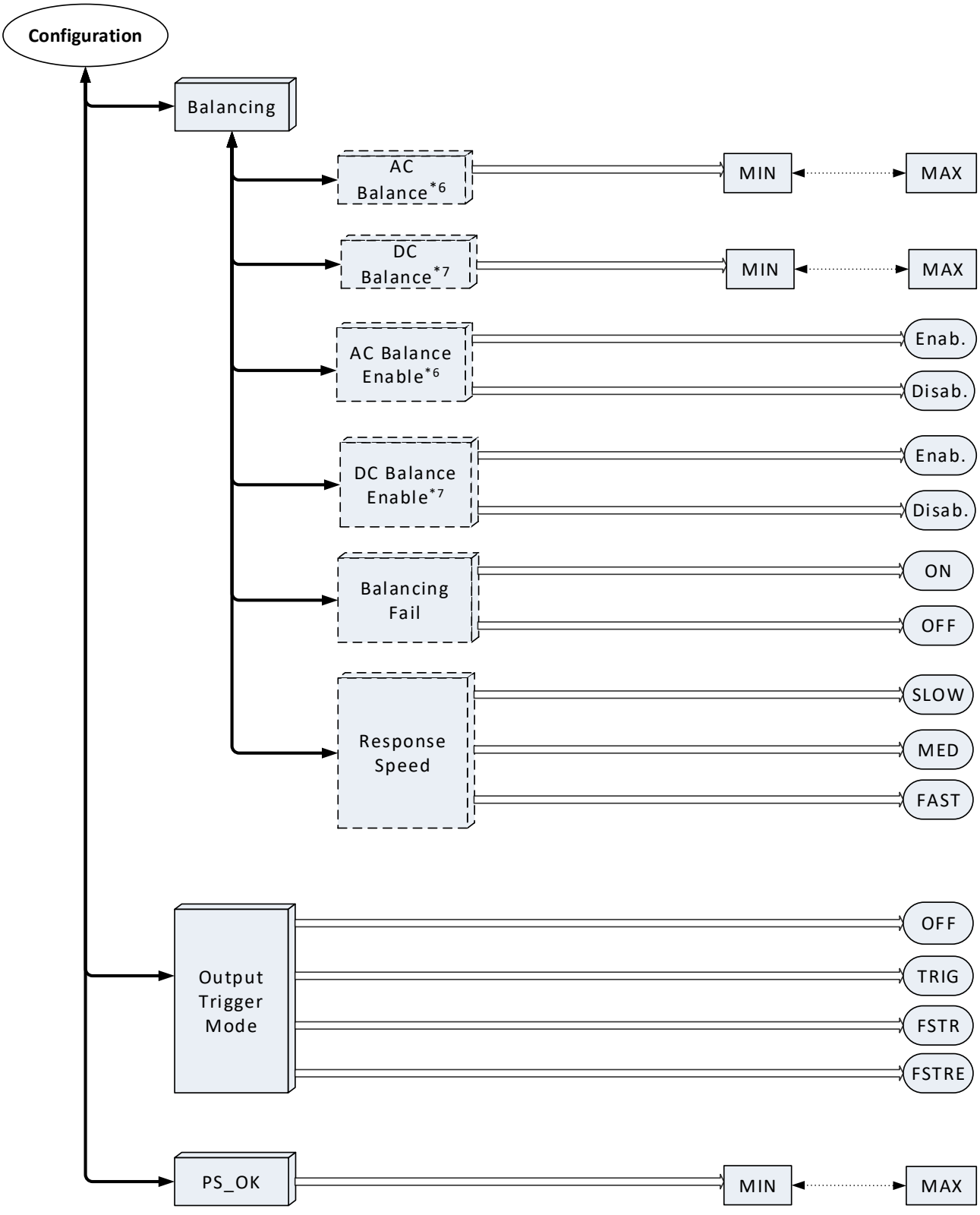
*3. Not available in DC Mode.
*4. Not available in AC mode.
*5. Not available in DC mode.
NOTE: AC/DC Slew Up and Slew Down, and External Control sub-menus also have a Phase selection button if a multi-phase unit is setup.

CONFIGURATION - CONTINUED



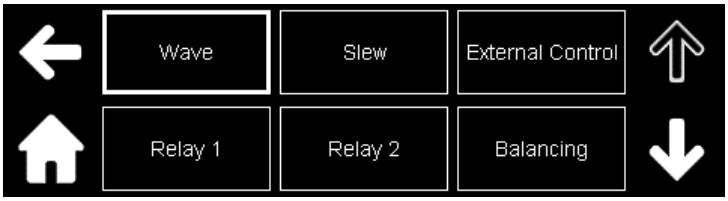
NOTE: External Control, Relay 1 and Relay 2 sub-menus also have a Phase selection button if a multi-phase unit is setup.

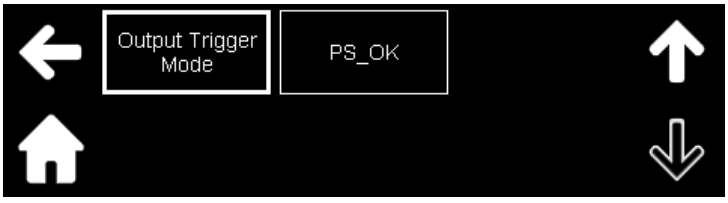
CONFIGURATION - CONTINUED



*6. Not available in DC mode.
*7. Not available in AC mode.
NOTE: Output Trigger sub-menu also has a Phase selection button if a multi-phase unit is setup.

After selecting **Configuration**, the sub-menus appear. The windows for a power source in AC and ACDC mode is shown below.





Wave

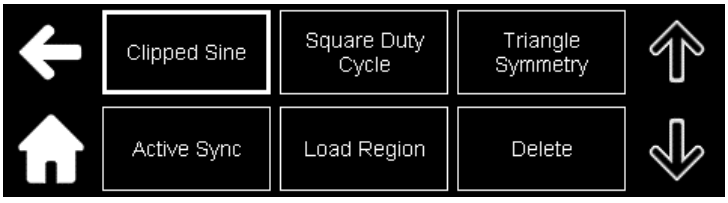
This sub-menu allows the user to create waveforms that are modified built-in waveforms. Different levels, duty-cycle, symmetries, and THD levels can be programmed.

Additionally, all the user waveforms (not sequencer values) can be stored in four different regions in the built-in memory with a total of up to 200 memory locations.

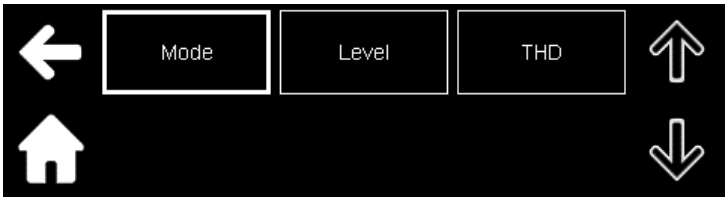
NOTE

Refer to **Section 14.13.6: Function Subsystem** for the programming parameters of the created waveforms.

Click **Wave**.



Click **Clipped Sine** to **c**ontrols various parameters of the Clipped Sine wave.



Mode: selects the Clipped Sine (CSINe) attribute (THD or LEVEL) used to generate the CSINe wave.



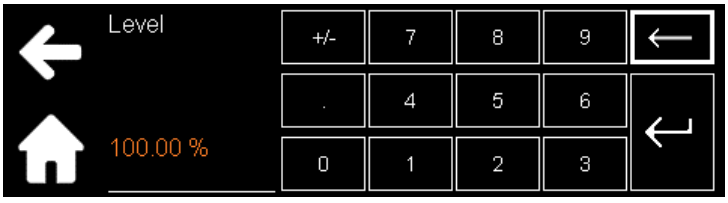
If a multi-phase unit is set up, the programming window for **Mode** also includes a phase selection button. The window with the phase button for selecting the mode is shown below.



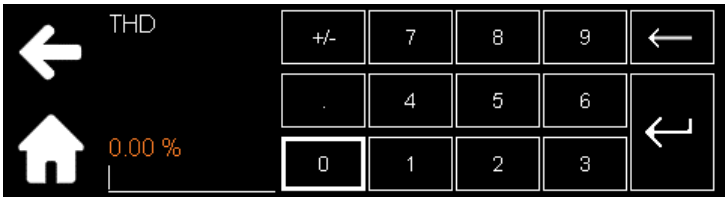
Phase: #1: By clicking **Phase: #1**, a screen opens that allows the user to select the phase.



Level: sets the clamping level of the built-in clipped sine wave.



THD: sets the Total Harmonic Distortion (THD) level of the built-in clipped sine wave.



NOTE

If a multi-phase unit is set up, the programming window for **Level** and **THD** also includes a phase selection button.

Under **Wave** sub-menu, click **Square Duty Cycle** to set the duty cycle of the built-in square wave.

Under **Wave** sub-menu, click **Triangle Symmetry** to set the duty cycle of the built-in triangle wave.

NOTE

If a multi-phase unit is set up, the programming window for **Square Duty Cycle** and **Triangle Symmetry** also include a phase selection button.

Under **Wave** sub-menu, click **Active Sync** to enable or disable the phase synchronization when switching the active wave. Refer to [FUNCtion:]WAVeform[:ACTivate]:SYNC:ENABle[#] <Bool> in **Section 14.13.6: Function Subsystem**.



NOTE

If a multi-phase unit is set up, the programming window for **Active Sync** also includes a phase selection button.

Under **Wave** sub-menu, click **Load Region** to select the region for storing, loading, or deleting the created waveform (not sequencer values). Refer to [FUNCtion:]WAVeform:REGion <NR1> in **Section 14.13.6: Function Subsystem**.



Under **Wave** sub-menu, click **Delete** to deletes the user-generated waveforms.

Slew

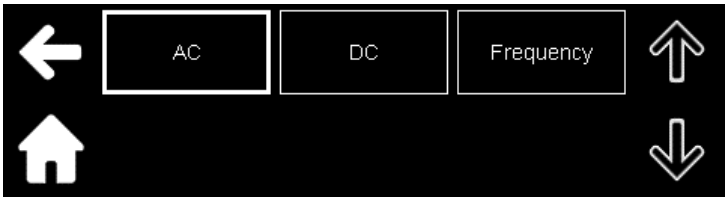
This sub-menu allows the user to program the slew rate of the up and down programming of the AC voltage, DC offset, and frequency.

NOTE

Refer to **Table 14-10** for the programming parameters of the slew rate.

Click **Slew**.

The window for programming the slew rate in ACDC mode is shown below.



Click **AC a**nd/or **DC.**



The window for programming the slew up rate is shown below.



Slew Down: sets the slew down programming rate.

NOTE

If a multi-phase unit is set up, the window for programming **AC Slew Up**, **AC Slew Down**, **DC Slew Up,** and **DC Slew Dow**n also include a phase selection button

Slew OFF: sets the slew down programming during ON to OFF transition.

Slew ON: sets the slew up programming during OFF to ON transition.

Under the Slew sub-menu, click **Frequency.**



The window to set the slew down programming is shown below.



NOTES

The slew rate is enabled only if the Sequencer and Analog Programming modes are disabled.

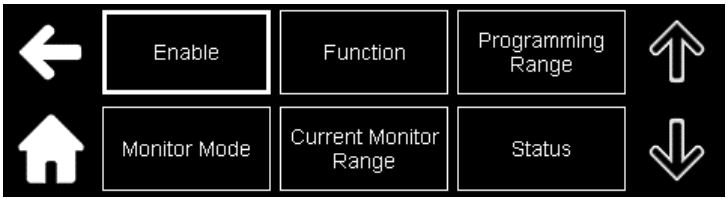
The slew rate depends on the load, load type (capacitive/inductive), and the rise/fall time capability.

The maximum slew rate is limited by the hardware.

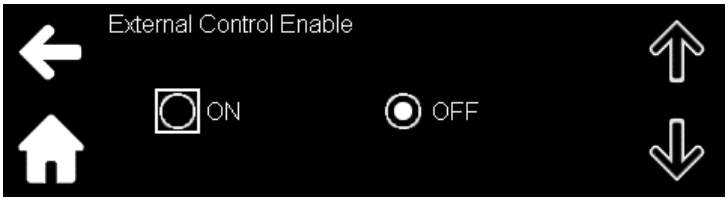
External Control

This sub-menu allows the user to perform external analog programming and monitoring via the rear panel connector (J4).

Click **External Control**.



Enable: enables or disables programming with an external voltage reference.



Function: sets the analog programming function. The argument indicates which parameter is controlled via analog programming.

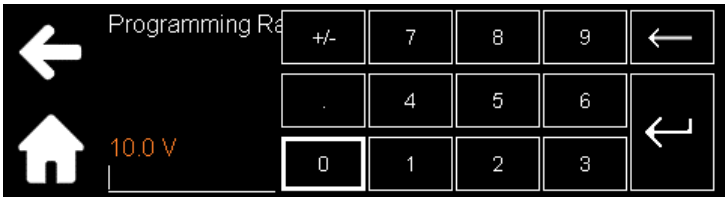


Refer to **Table 11-7** for an explanation of different types of arguments and how they control the programming parameters.

NOTE

In a multi-phase system, FULL and FREQ control are not available.

Programming Range: sets the range for analog programming and monitoring. The range is 2.5–10V.

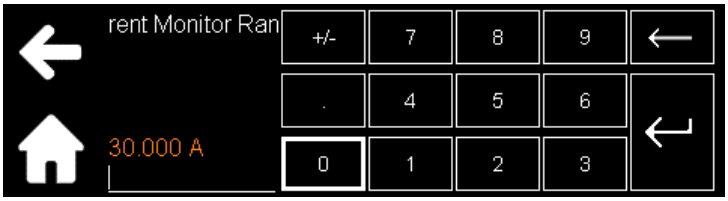


Monitor Mode: sets the analog monitoring function. The argument indicates which parameter is controlled via analog monitoring.



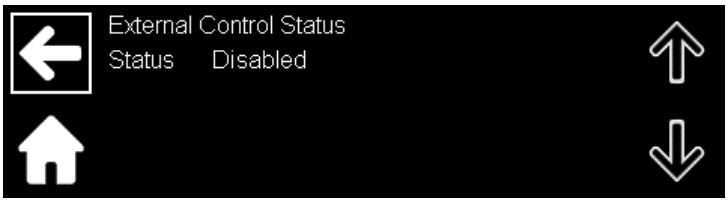
Refer to SYSTem:EXTernal:MONitor[:MODE][#] <DSC> in **Section 14.13.10: System Subsystem** for an explanation of different types of arguments and how they control the monitoring parameters.

Current Monitor Range: sets the maximum analog current monitoring value when the Monitor Mode is set to FULL.



Refer to SYSTem:EXTernal:MONitor:CURRent[:MAX][:LEVel][#]<NRf> in **Section 14.13.10: System Subsystem** for the programming parameter.

Status: return the actual state of the source of the voltage reference programming.



NOTE

If a muti-phase unit is set up, the programing window of sub-menus under **External Control** sub-menu also includes a phase selection button.

Relay 1

Relay 1 is a general-purpose open drain signal. Refer to **Section 11.12: Programmable Pin #1 (J4-21) and Programmable Pin #2 (J4-20)**.

Click **Relay 1**.

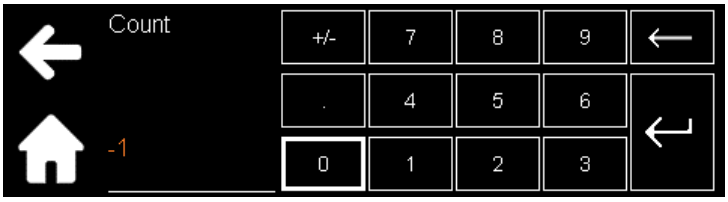


- **Low**: The signal is low.
- **High**: The signal is high.
- **PWM**: The signal is in the form of pulses.

  Under **PWM**, click **Configure**



Count: sets the number of generated pulses.



Duty Cycle: sets the Duty Cycle

Period: sets the Period

Refer to OUTPut:RELay1:COUNt[#] <NR1>, OUTPut:RELay1:DCYCle[#] <NRf>, OUTPut:RELay1:PERiod[#] <NR1> in **Section 14.13.5: Output Subsystem** for the programming parameter.

NOTE

If a multi-phase unit is set up, the programming window of sub-menus under **Relay 1** sub-menu also includes a phase selection button.

Relay 2

Relay 2 is an additional general-purpose, open-drain user-programmable pin that has the same function and operating features as Relay 1.

Refer to OUTPut:RELay2:COUNt[#] <NR1>, OUTPut:RELay2:DCYCle[#] <NRf>, OUTPut:RELay2:PERiod[#] <NR1> in **Section 14.13.5: Output Subsystem** for the programming parameter**.**

NOTE

If a multi-phase unit is set up, the programming window of sub-menus under **Relay 2** sub-menu also includes a phase selection button.

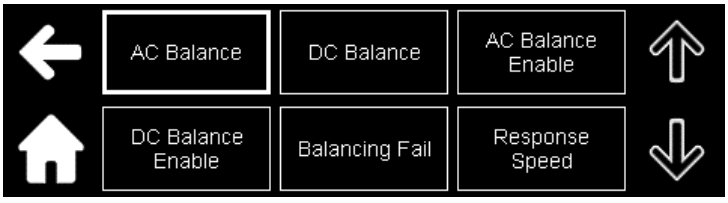
Balancing

The balancing section detects the difference between the voltage setting and the measured output voltage, and if required, applies voltage correction. Balancing can be carried out for the AC component in AC and ACDC mode and for the DC component in DC and ACDC mode.

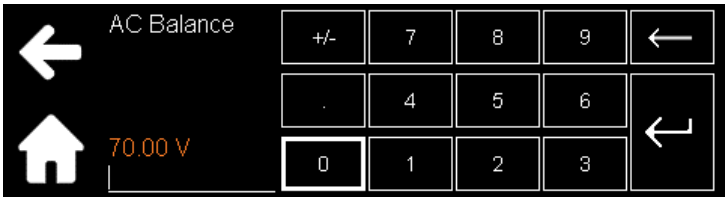
NOTE

Refer to **Section 14.13.8: Source Subsystem** for the programming parameter.

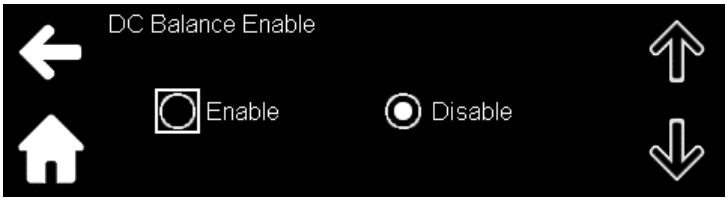
Click **Balancing.**



Balance: sets the voltage correction level for the AC/DC component. The window for the AC component is shown.



Balance Enable: enables or disables the balancing. The window to enable or disable the balancing in DC mode is shown.



Balancing Fail: enables or disables the balancing failure fault. If disabled, the fault does not cause the output to be turned off, and the fault is not reported.



Response Speed: sets the response speed of voltage balancing. This also affects the transition time between CV and CC.



Output Trigger Mode

Click **Output Trigger Mode** to select the operation mode of the Trigger Out (J4-23/J6) signal. Refer to OUTPut:TTLTrg:MODE[#] <DSC> in **Section 14.13.5: Output Subsystem**.

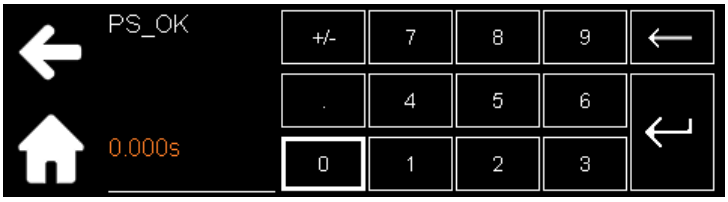


NOTE

if a multi-phase unit is set up, the programming window for **Output Trigger** also includes a phase selection button.

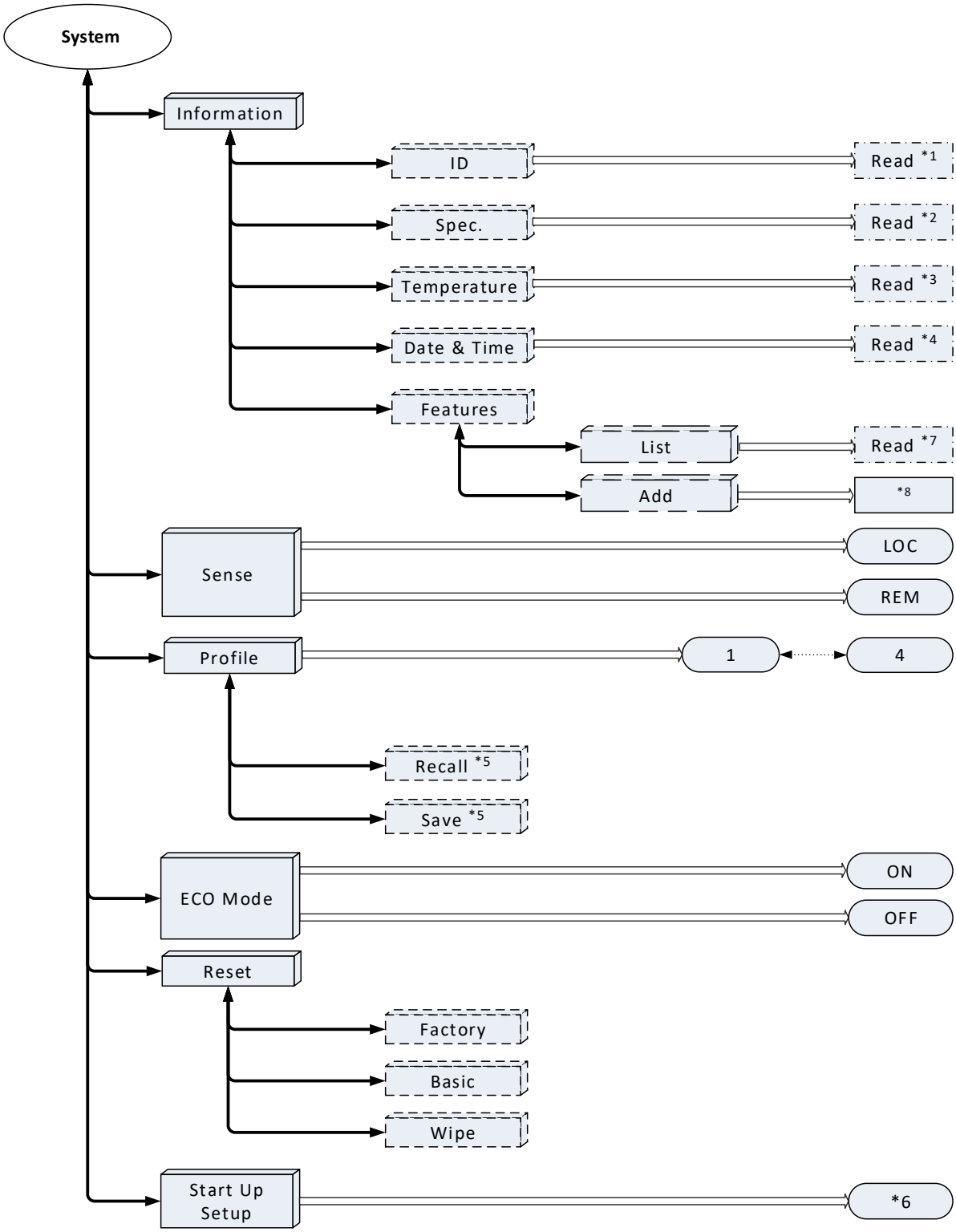
PS_OK (Power Source OK) Signal

Click **PS_OK** to set the delay for the PS_OK (power source OK) signal following output ON.



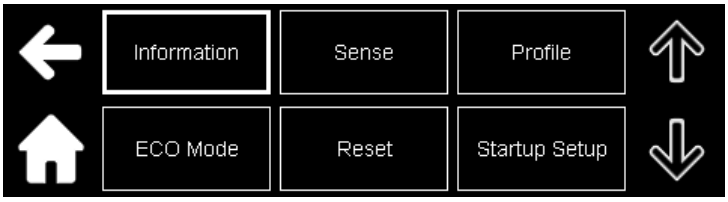
Refer to SYSTem:PSOK:DELay <NRf> in **Section 14.13.10: System Subsystem** for the programming parameter.

9.4.6 System Menu



*1. Power Source information – IDN, serial no., software versions.
*2. Power Source specifications – voltage rating, current rating, power rating, frequency.
*3. Internal Temperature.
*4. Date of last calibration, the time for which the unit is connected to the AC with the power switch ON and power switch OFF.
5. Save and Recall have a Yes/No option.
*6. Start Up options: LAST,1,2,3,4,FRST
*7 Standards supported
*8 Activation key

After selecting **System**, the sub-menus appear.



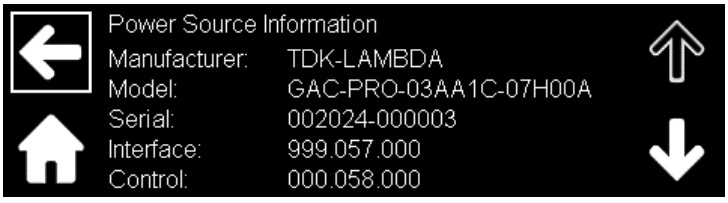
Information

This section provides information about the power source.

Click **Information**.



ID: displays the details of the power source such as manufacturer, model name, serial number, and software versions of the interface, control, and display.



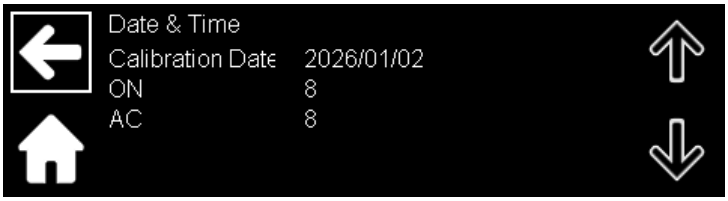
Specifications: displays the specifications of the power source, such as voltage, current, power, and frequency rating, and indicates whether the DC option is enabled or disabled.



T**emperature**: displays the measured internal temperature.



Date & Time: displays the date of the last calibration and the time for which the power source is connected to the AC with the power switch ON and the power switch OFF.



Features: displays the capabilities of the power source and allows the user to enter the standard activation key.



List: displays the power source capabilities.



Add: enter the activation key received to enable standards.



Aa12 3: switch between characters and numbers.
More: extend the range of the characters.
←: delete character/number.
← →: insert character/number.

Sense

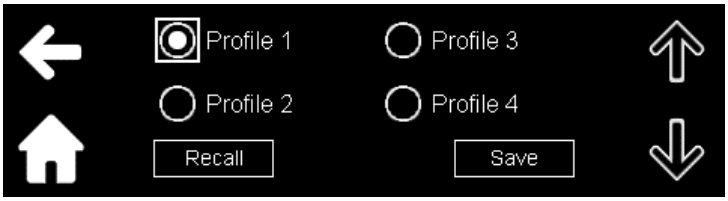
Click **Sense** to select the point for sensing the output voltage for regulation.



- **LOC**: Sensing is at the rear panel
- **REM**: Sensing is at the load

Profile

Click **Profile** to select one of four locations in the non-volatile memory used to save and recall the power source state and settings (same as *SAV [<NR1>] and *RCL [<NR1>] in **Section 14.12: SCPI Common Commands**). Refer to **Table 13-1** (Recall and PON profile column).



Select the profile and then the required (Recall/Save) button.

ECO Mode

Click **ECO mode** to enable or disable the ECO mode. Refer to OUTPut:ECO[:MODE][:ENABle] <Bool> in **Section 14.13.5: Output Subsystem**.

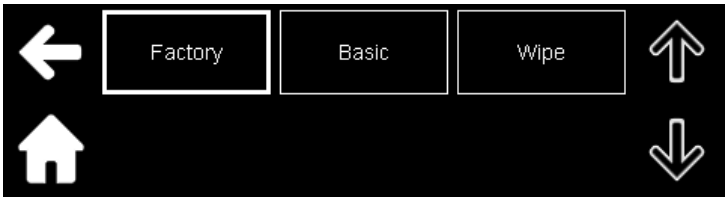


NOTE

ECO mode is applicable only if the power source is in the OFF state.

Reset

Click **Reset**



Factory: make a factory reset (defaults settings); refer to **Table 13-1**. Sets communication interface to USB.

Basic: make a basic reset; refer to **Table 13-1**.

Wipe: carries out the following functions:

- Fully wipes the non-volatile memory and user-created waveforms in all four regions.
- Restores factory default (factory reset) parameters.
- Sets communication interface to USB.

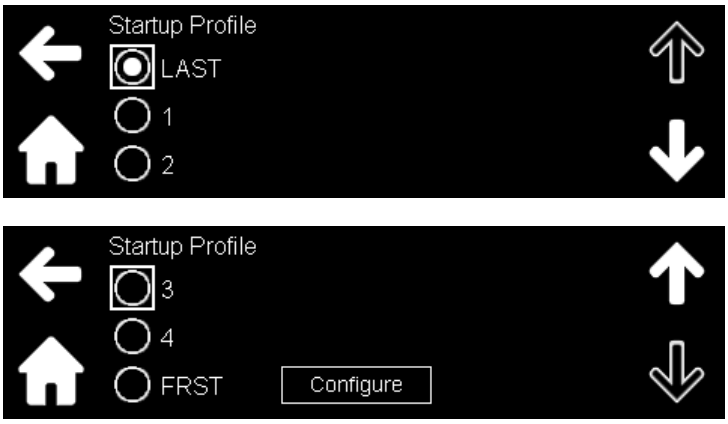
NOTE

The **Wipe** sub-menu sanitizes the entire non-volatile memory.

Start Up Setup

Selects the power-on (PON startup) profile.

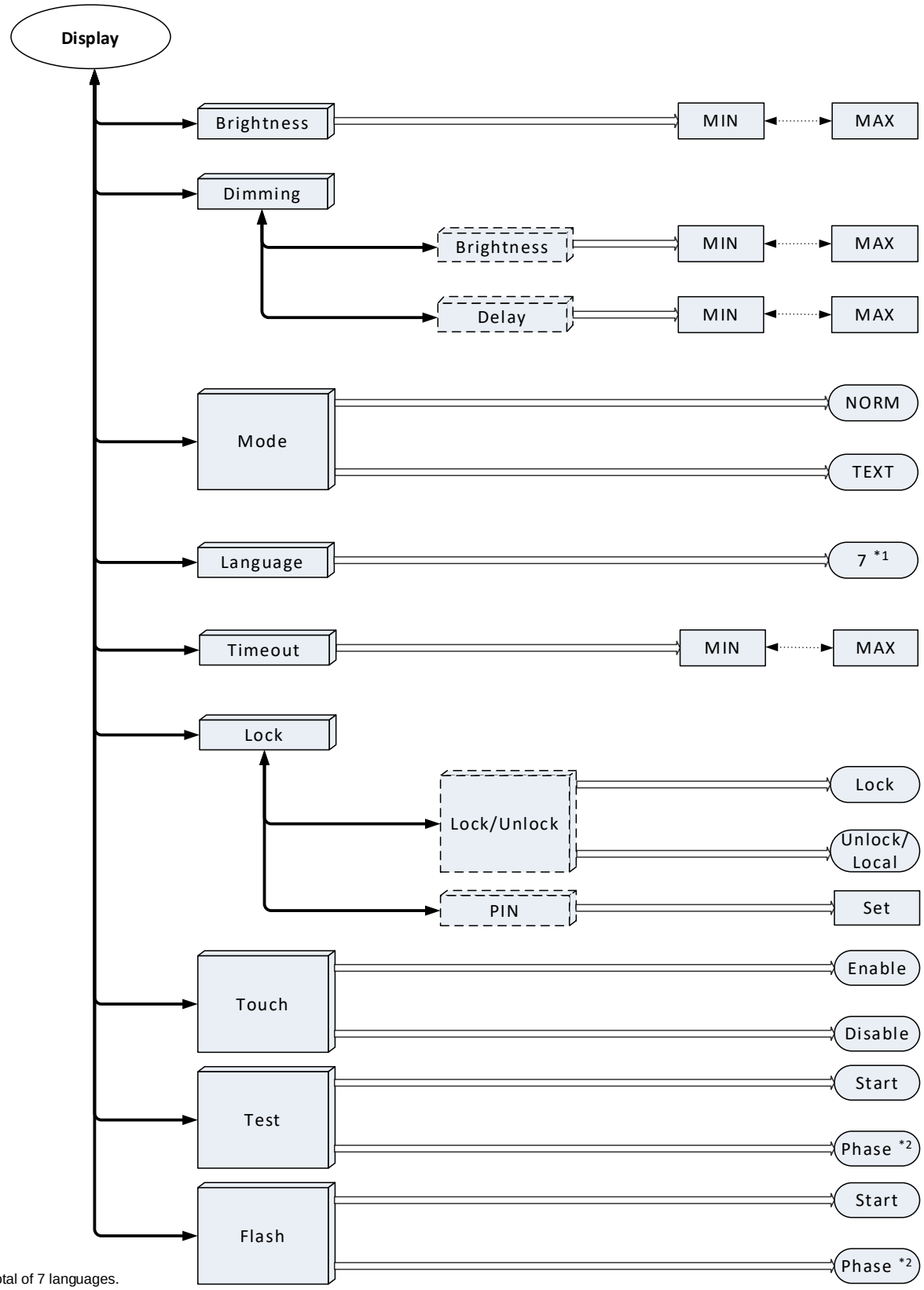
Click **Start Up Setup**.



Refer to OUTPut:PON:PROFile <DSC> in **Section 14.13.5: Output Subsystem**.

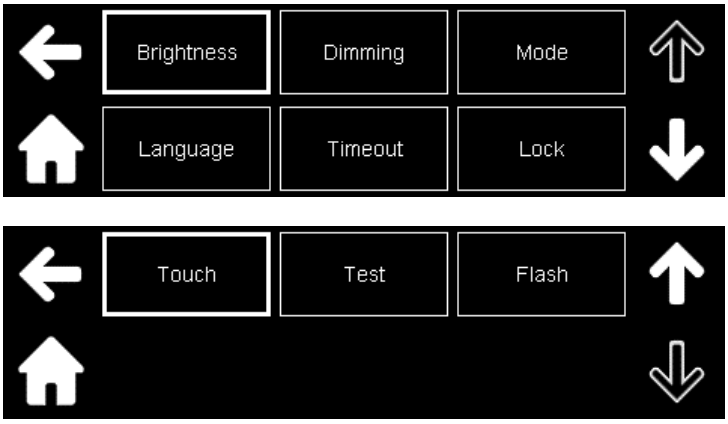
If FRST is selected, the communication interface can also be selected using **Configure**.

9.4.7 Display Menu



*1. Total of 7 languages.
NOTE: Brightness, Dimming, and Mode sub-menus also have a Phase selection button if a multi-phase unit is set up.
*2. Varies, depending on the number of phases

After selecting **Display**, the sub-menus appear.

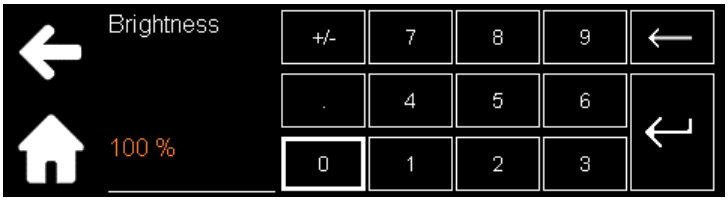


NOTE

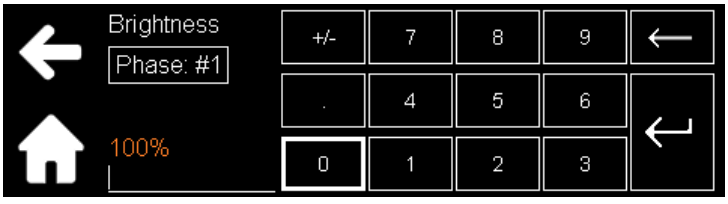
Refer to **Section 14.13.1: Display Subsystem** for the programming parameters of Brightness, Dimming, and Timeout.

Brightness

Click **Brightness** to set the brightness of the display.



If a multi-phase unit is set up, the programming window for **Brightness** also includes a phase selection button.



Phase: #1 : By clicking **Phase: #1**, a screen opens that allows to select the phase.

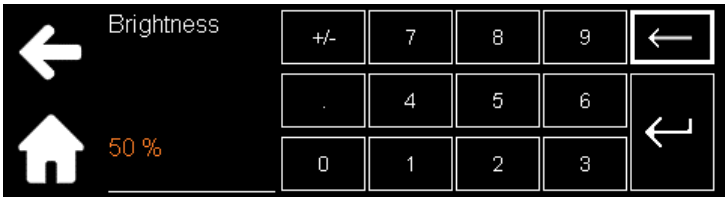


Dimming

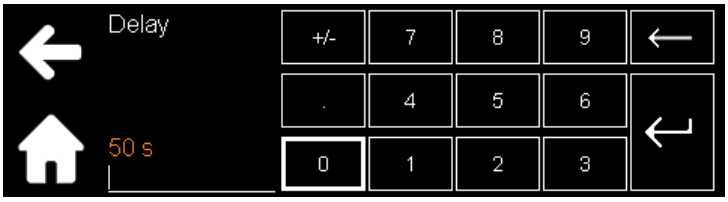
Click **Dimming** to set the dimming brightness and the delay after which the display goes into a dimming state.



Brightness: sets the dimming brightness.



Delay: sets the dimming delay.



NOTE

If a multi-phase unit is set up, the programming window for **Brightness** and **Delay** also includes a phase selection button.

Mode

Click **Mode** to select the type of content to be displayed on the dashboard. Refer to DISPlay[:WINDow]:MODE[#] <DSC> in **Section 14.13.1: Display Subsystem**.



NOTE

If a multi-phase unit is set up, the programming window for **Mode** also includes a phase selection button.

Language

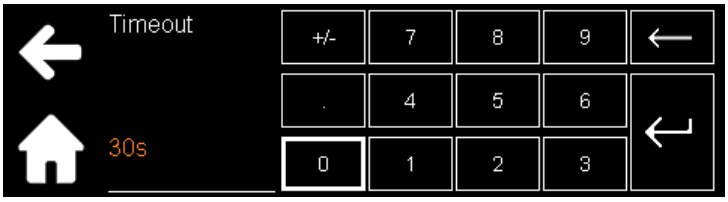
Click **Language** to select the language for working with the display: English, Chinese, French, Deutsch, Japanese, Korean, and Spanish.





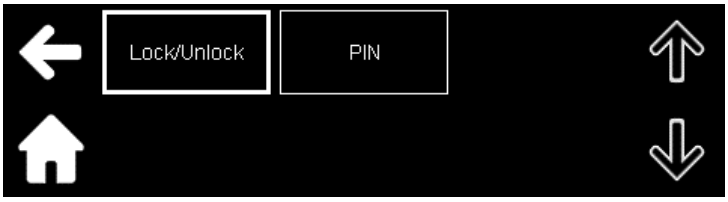
Timeout

Click **Timeout** to set the time to return from the menu or the sub-menu to the dashboard screen if no activity takes place on them.



Lock

Click **Lock** to lock or unlock the front panel programming with or without a PIN.



Locking/Unlocking the front panel programming with the Lock/Unlock button.

1. Click **Lock/Unlock**.



2. Click **Lock** or **Unlock/Local** to lock or unlock the front panel. On the dashboard, **LOCK** is seen when the front panel is locked and **UNLOCK** is seen when the front panel is unlocked.

NOTE

LOCK, **UNLOCK**, and LOC on the dashboard can also be used to Lock/Unlock the front panel. Clicking the icons transfers you to the figure under step 1.

A) Locking the front panel with a PIN.

1. From the **Lock** sub-menu, click **PIN**.



2. Click **Set**.



3. Enter the desired PIN.
4. Verify the PIN.

   A message appears confirming that the PIN is accepted. At this stage, the front panel is not locked.
5. Click the **Lock/Unlock** button.
6. Enter the PIN and click the **Lock** button.

   The front panel is locked, and **LOCK** appears on the dashboard.

B) Un-locking the front panel if there is a PIN.

1. From the **Lock** sub-menu, click **Lock/Unlock**.
2. Enter the PIN.
3. Click **Unlock/Local.** The front panel is un-locked and **UNLOCK** appears on the dashboard.

NOTE

LOCK and LOC on the dashboard can also be used to unlock the front panel if there is a PIN.

C) Modifying the PIN and locking.

1. From the **Lock** sub-menu, click **PIN**.
2. Click **Modify.**

   Enter the old PIN, new PIN, and verify the new PIN.
3. **Lock/Unlock** button appears. Click on it.
4. Enter the PIN and click the **Lock** button.

B) Deleting the PIN.

1. Under the **Lock** sub-menu, click **PIN**.
2. Click **Delete.**
3. Enter the PIN**.**

   The PIN is deleted.

Touch

Click **Touch** to disable the touch screen.

NOTE

NAVIGATION PANEL is active if the touch screen is disabled and can be used to enable the touch screen again.

Test

Click **Test** and then **Start** to put the display into test mode. To bring back the display, use the following options:

- tap on the screen
- press any button on the navigation panel
- press the **RETURN** button
- send DISPlay[:WINDow]:TEST[#] 0
- recycle AC or Power Switch

For Multi-phase units

1. Click **Test.**
2. Select the Phase.
3. Click **Start** to put the display into test mode.

NOTE

For units in multiple phases, if any unit other than the System Master and the units connected to it (refer to **CHAPTER 18: PARALLEL OPERATION**) are tested using the front panel, the testing can be stopped in three ways: by clicking **Start** on the System Master front panel display, by using DISPlay[:WINDow]:TEST[#] 0, or by recycling AC or the Power Switch. A minimum interval of five seconds is required at the power switch OFF state.

Flash

Click **Flash** and then **Start** to flash the front panel display. To stops flashing, use the following options:

- tap on the screen
- press any button on the navigation panel
- press the **RETURN** button
- send DISPlay[:WINDow]:FLASh[#] 0
- recycle AC or Power Switch

For Multi-phase units

1. Click **Flash.**
2. Select the Phase.
3. Click **Start** to put the display into flash mode.

NOTE

For units in multiple phases, if any unit other than the System Master and the units connected to it (refer to **CHAPTER 18: PARALLEL OPERATION**) are flashed using the front panel, the flashing can be stopped in three ways: by clicking **Start** on the System Master front panel display, or by using DISPlay[:WINDow]:FLASh[#] 0, or by recycling AC or the Power Switch. A minimum interval of five seconds is required at the power switch OFF state.

9.4.8 Parallel Menu



*1. Select the number of phases.

NOTE

This menu is available for a Parallel setup only.

After selecting **Parallel**, the sub-menus appear.

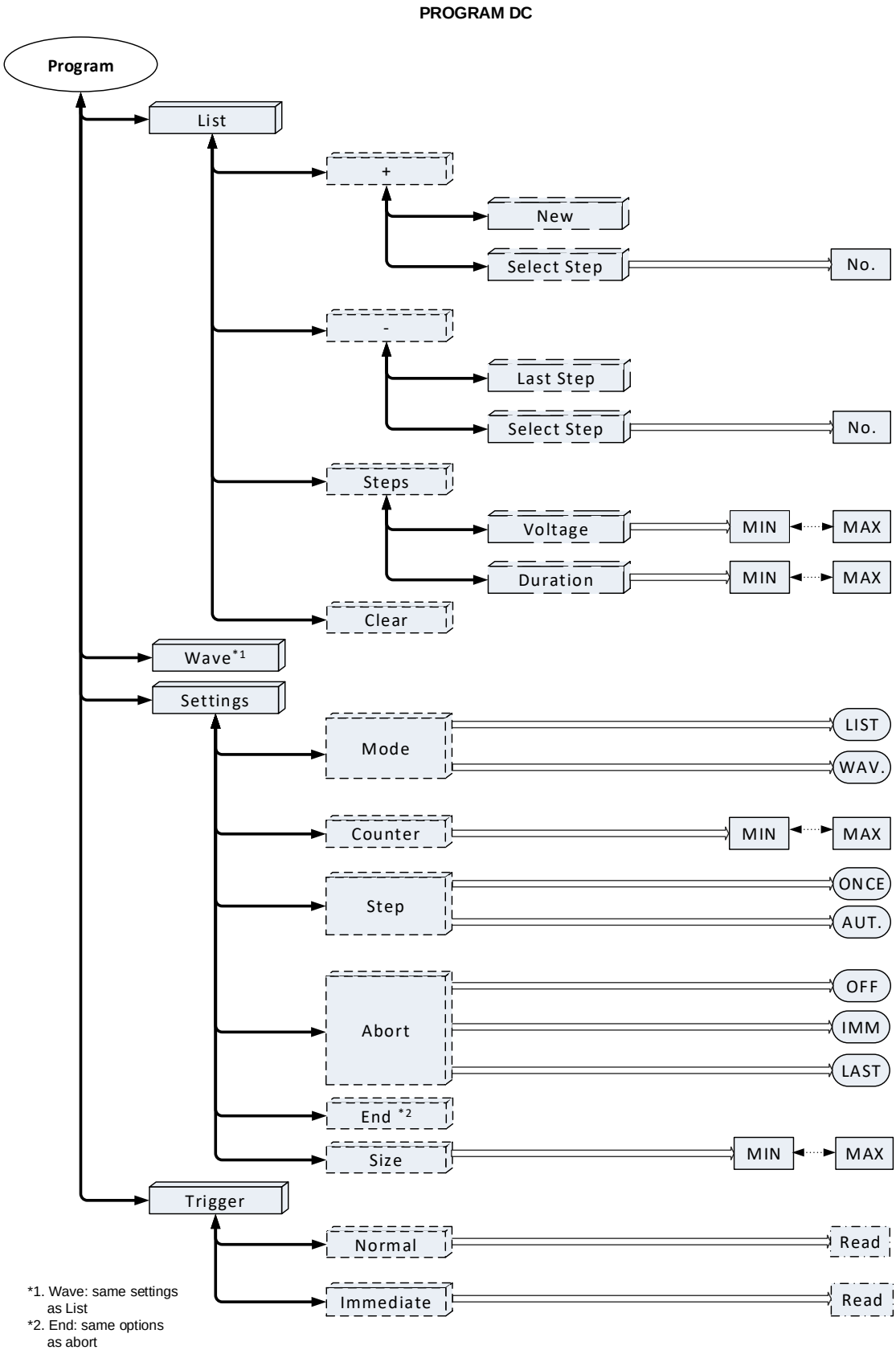
Configure

Sets the number of phases for the output.

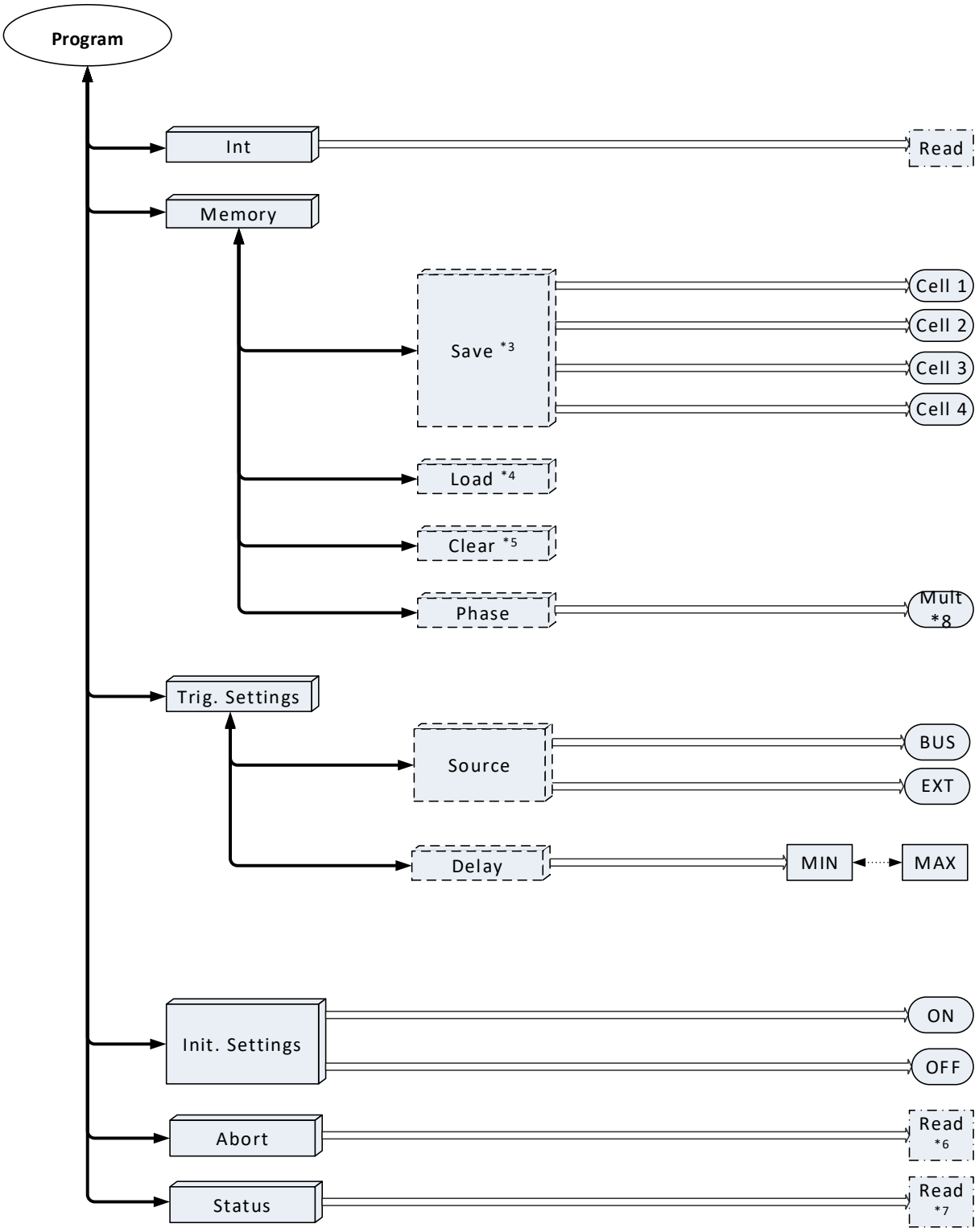
Phase Shift

Sets the difference in phase angle between phase 1 and the other phases. Refer to [SOURce:]PHASe:SHIFt[#] <NRf> in **Section 14.13.8: Source Subsystem**.

9.4.9 Program Menu

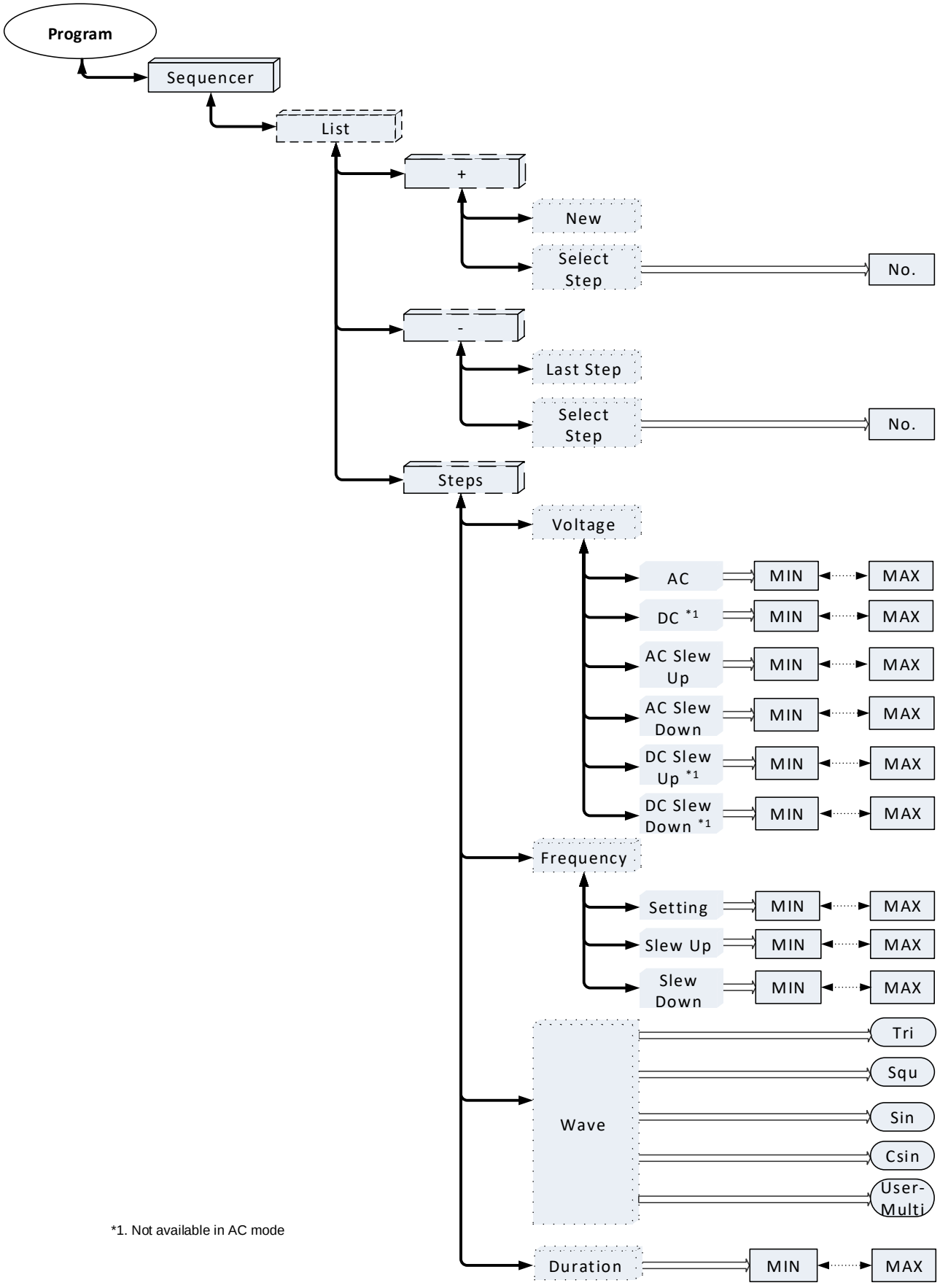


PROGRAM DC - CONTINUED



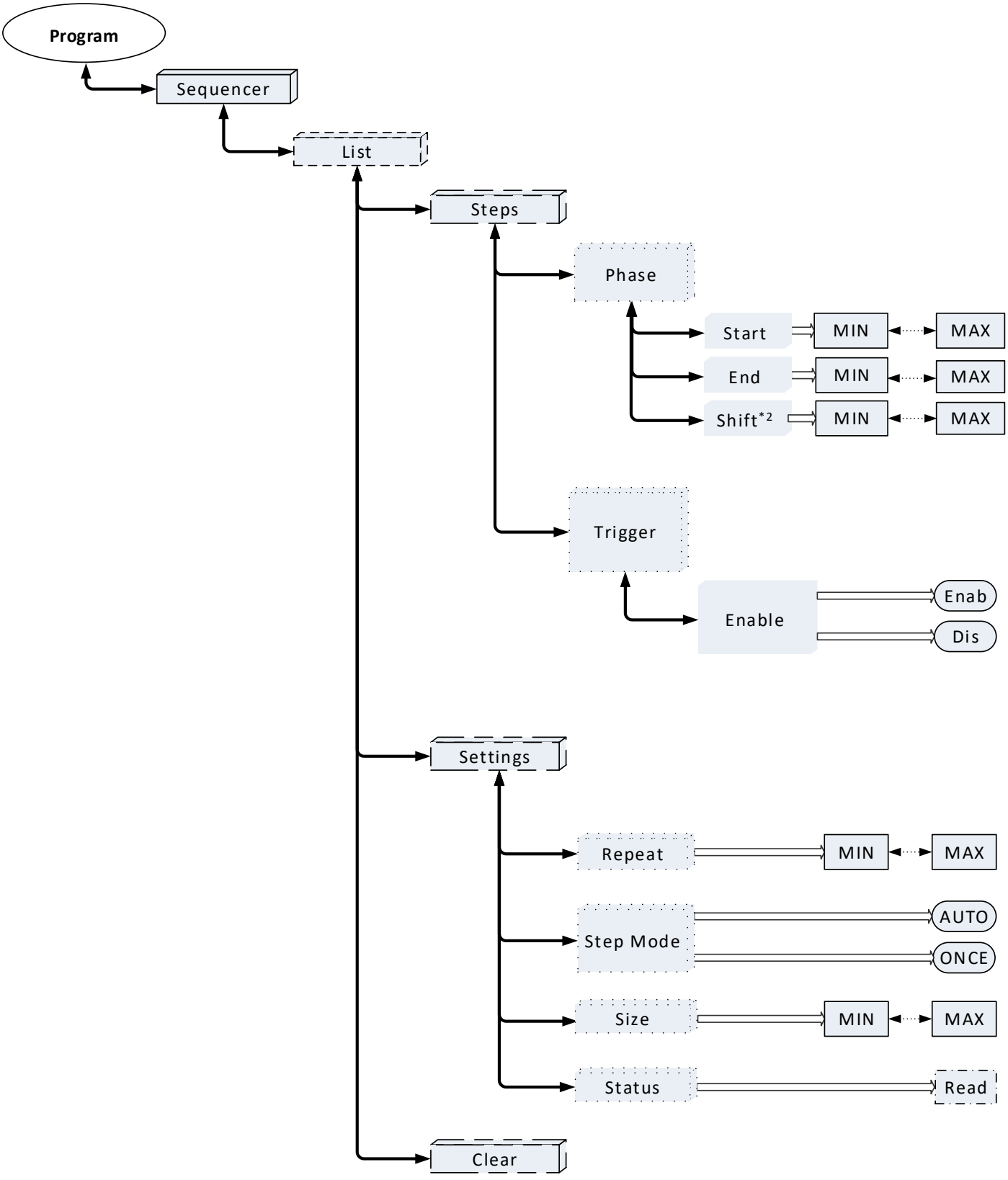
*3. Contains save button
*4. Same options like save and also includes load button
*5.Same options like save and also includes clear button
*6. Abort Status
*7. Sequence Status
*8. Varies, depending on the number of phases. In a single-phase unit, Phase button is not present

PROGRAM AC/ACDC



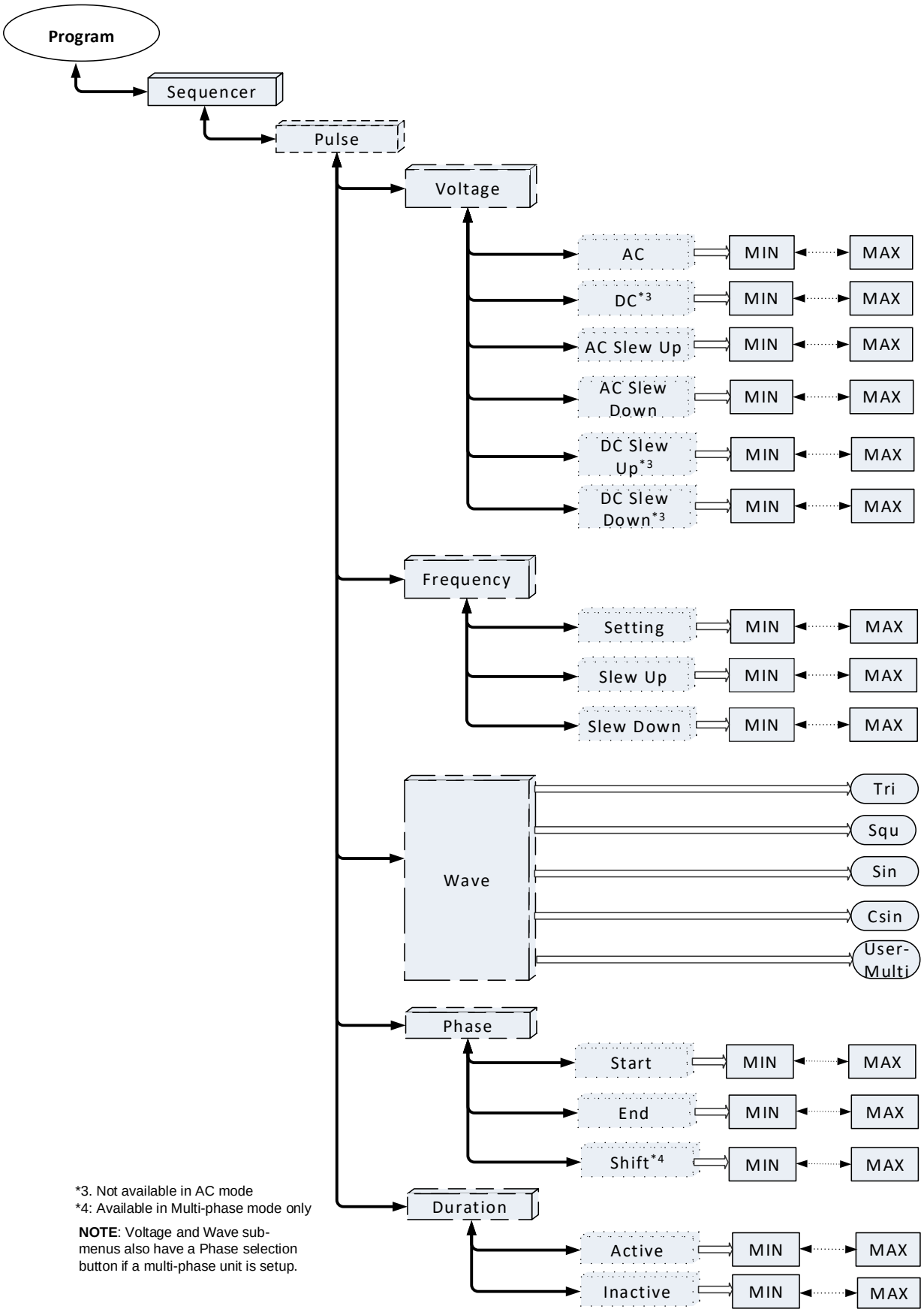
*1. Not available in AC mode

PROGRAM AC/ACDC - CONTINUED



*2. Available in Multi-phase mode only

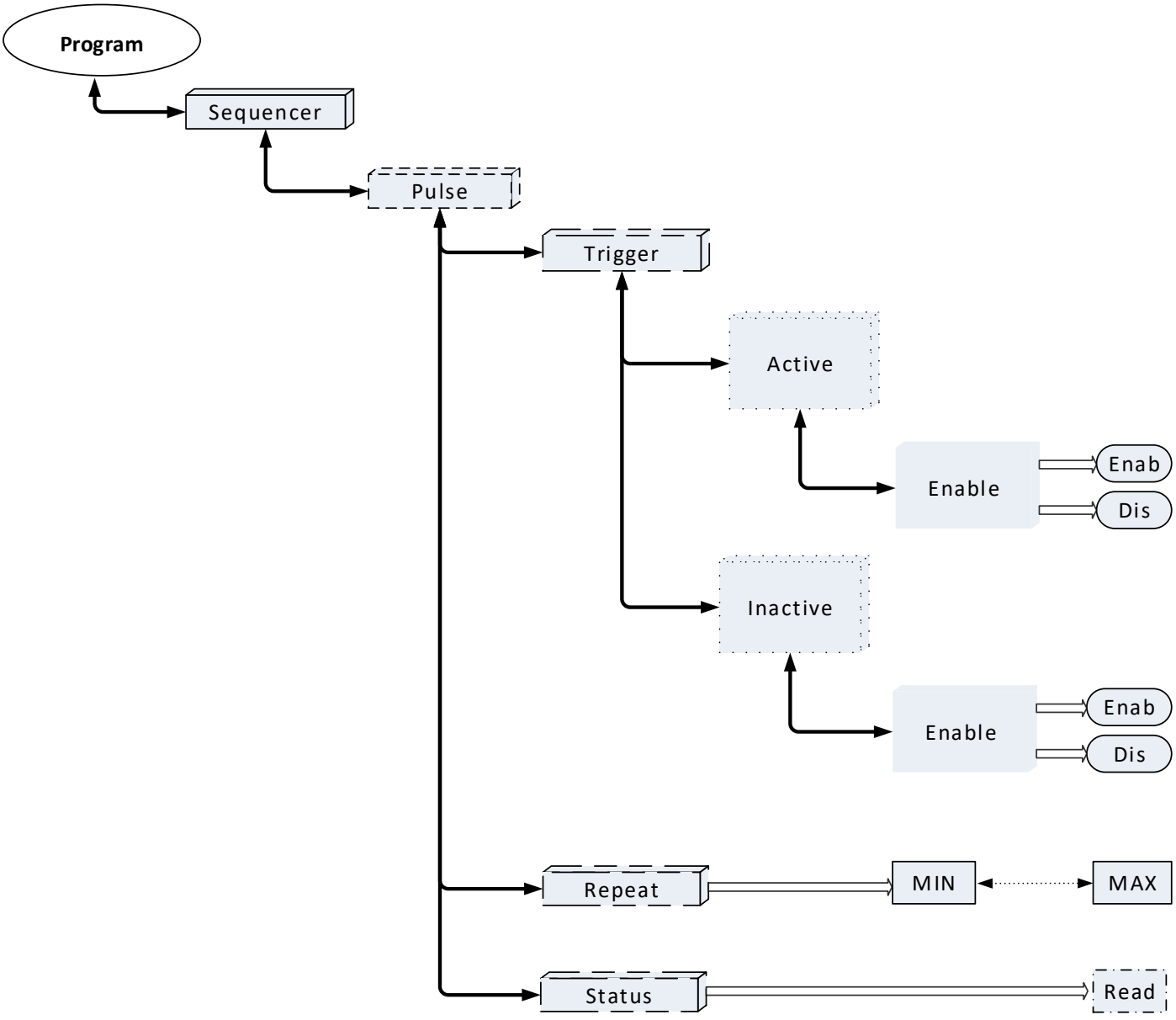
PROGRAM AC/ACDC - CONTINUED



*3. Not available in AC mode
*4: Available in Multi-phase mode only

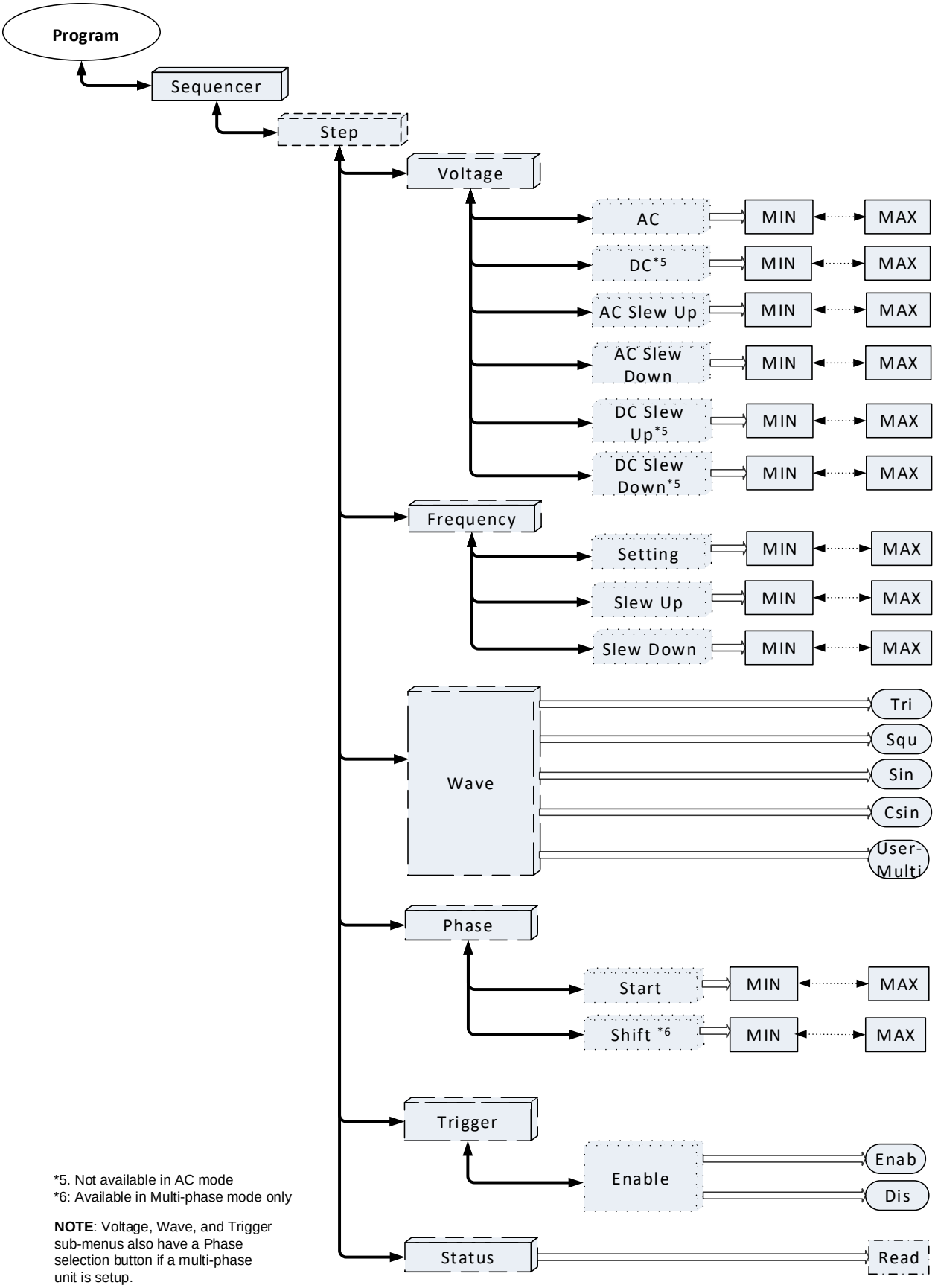
NOTE: Voltage and Wave sub-menus also have a Phase selection button if a multi-phase unit is setup.

PROGRAM AC/ACDC - CONTINUED



NOTE: Trigger sub-menu also have a Phase selection button if a multi-phase unit is setup.

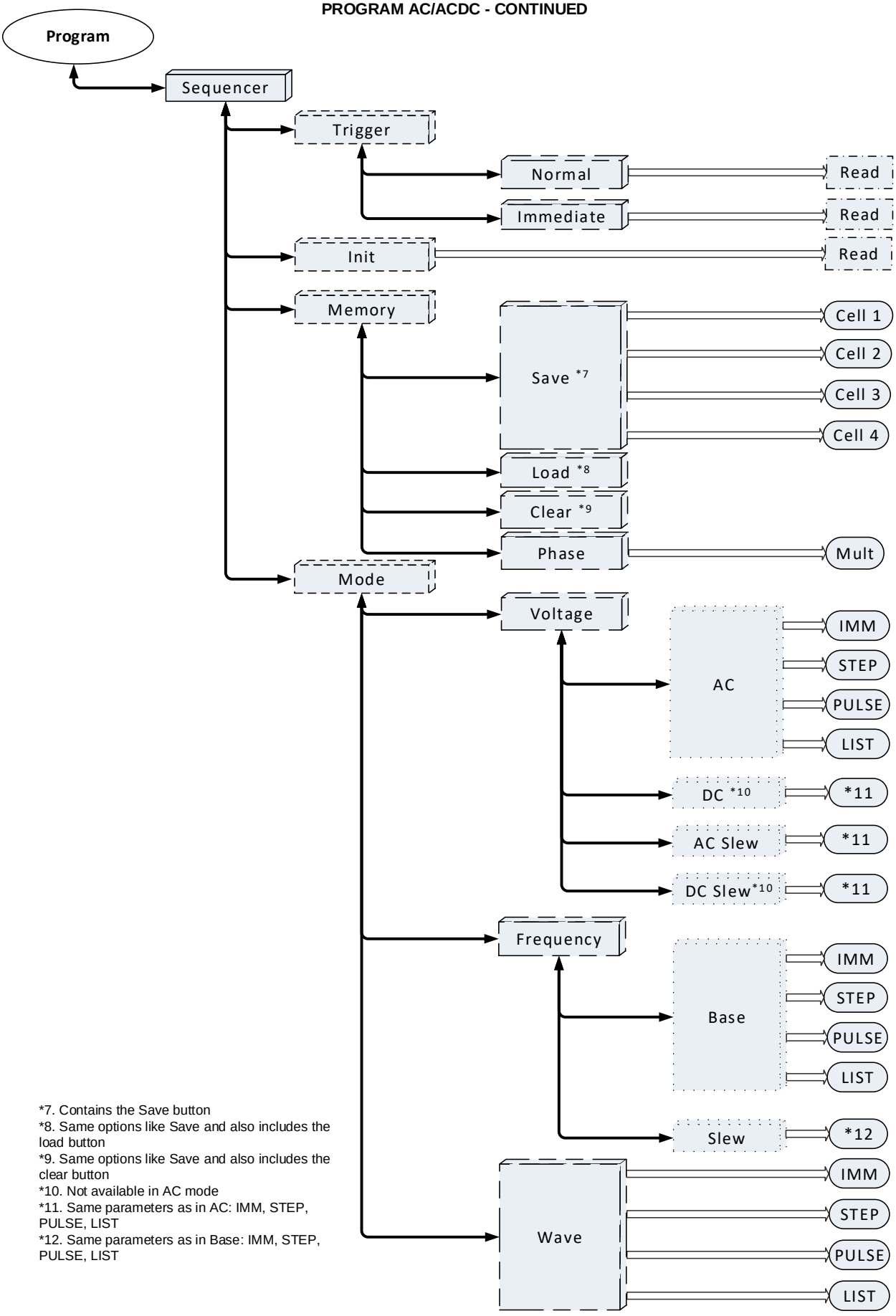
PROGRAM AC/ACDC - CONTINUED



*5. Not available in AC mode
*6: Available in Multi-phase mode only

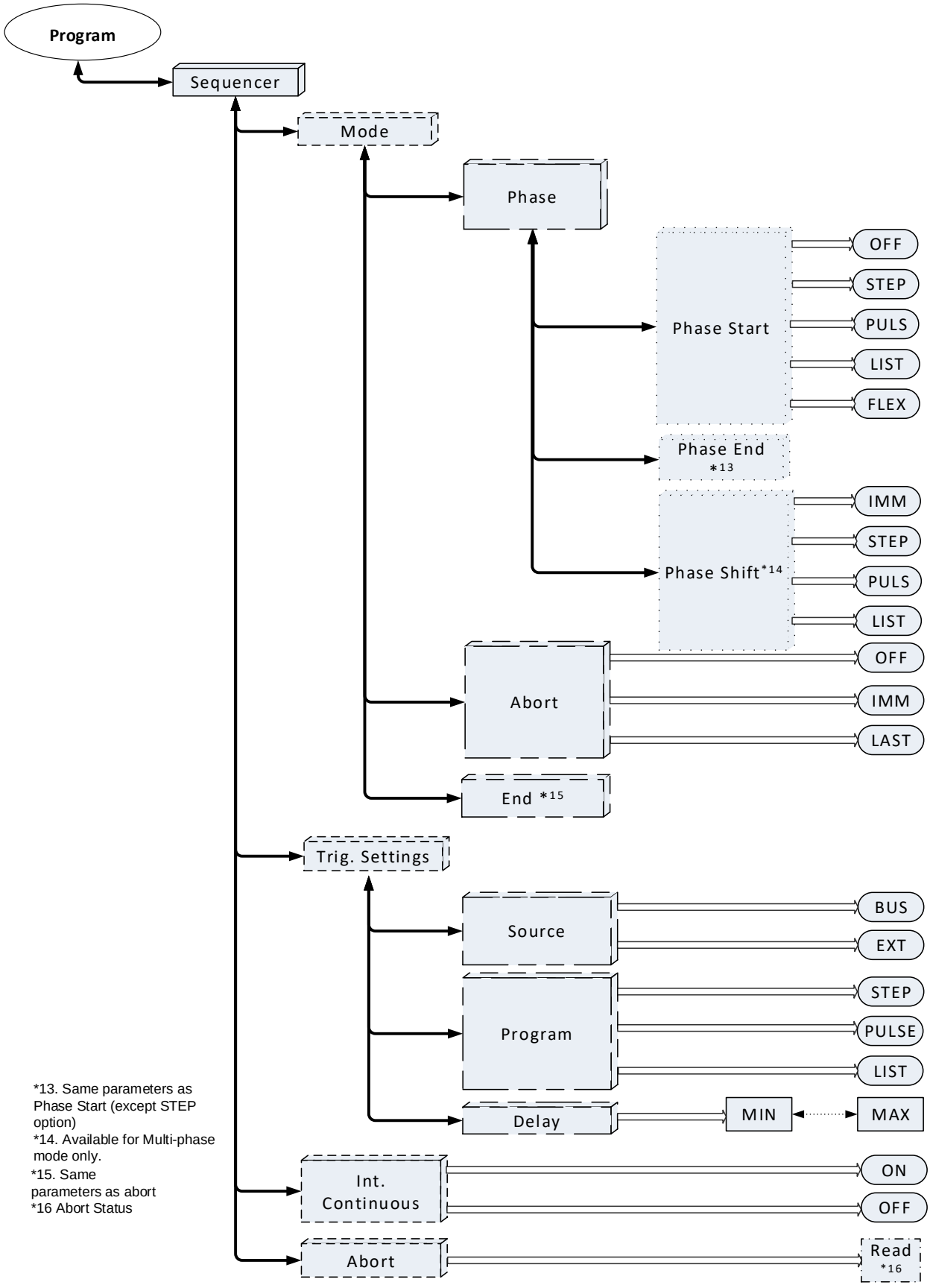
NOTE: Voltage, Wave, and Trigger sub-menus also have a Phase selection button if a multi-phase unit is setup.

PROGRAM AC/ACDC - CONTINUED



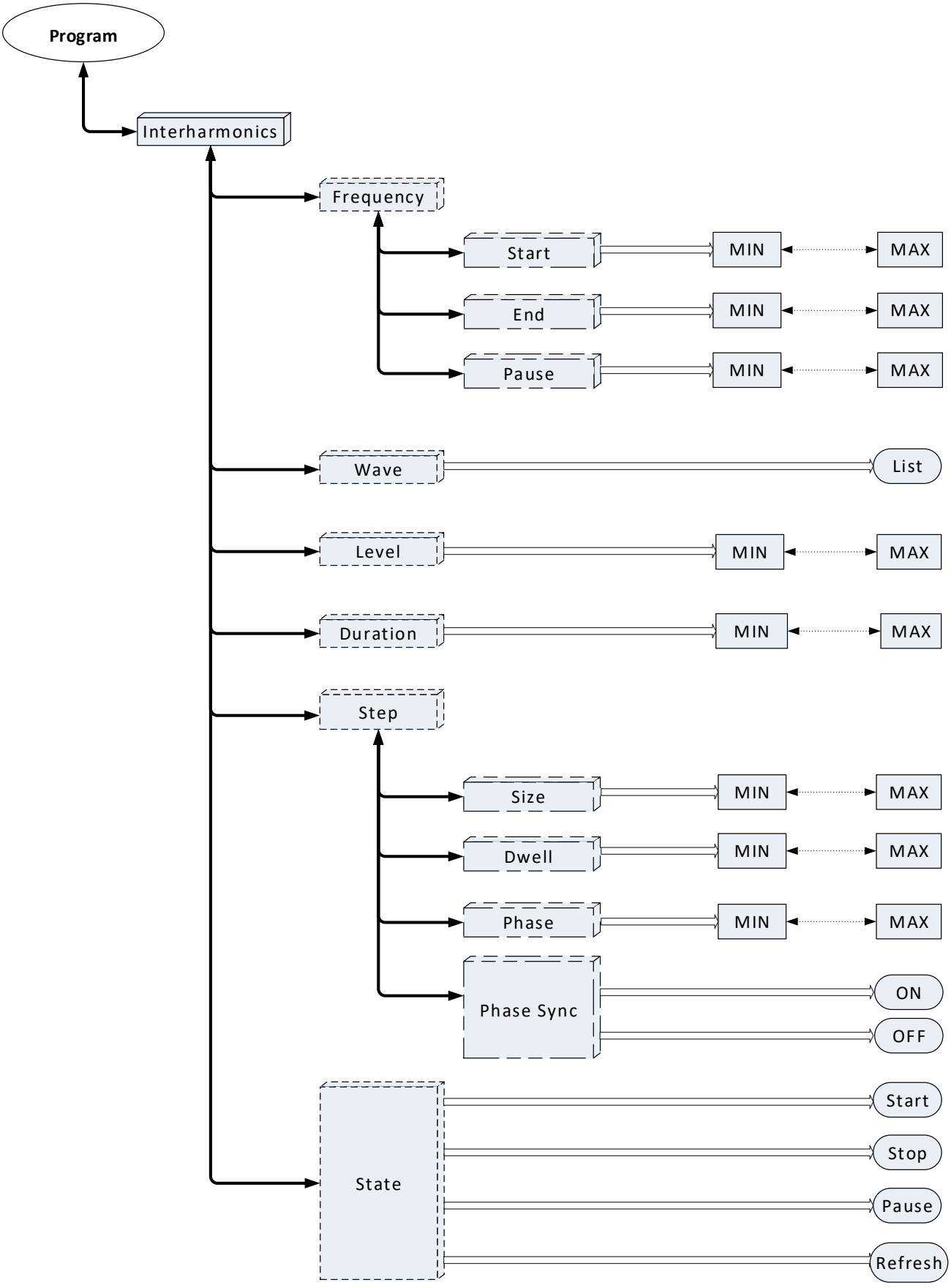
*7. Contains the Save button
*8. Same options like Save and also includes the load button
*9. Same options like Save and also includes the clear button
*10. Not available in AC mode
*11. Same parameters as in AC: IMM, STEP, PULSE, LIST
*12. Same parameters as in Base: IMM, STEP, PULSE, LIST

PROGRAM AC/ACDC - CONTINUED



*13. Same parameters as Phase Start (except STEP option)
*14. Available for Multi-phase mode only.
*15. Same parameters as abort
*16 Abort Status

PROGRAM AC/ACDC - CONTINUED

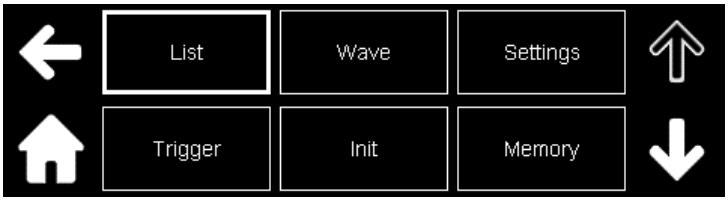


The menu is related to the sequencer function, and all the settings for the sequencers can be carried out from this menu. The sequencer functions are available for the AC, ACDC, and the DC modes.

For Sequencer In DC mode only

Refer to **CHAPTER 16: ADVANCED FUNCTIONS-DC SEQUENCER** for advanced explanation and examples of the DC sequencer.

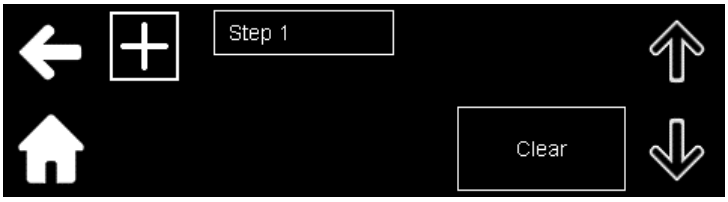
After selecting **Program**, the sub-menus appear.





List

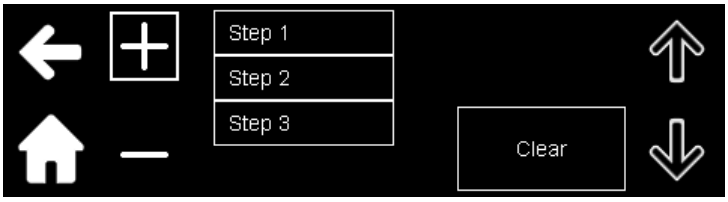
This sub-menu allows the user to add or remove the steps or make modifications to the present steps in the list sequencer. The duration and voltage level of each step can also be programmed.
Click **List**.



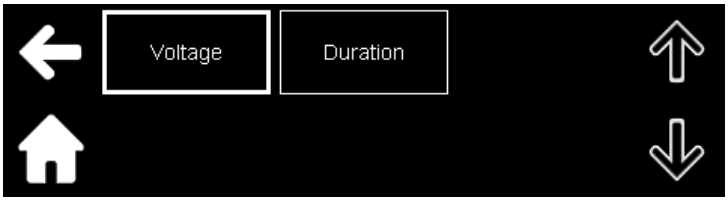
: This adds steps to the list. By default, the first step in the list is Step 1. Click to add another step.



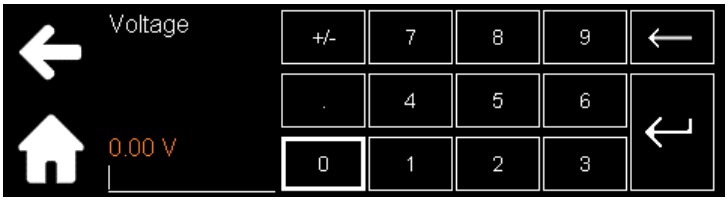
- Click **New** to add a new step. This button adds steps in sequence; Step 2, Step 3, and so on.
- Click **Select Step** to add a new step to a particular index. For example, if the sequence consists of Step 1 and Step 2, click **Select Step** and then enter **2** to insert a step at location 2. The step that was in location 2 moves to 3.

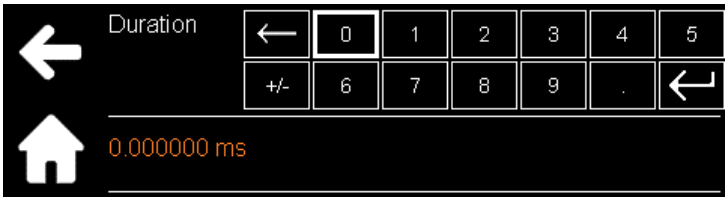


Steps: This programs the voltage level and the duration of each step. Refer to **Section 14.13.7.1: DC Sequencer** for the programming parameter. Click **Step 'x' (the step number)** to enter its setup option.



Enter the values.





NOTE

Voltage and **Duration** values are not sent as soon as they are entered. They are sent only when they are saved with the **Save** button that is under the **Memory** sub-menu.

: The removes steps from the list.



- Click **Last Step** to remove the last step.
- Click **Select Step** to remove the required step. For example, click **Select Step** and then enter **2** to remove the step at location 2. The step at location 3 (if present) becomes the step at location 2.

Clear: Clears all the steps in the sequencer.

Wave

From the **Program** sub-menu, click **Wave** to add or remove the steps in the wave sequencer or make modifications to the present steps. The duration and voltage level of each step can also be programmed.

NOTE

Follow the same steps as described in the List mode to configure the steps in this sequencer.

Settings

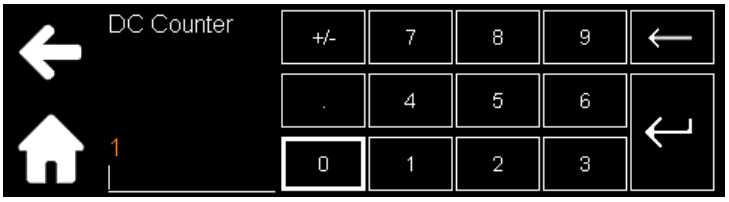
From the **Program** sub-menu, click **Settings** to program the parameters that are also required for the creation of the list or wave sequencers.



Mode: selects the sequencer mode - list or wave.



Counter: sets the number of times the entire sequence is to be repeated. Refer to [PROGram:]DC:COUNter <NR1>|INFinity in **Section 14.13.7.1: DC Sequencer** for the programming parameter.



Step: selects if each step in the sequencer is to be run at one time or the complete sequence is to be run.



Abort: sets the settings of the power source at abort state.

Refer to [PROGram:]DC:MODE:ABORt <DSC> in **Section 14.13.7.1: DC Sequencer**.



End: sets the settings of the power source at end state.

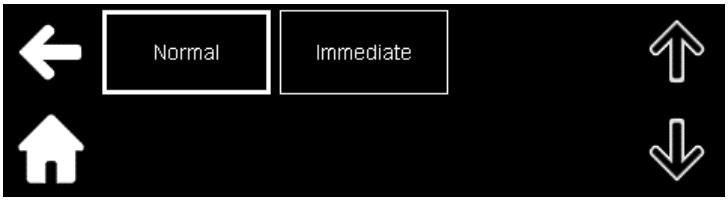
Refer to [PROGram:]DC:MODE:END <DSC> in **Section 14.13.7.1: DC Sequencer**.

Size: sets the total size of the list (total number of members).

Refer to [PROGram:]DC:LIST:SIZE <NR1> in **Section 14.13.7.1: DC Sequencer**.

Trigger

From the **Program** sub-menu, click **Trigger** to trigger a sequence.



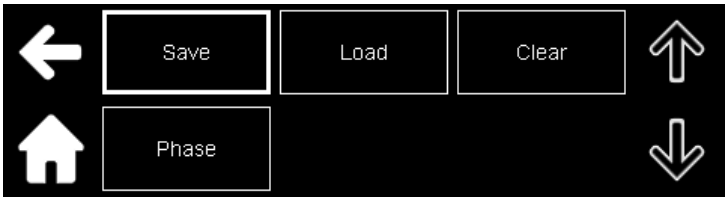
- **Normal:** trigger the sequence with a delay.
- **Immediate:** triggers the sequence immediately.

Int

This initiates the trigger.

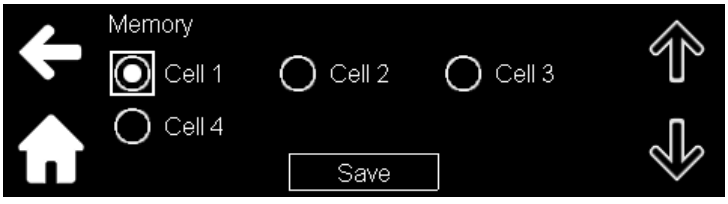
Memory

From the **Program** sub-menu, click **Memory** to save, load, or clear a sequence.



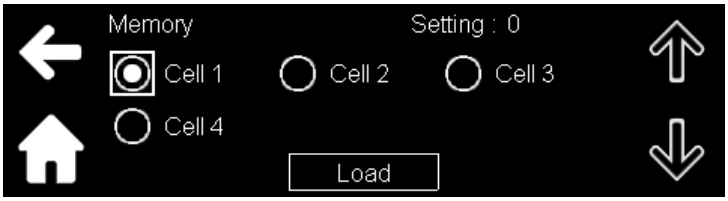
Save: saves a sequence to a memory location.

Click **Save**.

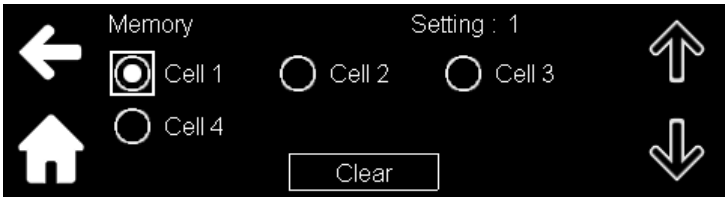


Click on any of the cell and then click **Save** to save the settings.

Load: loads a sequence from a memory location. The setting number shows if cell is loaded. Setting of 0 means no cell is loaded.



Clear: clears a sequence from a memory location. The setting number shows if the cell is loaded or empty. Setting of 1 means cell is empty.



For more details on Save, Load, and Clear, refer to **Section 14.13.7.6: AC/DC/ACDC Sequencer - Memory Commands**.

Phase (multi-phase unit only): selects a phase or all the phases to save the parameters associated with the phases.

Trigger Settings

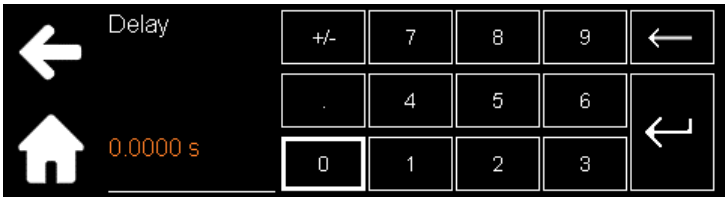
From the **Program** sub-menu, click **Trigger Settings** to select the source of the trigger and set the delay for triggering the sequence.



Source: selects the trigger source. Refer to TRIGger:SOURce <DSC> in **Section 14.13.11: TRIGger Subsystem.**



Delay: sets the trigger delay. Refer to TRIGger:DELay <NRf> in **Section 14.13.11: TRIGger Subsystem** for the programming parameter**.**



Initiate Settings

In some applications, it may be required to have the sequencer system bypass the idle state and return directly to the initiated state after the sequence has completed, thus preventing the need for re-initiation.
From the **Program** sub-menu, click **Initiate Settings.**



- **ON**: The trigger system is continuously initialized.
- **OFF**: The trigger system is to be initialized (using **Int**) every time a sequence is completed.

Abort

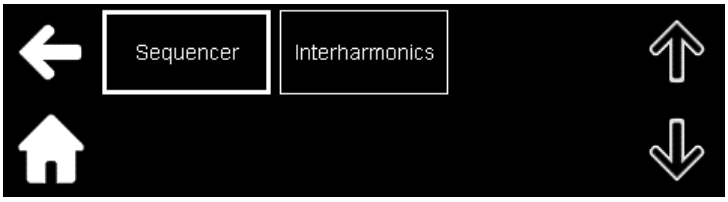
Aborts the sequence

Status

Indicates the state of the sequencer, the node that is being executed, and the iteration (repetition) number.
Refer to [PROGram:]DC:STATe? in **Section 14.13.7.1: DC Sequencer**.

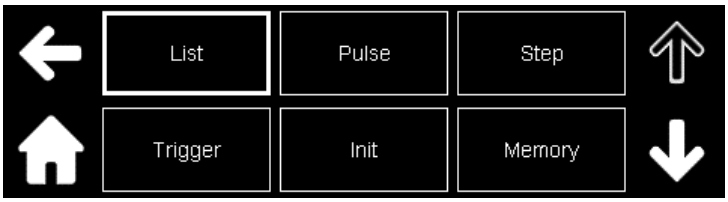
For Sequencer In AC and ACDC mode only

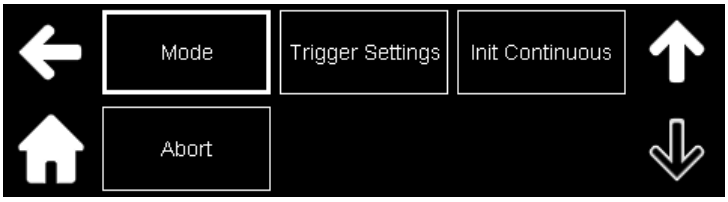
Refer to **CHAPTER 17:ADVANCED FUNCTIONS-AC/ACDC SEQUENCER** for advanced explanation and examples of the AC and ACDC sequencer.
After selecting **Program**, the sub-menus appear.



Sequencer

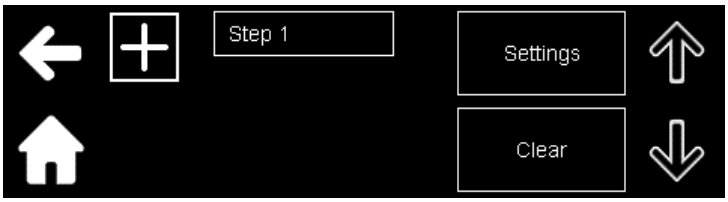
This sub-menu allows the user to program the sequencers in AC and ACDC mode. The different modes that can be generated are list, pulse, and step.
Click **Sequencer**.





List Sequencer

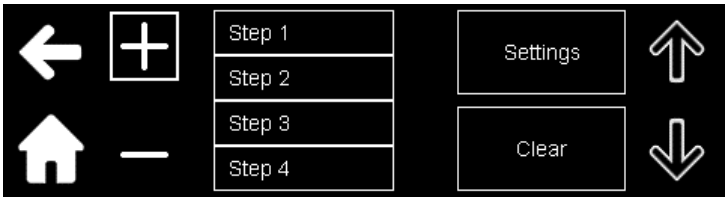
Click **List** to enter its setup options. All the parameters related to the list sequencer are programmed in this sub-menu.



: adds members to the list. By default, the first member in the list is Step 1. Click to add another member.



Click **New** to add a new member. This button adds members in sequence; member 2, member 3, and so on.
Click **Select Step** to add a new member to a particular location. For example, if the sequence consists of member 1 to member 3, click **Select Step** and then enter **3** to insert a member at location 3. The member that was in location 3 moves to 4.



: The removes members from the list.



Click **Last Step** to remove the last member.
Click **Select Step** to remove the required member. For example, click **Select Step** and then enter **2** to remove the member at location 2. The member at location 3 becomes the member at location 2.

Steps: The parameters related to each member of the list sequencer are programmed in this sub-menu. Click **Step 'x' (the step number)'** to enter its setup option.

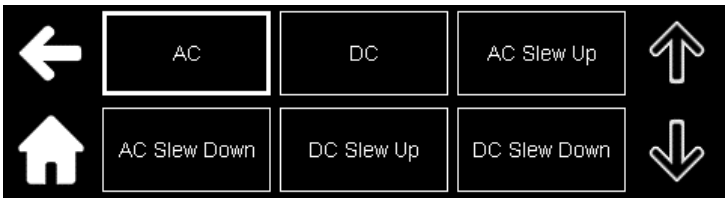


NOTE

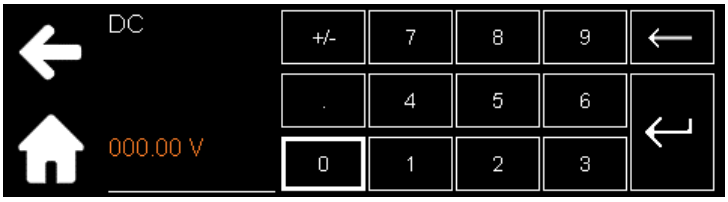
All parameters under **Steps** are not sent as soon as they are entered. They are sent only when they are saved with the **Save** button that is under the **Memory** sub-menu. From the **Memory** sub-menu, the phase can also be selected (multi-phase only).

- **Voltage**: sets the voltage amplitude and its slew rate for each member in the list.

  The window for setting all the levels in ACDC mode is shown below. Refer to **Table 14-8** for the programming parameter.



  The window to set the DC level and its slew rate up programming is shown below.





- **Frequency**: sets the output frequency and its slew rate for each member in the list. These can be set in AC and ACDC mode.

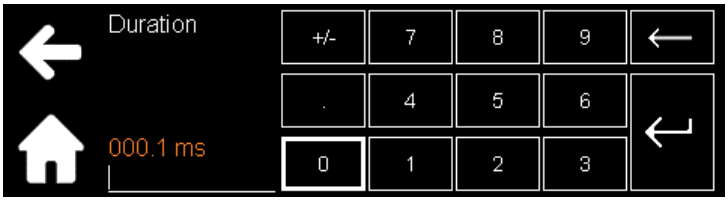
  The window to set all the levels is shown below. Refer to **Table 14-8** for the programming parameter.



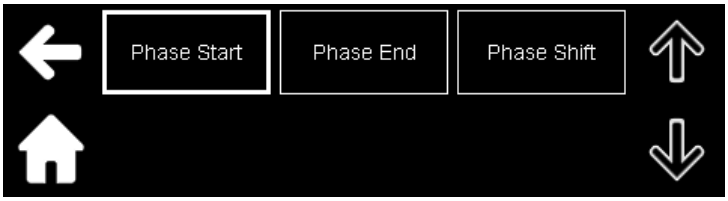
- **Wave**: selects the waveform to which the parameters are applied.

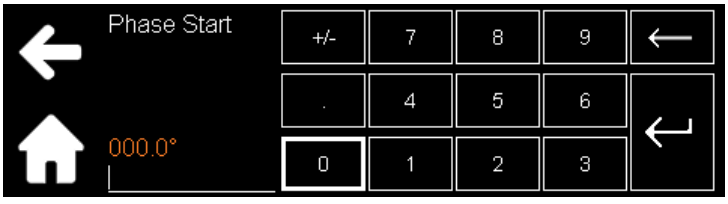


- **Duration**: sets the duration of each member in the list. Refer to **Section 14.13.7.2: AC/ACDC Sequencer - List Subsystem** for the programming parameter.



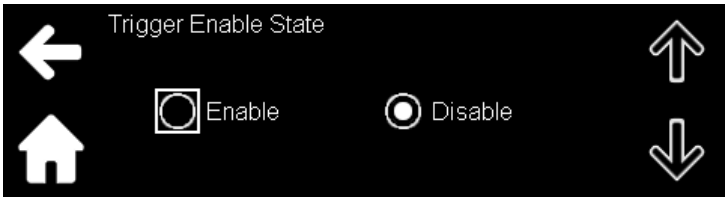
- **Phase**: sets the phase angle at which the step starts and ends for each member in the list. This also sets the phase shift angle between phase 1 and other phases (#). Refer to **Section 14.13.7.2: AC/ACDC Sequencer - List Subsystem** for the programming parameter.





- **Trigger**: enables or disables the trigger out signal when the list member starts executing; refer to **Section 14.13.7.2: AC/ACDC Sequencer - List Subsystem**.





From the **List** sub-menu, click **Settings** to set other parameters related to the list sequencer.



Repeat: sets the number of times the list is repeated. Refer to **Section 14.13.7.2: AC/ACDC Sequencer - List Subsystem** for the programming parameter.

Step Mode: sets the power source to execute the whole sequence or a single step once the trigger is received

Size: sets the total size of the list.

Status: indicates the state of the sequencer, the member number (node) that is being executed, the iteration (repetition) number, and the list size.

From the **List** sub-menu, click **Clear** to clear all the steps in the sequencer.

Pulse Sequencer

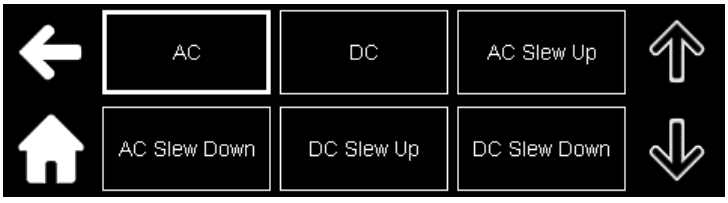
Under **Sequencer** sub-menu, click **Pulse** to enter its setup options. All the parameters related to the pulse sequencer are programmed in this sub-menu.





Voltage: sets the voltage amplitude and its slew rate.

The window for setting all the levels in ACDC mode is shown below. Refer to **Table 14-8** for the programming parameter.



The window to set the DC level and its slew rate up programming are shown below.



NOTE

If a multi-phase unit is set up, sub-menus under **Voltage** sub-menu also include a phase selection button.

Frequency: sets the output frequency and its slew rate. These can be set in AC and ACDC mode.
The window for setting the levels is shown below. Refer to **Table 14-8** for the programming parameter.



Wave: selects the waveform to which the parameters are applied.



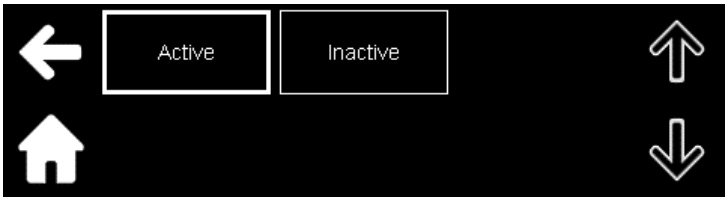
NOTE

If a multi-phase unit is set up, **Wave** sub-menu also include a phase selection button.

Phase: sets the phase angle at which the pulse starts and ends. This also sets the phase shift angle between phase 1 and other phases (#). Refer to **Section 14.13.7.3: AC/ACDC Sequencer - Pulse Subsystem** for the programming parameter.
Duration: sets the active and inactive duration of the pulse. Refer to **Section 14.13.7.3: AC/ACDC Sequencer - Pulse Subsystem** for the programming parameter.
The window to set the active duration is shown below.



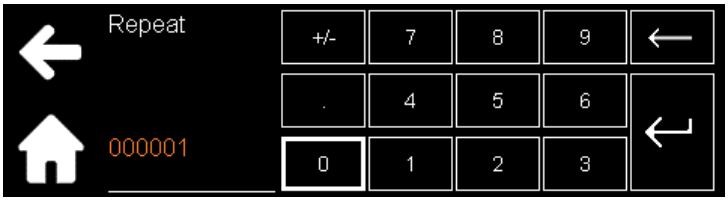
Trigger: enables or disables the trigger out signal when the pulse program enters the active and/or inactive state; refer to **Section 14.13.7.3: AC/ACDC Sequencer - Pulse Subsystem**.



NOTE

If a multi-phase unit is set up, sub-menus under **Trigger** sub-menu also include a phase selection button.

Repeat: Sets the number of times the pulse (active state) is repeated. Refer to **Section 14.13.7.3: AC/ACDC Sequencer - Pulse Subsystem** for the programming parameter.



Status: indicates the state of the sequencer and the iteration (repetition) number.

Step Sequencer

Under **Sequencer** sub-menu, click **Step** to enter its setup options. All the parameters related to the step sequencer are programmed in this sub-menu.

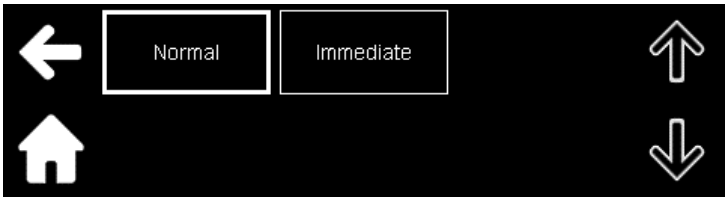


Voltage: sets the voltage amplitude and its slew rate. Refer to **Table 14-8** for the programming parameter.
Frequency: sets the output frequency and its slew rate. Refer to **Table 14-8** for the programming parameter.
Wave: selects the waveform to which the parameters are to be applied.
Phase: sets the phase angle at which the step starts. This also sets the phase angle difference between phase 1 and other phases (#). Refer to **Section 14.13.7.4: AC/ACDC Sequencer - Step Subsystem** for the programming parameter.
Trigger: enables or disables the trigger out signal when the step program enters the active state. Refer to **Section 14.13.7.4: AC/ACDC Sequencer - Step Subsystem**.
Status: indicates the status of the step sequencer.

NOTE

If a multi-phase unit is set up, sub-menus under **Voltage, Wave**, and **Trigger** sub-menus also include a phase selection button.

Under **Sequencer** sub-menu, click **Trigger**.



Normal: Applies the trigger with a delay.

Immediate: Applies the trigger immediately.

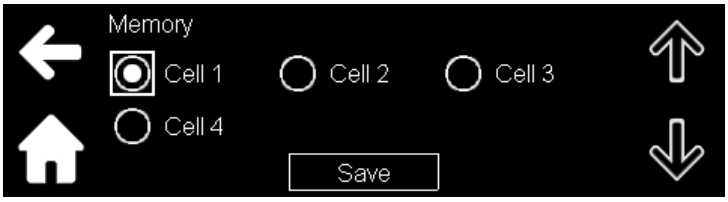
Under **Sequencer** sub-menu, click **Int** to initiate the trigger.

Under **Sequencer** sub-menu, click **Memory**.



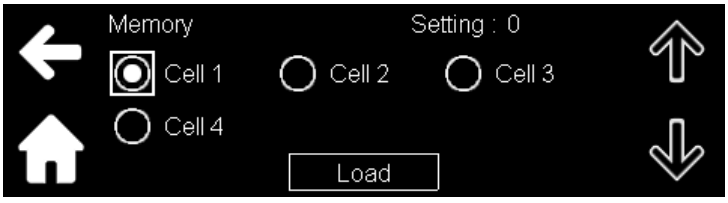
Save: Saves a sequence to a memory location.

Click **Save**.

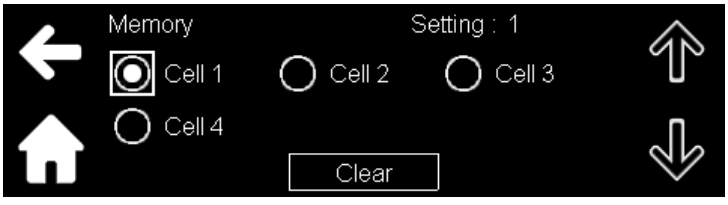


Click on any of the cell and then click **Save** to save the settings.

Load: Loads a sequence from a memory location. The setting number shows which cell is loaded. Setting of 0 means no cell is loaded.



Clear: Clears a sequence from a memory location. The setting number shows if the cell is loaded or empty. Setting of 1 means cell is empty.



For more details on Save, Load, and Clear, refer to **Section 14.13.7.6: AC/DC/ACDC Sequencer - Memory Commands**.

Phase: Select a phase to save the list sequencer parameters associated with the phases.

Under **Sequencer** sub-menu, click **Mode**. This sub-menu allows the user to select the mode that controls the parameters of the waveform when a sequence is triggered. Refer to **Section 14.13.7.5: PROGram MODE Commands** for an explanation of the modes.



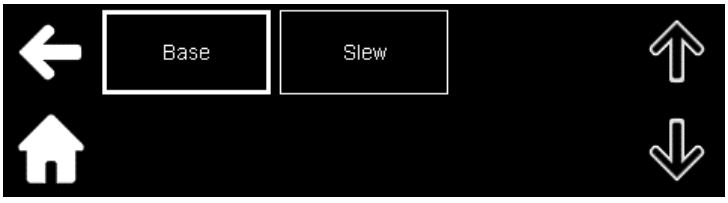
Voltage: Different parameters of the output voltage such as the AC component, the DC offset, and their slew rate can be controlled by different modes.
Click **Voltage** to select the different parameters.



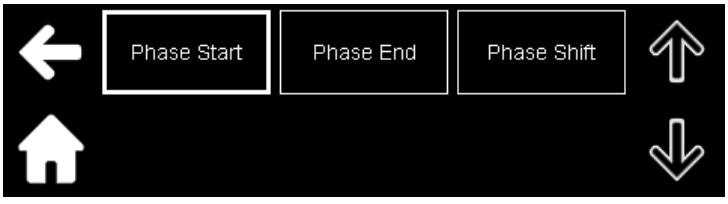
For example, click **AC** to select the mode.



Frequency: Frequency setting and its slew rate can be controlled by different modes.
Click **Frequency** to select the different parameters.



Wave: The waveform can be controlled by different modes.
Phase: Phase Start angle, Phase End angle, and Phase Shift angle can be controlled by different modes.
Click **Phase.**



Abort: Sets the behavior of the power source when ABORt is sent. Abort can be controlled by different modes.
End: Sets the behavior of the power source when End is sent. End can controlled by different modes.

Under **Sequencer** sub-menu, click **Trigger Settings**. This sub-menu allows the user to set the source of the trigger, the mode that controls the sequencer, and the delay for triggering the sequence.



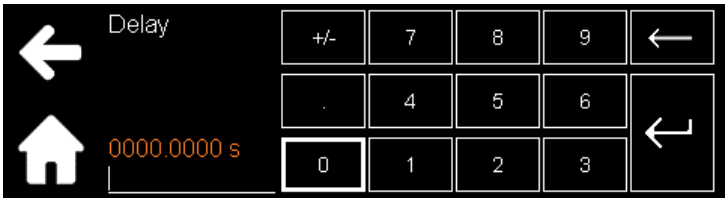
Source: selects the trigger source. Refer to TRIGger:SOURce <DSC> in **Section 14.13.11: TRIGger Subsystem**.



Program: selects which mode controls the sequencer waveform.



Delay: sets the delay. Refer to TRIGger:DELay <NRf> in **Section 14.13.11: TRIGger Subsystem** for the programming parameter.



Under **Sequencer** sub-menu, click **Initiate Continuous**. In some applications, it may be required to have the sequencer system return directly to the initiated state and bypasses the idle state after the sequence has completed, thus preventing the need for re-initiation.



- **ON**: The trigger system is continuously initialized.
- **OFF**: The trigger system is to be initialized every time a trigger is to be sent.

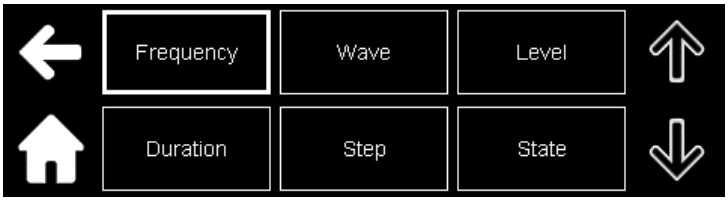
Under **Sequencer** sub-menu, click **Abort** to abort the sequencer.

Interharmonics

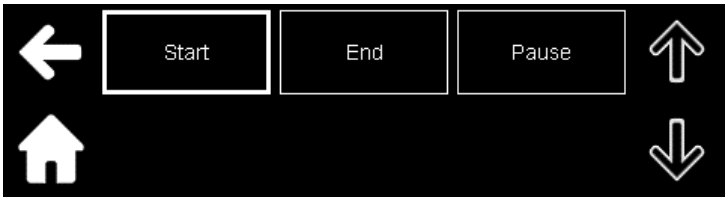
In the Interharmonics function, a frequency waveform with a variable voltage and frequency component is added to the base frequency to test certain interferences.

Refer to **Section 14.13.12: IHARmonics (Interharmonics Subsystem)** for the programming parameters.

Click **Interharmonics**.



Click **Frequency** to enter its setup options.



Start: set the start frequency of the interharmonics wave sweep.

End: set the end frequency of the interharmonics wave sweep.

Pause: pause the sweep at the selected frequency.

Wave: selects the waveform used for the interharmonics.

Level: sets the weight (in percentage) of the interharmonics amplitude relative to the amplitude of the fundamental frequency.

Duration: sets the total duration of the sweep.

Click **Step** to enter its setup option.

Size: set the step size of the wave sweep

Dwell: set the total dwell time of the selected step

Phase: set the start phase of the step

Phase Sync: Enable or disable the phase sync

State: controls the state of the sweep: start, stop, pause, and refresh.

9.5 Output ON/OFF Button

The output can be turned ON or OFF by pressing **OUT**.

A green LED lights up when the output is enabled and turns off when the output is disabled. In the event of an alarm, a red LED blinks. The green and red LEDs are integrated into the **OUT** button.

10.1 Introduction

This chapter describes the communication protocol, configuration, and operation of RS232, RS485, USB, LAN, and GPIB interfaces that can be used to operate the power source.

The power source may be operated through five interfaces as shown in the **Table 10-1**.

No.	Mode	Control Type	Description
1	LAN	Control using an Ethernet connection	Disables serial and GPIB ports. Local and analog modes may still be used to set, measure, and read.
2	Local	Control using the front panel display and buttons	All communication ports may still be used to set, measure, and read.
3	Serial	Control using RS-232, RS-485, or USB	Disables the LAN port and GPIB ports. Local and analog modes may still be used to set, measure, and read.
4	Analog	Control using analog signals	All communication ports may still be used to set, measure, and read.
5	GPIB (optional)	Control using GPIB communication	Disables the LAN and serial ports. Local and analog modes may still be used to set, measure, and read.

Table 10-1: Types of Interfaces

NOTES

The default communication interface is set to USB.

10.2 Programming with RS232 and RS485 Communication

The RS232 and RS485 communication can be performed through a single RS232 and RS485 connector labeled **J1** on the rear panel.

10.2.1 Communication Cable

Prepare the RS232 and RS485 cable using the pinout in **Figure 10-1, Table 10-2,** and **Table 10-3**.

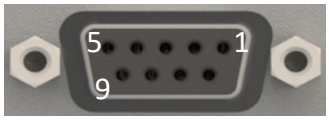


Figure 10-1: RS232 and RS485 Pinout

Pin no.	Name	Signal Name	Remarks
2	Tx	Transmit Data	Twisted pair
3	Rx	Receive Data	
5	COMMON	COMMON	
7	CTS (*)	Clear to Send	Twisted pair
8	RTS (*)	Request to Send	

Table 10-2: Pinout for RS232 Cable

NOTE

(*) CTS and RTS (flow control signals) are optional and can be enabled or disabled from the front panel or with a communication command.

Pin no.	Name	Signal Name	Remarks
1	TxD+	Transmit Data (+)	Twisted pair
6	TxD-	Transmit Data (-)	
5	COMMON	COMMON	—
4	RxD-	Receive Data (-)	Twisted pair
9	RxD+	Receive Data (+)	

Table 10-3: Pinout for RS485 Cable

10.2.2 Interface Selection

Refer to **Section 9.4.4: Interface Menu** to select 232 or 485 interface from the front panel.
Refer to SYSTem[:COMMunicate]:INTerface <DSC> in **Section 14.13.10: System Subsystem** to set 232 or 485 interface with a communication command.

10.2.3 Baudrate and Flow Control Setting (RS-232 only)

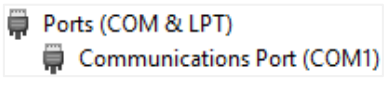
Refer to **Section 9.4.4: Interface Menu** to select the baudrate and enable/disable the flow control from the front panel.
Refer to SYSTem[:COMMunicate]:BAUDrate <DSC> and SYSTem[:COMMunicate]:RS232:CONTrol <Bool> in **Section 14.13.10: System Subsystem** to set the baudrate and enable/disable the flow control with a communication command.

10.2.4 Baudrate, Address, Termination, and State Setting (RS-485 only)

Refer to **Section 9.4.4: Interface Menu** to select the baudrate and address, enable/disable the termination, and enable/disable the address state from the front panel.
Refer to SYSTem[:COMMunicate]:BAUDrate <DSC>, SYSTem[:COMMunicate]:RS485:ADDRess <NR1>, SYSTem[:COMMunicate]:RS485:TERMination:STATe <Bool>, and SYSTem[:COMMunicate]:RS485:ADDRess:STATe <Bool> in **Section 14.13.10: System Subsystem** to set the baudrate and address, enable/disable the termination, and enable/disable the address state with a communication command.

10.2.5 Establishing Communication

After the cable is connected, the COM port of the power source is detected in Device Manager under the Ports (COM & LPT) category as **Communications Port (COMX)**; X stands for the COM address.



Communication with the power source can be established with any terminal software.

For RS232, configure the terminal software as shown in **Table 10-4**.

Parameter	Setting
Port	Assigned port
Baudrate	19200–921600
Data Bits	8
Parity	None
Stop Bits	1
Flow Control	None or RTS/CTS (optional)
Incoming Termination	CR is recommended
Outgoing Termination	CR+LF is recommended

Table 10-4: RS232 Terminal Configuration

NOTE

There is no addressing in RS232 communication.

For RS485, configure the terminal software as shown in **Table 10-5**.

Parameter	Setting
Port	Assigned port
Baudrate	19200–921600
Data Bits	8
Parity	None
Stop Bits	1
Incoming Termination	CR is recommended
Outgoing Termination	CR+LF is recommended

Table 10-5: RS485 Terminal Configuration

NOTE

485 logic is supported only for RS485 bus constructed in a parallel format, and it does not support a multidrop OUT-IN configuration.

NOTE

Power source addressing is lost after an address change, AC recycle, or power switch recycle (power switch recycle time must be at least 5 seconds).

10.3 Programming with USB

The USB communication can be performed through the USB connector labeled **J2** on the rear panel.

10.3.1 USB Driver Installation (PC)

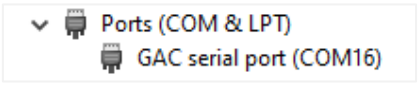
To communicate with the unit, it is recommended to install the USB driver before connecting the USB cable. To install the USB driver, download the Virtual Control Panel (VCP) application that holds the USB drivers:
https://product.tdk.com/en/products/power/switching-power/prg-power/designtool/software_vcp.html

Refer to the Installation and Application Guide, available under the same link, for a step-by-step installation procedure.

After installing the driver, connect the power source to the PC using a USB cable.



After the cable is connected, the COM port of the power source is detected in Device Manager under the Ports (COM & LPT) category as **GAC serial port (COMX)**; X stands for the COM address.



10.3.2 Interface Selection

Refer to **Section 9.4.4: Interface Menu** to select USB from the front panel.
Refer to SYSTem[:COMMunicate]:INTerface <DSC> in **Section 14.13.10: System Subsystem** to set USB interface with a communication command.

10.3.3 Establishing Communication

Communication with the power source can be established with any terminal software.
Configure terminal software as shown in **Table 10-6**.

Parameter	Setting
Port	Assigned port
Incoming Termination	CR is recommended
Outgoing Termination	CR+LF is recommended

Table 10-6: USB Terminal Configuration

10.4 Programming with LAN

The LAN communication is accessible through the LAN connector labeled **J3** on the rear panel.

10.4.1 Feature Summary

Communicate over any standard TCP/IP network

- LAN (Local Area Network)
- WAN (Wide Area Network)
- Communicate worldwide using the Internet

Viewable web page with any web page browser (e.g., Google Chrome™)

- Configurable network connection settings
- Active web page (GUI) that programs the power source output, sets the protection values, and displays the settings, status, measurements, and harmonic details
- Optional password protection to prevent unauthorized operation

Google Chrome™ is the registered trademark of Google LLC.

LAN protocols

- VISA, TCP sockets, and UDP sockets are supported
- VXI-11 Discovery and PING server are supported
- ARP, DNS, mDNS, and DNS-SD connectivity protocols are supported

Full remote programming functions

- Uses the SCPI command language, an instrumentation standard
- Compatible with VISA drivers and all the test and measurement utilities
- TCP sockets and UDP sockets that support PLCs, Linux®, and other non-VISA controllers

Front Panel Features

- Configure and view the LAN settings
- LAN Reset
- Blinks to locate the required power source in a rack and to indicate duplicate IP

10.4.2 Specifications

NETWORK CONFIGURATION

MAC Address	TDK-Lambda assigned: 00:19:f9:xx:xx:xx xx:xx:xx is the unique address for each unit
IP Address	Set and read via the front panel, the web page, or a communication command
DHCP	Receive an address from a network server. Leasing services.
Auto-IP	Create its own IP address: 169.254.xxx.xxx
Static IP	Any IP fixed by an operator
Address Resolution	ARP Protocol
Hostname	DNS and mDNS protocols. Operator settable hostname.
Service Name	Service Discovery Protocol (DNS-SD)
Duplicate IP Detection	Reject duplicate setting or disconnect from network
Subnet Mask	Mask set by DHCP or static
Default Gateway	Address set by DHCP or static
DNS Server	Address set by DHCP or static
LAN Reset	Resets configuration

LAN PROTOCOLS

TCP	LAN packets follow Transmission Control Protocol (TCP)
IPv4	Internet Protocol version 4

Linux® is the registered trademark of Linus Torvalds.

VXI-11 is Copyright © of VXIbus Consortium.

SCPI is Copyright © 2001-2023 of IVI Foundation.

INSTRUMENT PROTOCOLS

VXI-11	Supports Core channel, not Abort or Interrupt channels
VISA	VXI-11 compliant, uses RPC and Portmapper, SCPI commands
TCP Sockets	Sends SCPI commands to port 8003
UDP Sockets	Sends SCPI commands to port 8005
VXI-11 Discovery	Finds connected instruments
SNMP Ping Server	Verifies LAN connection to instrument
HTTP/HTTPS	Web page server with Java scripts

NOTE

HTTPS protocol is available in firmware version 001.010.000 and later.

COMMANDS

SCPI	SCPI 1999 compliant command set
IEEE-488.2	Condition and event register tree

MULTIPLE CONTROLLERS

Multiple Client Setting	Maximum number or connections is limited to 4 (VISA, TCP or UDP sockets, or a combination of all). Web page cannot be logged-in in this case. If the web page is logged-in, all other connections are blocked.

WEB PAGES

Multiple users	Two web pages can be open at the same time. Only one can be logged-in.
Identity	Identify power source details such as model, serial number, and revision
LAN Configuration	View and set LAN configuration
Active Control GUI	Program the power source output, protection, and displays the status, measurements, and harmonic details
Send Commands	Send SCPI commands, read errors

INDICATORS

Link and Activity LED	Indicate that connection is active and network packets are being received and transmitted
Speed LED	Indicate the speed
LAN Status LED	**Green**: power source has a valid IP connection **Red**: power source does not have a valid IP connection
Blink Identify	Find the power source by remotely blinking the front panel display and the rear panel LAN status LED (green) Duplicate IP detection by blinking the front panel display and the rear panel LAN status LED (green)

SECURITY

Web Page Password	Set password to prevent unauthorized or accidental changes to LAN settings or power source output settings
Disable VXI-11 Discovery	Stop power source detection
Disable Ping Server	Stop power source detection
Disable mDNS	Stop power source detection

10.4.3 Interface Selection

Refer to **Section 9.4.4: Interface Menu** to select LAN from the front panel.

Refer to SYSTem[:COMMunicate]:INTerface <DSC> in **Section 14.13.10: System Subsystem** to set LAN interface with a communication command.

10.4.4 Link and Activity, Speed, and Status LEDs

Refer to **Figure 10-2** showing the different types of LEDs.

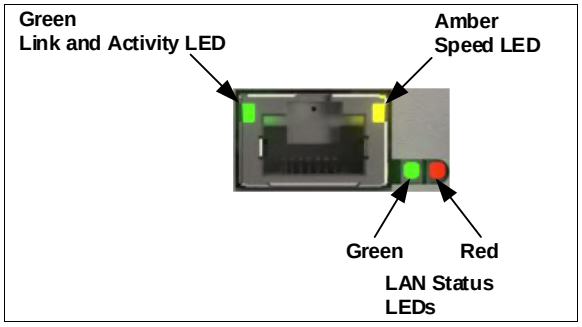


Figure 10-2: LAN LEDs

There are two LEDs built into the LAN connector:

- **Green**: This LED functions as a Link and Activity LED. It glows green when a connection is made to an active network and blinks when any message packets are detected.
- **Amber**: This LED functions as a Speed LED. It glows amber when the LAN communicates at 100Mbps and is off at 10Mbps.

There are two **LAN status** LEDs to the right of the LAN connector (while viewing the rear panel):

- **Green**: This LED has three functions:

  Steady green: The power source has an active LAN connection.

  Blinking green: The Identify function is turned on to detect the required power source in a rack of instruments.

  OR

  Blinking green: A duplicate IP is detected; there are two or more instruments with the same IP address.

  In both cases, the front panel display blinks along with the LED.

- **Red**: This LED indicates a LAN fault. It indicates that the LAN mode is not enabled, that the LAN connection was never made, or that the LAN connection was made and then broken.

10.4.5 Connect to a Network

10.4.5.1 LAN Cable

The customer must arrange the LAN cable. One of the following cables can be used:

- standard straight patch CAT-5 (or better) network cable
- crossover cable

The cable type is auto detected by the power source.

10.4.5.2 Types of Networks

There are two types of networks:

- **NETWORK WITH A DHCP SERVER**

  A typical local area network with a server computer and network administrator to keep it operating. The server downloads the IP address and other settings to the power source.

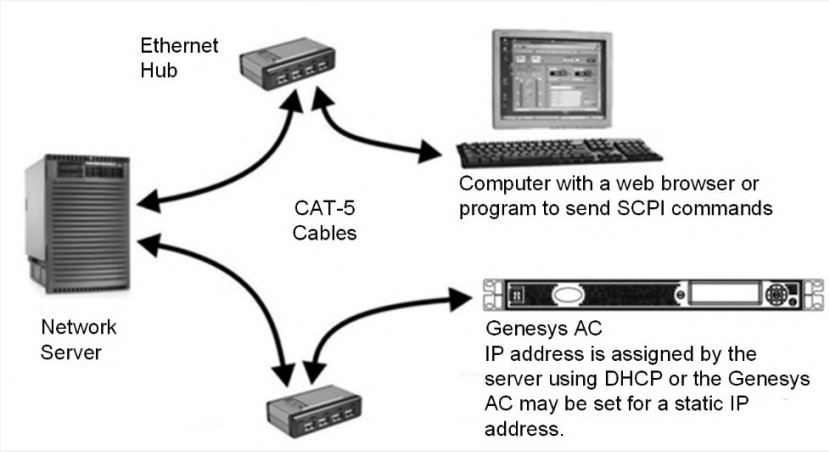


Figure 10-3: Network with a DHCP Server

- **PEER-TO-PEER NETWORK**

  In this type of configuration, the power source is connected directly to a computer that is not a network server. The power source configures its own IP address and other settings.

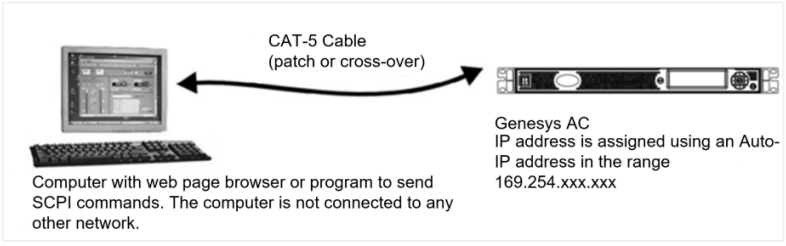


Figure 10-4: Peer-to-Peer Network

10.4.6 Power-up the LAN

The LAN option automatically detects if it is connected to or disconnected from a network. It automatically searches for a network server and receives or creates an IP address. It also broadcasts its IP address and hostname to all other devices on the network.

1. Apply the AC power and switch ON the power source.
2. Connect the LAN cable.

NOTE

The LAN cable can also be connected before switching the power source to ON.

For a DHCP or a static-IP configuration, wait for about 10 seconds. The rear panel LAN status LED (green) turns ON.

For a peer-to-peer auto-IP configuration, wait for about 60 seconds. The rear panel LAN status LED (green) turns ON. The computer screen may show a LAN notification saying, “This connection has limited or no connectivity.”

NOTE

If the LAN status LED (green) does not turn ON, refer to **Section 10.4.6.6: LAN Reset.**

10.4.6.1 IP Addresses

The simplest and most reliable way to open a network connection is with the IP address, which is represented by a group of four numbers separated by periods (e.g., 10.1.15.123).

An IP address can be assigned to the power source in three modes as shown in **Table 10-7**.

	DHCP	Auto-IP	Static IP
IP Mode Select	DHCP is the default after a LAN reset	Default after LAN Reset, if no DHCP server is used	Assigned via: **LAN Modify** web page, setting on the front panel, a communication command. Refer to **Section 10.4.6.3: Changing the IP Address**.
Assignment	Assigned by the network server	Assigned by the power source	Assigned via: **LAN Modify** web page, setting on the front panel, a communication command. Refer to **Section 10.4.6.3: Changing the IP Address**.
Range	Any address	169.254.xxx.xxx	Any address
Lifetime	Address may change as the DHCP server assigns addresses dynamically to many instruments	Fixed prefix for the power source, except if an address collision is detected	Always fixed for the power source
Duplicate Addresses	The DHCP server should prevent duplication of IP addresses	Finds another available auto-IP address	Returns to the original IP (before change). LAN status LED (green) and front panel blink. If a duplicate IP is detected at AC ON (if the device was in Static IP mode), the IP goes to 0.0.0.0, LAN status LED (red) turns on, and the front panel blinks.

Table 10-7: Assignment of IP Address

10.4.6.2 View and Read the IP and MAC Addresses

Refer to **Section 9.4.4: Interface Menu** to view the IP address and MAC address from the front panel.

Refer to **Section 10.4.7.8: LAN Settings Page** to view the IP address from the **LAN Modify** page.

Refer to SYSTem[:COMMunicate]:LAN:IP:ACTual? and SYSTem[:COMMunicate]:LAN:MAC? in **Section 14.13.10: System Subsystem** to read the IP and the MAC address with a communication command.

10.4.6.3 Changing the IP Address

Refer to **Section 9.4.4: Interface Menu** to set the IP address from the front panel.

Refer to **Section 10.4.7.8: LAN Settings Page** to set the IP address from the **LAN Modify** page.

Refer to SYSTem[:COMMunicate]:LAN:IP[:STATic]<SRD> in **Section 14.13.10: System Subsystem** to set the IP address with a communication command.

NOTE

Modifying the IP address from the **Interface** menu, or from the **LAN Modify** page, or using a communication command switches the IP addressing to STATIC IP; DHCP and Auto-IP addressing are disabled.

10.4.6.4 Hostname

The hostname is an address in the form of a name (e.g., GAC-000007) instead of an IP address. This address mode is less common than the IP address because a naming service (such as DNS) must be running on the LAN computer.

The default hostname has the following format:

< Product Code>–<Order Code>-< Serial Number>

For example:

Product	Default Hostname
GAC-PRO with Order Code 03AA1C-07H00A and Serial No. 002024-000003	GAC-PRO-03AA1C-07H00A-002024-000003

A custom host name can be created on the **LAN Modify** web page (refer to **Section 10.4.7.8: LAN Settings Page**) or via a communication command (refer to SYSTem[:COMMunicate]:LAN:HOSTname <STR> in **Section 14.13.10: System Subsystem**).

For example, host name can be set to TDK. In this case, the control program can send commands to TDK.

The power source can detect if its host name is already in use by another device. This state is called a host name conflict. In this case, the conflicting power source makes its host name unique by appending a dash and a number (e.g., GAC-000007-2).

NOTE

Hostname is case-sensitive (e.g., TDK and tdk are not treated as a duplicate hostname). It is recommended to avoid naming such as TDK and tdk on the same network, as the network server might incorrectly interpret them.

A LAN Reset (refer to **Section 10.4.6.6: LAN Reset)** does not change the host name, even if it is a custom name, but it may remove the dash and the number if the host name conflict has been removed. To restore the factory default host name, open the **LAN Modify** web page and enter a blank in the **Hostname** window; refer to **Section 10.4.7.8: LAN Settings Page**.

The power source may be set to one of the three network modes, each with a different way to use the host name.

	DHCP	Auto-IP	Static IP
Default Hostname	Refer to the default format	Refer to the default format	None, hostname cannot be used
Hostname Protocol	Hostname by DNS	Hostname by DNS	None, hostname cannot be used
Hostname on Web Pages	Shows hostname on the Home page, LAN Settings page, and LAN Configure page		

10.4.6.5 Description and DNS Service Names

The default description has the following format:

< Genesys Power Source >-< serial number >

Example: Genesys Power Source-002024-000003

A custom description can be created on the **LAN Modify** web page (refer to **Section 10.4.7.8: LAN Settings Page**) or via a communication command (refer to SYSTem[:COMMunicate]:LAN:DESCription <STR> in **Section 14.13.10: System Subsystem**).

The power source can detect if its service name (description) is already in use by another device. This is called a service name conflict. In this case, the conflicting power source makes its service name unique by appending a number in brackets (e.g., Genesys Power Source-000007 (2)).

NOTE

DNS Service Name is case-sensitive (e.g., TDK-LAMBDA Source 123 and tdk-lambda source 123 are not treated as a duplicate Service Name). It is recommended to avoid naming such as TDK-LAMBDA Source 123 and tdk-lambda source 123 on the same network, as the network server might incorrectly interpret them.

A LAN reset does not change the service name, even if it is a custom name, but it may remove the brackets and the number if the service name conflict has been removed. To restore the factory default service name, open the **LAN Modify** web page and enter a blank in the **Description** window; refer to **Section 10.4.7.8: LAN Settings Page**.

10.4.6.6 LAN Reset

Refer to **Section 9.4.4: Interface Menu** to reset the power source LAN settings to default from the front panel. Refer to SYSTem[:COMMunicate]:LAN:RESet in **Section 14.13.10: System Subsystem** to reset the power source LAN settings to default with a communication command. The default LAN settings are shown in **Table 10-8**.

If the IP address is obtained via DHCP:

IP Address	According to the network settings
Subnet Mask	According to the network settings
Default Gateway	According to the network settings
Hostname	Refer to **Section 10.4.6.4: Hostname**
Description	Refer to **Section 10.4.6.5: Description and DNS Service Names**
LAN Timeout	1800 seconds (30 minutes)
Ping Server	Enabled
VXI-11 Discovery	Enabled
Multicast DNS	Enabled
UDP Enable	Enabled
Maximum Number of Connections	4
Password	None

If the IP address is obtained via Auto-IP:

IP address (Auto-IP mode)	169.254.xxx.xxx
Subnet Mask	255.255.0.0
Default Gateway	0.0.0.0
DNS Server	0.0.0.0
Hostname	Refer to **Section 10.4.6.4: Hostname**
Description	Refer to **Section 10.4.6.5: Description and DNS Service Names**
LAN Timeout	1800 seconds (30 minutes)
Ping Server	Enabled
VXI-11 Discovery	Enabled
Multicast DNS	Enabled
UDP Enable	Enabled
Maximum Number of Connections	4
Password	None

Table 10-8: Default LAN Settings

10.4.7 Web Pages

10.4.7.1 Benefits of the Web Pages

The web pages of the Genesys Series Programmable AC Power Source can be used for the following:

- reading the power source model, identity, firmware revisions, and information on the LAN settings
- programming and viewing the power source output
- setting and viewing the output modes
- programming and viewing the protection state values
- displaying measurements for up to three phases
- displaying harmonic measurements
- configuring the LAN connection

10.4.7.2 Opening the HOME Page

Once the rear panel LAN status LED (green) turns ON, the web page is accessible.

1. Read the IP address from the front panel.
2. Open a web browser (e.g., Google Chrome) and enter the power source IP address. With HTTP, the Home page appears immediately. If the Home page does not open, perform a LAN reset. With HTTPS, a screen as shown in **Figure 10-5** appears.

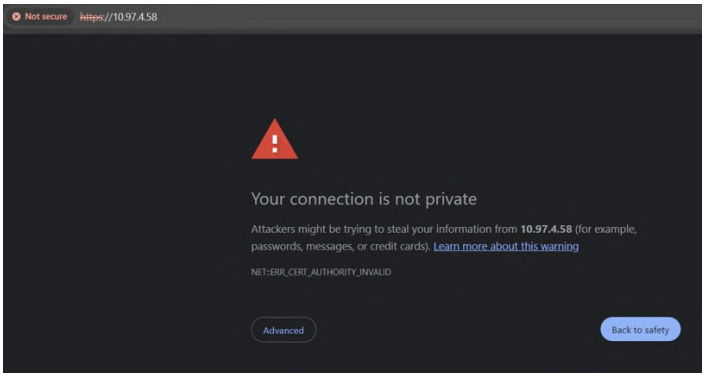


Figure 10-5: HTTPS Screen

3. Read the warning message. If agreed, Click **Advanced**. A screen as shown in **Figure 10-6** appears.

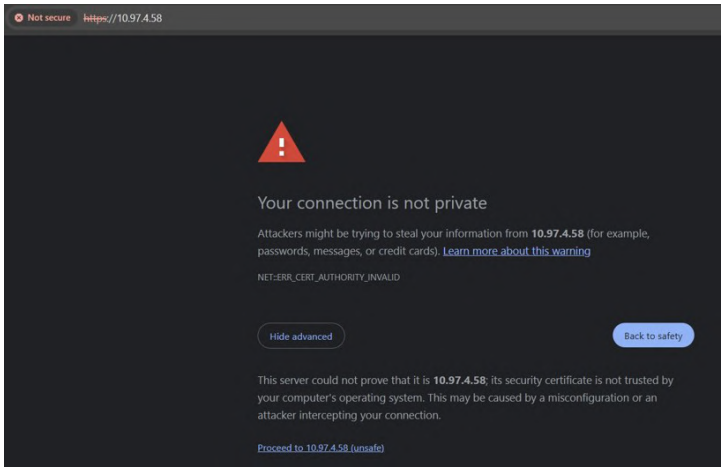


Figure 10-6: HTTPS Screen

4. Read the warning message. If agreed, click on the message that asks to proceed. The Home page appears. If the web page does not open, perform a LAN reset
5. Alternately, enter the power source hostname (if the power source is set for DHCP/Auto-IP, and if a DNS naming service is running on the computer). With HTTPS, screens as shown in **Figure 10-5** and **Figure 10-6** appear. If terms in both the screens are agreed, click on the message that asks to proceed. The Home page appears. If the Home page does not open, perform a LAN reset.

10.4.7.3 The Home Page

The Home page appears after entering the IP address in the web browser.

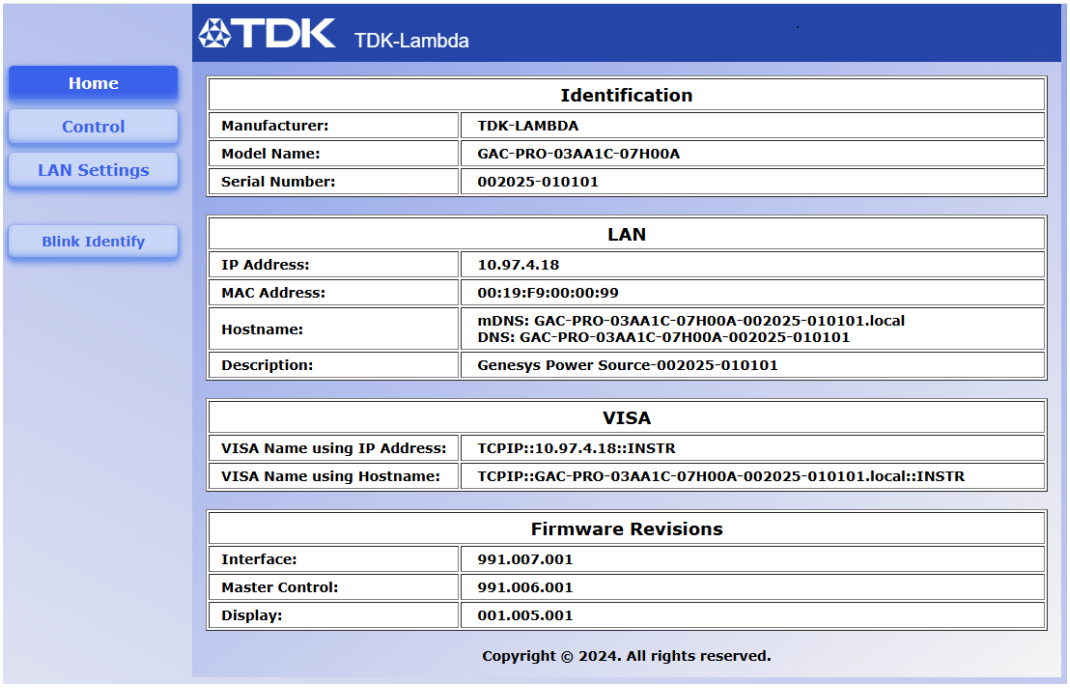


Figure 10-7: Home Page

IDENTIFICATION

Power Source Identification

The Manufacturer, Model Name, and Serial Number of the power source

LAN

IP Address

The IP address assigned to the power source. The IP address can be assigned via DHCP or Auto-IP by default, or it can be assigned manually (Static-IP).

MAC Address

The power source unique address used to identify individual devices on a network

Hostname

A unique name for a device on a network; refer to **Section 10.4.6.4: Hostname**.

Description

This is also called DNS-SD Service Name; refer to **Section 10.4.6.5: Description and DNS Service Names**.

VISA

VISA Name Using IP Address

For automation programming, VISA is a type of communication driver.

For LAN instruments, the IP address may be used in the VISA resource descriptor.

VISA Name Using Hostname

An alternate VISA resource descriptor may be the hostname; refer to **Section 10.4.6.4: Hostname**.

Firmware Revisions

The firmware revision: Interface, Master Control, Display, and optional GPIB.

10.4.7.4 Logging In

To make changes to any page, the user must login first.

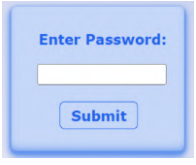
When any menu other than the **Home** menu is clicked, **LOGIN** appears.

NOTE

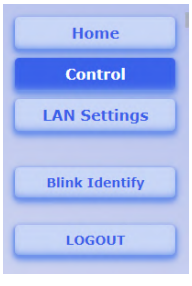
Home page does not require a log-in.



1. Click **LOGIN**. The field to enter the password appears.



2. By default, the password field is empty. If the password is not at default, enter it.
3. Click **Submit**.
4. Once any page logs-in, the **LOGIN** button changes to **LOGOUT**.



10.4.7.5 Login Rules

- Up to two users may view the web pages of the power source at the same time. The update rate becomes slower when a second copy of the web page is opened.
- Only one user at a time may be logged-in to modify the settings of the power source.
- If an automation program with VISA or socket is running, the user may view the web pages but cannot login to change settings.
- If a user is logged in, a VISA or socket connection cannot be opened.
- A user may logout by clicking **LOGOUT**, by closing the web browser, or by leaving the web browser idle for the time set by the LAN timeout function.

10.4.7.6 Control Page

When **Control** is clicked, the **Basic Control** page opens by default.

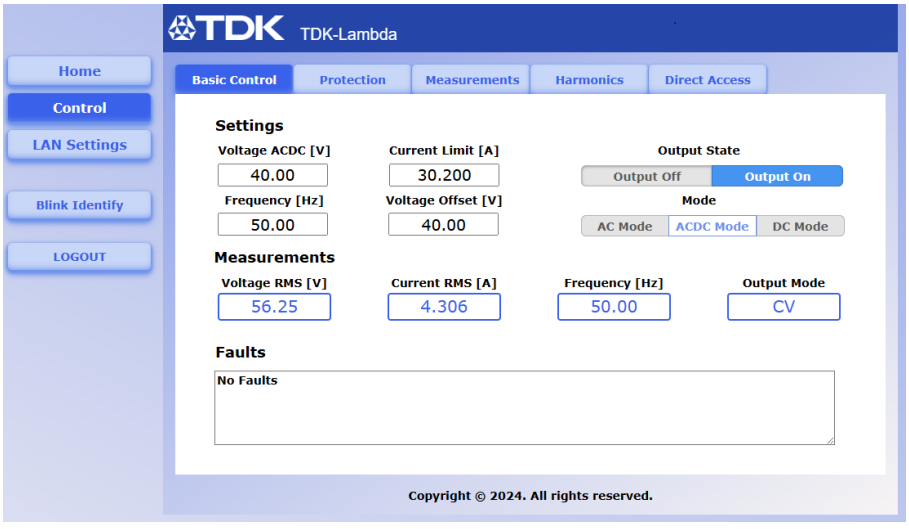


Figure 10-8: Control → Basic Control—Single Phase

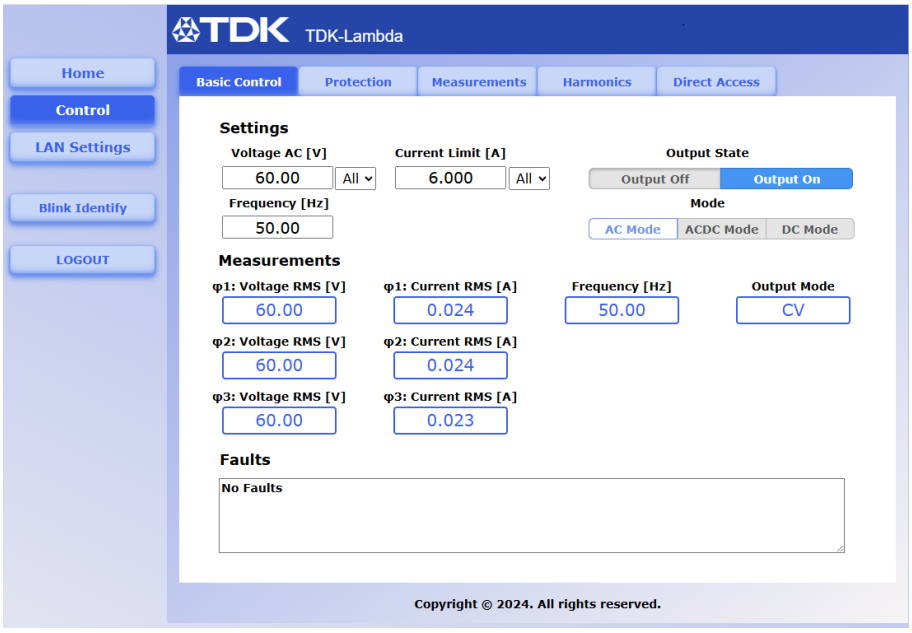


Figure 10-9: Control → Basic Control—Multi Phase (Three Phase shown as an example)

Control → Basic Control

- Setting of the output voltage, output current limit, frequency, and displaying their measured values
- Turning the output ON or OFF and displaying the actual output mode (OFF, CV, CC)
- Displaying and changing the operating mode (AC, ACDC, or DC)
- Displaying the fault
- Selecting the phase (for multi-phase system only)

Settings

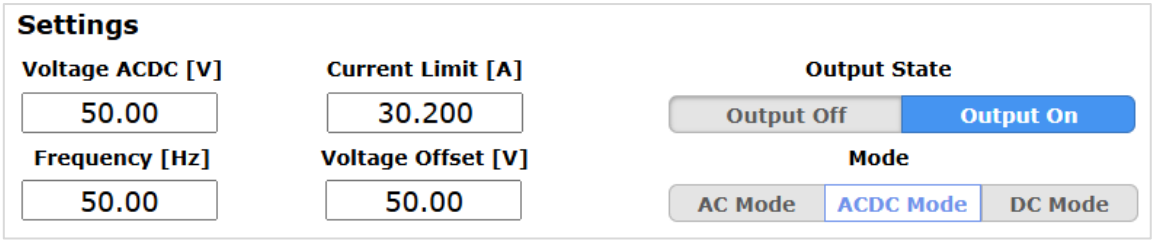


Figure 10-10: Basic Control → Settings (Single Phase)

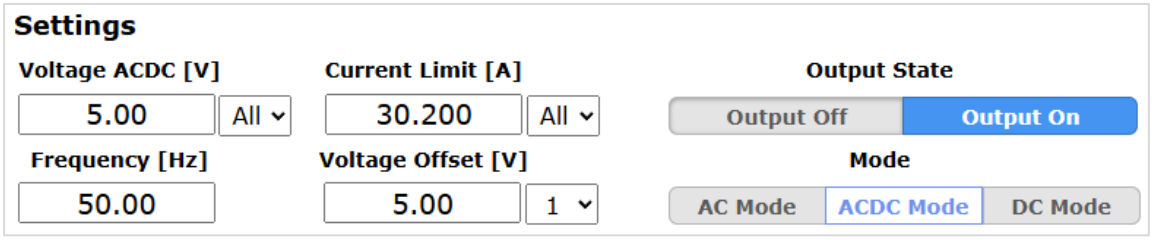


Figure 10-11: Basic Control → Settings (Multi Phase)

To change a setting, set the desired value and click **Enter** on the keyboard. For a multi-phase setting, there is a drop-down menu next to the Voltage and Current setting field. The options for the drop-down menu are the individual phase number or ALL. Voltage/Current values can be sent to individual phase, or they can be sent to all the phases simultaneously. To select an output state or operating mode, click the desired button.

NOTE

Refer to **Table 14-10** for the programming parameters of voltage, current, and frequency.

NOTES

In AC mode and DC mode, the window for setting the voltage offset is not displayed.

In DC mode, the window for setting the frequency is not displayed.

During the output ON condition, the mode window is disabled. To change the mode, make the output OFF.

Measurements



Figure 10-12: Basic Control → Measurements (Single Phase)

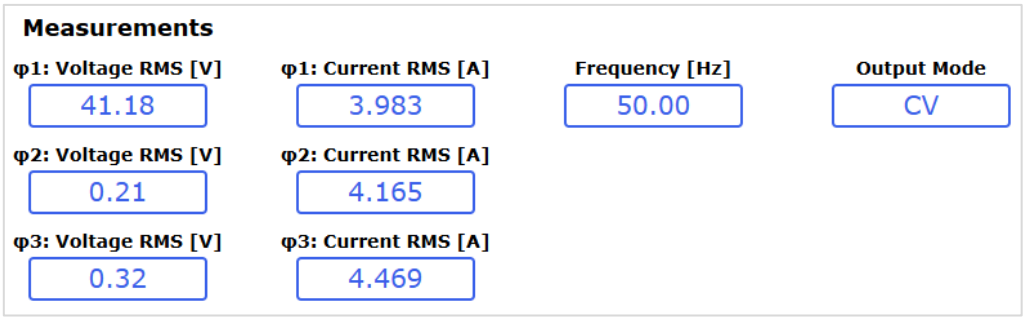


Figure 10-13 Basic Control → Measurements (Multi Phase) (Three Phase shown as an example)

NOTE

If the output is OFF, the measurements are not displayed.

Faults

Faults are displayed in the **Faults** window.



Control → Protection

The following settings are possible:

- Over-Voltage Protection (OVP) and Under-Voltage Protection (UVP) levels
- High and low peak voltage protection levels
- Drop on Wire
- High and low peak current protection (OCP) levels
- Over-Power Protection (OPP) levels
- Auto-Start/Safe-Start mode
- Foldback Protection mode

Click **Control** and then **Protection** to enter the **Protection** page.

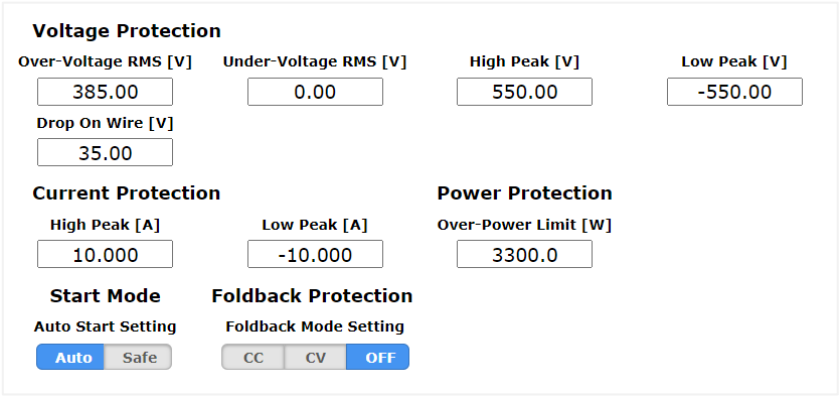


Figure 10-14: Control → Protection

To change the setting, set the desired settings and click **Enter** on the keyboard. To select a mode, click on the desired button.

The selected mode (Auto-Start, Foldback Protection) is indicated with a blue background in the log-in state and with a blue-colored text in the log-out state.

NOTE

Refer to **Section 14.13.8: Source Subsystem** for the programming parameters of all items in Voltage Protection, Current Protection, and Power Protection.

Control → Measurements

This page displays the following measurements:

- Output voltage and output current depending on the operating mode (AC, ACDC, or DC)
- Frequency
- Crest Factor
- Apparent and Active Power

Click **Control** and then **Measurements** to enter the **Measurements** page.

Measurement	Phase: 1	Phase: -	Phase: -
Frequency [Hz]	50.00	--	--
Voltage RMS [V]	41.18	--	--
Voltage AC [V]	40.00	--	--
Voltage DC [V]	9.79	--	--
Current RMS [A]	0.000	--	--
Current AC [A]	0.000	--	--
Current DC [A]	4.022	--	--
Crest Factor	1.036	--	--
Apparent Power [VA]	165.6	--	--
Active Power [W]	39.8	--	--

Figure 10-15: Control → Measurements Page (Single Phase)

Measurement	Phase: 1	Phase: 2	Phase: 3
Frequency [Hz]	50.00	0.00	0.00
Voltage RMS [V]	41.18	0.21	0.32
Voltage AC [V]	40.00	0.15	0.00
Voltage DC [V]	9.79	-0.15	-0.31
Current RMS [A]	0.000	0.000	0.000
Current AC [A]	0.000	0.000	0.000
Current DC [A]	3.984	4.164	4.467
Crest Factor	1.030	1.066	1.021
Apparent Power [VA]	164.1	0.9	1.4
Active Power [W]	39.2	-0.6	-1.4

Figure 10-16: Control → Measurements Page (Multi Phase) (Three Phase shown as an example)

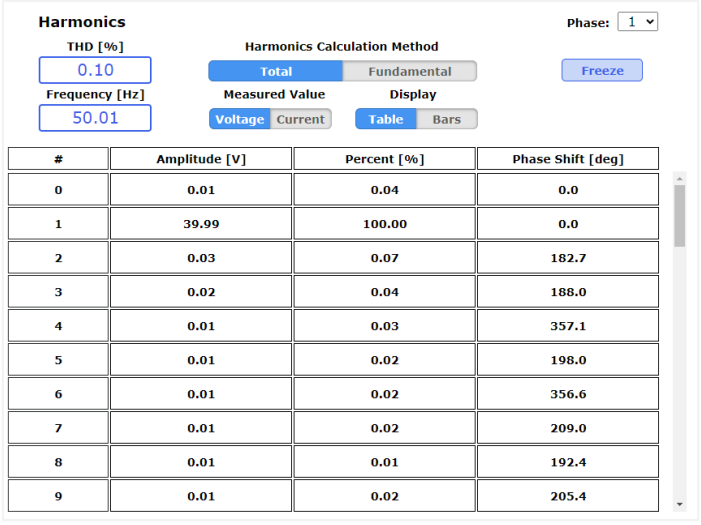
This page provides more detailed measurements and is an addition to **Measurements** in the **Basic Control** page. The voltage and current values are displayed with their respective AC and DC values.

Control → Harmonics

This page displays the following:

- The Total Harmonic Distortion (THD)
- The output frequency
- The rms value, percentage value, and the phase angle of 51 harmonics of output voltage or output current in table or bar format

Click **Control,** and then **Harmonics** to enter the **Harmonics** page.



#	Amplitude [V]	Percent [%]	Phase Shift [deg]
0	0.01	0.04	0.0
1	39.99	100.00	0.0
2	0.03	0.07	182.7
3	0.02	0.04	188.0
4	0.01	0.03	357.1
5	0.01	0.02	198.0
6	0.01	0.02	356.6
7	0.01	0.02	209.0
8	0.01	0.01	192.4
9	0.01	0.02	205.4

Figure 10-17: Harmonics in Table Format

For a multi-phase setting, there is a drop-down menu next to **Phase**. The option for the drop-down menu is the individual phase number.

Use the respective button under **Harmonics Calculation Method** to select the calculation method used for calculating the percentage value of the harmonics. Refer to MEASure:HARMonic:PERCent[:TYPE] <DSC> in **Section 14.13.4: Measure Subsystem**.

Use the respective button under **Measured Value** to select voltage or current.

The measured values can be displayed in table (refer to **Figure 10-17**) or in bars format (refer to **Figure 10-18**). Use the respective button under **Display** to select table or bars format.

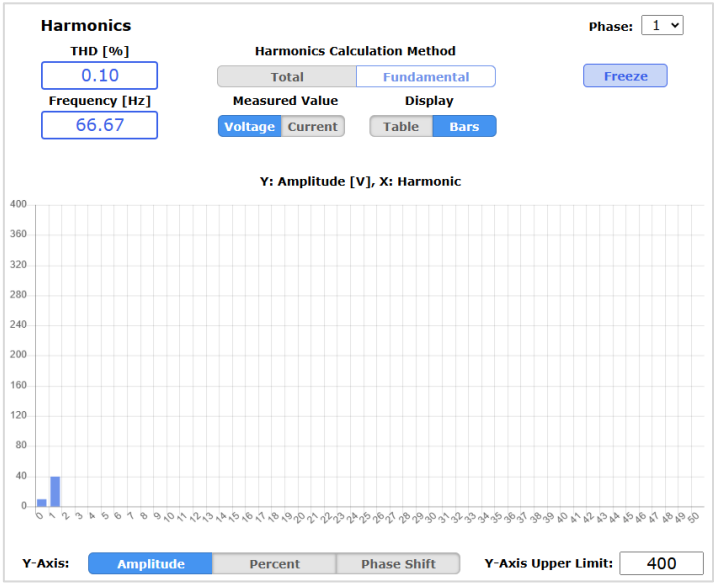


Figure 10-18: Harmonic in Bars Format

In the bars format, use the respective button to select Amplitude, Percent, or Phase Shift. The X-axis in all the three cases represents the harmonic number. The Y-axis represents the maximum allowable limit. Move the mouse over the bars to view the harmonic number and its value.

Use **Freeze** to freeze the samplings.

NOTE

If the output is OFF, the measurements are not displayed.

Control → Direct Access

Click **Control** and then **Direct Access** to enter the **Direct Access** page.



Figure 10-19: Control → Direct Access

The page can be used for the following:

- send any command and view the response.
- read the system errors.

This page allows operations that may not be available on the web pages.

Type any command or query in the top text box and press **Enter** on the keyboard. For commands, there is no response. For queries, the response appears in the middle text box.

System Error messages can be read by clicking the **Read Errors** button. The error message or 0, "No error" appears in the bottom text box.

10.4.7.7 Blink Identify

When this button is clicked, the front panel display and the rear panel LAN status LED (green) blink (refer to **Figure 10-2).**

The blinking is turned OFF by clicking this button again, by clicking any button or tapping the display on the front panel, or with a communication command (refer to SYSTem[:COMMunicate]:IDLED <Bool> in **Section 14.13.10: System Subsystem**).

NOTE

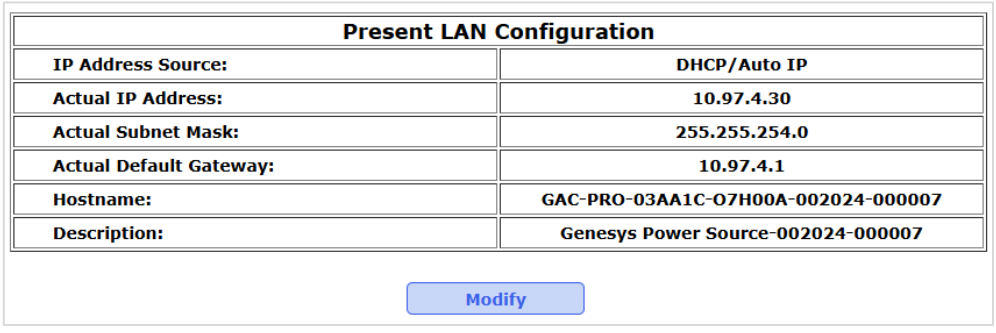
This function does not require a log-in.

10.4.7.8 LAN Settings Page

The LAN Settings page and its sub-pages allow the user to view and configure the power source's LAN settings.

LAN Settings ➔ Configure Page and LAN Settings ➔ Configure ➔ Modify Page

When **LAN Settings** is clicked, the **Configure** page opens by default.



Present LAN Configuration	
IP Address Source:	DHCP/Auto IP
Actual IP Address:	10.97.4.30
Actual Subnet Mask:	255.255.254.0
Actual Default Gateway:	10.97.4.1
Hostname:	GAC-PRO-03AA1C-O7H00A-002024-000007
Description:	Genesys Power Source-002024-000007

Modify

Figure 10-20: LAN Configure Page

The following settings can be seen under this page:

IP Address Source

The IP address source: DHCP/Auto-IP or Static IP

Actual IP Address

The IP address assigned to the power source through DHCP/Auto-IP or Static IP

Actual Subnet Mask

The subnet mask assigned to the power source through DHCP/Auto-IP or Static IP

Actual Default Gateway

The address of the network router that allows the power source to communicate outside of the local subnet

Hostname

The power source hostname may be used instead of the IP address to create a communication link

Description

This is also called DNS-SD Service Name

The **LAN Settings➔ Configure ➔ Modify** page allows changing of the LAN settings. The following page appears after **Modify** is clicked.

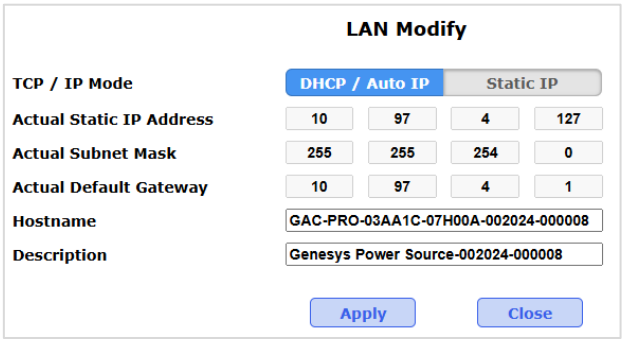


Figure 10-21: LAN Configure → Modify Page-DHCP/Auto IP

The fields that can be changed depend on the selection of the IP address source: DHCP/AUTO IP or Static IP.

TCP/IP Mode

This field allows to select the source of the IP address.

DHCP / Auto IP

This is the default mode. If this source is selected, the network server uses DHCP mode to assign the IP address, subnet mask, and default gateway. Therefore, these fields are disabled (gray) on the web page. Refer to **Figure 10-21.**

If the server cannot make the assignment, the power source reverts to the Auto IP mode.

In both these modes, the user can change the hostname and description only.

NOTE

The Hostname must not exceed 50 characters. Uppercase and lowercase characters, numbers (0–9), and - (hyphen), can only be used.

Static IP

If this mode is selected, the IP address, subnet mask, and default gateway must be entered in the fields. The settings must be compatible with the requirements of the network server. These settings do not change if the power source is transferred to a different LAN connection. The Hostname field is disabled (gray). The user can change the description also. Refer to **Figure 10-22**.

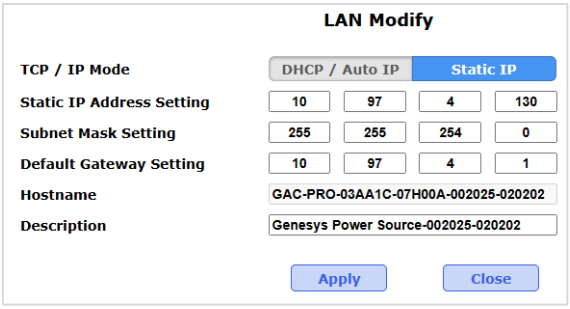


Figure 10-22: LAN Configure → Modify Page-Static IP

NOTE

In static IP mode, there is no hostname connectivity.

Apply

The web page logs out after the button is clicked.

NOTE

After changing the LAN settings, the web page refreshes automatically. If the change duplicates the IP, the rear panel LAN Status LED (green) and the front panel display blink, and the IP address reverts to the previous state. The blinking can be turned OFF by clicking the **Blink Identity** button on the web page, by clicking any button on the display, by tapping the display on the front panel, or with a communication command (refer to SYSTem[:COMMunicate]:IDLED <Bool> in **Section 14.13.10: System Subsystem**).

NOTE

It may be required to perform AC reset of the power source after changing the LAN settings.

Close

Click this button to return to the LAN Configure Page. New settings are not saved.

LAN Settings ➔ Advanced and LAN Settings ➔ Advanced ➔ Modify Page

Click **LAN Settings➔ Advanced** to view advanced LAN settings and **LAN Settings➔ Advanced➔Modify** to change its settings.

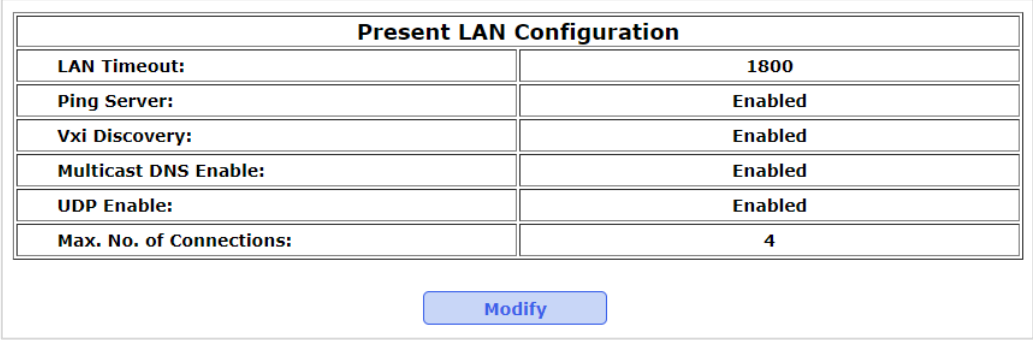


Figure 10-23: LAN Advanced Page

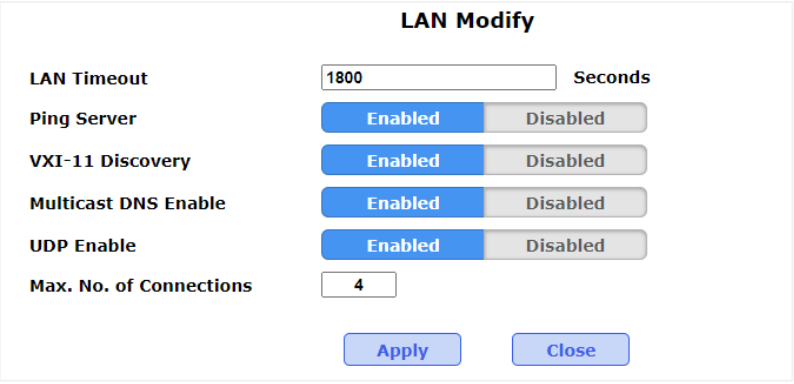


Figure 10-24: LAN Advanced → Modify Page

LAN Timeout

If the user is logged in through the web page or is connected via VISA or TCP sockets, this is the time duration (in seconds) during which the web pages, VISA, or TCP sockets can be inactive (idle) before the power source automatically logs out.

Timeout disabled: 0

Default timeout: 1800 seconds (30 minutes)

Minimum timeout limit: 30 seconds

Maximum timeout limit: 60000 seconds (1000 minutes)

Ping Server

Ping is a network utility that allows the computer to verify communication with the power source. This service can be disabled for security reasons.

VXI-11 Discovery

This is a protocol that allows the network server to detect which instruments are connected to the LAN. This service can be disabled for security reasons.

Multicast DNS Enable

Default setting is enabled, and this service may be disabled for security reasons or just to reduce network traffic.

UDP Enable

Default setting is enabled, and this protocol may be disabled.

Maximum Number of Connections

The maximum number of users that can access the device. The default and maximum is 4 and it can be changed.

NOTE

The maximum number of connections is applicable only for TCP sockets and VISA sessions.

Apply

The web page logs out after the button is clicked.

NOTE

After changing the LAN settings, the web page refreshes automatically.

NOTE

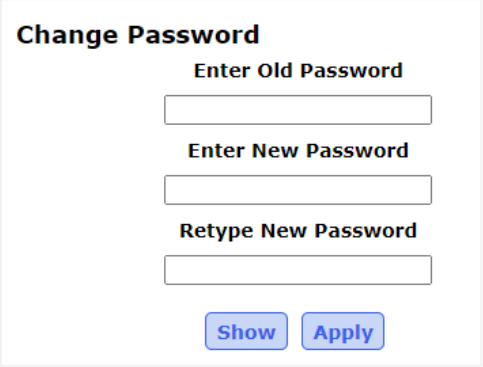
It may be required to perform AC reset of the power source after changing the LAN settings.

Close

Click this button to return to the LAN Configure Page. New settings are not saved.

LAN Settings ➔ Users Page

This page allows creating password for protection of the web pages.



By default, the old password is blank.

For entering the password for the first time, keep the **Enter old Password** box blank. The new password must contain 6 to 16 characters.

Password is case sensitive.

NOTES

Only a–z, A–Z, and 0–9 characters are allowed.

There is no password protection for automation programming with VISA or sockets.

Reset Password

Once a password is applied, it may be changed by using the same screen, but it can only be removed and set to default by performing the LAN Reset function.

10.4.8 Programming Using VISA Drivers

10.4.8.1 VISA Description

In the test and measurement industry, Virtual Instrument Software Architecture (VISA) is a popular framework that includes hardware drivers, configuration utilities, and connection managers. A variety of communication busses are supported. VISA drivers are available from several instrument vendors. Any programming language that supports Windows COM or DLL libraries can call the VISA functions.

10.4.8.2 VXI-11 Compatibility

VXI-11 is a protocol that allows communications between a computer port and an instrument. VISA is built upon the VXI-11 specification. The power source is compatible with the following VXI-11 protocols:

- **VXI–11 Device_link**: open link to an instrument
- **VXI–11 Device_write**: write text to an instrument
- **VXI–11 Device_read**: read text from an instrument
- **VXI-11 Destroy_link**: close link to an instrument

10.4.8.3 Opening a VISA Connection

Test and automation programs may easily be written if they use the VISA libraries. The supported VISA functions include Open, Read, Write, and Close. A VISA resource descriptor is used to describe a particular source. For the power source, the descriptors are found on the power source's Home web page. The VISA resource may use the power source's IP address or hostname.
Format of a VISA resource descriptor:
TCPIP[board]::IP address/Host Name[::LAN device name][::INSTR]
[board] is the LAN card number, zero is optional
[::LAN device name] is by default **inst0** and is optional
[::INSTR] is optional

Examples:
TCPIP::10.255.26.60
TCPIP::10.225.26.60::inst0::INSTR
TCPIP0::GAC-000007::inst0::INSTR

10.4.8.4 Communicating Using VISA

The VISA Write function sends SCPI commands to the power source. The VISA read function reads the response returned for the SCPI query.

10.4.9 Programming Using Sockets

10.4.9.1 Socket Description

The VISA drivers for the Genesys Series Programmable AC Power Source are commonly used in the Test and Measurement industry. For customers who cannot use VISA because of installation issues, licensing issues, or because the controller (e.g., industrial PLC) does not support VISA, the Genesys Series Programmable AC Power Source offers socket connections. Socket is a low-level LAN protocol that is universally available in all operating systems and programming environments.

Windows is a trademark of Microsoft Corporation.

10.4.9.2 Communicating Using Sockets

Communicating through sockets involves opening a socket connection, sending SCPI text commands, and reading the responses. The function by which a programming language manages the socket is the TCP stack. There are two types of socket protocols that may be used: TCP and UDP. Each has its own port number.

10.4.9.3 Using TCP Sockets

This is the most used socket type. It features managed connection, message acknowledgements, transmission error detection and correction.

Open **TCP socket port 8003** to send SCPI commands and queries. Responses to queries are sent back automatically with a line-feed terminator and carriage return appended.

NOTE

SCPI commands and queries sent via TCP sockets must be terminated with either <LF>, or <CR>, or <LF><CR>.

10.4.9.4 Using UDP Sockets

This is a simpler socket type with reduced network traffic. It is a connectionless protocol because messages are sent, and there is no acknowledgement that they have been received.

Open **UDP socket port 8005** to send SCPI commands and queries. Responses to queries are sent back automatically with a line-feed terminator and carriage return appended.

10.4.9.5 Input Buffer Requirements

With a controller using TCP or UDP sockets, the power source can receive commands much faster than it can process them. To make sure that the LAN is not overloaded, it is required that the controller sometimes send a query and then wait for the response. The response is an acknowledgement from the power source that it has finished processing all commands.

It is recommended that your controller routinely sends SYST:ERR?

10.4.10 Connecting Over WAN

To connect to the Wide Area Network (i.e., the global internet), the following settings must be made in the network server:

View Web Pages Over WAN

The Genesys Power Source LAN interface has a server for running the web pages. The web server is listening in port 80. The network administrator must obtain and assign a global IP for the power source. On the network server, the network administrator also must ensure port 80 is exposed to WAN connectivity.

Use Sockets Over WAN

The network administrator must obtain and assign a global IP for the power source. On the network server, the network administrator also must ensure port 8003 (for TCP sockets) or port 8005 (for UDP sockets) is exposed to WAN connectivity.

CHAPTER 11: CONFIGURING THE J4 CONNECTOR

11.1 Introduction

Refer to **Section 8.4: Remote Programming and Logic Control Connector (J4)** for a brief description of the connector and its pinout.

NOTE

All signals (except NC (Not Connected) pins) on the J4 connector are referenced to COMMON.

11.2 CV/CC Signal (J4-1)

The CV/CC signal indicates the power source's operating mode: Constant Voltage or Constant Current. This is an open collector output signal.

Operating Mode	Signal Level	Note
Constant Voltage (CV) or OFF	High	The maximum voltage rating is 30V
Constant Current (CC)	0–0.6V (low)	The maximum allowed sink current is 10mA.

Table 11-1: CV/CC Signal

CAUTION

Do not connect the signal to a voltage source greater than 30V. Always connect this signal to the voltage source with a series resistor to limit the sink current to less than 10mA.

11.3 Power Source OK Signal #2 (J4-2)

The Power Source OK Signal #2 indicates the power source's output state: ON or OFF. This is a push-pull signal.

Output State	Signal Level	Note
OFF	0–0.6V	The maximum allowed sink current is 10mA
ON	4.5–5.5V	The maximum voltage rating is 5.5V. The maximum allowed source/sink current is 10mA.

Table 11-2: Power Source OK Signal #2

This signal can also be set with a time delay. This delay is used to prevent the signal from rising before the set output is reached. To set the delay from the front panel, refer to **Section 9.4.5: Configuration Menu**. To set the delay with a communication command, refer to SYSTem:PSOK:DELay <NRf> in **Section 14.13.10: System Subsystem**.

NOTE

The delay affects only the OFF-to-ON transition. The ON-to-OFF transition is not affected.

11.4 Power Source OK Signal #1 (J4-3)

The power source OK Signal #1 indicates the power source's output state: ON or OFF. This is an open collector signal.

Output State	Signal Level	Note
OFF	High	The maximum voltage rating is 30V.
ON	0–0.6V	The Maximum allowed sink current is 10mA.

Table 11-3: Power Source OK Signal #1

This signal can also be set with a time delay. This delay is used to prevent the signal from rising before the set output is reached. To set the delay from the front panel, refer to **Section 9.4.5: Configuration Menu.** To set the delay with a communication command, refer to SYSTem:PSOK:DELay <NRf> in **Section 14.13.10: System Subsystem.**

CAUTION

Do not connect the signal to a voltage source greater than 30V. Always connect this signal to the voltage source with a series resistor to limit the sink current to less than 10mA.

NOTE

The delay affects only the OFF-to-ON transition. The ON-to-OFF transition is not affected.

11.5 Trigger In #1 (J4-4)

This signal triggers an execution of a sequence.
To select the trigger source via the front panel, refer to **Section 9.4.9: Program Menu**. To set the trigger source with a communication command, refer to TRIGger:SOURce <DSC> in **Section 14.13.11: TRIGger Subsystem**.

Signal	Level / Time
Maximum low-level Input	0.8V
Minimum high-level Input	2.5V
Maximum high-level Input	5V
Minimum Positive Edge Trigger Width	10µs
Maximum T_r,T_f	1µs
Minimum delay between 2 pulses	1ms

Table 11-4: Trigger In Level / Time

11.6 Local/Remote Analog Monitor/Enable (J4-5 and J4-6)

11.6.1 Introduction

The user can program the power source output voltage with an external analog voltage source (remote programming). Local or remote programming can be selected using the Local/Remote Analog Enable pin **(J4-6)** along with the external control mode, and the type of programming source can be detected using the Local/Remote Analog Monitor pin **(J4-5)**.

11.6.2 Local/Remote Analog Enable (J4-6)

Local or remote programming can be selected using the Local/Remote Analog Enable pin that accepts an electrical signal or dry contact. This pin is used in combination with the external control mode to select between local or remote programming.

In local mode, the output voltage can be programmed from the front panel or with a communication command.

In remote mode, the output voltage can be programmed with an analog voltage source.

11.6.3 Local/Remote Analog Monitor (J4-5)

The Local/Remote Analog Monitor is an open collector output signal that indicates if the power source is in local or remote mode.

11.6.4 Local/Remote Analog Enable and Local/Remote Analog Monitor

NOTE

The external control mode must be set to ON for analog programming. To select the mode via the front panel, refer to **Section 9.4.5: Configuration Menu.** To set the mode with a communication command, refer to SYSTem:EXTernal:ENABle[#] <Bool> in **Section 14.13.10: System Subsystem.**

Local/Remote Analog Input (J4-6)	Programming Source	Local/Remote Monitor (J4-5)
2–30V or open (disabled)	Front panel	30V maximum
0–0.6V or short (enabled)	External voltage	0–0.6V (10mA sink current maximum)

Table 11-5: Local/Remote Analog Enable and Monitor

CAUTION

Do not connect the Local/Remote Analog Monitor signal to a voltage source greater than 30V. Always connect this signal to the voltage source with a series resistor to limit the sink current to less than 10mA.

NOTE

Even if the Analog input (J4-6) is 0–0.6V or short (enabled), the external voltage programming source is not enabled if the external control mode is set to OFF.

11.7 Trigger Out #2 (J4-7)

This signal indicates that the triggered measurements data that was captured is ready.

Signal	Level / Time
Maximum low-level output voltage	0.6V
Minimum high-level output voltage	4.5V
Maximum high-level output voltage	5V
Maximum source / sink current	10mA
Minimum pulse width	100 µs

Table 11-6: Trigger Out Level / Time

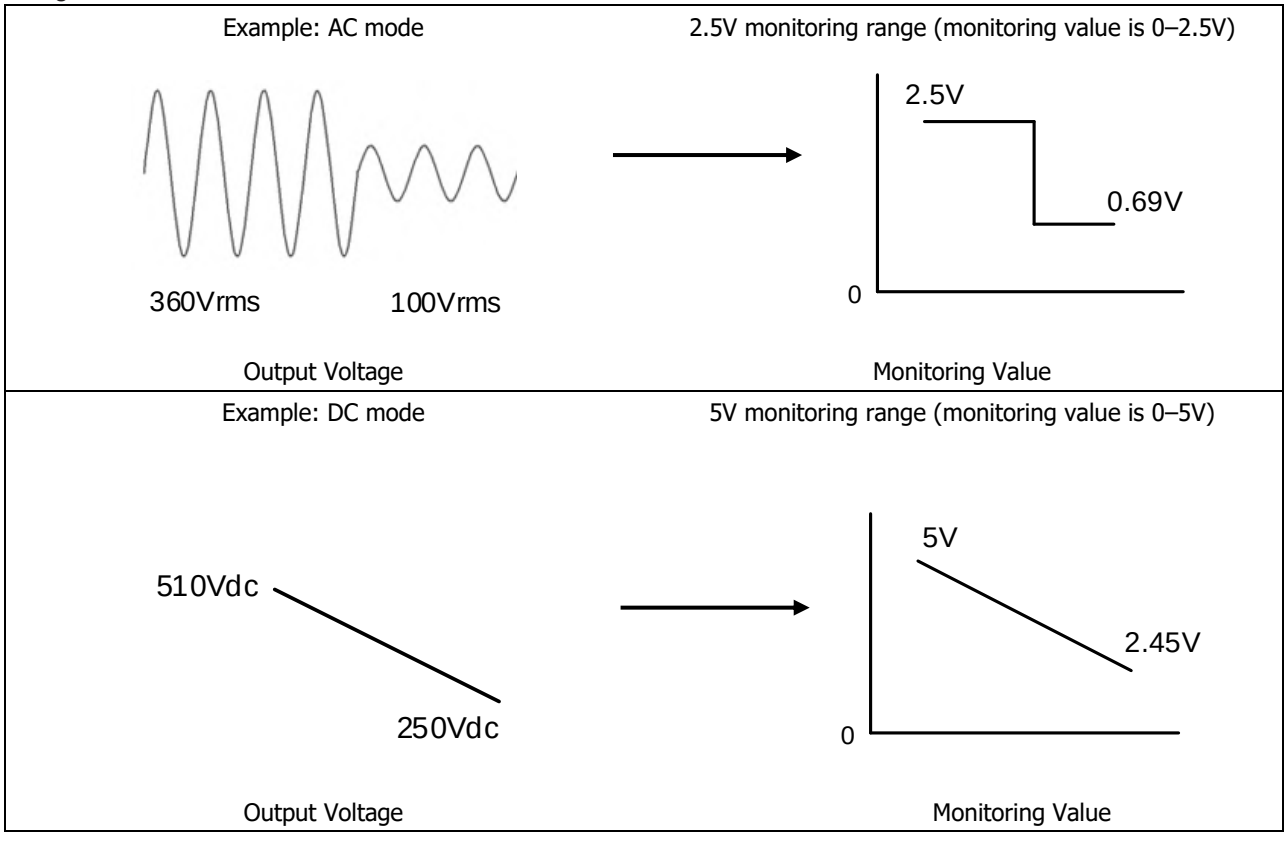
11.8 External Voltage Monitoring (J4-8)

The user can monitor the output voltage using an analog signal via this pin located on the **J4** connector. There are two monitor modes.

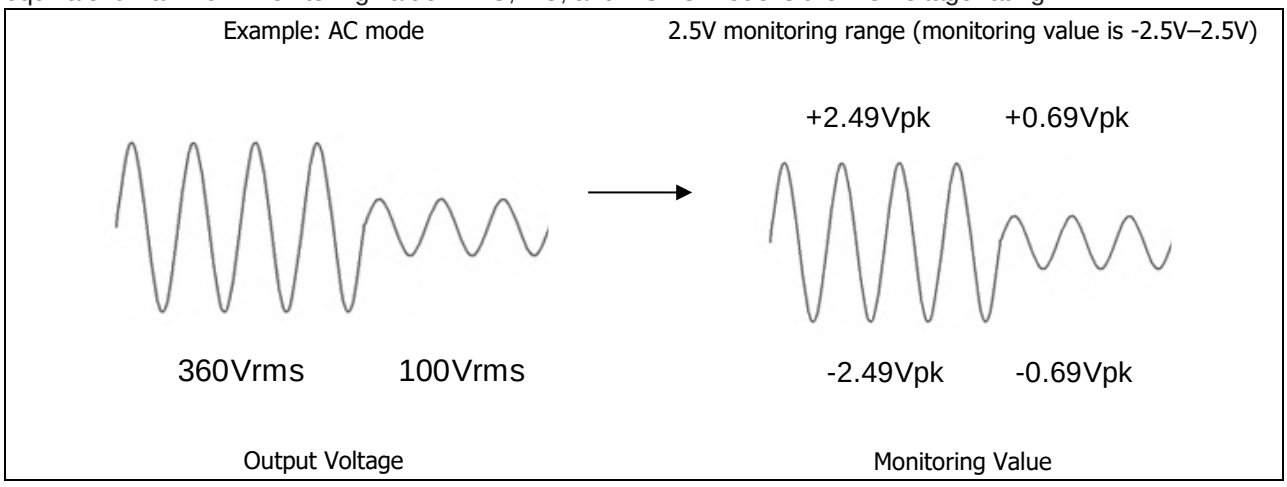
CAUTION

To maintain the accuracy, ensure that the sensing circuit has an input resistance of greater than 500kΩ.

RMS control: The monitoring value is in the range of 0 to the programming/monitoring range. The equivalent maximum monitoring value in AC and ACDC mode is rms voltage rating and in DC mode is the DC voltage rating.



FULL control: arbitrary measurement of the output voltage. The measurement follows the output voltage. The monitoring value is in the range of (-programming/monitoring range to +programming/monitoring range). The equivalent maximum monitoring value in AC, DC, and ACDC mode is the DC voltage rating.



To select RMS control or FULL control via the front panel, refer to **Section 9.4.5: Configuration Menu.** To set RMS control or FULL control with a communication command, refer to SYSTem:EXTernal:MONitor[:MODE][#] <DSC> in **Section 14.13.10: System Subsystem**.

11.9 External (Analog) Voltage Programming (J4-9)

The rear panel **J4** connector allows the user to program the power source output voltage with an external analog voltage source.

External analog programming can be selected using the Local/Remote Analog Enable pin that accepts an electrical signal or dry contact. This pin is used in combination with the external control mode to select between local or remote programming. Refer to **Section 11.6: Local/Remote Analog Monitor/Enable (J4-5 and J4-6)**.

CAUTION

To maintain the isolation of the power source, use a programming source with floating outputs when programming from J4.

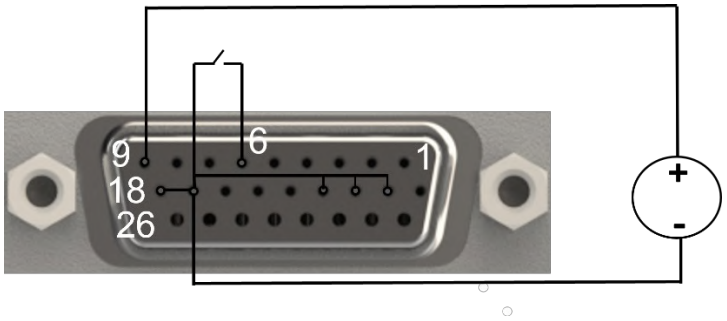


Figure 11-1: Setup for External Voltage Programming

The selection range for external (analog) voltage programming is 2.5V to 10V. To select the range via the front panel, refer to **Section 9.4.5: Configuration Menu.** To set the range with a communication command, refer to SYSTem:EXTernal:RANGe[#] <NR2> in **Section 14.13.10: System Subsystem**. The programming range is dependent on the selection range.

There are four different types of voltage programming as shown in **Table 11-7.**

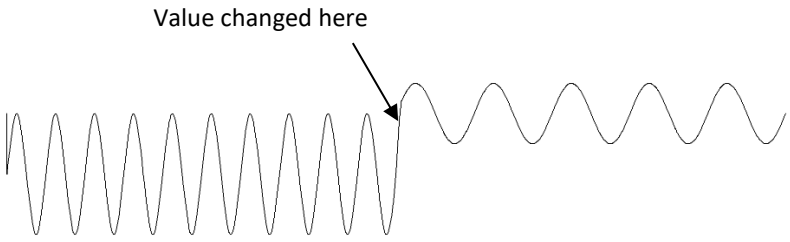
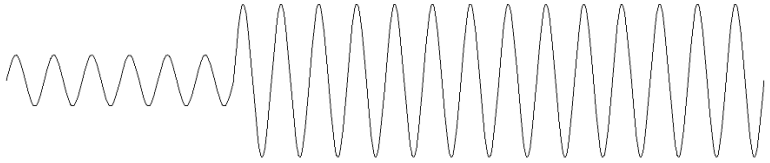
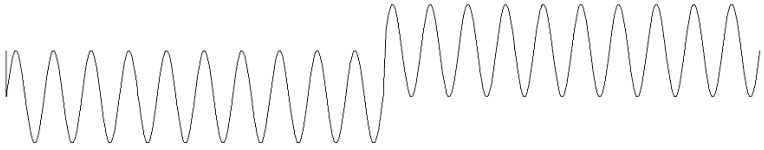
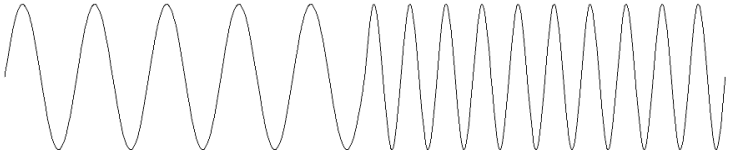
Mode	Value Set	Programming Range (V)
Full 	Instantaneous (AC, DC, Frequency) (DC and Frequency: Applicable for GAC-PRO models only, refer to order code)	±2.5 to ±10. Ex- With 2.5V selection range, the programming range is -2.5V to +2.5V
AC 	AC Voltage	2.5 to 10 Ex- With 5V selection range, the programming range is 0 to 5V which is equivalent to 0 to 360Vrms
DC 	DC Voltage (Applicable for GAC-PRO models only, refer to order code)	±2.5 to ±10 Ex- With 3V selection range, the programming range is -3V to +3V which is equivalent to -510 to 510Vdc.
Freq 	Frequency (Applicable for GAC-PRO models only, refer to order code)	2.5 to 10 Ex- With 10V selection range, the programming range is 0V to 10V which is equivalent to 16 to 1200Hz or 16 to 5000Hz

Table 11-7: Voltage Programming Modes

11.10 ENABLE IN (ENA) (J4-10)

The Enable signal (ENABLE IN) serves as the power source enable control. A connection can be made between J4-10 and J4-11.

11.10.1 ENABLE IN Function

To enable or disable the ENABLE function from the front panel, refer to **Section 9.4.3: Protection Menu**.
To enable or disable the ENABLE function with a communication command, refer to OUTPut:ENA[:STATe] <Bool> in **Section 14.13.5: Output Subsystem**.

11.10.2 ENABLE IN Polarity

The user can select the polarity of the ENABLE IN signal: Normal (Norm) or Reverse (Rev).
To select the polarity from the front panel, refer to **Section 9.4.3: Protection Menu**.
To set the polarity with a communication command, refer to OUTPut:ENA:POLarity[:STATe] <DSC> in **Section 14.13.5: Output Subsystem**.

11.10.3 ENABLE IN, ENABLE IN Function, and ENABLE IN Polarity

Table 11-8 shows the status of the power source output with respect to the ENABLE IN signal and its polarity.

ENABLE IN Function	ENABLE IN Polarity	ENABLE IN (J4-10 to J4-11)	Power Source Output
0/OFF (Disabled)	Norm/Rev	Open or Short	ON
1/ON (Enabled)	Norm	Open or 2–30V	OFF
	Norm	Short or 0–0.6V	ON
	Rev	Open or 2–30V	ON
	Rev	Short or 0–0.6V	OFF

Table 11-8: ENABLE IN (ENA) Signal and Polarity

NOTE

If the ENABLE IN function is disabled, the connection between J4-10 and J4-11 and/or the polarity setting have no effect, and the output always remain ON.

CAUTION

To prevent damage to the unit, **do not** connect the input to the positive or negative output potential.

11.10.4 ENABLE IN Latch

The latch function of the ENABLE IN signal can be enabled or disabled.
To enable or disable the latch function from the front panel, refer to **Section 9.4.3: Protection Menu**.
To enable or disable the latch function with a communication command, refer to OUTPut:ENA:LATCh[:STATe] <Bool> in **Section 14.13.5: Output Subsystem**.

NOTE

To enable the output, switch the enable signal level (refer to **Table 11-8)** to output enable level and recover from the latched condition by:

1. sending output ON from the front panel or with a communication command.

2. clicking Ack on the front panel.

3. recycling the power switch.

4. recycling the AC.

5. sending the Output Protection Clear command.

For recovery with options 2–5, the output is OFF irrespective of the start-up mode (AUTO/SAFE).

CAUTION

To prevent damage to the unit, **do not** connect the input to the positive or negative output potential.

11.11 INTERLOCK IN (ILC) (J4-19)

The Interlock signal (ILC) serves as the power source enable control. A connection can be made between J4-19 and J4-11.

11.11.1 INTERLOCK Function

To enable or disable the INTERLOCK function from the front panel, refer to **Section 9.4.3: Protection Menu**.
To enable or disable the INTERLOCK function with a communication command, refer to OUTPut:ILC[:STATe] <Bool> in **Section 14.13.5: Output Subsystem.**

11.11.2 INTERLOCK IN and INTERLOCK Function

Table 11-9 shows the status of the power source output with respect to the ILC signal.

INTERLOCK function	INTERLOCK IN (J4-19 to J4-11)	Power Source Output
0/OFF (disabled)	Open or Short	ON
1/ON (enabled)	Open or 2–30V	OFF
	Short or 0–0.6V	ON

Table 11-9: INTERLOCK IN (ILC) Signal

NOTE

If the INTERLOCK IN function is disabled, the connection between J4-19 and J4-11 has no effect, and the output always remain ON.

11.11.3 INTERLOCK Latch

The latch function of the INTERLOCK signal can be enabled or disabled.
To enable or disable the latch function from the front panel, refer to **Section 9.4.3: Protection Menu**.
To enable or disable the latch function with a communication command, refer to OUTPut:ILC:LATCh[:STATe] <Bool> in **Section 14.13.5: Output Subsystem**.

NOTE

To enable the output, switch the interlock signal level (refer to **Table 11-9)** to output enable level and recover from the latched condition by:

1. sending output ON from the front panel or with a communication command.

2. clicking Ack on the front panel.

3. recycling the power switch.

4. recycling the AC.

5. sending the Output Protection Clear command.

For recovery with options 2–5, the output is OFF irrespective of the start-up mode (AUTO/SAFE)

CAUTION

To prevent damage to the unit, **do not** connect the input to the positive or negative output potential.

11.12 Programmable Pin #1 (J4-21) and Programmable Pin #2 (J4-20)

Programmable Pin #1 and Programmable Pin #2 are general purpose open drain signals. To make the settings from the front panel, refer to **Section 9.4.5: Configuration Menu**. To make the settings with a communication command, refer to OUTPut:RELay1(2)[:STATe][#] <DSC> in **Section 14.13.5: Output Subsystem**.

Setting	Signal	Note
Low	Low	Maximum allowed sink current is 100mA
High	High	The maximum voltage rating is 25V
PWM	Pulsed Signal (Pulse Width Modulation)	The pulses can be configured for different duty cycles, periods, and the number of pulses

Table 11-10: Programmable Pin #1 and #2

CAUTION

Do not connect the signals to a voltage source greater than 25V. Always connect these signals to the voltage source with a series resistor to limit the sink current to less than 100mA.

11.13 Trigger In #2 (J4-22)

This signal triggers the start of the measurements.

To select the trigger source via the front panel, refer to **Section 9.4.2: Measurements Menu**. To set the trigger source with a communication command, refer to MEASure:TRIGger:SOURce <DSC> in **Section 14.13.4: Measure Subsystem**. Refer to **Table 11-4** for the levels.

11.14 Trigger Out #1 (J4-23)

Trigger Out is an active high output signal and is used to trigger other equipment. The signal is user selectable and there are four trigger out modes. To select the Trigger Out mode via the front panel, refer to **Section 9.4.5: Configuration Menu**. To set the Trigger Out mode with a communication command, refer to OUTPut:TTLTrg:MODE[#] <DSC> in **Section 14.13.5: Output Subsystem**. Refer to **Table 11-6** for the levels.

11.15 AC-OK Signal (J4-24)

The AC-OK signal indicates the power source's AC input state. This is an open collector output signal.

State	AC-OK Signal	Note
AC Fault	High	The maximum voltage rating is 30V
No Fault	0–0.6V	The maximum allowed sink current is 10mA

Table 11-11: AC-OK Signal

CAUTION

Do not connect the signal to a voltage source greater than 30V. Always connect this signal to the voltage source with a series resistor to limit the sink current to less than 10mA.

11.16 ALARM Signal (J4-25)

The ALARM Signal indicates the power source's state. This is an open collector output signal.

State	ALARM Signal	Note
Fault or OFF	High	The maximum voltage rating is 30V
No Fault	0–0.6V	The maximum allowed sink current is 10mA

Table 11-12: ALARM Signal

CAUTION

Do not connect the signal to a voltage source greater than 30V. Always connect this signal to the voltage source with a series resistor to limit the sink current to less than 10mA.

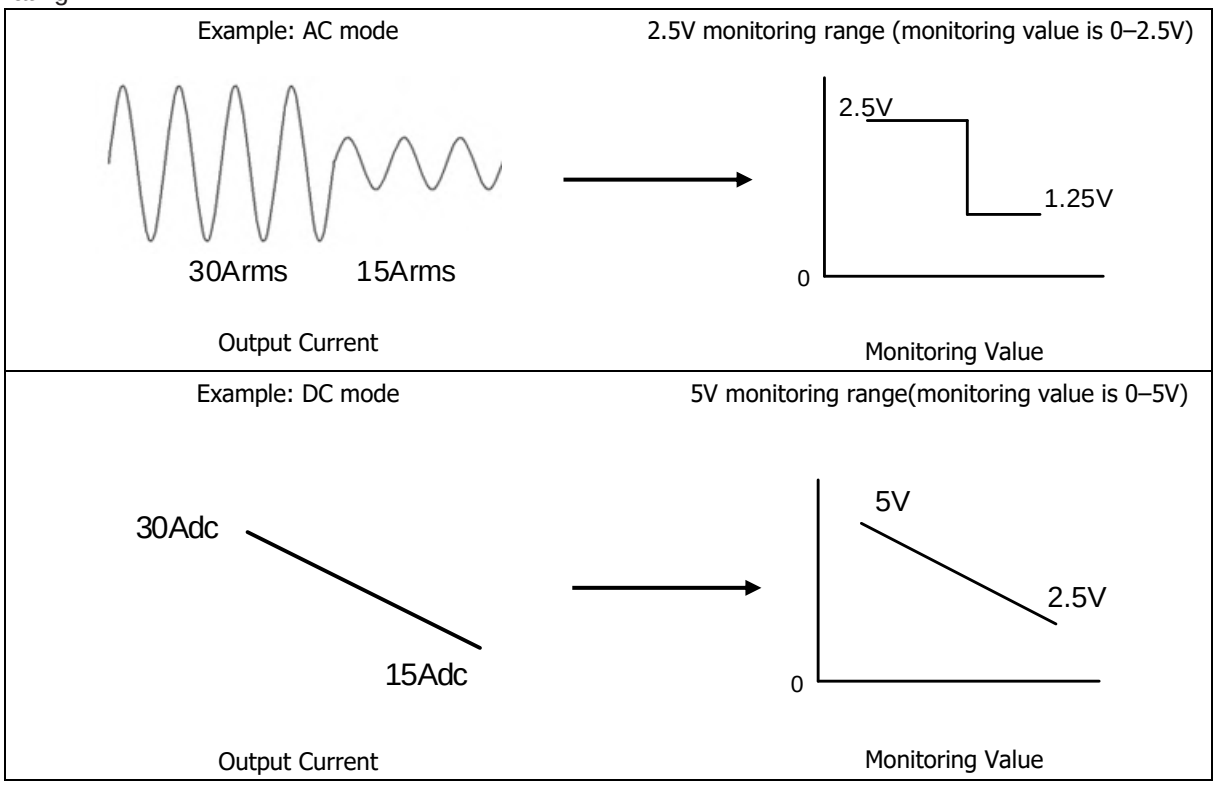
11.17 External Current Monitoring (J4-26)

The user can monitor the output current using an analog signal provided via this pin located on the **J4** connector.

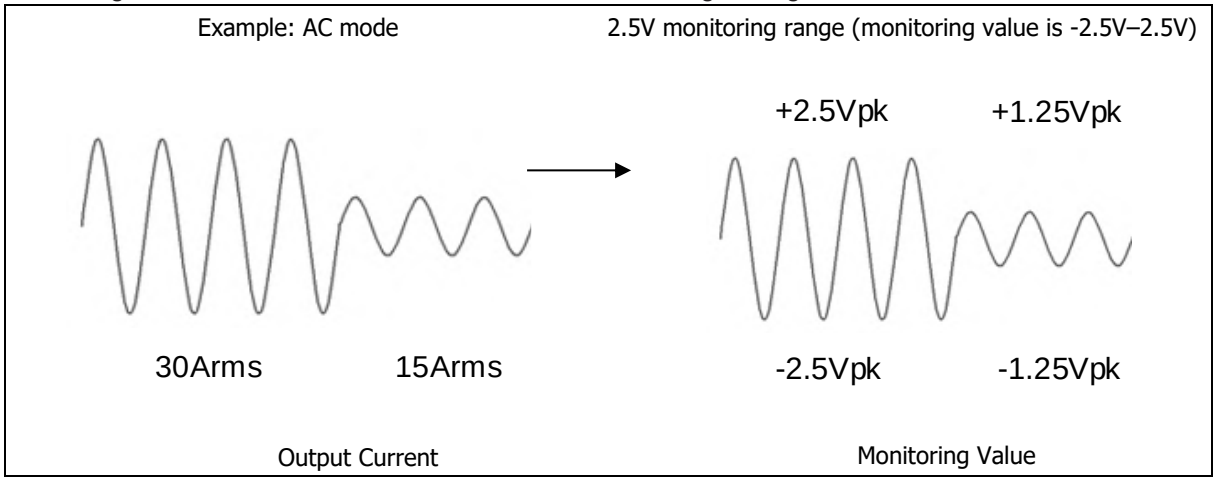
CAUTION

To maintain the accuracy, ensure that the sensing circuit has an input resistance of greater than 500kΩ.

RMS control: The monitoring value is in the range of 0 to the programming/monitoring range. The equivalent maximum monitoring value in AC and ACDC mode is rms current rating and in DC mode is the DC current rating.



FULL control: arbitrary measurement of the output current. The measurement follows the output current. The monitoring value is in the range of (-programming range to +programming range). The equivalent maximum monitoring value in AC, DC, and ACDC mode is the DC voltage rating.



To select the mode via the front panel, refer to **Section 9.4.5: Configuration Menu.** To set the mode with a communication command, refer to SYSTem:EXTernal:MONitor[:MODE][#] <DSC> in **Section 14.13.10: System Subsystem**.

12.1 Introduction

There are several conditions that cause protection, faults, and alarms. When a fault or protective function occurs, the respective message appears on the display, the alarm LED (full panel: **RED** and incorporated into the **OUT** button, blank panel: **RED** led) blinks, and the respective bits in the fault register trigger.

12.2 Types of Faults and Protective Functions

The faults and protective functions are divided into three main categories: Latched, Non-latched, and Hardware. For the list of the latched and non-latched faults refer to **Table 12-1**.

Latched: There are five methods to recover from a latched state after the fault condition is removed:

- output ON from the front panel or with a communication command
- clicking Ack on the front panel
- recycling of the power switch
- recycling of AC
- sending the Output Protection Clear command

NOTE

After recovery from a latched state, the output is always OFF (except recovery with output ON from the front panel or output ON with a communication command) irrespective of the start-up mode (AUTO/SAFE).

Non-latched: The recovery from these faults or protective functions depends on the type of the start modes:

- **Auto-Start Mode**: The power source recovers to the previous state (before the non-latching fault occurred) or to the last setting if an AC recycle was done.
- **Safe-Start Mode**: The power source always returns to OFF.

Hardware: Hardware fault has occurred. If fault persists, please consult with an authorized TDK-Lambda service center.

The following happens when a fault occurs:

- output power is disabled.
- the fault message is displayed.
- the alarm LED blinks at a 1Hz frequency (except for Front Panel Output OFF).
- bit **x** of the Condition Register in the Questionable Condition (Fault Register) Group (refer to **Section 14.11.1: SCPI Register Tree**) is set to **1**.
- bit **x** of the Event Register in the Questionable Condition (Fault Register) Group (refer to **Section 14.11.1: SCPI Register Tree**) is set to **1**. The bit is set to **1** only if the corresponding bit is enabled in the Enable Register. **x**=the bit number.

NOTE

Some faults and protective functions will not trigger the register bits in the Condition Register and the Event Register of the Fault Register Group.

Faults/Protective Functions	Latched Fault (fault cleared by)				Bit in Condition Register and Event Register of Fault Register Group
	AC Recycle	Output ON/OFF (*1)	Power Switch (Short) (*2)	Power Switch (Long) (*3)	
AC	NA	NA	NA	NA	1
Over-Temperature Protection (Hardware)	NA	NA	NA	NA	2
Foldback	+	+	+	+	3
Over-Voltage Protection (rms)	+	+	+	+	4
Over-Power Protection	+	+	+	+	5
Front Panel Output OFF	NA	NA	NA	NA	6
Under-Voltage Protection	+	+	+	+	7
System Setup Required	NA	NA	NA	NA	-
Advanced Slave Fault (Parallel Acknowledge)	+	-	-	+	8
General Error	+	-	-	-	9
Parallel Error	+	-	-	+	10
Waiting for Slaves (Parallel Wait Slave)	NA	NA	NA	NA	11
Power Switch OFF	NA	NA	NA	NA	12
E-STOP (*4)	+	+	+	+	14
Peak Over-Voltage	+	+	+	+	15
Drop-On-Wire	+	+	+	+	16
Peak Drop-On-Wire	+	+	+	+	17
Hardware	+	-	-	+	18
Ambient Over-Temperature Protection (Software)	NA	NA	NA	NA	19
Over-Power Protection (Low Line)	+	+	+	+	20
Peak Over-Current	+	+	+	+	21
Shorted Output	+	+	+	+	22
Over-Frequency	+	+	+	+	23
Under-Frequency	+	+	+	+	24
Voltage Controlled Frequency	NA	NA	NA	NA	25
Current Imbalance	+	+	+	+	26
Peak Maximum Over-Current	+	+	+	+	27
Peak DCDC Over-Current (*5)	+	+	-	+	28
Balancing Failure	+	+	+	+	-
Firmware is not Compatible (*5)	NA	NA	NA	NA	-
Analog Programming while Output On	+	+	+	+	-
Display Failure	+	-	-	+	-
USB Failure	+	+	+	+	-
Parallel Error: Control Communication	+	-	-	+	-
Critical System Fault	+	-	-	+	-

Table 12-1: Faults and Protective Functions

NOTES:

(*1) Includes Output ON/OFF via the front panel, ON/OFF command, OUTPUT:PROTECTION:CLEAR command, and clicking Ack via the front panel.

(*2) Power Source does not completely shut down.

(*3) Power Source completely shuts down.

(*4) Depends on additional settings (enable/disable latching).

(*5) AC reset required to remove the fault condition.

NA: Not applicable as fault is not latched.

+: Latch cleared, -: Latch not cleared

NOTE

In the case of a fault, if the event register is read, it is set to **0**, even if the fault is still present.

Once the fault condition is removed, bits of the Condition Register are set to **0**, but the bits of the Event Register are still set to **1** unless this register is read.

12.3 Displaying the Faults/Alarm on the Front Panel

It is possible that more than one fault/alarm or a protective function may be triggered. When any fault/alarm occurs, the respective fault/alarm message appears on the display.



Figure 12-1: Single Fault/Alarm

If a fault/alarm exists and another one occurs later, the new one will not be seen but there will be an indicator (**right** arrow) which indicates that more faults/alarms have occurred. They can be viewed by pressing the **right** icon. As shown in **Figure 12-2**, Enable shutdown occurs first, and the figure also shows that Enable shutdown is followed by E-STOP shutdown.

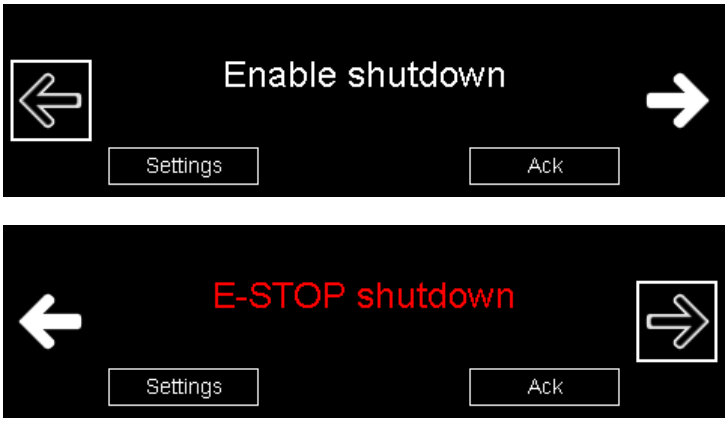


Figure 12-2: Multiple Faults/Alarms

NOTE

Only faults are displayed in RED.

When more than two faults/alarms occur, all of them can be viewed by using the **left** and the **right** icons.



CHAPTER 13: MEMORY CONFIGURATION

13.1 Introduction

The power source has several memory configuration modes that can be used to store/restore parameters to/from a pre-determined state.

13.2 Default Setting or Factory Reset

NOTE

If this function is performed, the addressing is lost and the power source loses communication as the communication settings change.

To restore the factory default settings from the front panel, refer to **Section 9.4.6: System Menu**.
To restore the factory default settings from the rear panel, press and hold the **Reset** button for 5 to 10 seconds. This also sets the communication interface to USB.
To restore the factory default settings with a communication command, refer to SYSTem:FRST [<DSC>] in **Section 14.13.10: System Subsystem.**

13.3 Factory Wipe

Carries out the following functions:

- Fully wipes the non-volatile memory and user-created waveforms from all four regions.
- Restores factory default parameters (Factory Reset).
- Sets communication interface to USB.

NOTE

This function sanitizes the entire non-volatile memory.

13.4 Reset

This function sets parameters to their reset state.

13.5 Last Setting

This function stores the power source state and settings into the non-volatile memory at AC fail.
The settings are restored at AC ON.

13.6 Save <1–4>

This function stores the power source state and settings into the non-volatile memory.
The user can save up to 4 sets of parameters.

13.7 Recall <1–4>

This function recalls the power source state and settings from the non-volatile memory.
The user can recall up to 4 sets of parameters.

NOTES

To wipe, reset, save, or recall the settings from the front panel, refer to **Section 9.4.6: System Menu**. To reset from the rear panel, press and hold the **Reset** button for 5 seconds.

To reset, save, or recall the settings with a communication command, refer to *RST, *SAV[<NR1>], or *RCL[<NR1>] in **Section 14.12: SCPI Common Commands.** To wipe with a communication command, refer to SYSTem:FRST:WIPe [<DSC>] in **Section 14.13.10: System Subsystem.**

Refer to **Table 13-1** for a complete table of parameter settings. This includes settings at Default State (Factory Reset), Reset, Last Setting, Save and Recall (Recall and PON profile column), changes to the parallel system, and changes to the number of phases.

13.8 Non-Volatile Memory Parameters

Command / Function	Default Settings (Factory Reset)	Reset	Last Setting	Recall and PON Profile	Parallel System Change	Number of Phase Change
*ESE	0	-	+	+	0	-
*PSC	1	-	+	+	1	-
Profiles (*RCL/*SAV)	-	-	-	-	Clears all profile slots 1–4	Clears all profile slots 1-4
*SRE	0	-	+	+	0	-
DISPlay[:WINDow][:STATe]	ON	-	+	-	ON	ON
DISPlay[:WINDow]:BRIGhtness	80	-	+	-	80	80
DISPlay[:WINDow]:DIMMing:BRIGhtness	50	-	+	-	50	50
DISPlay[:WINDow]:DIMMing:DELay	-1	-	+	-	-1	-1
DISPlay[:WINDow]:FLASh	OFF	-	-	-	OFF	OFF
DISPlay[:WINDow]:MODE	NORM	-	+	-	NORM	NORM
DISPlay[:WINDow]:TOUCh	ON	-	+	-	ON	ON
DISPlay[:WINDow]:IDLE:TIMeout	300	-	+	-	300	300
DISPlay[:WINDow]:LANGuage	ENG	-	+	-	ENG	ENG
DISPlay[:WINDow]:TEST	OFF	-	-	-	OFF	OFF
DISPlay[:WINDow]:TEXT	\n	-	+	-	\n	\n
DISPlay[:WINDow]:TEXT:FORMat	5,5,5,#HFFFFFF	-	+	-	5,5,5,#HFFFFFF	5,5,5,#HFFFFFF
INITiate[:IMMediate]	Not Inilialized	Not Inilialized	Not Inilialized	Not Inilialized	Not Inilialized	Non initialized
MEASure:ARRay:PHASe	0	-	+	+	0	-
MEASure:HARMonic:PERCent[:TYPE]	FUND	-	+	+	FUND	-
MEASure:TRIGger:DELay	0	-	+	+	0	-
MEASure:TRIGger:SYNC:ENABle	OFF	-	+	+	OFF	-
MEASure:TRIGger:SYNC:PHASe	0	-	+	+	0	-

Command / Function	Default Settings (Factory Reset)	Reset	Last Setting	Recall and PON Profile	Parallel System Change	Number of Phase Change
MEASure:TRIGger:SOURce	BUS	-	+	+	BUS	-
OUTPut[:STATe]	OFF	OFF	+[*1]	+	OFF	OFF
OUTPut:ECO[:MODE][:ENABle]	OFF	-	+	+	OFF	-
OUTPut:ENA[:STATe]	OFF	-	+	+	OFF	-
OUTPut:ENA:LATCh[:STATe]	OFF	-	+	+	OFF	-
OUTPut:ENA:POLarity[:STATe]	REV	-	+	+	REV	-
OUTPut:ESTOp[:STATe]	OFF	-	+	+	OFF	-
OUTPut:ESTOp:LATCh[:STATe]	ON	-	+	+	ON	-
OUTPut:FUNCtion:PRIOrity	CV	CV	+	+	CV	-
OUTPut:ILC[:STATe]	OFF	-	+	+	OFF	-
OUTPut:ILC:LATCh[:STATe]	OFF	-	+	+	OFF	-
OUTPut:PHASe:ON	-1	-	+	+	-1	-
OUTPut:PHASe:OFF	-1	-	+	+	-1	-
OUTPut:PON[:STATe]	SAFE	SAFE	+	+	SAFE	-
OUTPut:PON:PROFile	LAST[*2]	-	-	-	LAST[*2]	LAST[*2]
OUTPut:PON:PROFile:FRST:INTerface	USB	-	+	+	USB	-
OUTPut:PROTection:FOLDback[:MODE]	OFF	OFF	+	+	OFF	-
OUTPut:PROTection:FOLDback:DELay	1	1	+	+	1	-
OUTPut:RELay1[:STATe]	LOW	LOW	+	+	LOW	LOW
OUTPut:RELay1:COUNt	-1	-1	+	+	-1	-1
OUTPut:RELay1:DCYCle	0.5	0.5	+	+	0.5	0.5
OUTPut:RELay1:PERiod	1	1	+	+	1	1
OUTPut:RELay2[:STATe]	LOW	LOW	+	+	LOW	LOW
OUTPut:RELay2:COUNt	-1	-1	+	+	-1	-1
OUTPut:RELay2:DCYCle	0.5	0.5	+	+	0.5	0.5
OUTPut:RELay2:PERiod	1	1	+	+	1	1
OUTPut:TTLTrg:MODE	OFF	-	+	+	OFF	OFF
[FUNCtion:]WAVeform[:ACTivate][:NAME]	SINe	SINe	+	+	SINe	SINe
[FUNCtion:]WAVeform[:ACTivate]:SYNC:ENABle	OFF	OFF	+	+	OFF	OFF
[FUNCtion:]WAVeform:SQUare:DCYCle	50	50	+	+	50	50
[FUNCtion:]WAVeform:TRIangle:SYMMetry	50	50	+	+	50	50
[FUNCtion:]WAVeform:CSINe:LEVel	100	100	+	+	100	100
[FUNCtion:]WAVeform:CSINe:THD	0	0	+	+	0	0
[FUNCtion:]WAVeform:CSINe:MODE	LEV	LEV	+	+	LEV	LEV
[FUNCtion:]WAVeform:POINts	empty[*9]	-	-	-	empty[*9]	-
[FUNCtion:]WAVeform:POINts:OVERwrite	empty[*9]	-	-	-	empty[*9]	-
[FUNCtion:]WAVeform:TEMPlate	empty[*9]	-	-	-	empty[*9]	-
[FUNCtion:]WAVeform:REGion	1	1	+	+	1	1
[PROGram:]PULSe:VOLTage:AC	0	-	-	-	0	0
[PROGram:]PULSe:VOLTage:AC:SLEW:UP	4400/16340[*7]	-	-	-	4400/16340[*7]	4400/16340[*7]
[PROGram:]PULSe:VOLTage:AC:SLEW:DOWN	4400/16340[*7]	-	-	-	4400/16340[*7]	4400/16340[*7]
[PROGram:]PULSe:VOLTage:DC	0	-	-	-	0	0

Command / Function	Default Settings (Factory Reset)	Reset	Last Setting	Recall and PON Profile	Parallel System Change	Number of Phase Change
[PROGram:]PULSe:VOLTage:DC:SLEW:UP	4400/16340*7	-	-	-	4400/16340*7	4400/16340*7
[PROGram:]PULSe:VOLTage:DC:SLEW:DOWN	4400/16340*7	-	-	-	4400/16340*7	4400/16340*7
[PROGram:]PULSe:FREQuency	50	-	-	-	50	50
[PROGram:]PULSe:FREQuency:SLEW:UP	100000	-	-	-	100000	100000
[PROGram:]PULSe:FREQuency:SLEW:DOWN	100000	-	-	-	100000	100000
[PROGram:]PULSe:WAVeform	SINe	-	-	-	SINe	SINe
[PROGram:]PULSe:PHASe:STARt	0	-	-	-	0	0
[PROGram:]PULSe:PHASe:END	0	-	-	-	0	0
[PROGram:]PULSe:PHASe:SHIFt	-1	-	-	-	-1	-1
[PROGram:]PULSe:DURation:ACTive	0.1	-	-	-	0.1	0.1
[PROGram:]PULSe:DURation:INACtive	0.1	-	-	-	0.1	0.1
[PROGram:]PULSe:REPeat	1	-	-	-	1	1
[PROGram:]PULSe:TTLTrg:ENABle	0,0	-	-	-	0,0	0,0
[PROGram:]STEP:VOLTage:AC	0	-	-	-	0	0
[PROGram:]STEP:VOLTage:AC:SLEW:UP	4400/16340*7	-	-	-	4400/16340*7	4400/16340*7
[PROGram:]STEP:VOLTage:AC:SLEW:DOWN	4400/16340*7	-	-	-	4400/16340*7	4400/16340*7
[PROGram:]STEP:VOLTage:DC	0	-	-	-	0	0
[PROGram:]STEP:VOLTage:DC:SLEW:UP	4400/16340*7	-	-	-	4400/16340*7	4400/16340*7
[PROGram:]STEP:VOLTage:DC:SLEW:DOWN	4400/16340*7	-	-	-	4400/16340*7	4400/16340*7
[PROGram:]STEP:FREQuency	50	-	-	-	50	50
[PROGram:]STEP:FREQuency:SLEW:UP	100000	-	-	-	100000	100000
[PROGram:]STEP:FREQuency:SLEW:DOWN	100000	-	-	-	100000	100000
[PROGram:]STEP:WAVeform	SINe	-	-	-	SINe	SINe
[PROGram:]STEP:PHASe:STARt	0	-	-	-	0	0
[PROGram:]STEP:PHASe:SHIFt	-1	-	-	-	-1	-1
[PROGram:]STEP:TTLTrg:ENABle	0	-	-	-	0	0
[PROGram:]LIST:VOLTage:AC	0	-	-	-	0	0
[PROGram:]LIST:VOLTage:AC:SLEW:UP	4400/16340*7	-	-	-	4400/16340*7	4400/16340*7
[PROGram:]LIST:VOLTage:AC:SLEW:DOWN	4400/16340*7	-	-	-	4400/16340*7	4400/16340*7
[PROGram:]LIST:VOLTage:DC	0	-	-	-	0	0
[PROGram:]LIST:VOLTage:DC:SLEW:UP	4400/16340*7	-	-	-	4400/16340*7	4400/16340*7
[PROGram:]LIST:VOLTage:DC:SLEW:DOWN	4400/16340*7	-	-	-	4400/16340*7	4400/16340*7
[PROGram:]LIST:FREQuency	50	-	-	-	50	50
[PROGram:]LIST:FREQuency:SLEW:UP	100000	-	-	-	100000	100000
[PROGram:]LIST:FREQuency:SLEW:DOWN	100000	-	-	-	100000	100000
[PROGram:]LIST:WAVeform	SINe	-	-	-	SINe	SINe
[PROGram:]LIST:PHASe:STARt	0	-	-	-	0	0
[PROGram:]LIST:PHASe:END	0	-	-	-	0	0
[PROGram:]LIST:PHASe:SHIFt	-1	-	-	-	-1	-1
[PROGram:]LIST:DURation	0.1	-	-	-	0.1	0.1
[PROGram:]LIST:REPeat	1	-	-	-	1	1
[PROGram:]LIST:STEP	ONCE	-	-	-	ONCE	ONCE

Command / Function	Default Settings (Factory Reset)	Reset	Last Setting	Recall and PON Profile	Parallel System Change	Number of Phase Change
[PROGram:]LIST:TTLTrg:ENABle	OFF	-	-	-	OFF	OFF
[PROGram:]MODE:VOLTage:AC	IMM	-	-	-	IMM	IMM
[PROGram:]MODE:VOLTage:DC	IMM	-	-	-	IMM	IMM
[PROGram:]MODE:WAVeform	IMM	-	-	-	IMM	IMM
[PROGram:]MODE:FREQuency	IMM	-	-	-	IMM	IMM
[PROGram:]MODE:VOLTage:AC:SLEW	IMM	-	-	-	IMM	IMM
[PROGram:]MODE:VOLTage:DC:SLEW	IMM	-	-	-	IMM	IMM
[PROGram:]MODE:FREQuency:SLEW	IMM	-	-	-	IMM	IMM
[PROGram:]MODE:PHASe:STARt	OFF	-	-	-	OFF	OFF
[PROGram:]MODE:PHASe:END	OFF	-	-	-	OFF	OFF
[PROGram:]MODE:PHASe:SHIFt	IMM	-	-	-	IMM	IMM
[PROGram:]MODE:ABORt	OFF	-	-	-	OFF	OFF
[PROGram:]MODE:END	IMM	-	-	-	IMM	IMM
[PROGram:]DC:COUNter	1	-	-	-	1	1
[PROGram:]DC:LIST:DWELl	0.1	-	-	-	0.1	0.1
[PROGram:]DC:LIST:VOLTage	0	-	-	-	0	0
[PROGram:]DC:STEP	ONCE	-	-	-	ONCE	ONCE
[PROGram:]DC:WAVE:TIME	0.1	-	-	-	0.1	0.1
[PROGram:]DC:WAVE:VOLTage	0	-	-	-	0	0
[PROGram:]DC:ACTivate	LIST	-	-	-	LIST	LIST
[PROGram:]DC:MODE:ABORt	IMM	-	-	-	IMM	IMM
[PROGram:]DC:MODE:END	IMM	-	-	-	IMM	IMM
[PROGram:]LIST:SIZE	0	-	-	-	0	0
[PROGram:]DC:LIST:SIZE	0	-	-	-	0	0
[SOURce:]CURRent[:LEVel][:IMMediate][:AC]	20.2/30.2*3 *6	20.2/30.2*3 *6	+	+	20.2/30.2*3 *6	20.2/30.2*3 *6
[SOURce:]CURRent[:LEVel][:IMMediate]:ACDC	20.2/30.2*3 *6	20.2/30.2*3 *6	+	+	20.2/30.2*3 *6	20.2/30.2*3 *6
[SOURce:]CURRent[:LEVel][:IMMediate]:DC	20.2/30.2*3 *6	20.2/30.2*3 *6	+	+	20.2/30.2*3 *6	20.2/30.2*3 *6
[SOURce:]CURRent:PROTection:PEAK:HIGH[:LEVel] *12	130*3	130*3	+	+	130*3	130*3
[SOURce:]CURRent:PROTection:PEAK:LOW[:LEVel] *12	-130*3	-130*3	+	+	-130*3	-130*3
[SOURce:]FREQuency[:IMMediate]	50	50	+	+	50	-
[SOURce:]FREQuency[:IMMediate]:SLEW:DOWN	100000	100000	+	+	100000	-
[SOURce:]FREQuency[:IMMediate]:SLEW:UP	100000	100000	+	+	100000	-
[SOURce:]MODE	AC	AC	+	+	AC	-
[SOURce:]PHASe:SHIFt	Ref. to Table 13-2	Ref. to Table 13-2	+	+	-*4	-*4
[SOURce:]POWer:PROTection[:AC][:LEVel] *12	2200/3300/ 4400*3 *5	2200/3300/ 4400*3 *5	+	+	2200/3300/ 4400*3 *5	2200/3300/ 4400*3 *5
[SOURce:]POWer:PROTection:ACDC[:LEVel] *12	2200/3300/ 4400*3 *5	2200/3300/ 4400*3 *5	+	+	2200/3300/ 4400*3 *5	2200/3300/ 4400*3 *5
[SOURce:]POWer:PROTection:DC[:LEVel] *12	2200/3300/ 4400*3 *5	2200/3300/ 4400*3 *5	+	+	2200/3300/ 4400*3 *5	2200/3300/ 4400*3 *5
[SOURce:]VOLTage[:LEVel][:IMMediate][:AC]	0	0	+	+	0	0

Command / Function	Default Settings (Factory Reset)	Reset	Last Setting	Recall and PON Profile	Parallel System Change	Number of Phase Change
[SOURce:]VOLTage[:LEVel][:IMMediate]:ACDC[:AC]	0	0	+	+	0	0
[SOURce:]VOLTage[:LEVel][:IMMediate]:ACDC:DC	0	0	+	+	0	0
[SOURce:]VOLTage[:LEVel][:IMMediate]:DC	0	0	+	+	0	0
[SOURce:]VOLTage:BALance:RESPonse[:SPEed]	SLOW	SLOW	+	+	SLOW	-
[SOURce:]VOLTage:BALance:AC	70	70	+	+	70	-
[SOURce:]VOLTage:BALance:AC:ENABle	1	1	+	+	1	-
[SOURce:]VOLTage:BALance:DC	75	75	+	+	75	-
[SOURce:]VOLTage:BALance:DC:ENABle	0	0	+	+	0	-
[SOURce:]VOLTage:BALance:FAIL[:ENABle]	1	1	+	+	1	-
[SOURce:]VOLTage:AC:SLEW:OFF	4400	4400	+	+	4400	-
[SOURce:]VOLTage:AC:SLEW:ON	4400	4400	+	+	4400	-
[SOURce:]VOLTage:AC[:IMMediate]:SLEW:DOWN	4400/16340*7	4400/16340*7	+	+	4400/16340*7	4400/16340*7
[SOURce:]VOLTage:AC[:IMMediate]:SLEW:UP	4400/16340*7	4400/16340*7	+	+	4400/16340*7	4400/16340*7
[SOURce:]VOLTage:DC:SLEW:OFF	4400	4400	+	+	4400	-
[SOURce:]VOLTage:DC:SLEW:ON	4400	4400	+	+	4400	-
[SOURce:]VOLTage:DC[:IMMediate]:SLEW:DOWN	4400/16340*7	4400/16340*7	+	+	4400/16340*7	4400/16340*7
[SOURce:]VOLTage:DC[:IMMediate]:SLEW:UP	4400/16340*7	4400/16340*7	+	+	4400/16340*7	4400/16340*7
[SOURce:]VOLTage:PROTection[:AC]:PEAK:HIGH[:LEVel] *12	550	550	+	+	550	550
[SOURce:]VOLTage:PROTection[:AC]:PEAK:LOW[:LEVel] *12	-550	-550	+	+	-550	-550
[SOURce:]VOLTage:PROTection:ACDC:PEAK:HIGH[:LEVel] *12	550	550	+	+	550	550
[SOURce:]VOLTage:PROTection:ACDC:PEAK:LOW[:LEVel] *12	-550	-550	+	+	-550	-550
[SOURce:]VOLTage:PROTection:DC:PEAK:HIGH[:LEVel] *12	550	550	+	+	550	550
[SOURce:]VOLTage:PROTection:DC:PEAK:LOW[:LEVel] *12	-550	-550	+	+	-550	-550
[SOURce:]VOLTage:PROTection:DROP[:LEVel]	35	35	+	+	35	-
[SOURce:]VOLTage:PROTection[:AC][:LEVel] *12	385	385	+	+	385	385
[SOURce:]VOLTage:PROTection:ACDC[:LEVel] *12	385	385	+	+	385	385
[SOURce:]VOLTage:PROTection:DC[:LEVel] *12	550	550	+	+	550	550
[SOURce:]VOLTage:PROTection:LOW:DELay	0.5	0.5	+	+	0.5	-
[SOURce:]VOLTage:PROTection[:AC]:LOW:STATe*12	0	0	+	+	0	0
[SOURce:]VOLTage:PROTection[:AC]:LOW[:LEVel] *12	0	0	+	+	0	0
[SOURce:]VOLTage:PROTection:ACDC:LOW:STATe*12	0	0	+	+	0	0
[SOURce:]VOLTage:PROTection:ACDC:LOW[:LEVel] *12	0	0	+	+	0	0
[SOURce:]VOLTage:PROTection:DC:LOW:STATe *12	0	0	+	+	0	0
[SOURce:]VOLTage:PROTection:DC:LOW[:LEVel] *12	0	0	+	+	0	0
STATus:ALM:CONFigure	4294967295	-	+	+	4294967295	-
STATus:OPERation:ENABle	0	-	+	+	0	-
STATus:QUEStionable:ENABle	0	-	+	+	0	-
SYSTem[:COMMunicate]:RS485:ADDRess	6	-	+	-	-	-

Command / Function	Default Settings (Factory Reset)	Reset	Last Setting	Recall and PON Profile	Parallel System Change	Number of Phase Change
SYSTem[:COMMunicate]:RS485:ADDRess:STATe	0	-	+	-	-	-
SYSTem[:COMMunicate]:RS485:TERMination:STATe	1	-	+	-	-	-
SYSTem[:COMMunicate]:BAUDrate	921600	-	+	-	-	-
SYSTem[:COMMunicate]:INTerface	USB *10	-	+	-	USB *11	-
SYSTem[:COMMunicate]:IDLED	0	-	0	-	0	0
SYSTem[:COMMunicate]:LAN:IP[:STATic]	192.168.1.99*8	-	+	-	-	-
SYSTem[:COMMunicate]:LAN:IPSource	DHCP*8	-	+	-	-	-
SYSTem[:COMMunicate]:LAN:SUBNetmask	255.255.255.0*8	-	+	-	-	-
SYSTem[:COMMunicate]:LAN:DEFGateway	0.0.0.0*8	-	+	-	-	-
SYSTem[:COMMunicate]:LAN:HOSTname	Refer to LAN section*8	-	+	-	-	-
SYSTem[:COMMunicate]:LAN:DESCription	Refer to LAN section*8	-	+	-	-	-
SYSTem[:COMMunicate]:LAN:UDP:ENABle	1*8	-	+	-	-	-
SYSTem[:COMMunicate]:LAN:MDNSenable	1*8	-	+	-	-	-
SYSTem[:COMMunicate]:LAN:TIMEout	1800*8	-	+	-	-	-
SYSTem[:COMMunicate]:LAN:PINGenable	1*8	-	+	-	-	-
SYSTem[:COMMunicate]:LAN:VXIdiscovery	1*8	-	+	-	-	-
SYSTem[:COMMunicate]:LAN:CONNections	4*8	-	+	-	-	-
Web server (web page) login password	None*8	-	-	-	-	-
SYSTem[:COMMunicate]:RS232:CONTrol	0	-	+	-	-	-
SYSTem:ERRor:ENABle	1	-	+	-	1	-
SYSTem:EXTernal:ENABle	0	-	+	+	0	0
SYSTem:EXTernal:RANGe	10	-	+	+	10	10
SYSTem:EXTernal:FUNCtion	AC	-	+	+	AC	AC
SYSTem:EXTernal:MONitor[:MODE]	RMS	-	+	+	RMS	RMS
SYSTem:EXTernal:MONitor:CURRent[:MAX][:LEVel]	20/30*3 *6	-	+	+	20/30*3 *6	20/30*3 *6
SYSTem:PHASe:CONFiguration	-	-	+	+	-*4	-*4
SYSTem:PSOK:DELay	0	-	+	+	0	-
SYSTem:REMote[:STATe]	LOC	-	-	-	-	-
SYSTem:SENSe[:STATe]	LOC	-	+	+	LOC	-
TRIGger:PROGram	STEP,PULS,LIST	-	-	-	STEP,PULS,LIST	-
TRIGger:DELay	0	-	-	-	0	-
TRIGger:SOURce	BUS	-	-	-	BUS	-
IHARmonics:DURation	0.1	-	+	+	0.1	-
IHARmonics:FREQuency:STARt	50	-	+	+	50	-
IHARmonics:FREQuency:END	50	-	+	+	50	-
IHARmonics:FREQuency:PAUSe	-1	-	+	+	-1	-
IHARmonics:LEVel	0	-	+	+	0	-
IHARmonics:STEP:SIZE	1	-	+	+	1	-
IHARmonics:STEP:DWELl	0.1	-	+	+	0.1	-
IHARmonics:STEP:PHASe	0	-	+	+	0	-

Command / Function	Default Settings (Factory Reset)	Reset	Last Setting	Recall and PON Profile	Parallel System Change	Number of Phase Change
IHARmonics:STEP:PHASe:SYNC:ENABle	0	-	+	+	0	-
IHARmonics:STATe	OFF	-	-	-	OFF	OFF
IHARmonics:WAVeform	SINe	-	+	+	SINe	SINe

Table 13-1: Non-Volatile Memory Parameters

*1: Power source output will turn on only if Auto-Start is enabled.
*2: Saved profiles are deleted in case of a Parallel System Change (Clears all profile slots 1–4); PON profile resets to LAST.
*3: Multiplied by the number of units per phase (according to number of parallel units set to the same phase).
*4: According to number of phases selection.
*5: According to rated 1U unit apparent power (2kVA/3kVA).
*6: According to rated 1U unit current (20A/30A).
*7: According to rated frequency (1200Hz/5000Hz).
*8: Set by factory reset or LAN reset.
*9: Values are reset when SYSTem:FRST:WIPe is initiated, or new power source configuration is detected. Values are stored in memory.
*10: Set to USB when no parameter is set.
*11: Communication interface setting depends on the role of the unit. If the new role is Slave, communication is set to USB. Other role changes are not affected.
*12: Settings can be set per phase starting from revision 001.010.000 and go to defaults after number of phases change. For older revisions, settings are global and do not change during after number of phases change ('-').

Number of Phases / Phase Number	1	2	3
1	0	0	0
2	-	180	120
3	-	-	240

Table 13-2: Default Phase Shift per Phase per Number of Phases

13.9 Program Store, Load, and Clear Memory Functions

Command / Function	Store/Load:AC*1	Clear:AC*2	Store/Load:DC*3	Clear:DC*4
INITiate:CONTinuous	+	+	+	+
[PROGram:]PULSe:VOLTage:AC	+	+	-	-
[PROGram:]PULSe:VOLTage:AC:SLEW:UP	+	+	-	-
[PROGram:]PULSe:VOLTage:AC:SLEW:DOWN	+	+	-	-
[PROGram:]PULSe:VOLTage:DC	+	+	-	-
[PROGram:]PULSe:VOLTage:DC:SLEW:UP	+	+	-	-
[PROGram:]PULSe:VOLTage:DC:SLEW:DOWN	+	+	-	-
[PROGram:]PULSe:FREQuency	+	+	-	-
[PROGram:]PULSe:FREQuency:SLEW:UP	+	+	-	-
[PROGram:]PULSe:FREQuency:SLEW:DOWN	+	+	-	-
[PROGram:]PULSe:WAVeform	+	+	-	-
[PROGram:]PULSe:PHASe:STARt	+	+	-	-
[PROGram:]PULSe:PHASe:END	+	+	-	-
[PROGram:]PULSe:PHASe:SHIFt	+	+	-	-

Command / Function	Store/Load:AC*1	Clear:AC*2	Store/Load:DC*3	Clear:DC*4
[PROGram:]PULSe:DURation:ACTive	+	+	-	-
[PROGram:]PULSe:DURation:INACtive	+	+	-	-
[PROGram:]PULSe:REPeat	+	+	-	-
[PROGram:]PULSe:TTLTrg:ENABle	+	+	-	-
[PROGram:]STEP:VOLTage:AC	+	+	-	-
[PROGram:]STEP:VOLTage:AC:SLEW:UP	+	+	-	-
[PROGram:]STEP:VOLTage:AC:SLEW:DOWN	+	+	-	-
[PROGram:]STEP:VOLTage:DC	+	+	-	-
[PROGram:]STEP:VOLTage:DC:SLEW:UP	+	+	-	-
[PROGram:]STEP:VOLTage:DC:SLEW:DOWN	+	+	-	-
[PROGram:]STEP:FREQuency	+	+	-	-
[PROGram:]STEP:FREQuency:SLEW:UP	+	+	-	-
[PROGram:]STEP:FREQuency:SLEW:DOWN	+	+	-	-
[PROGram:]STEP:WAVeform	+	+	-	-
[PROGram:]STEP:PHASe:STARt	+	+	-	-
[PROGram:]STEP:PHASe:SHIFt	+	+	-	-
[PROGram:]STEP:TTLTrg:ENABle	+	+	-	-
[PROGram:]LIST:VOLTage:AC	+	+	-	-
[PROGram:]LIST:VOLTage:AC:SLEW:UP	+	+	-	-
[PROGram:]LIST:VOLTage:AC:SLEW:DOWN	+	+	-	-
[PROGram:]LIST:VOLTage:DC	+	+	-	-
[PROGram:]LIST:VOLTage:DC:SLEW:UP	+	+	-	-
[PROGram:]LIST:VOLTage:DC:SLEW:DOWN	+	+	-	-
[PROGram:]LIST:FREQuency	+	+	-	-
[PROGram:]LIST:FREQuency:SLEW:UP	+	+	-	-
[PROGram:]LIST:FREQuency:SLEW:DOWN	+	+	-	-
[PROGram:]LIST:WAVeform	+	+	-	-
[PROGram:]LIST:PHASe:STARt	+	+	-	-
[PROGram:]LIST:PHASe:END	+	+	-	-
[PROGram:]LIST:PHASe:SHIFt	+	+	-	-
[PROGram:]LIST:DURation	+	+	-	-
[PROGram:]LIST:REPeat	+	+	-	-
[PROGram:]LIST:STEP	+	+	-	-
[PROGram:]LIST:TTLTrg:ENABle	+	+	-	-
[PROGram:]MODE:VOLTage:AC	+	+	-	-
[PROGram:]MODE:VOLTage:DC	+	+	-	-
[PROGram:]MODE:WAVeform	+	+	-	-
[PROGram:]MODE:FREQuency	+	+	-	-
[PROGram:]MODE:VOLTage:AC:SLEW	+	+	-	-
[PROGram:]MODE:VOLTage:DC:SLEW	+	+	-	-
[PROGram:]MODE:FREQuency:SLEW	+	+	-	-
[PROGram:]MODE:PHASe:STARt	+	+	-	-
[PROGram:]MODE:PHASe:END	+	+	-	-
[PROGram:]MODE:PHASe:SHIFt	+	+	-	-

Command / Function	Store/Load:AC*1	Clear:AC*2	Store/Load:DC*3	Clear:DC*4
[PROGram:]MODE:ABORt	+	+	-	-
[PROGram:]MODE:END	+	+	-	-
[PROGram:]LIST:SIZE	+	+	-	-
[PROGram:]DC:COUNter	-	-	+	+
[PROGram:]DC:LIST:DWELl	-	-	+	+
[PROGram:]DC:LIST:VOLTage	-	-	+	+
[PROGram:]DC:STEP	-	-	+	+
[PROGram:]DC:WAVE:TIME	-	-	+	+
[PROGram:]DC:WAVE:VOLTage	-	-	+	+
[PROGram:]DC:ACTivate	-	-	+	+
[PROGram:]DC:MODE:ABORt	-	-	+	+
[PROGram:]DC:MODE:END	-	-	+	+
[PROGram:]DC:LIST:SIZE	-	-	+	+

Table 13-3: Program Store, Load, and Clear Memory Functions

*1: Refers to [PROGram:]LOAD:AC and [PROGram:]STORe:AC commands.
*2: Refers to [PROGram:]CLEAr:AC command.
*3: Refers to [PROGram:]LOAD:DC and [PROGram:]STORe:DC commands.
*4: Refers to [PROGram:]CLEAr:DC command.

NOTES

[PROGram:]CLEAr:AC and [PROGram:]CLEAr:DC commands clear non-volatile memory. Volatile memory data retains until AC turn off.

Power switch does not affect non-volatile nor volatile memory.

CHAPTER 14: SCPI PROTOCOL AND COMMANDS

14.1 Introduction

The Standard Commands for Programmable Instruments (SCPI) is a set of syntax and commands that can be utilized to control programmable test and measurement devices.

NOTE

Recommended time delay between commands: 5ms minimum. Some commands or queries may require longer time. In such cases, refer to **NOTE** following the description of command or query.

14.2 Command Terminators

The command terminator indicates the end of command and is either the **Carriage Return** (CR) character (ASCII 13, 0x0D), the **Line Feed** (LF) character (ASCII 10, 0x0A), or both.

14.3 Header

Headers are instructions recognized by the power source. Headers (which are sometimes known as **keywords**) may either be in long form or short form. Consider VOLTage as an example:
Long form: The header is completely spelled out, such as VOLTAGE.
Short form: The header has only the first three or four letters, such as VOLT.
The SCPI interface is not case sensitive. It recognizes mixtures of any case. For example, VOLTAGE, VOLTage, voltAGE, voltage, VOLT, or volt are all acceptable. Combinations like VOL, vol, VOLTA, or VOLTa are not acceptable.

NOTE

Short form headers result in faster program execution.

14.4 SCPI Command Hierarchy

SCPI is an ASCII-based command language designed for use in test and measurement instruments. The command structure is organized around common roots, or nodes, which are the building blocks of the SCPI subsystems. An example of a common root is OUTPut. Some of the commands that reside in the OUTPut subsystem are:

```
OUTPut
        [:STATe] <bool>
        :PON
                [:STATe] <DSC>
        :PROTection
                :CLEar
                :FOLDback
                        [:MODE] <DSC>
```

A colon (:) is used to separate a command keyword from a lower-level keyword.

14.5 Brackets, Braces, and Bars in Commands

14.5.1 Angle Brackets <>

Expressions enclosed in angle brackets (**<>**) are programming values (parameters). Expressions are entered without the **<>**. For example, *ESE <255> is entered as *ESE 255.

14.5.2 Square Brackets []

Expressions enclosed in square brackets (**[ ]**) are optional. For example, in [SOURce:]CURRent, [SOURce:] may be omitted and the command can be written as CURRent.
In MEASure:CURRent:HARMonic[#]? <NR1>[,<DSC>], [#] and [,<DSC>] may be omitted and the command can be written as MEASure:CURRent:HARMonic? <NR1>.

14.5.3 Braces {}

Braces (**{ }**) enclose parameters within a command string. For example [PROGram:]DC:WAVE:VOLTage [#] <NRf>{,<NRf>} can be entered as DC:WAVE:VOLTage 2.0,2.5,3.0.

14.5.4 Vertical Bar |

Vertical bars (**|**) separate alternate parameters. For example, in TRIGger:SOURce BUS|EXT, BUS or EXT can be sent.

14.6 Message Parameters

The simplest SCPI command is a single message consisting of a keyword followed by a message terminator. The message may include a parameter after the keyword. The parameter may be numeric or string.
For example:

- *TRG<LF>
- CURRent 20 <LF><CR>. A blank space is required between the keyword and parameter.

14.7 Queries

Queries the current values of most commands by adding a question mark to the command.
For example:

- VOLTage?<LF>
- CURRent?<CR>

If the query contains a parameter, place the query indicator (?) and any subsequent parameter with a blank space between the query indicator and the parameter.
For example: MEASure:CURRent:HARMonic:PHASe? 20.

14.8 Multiple Commands from Different Subsystems (Concatenated)

To combine commands from different subsystems, you need to reset the command path. Beginning the command with a colon (:) discards the previous path. The following message shows commands combination from different subsystems as well as within the same subsystem.

OUTP:ENA:STATe ON;LATCh ON;POL NORM;

VOLT:AC 100;:CURR 30;:OUTP 1;

Note the use of the root specifier (:) to move between subsystems.

14.9 Data Formats

Data Formats	Description
<NR1>	Digits with an implied decimal point assumed at the right of the least significant digit. Leading 0's can be added. Example: 255, 0240
<NR2>	Digits with an explicit decimal point. Leading 0's can be added Example: .0253, 0.0222
<NR3>	Digits with an explicit decimal point and exponent. Leading 0's can be added Example: 3.3E+1, 03.5E+1
<NRf>	Extended format that includes <NR1>, <NR2>, and <NR3> Examples: 263, 263.1, 26.3E+2
<Bool>	Boolean data: examples: 0|1 or OFF|ON. Boolean parameters represent a single binary condition that is either TRUE or FALSE. i.e., for a false condition, the power source accepts **OFF** or **0**. For a true condition, the power source accepts **ON** or **1** (e.g., OUTPut OFF|ON). Any number x that holds -0.5<x<0.5 is regarded as FALSE, otherwise TRUE.
<DSC>	Discrete: discrete parameters are used to program settings that have a limited number of values (e.g., TRIGger:SOURce BUS|EXTernal). Discrete parameters have a short form and a long form, just like command keywords. Upper-case and lower-case letters can used or can be mixed. Query responses always return the short form in all upper-case letters.
<SRD>	String Response Data: a predefined format of symbolic string parameters. Example: 29920Bits/V,00000Bits,3.3459E-05Volt/Bit,-0.0016Volts
<STR>	String: string parameters are ASCII strings sent with double quotes as delimiters. Example: "Example"
<USTR>	Unquoted String: Unquoted string parameters are ASCII strings sent without double quotes as delimiters. Example: Example

14.10 Checksum

The user may optionally add a checksum to the end of the command. The checksum is **$** followed by two hex characters. Command and query can have a checksum. In the case of a query with checksum, the response will have a checksum. There is no CR between the command string and the **$** sign.

For example, the checksum for OUTP?$87 is calculated as follows:

O = 0x4F, U = 0x55, T = 0x54, P = 0x50, ? = 0x3F. 0x4F + 0x55 + 0x54 + 0X50 + 0x3F = 0x0187

Checksum is the least significant byte – 0x87.

14.11 Status, Fault, and SRQ Registers

14.11.1 SCPI Register Tree

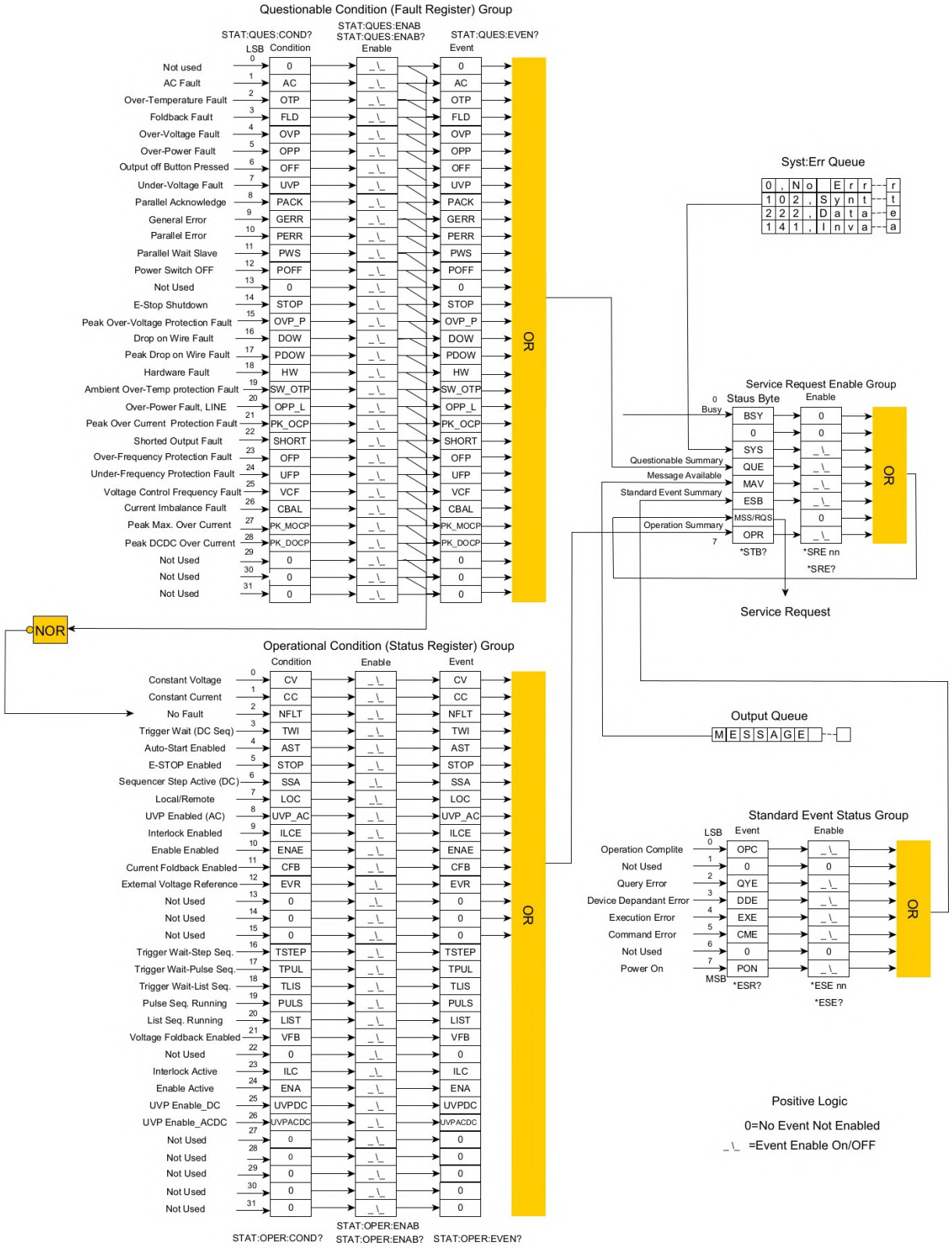


Figure 14-1: SCPI Register Tree Diagram

The SCPI register tree is shown in **Figure 14-1**.

This figure describes the structure of the following register group: Questionable Condition (Fault Register), Operational Condition (Status Register), Service Request Enable, and Standard Event Status.

In the Questionable Condition (Fault Register) and Operational Condition (Status Register) Groups:

- the Condition Registers hold a snapshot of the actual state and may change even if the registers are not read. If a change in state occurs, the corresponding bit is set in the Condition Register. If that state changes again, the corresponding bit is cleared.
- The user can set the Enable Registers to enable SRQ (Service request) if a change in state occurs.
- the Event Registers latch the state of the Condition Registers if the corresponding Enable Registers are set to logical **1**. The Event Registers remain set (latched) even if the fault event is not present, until the user reads them. Reading the register clears its values until the next event.

NOTE

The Event Register does not specify that a single condition event has occurred. In the period where an event has occurred and the user has read the value the Condition Register might change its value multiple times.

14.11.2 Questionable Condition (Fault Register) Group Structure

The Questionable Condition (Fault Register) Group contains the Condition Register, the Enable Register, and the Event Register.

Some of the faults might quickly change states (fault clears) before the controlling PC detects them. So, by enabling bits in the Enable Register, events can be stored in the Event Register; refer to **Section 14.13.9: Status Subsystem**. **Table 14-1** describes the bit configuration of the Questionable Condition (Fault Register) Group.

Bit Number	Bit Symbol	Description
0	0	Not Used
1	AC	AC Fault
2	OTP	Over-Temperature Protection Fault
3	FLD	Foldback Fault
4	OVP	Over-Voltage Protection Fault
5	OPP	Over-Power Protection Fault
6	OFF	Output-Off Button Pressed
7	UVP	Under-Voltage Protection Fault
8	PACK	Parallel Acknowledge
9	GERR	General Error
10	PERR	Parallel Error
11	PWS	Parallel Wait Slave
12	POFF	Power Switch OFF
13	0	Not Used
14	STOP	E-STOP fault
15	OVP_P	Peak Over-Voltage Protection fault
16	DOW	Drop on Wire Protection fault
17	PDOW	Peak Drop on Wire Protection fault
18	HW	Hardware Fault
19	SW_OTP	Ambient Over-Temperature Protection Fault

Bit Number	Bit Symbol	Description
20	OPP_LINE	Over-Power Protection Fault (Low line)
21	PK_OCP	Peak Over Current Protection fault
22	SHORT	Shorted Output fault
23	OFP	Over-Frequency Protection fault
24	UFP	Under-Frequency Protection fault
25	VCF	Voltage Controlled Frequency Shutdown fault
26	CBAL	Current Imbalance fault
27	PK_MOCP	Peak Maximum Over Current Shutdown
28	PK_DOCP	Peak DCDC Over Current Shutdown
29	0	Not Used
30	0	Not Used
31	0	Not Used

Table 14-1: Bit Configuration of Questionable Condition Register

14.11.3 Operational Condition (Status Register) Group Structure

The Operational Condition (Status Register) Group contains the Condition Register, the Enable Register, and the Event Register.

Some of the status might quickly change before the controlling PC detects them. By enabling bits in the Enable Register, events can be stored in the Event Register; refer to **Section 14.13.9: Status Subsystem**. **Table 14-2** describes the bit configuration of the Operational Condition (Status Register) Group.

Bit Number	Bit Symbol	Description
0	CV	Constant Voltage mode
1	CC	Constant Current mode
2	NFLT	No Fault
3	TWI	Trigger Wait (DC Sequencer)
4	AST	Auto-Start Enabled
5	STOP	E-STOP Enabled
6	SSA	Sequencer Step Active (DC Sequencer)
7	LOC	Local / Remote mode
8	UVP_AC	AC Under-Voltage Protection enabled
9	ILCE	Interlock Enabled
10	ENAE	Enable Enabled
11	CFB	Current Foldback Enabled
12	EVR	External Voltage Reference
13	0	Not Used
14	0	Not Used
15	0	Not Used
16	TSTEP	Trigger Wait for the STEP Sequencer
17	TPUL	Trigger Wait for the PULSE Sequencer
18	TLIS	Trigger Wait for the LIST Sequencer
19	PULS	PULSE sequencer is running
20	LIST	LIST sequencer is running
21	VFB	Voltage Foldback Enabled

Bit Number	Bit Symbol	Description
22	0	Not Used
23	ILC	Interlock Active
24	ENA	Enable Active
25	UVP_DC	DC Under-Voltage Protection enabled
26	UVP_ACDC	ACDC Under-Voltage Protection enabled
27	0	Not Used
28	0	Not Used
29	0	Not Used
30	0	Not Used
31	0	Not Used

Table 14-2: Bit Configuration of Operational Condition Register

14.11.4 Standard Event Status Group Structure

The Standard Event Status Group latches the error groups. This group contains the Event Register and the Enable Register. Events status might quickly change its condition before the controlling PC detects it. Events can be stored in the ESB (Standard Event Summary) bit of the Status Byte Register in the Service Request Enable Group only if the Enable Register in the Standard Event Status Group allows it. **Table 14-3** describes the bit configuration of the Standard Event Status Register Group. Event registers in the group are cleared when read; refer to *ESR? in **Section 14.12: SCPI Common Commands**. To program specific bits in the enable register, refer to *ESE in **Section 14.12: SCPI Common Commands**.

Bit Number	Bit Symbol	Description
0	OPC	Operation Complete
1	0	Not Used
2	QYE	Query Error
3	DDE	Device Dependent Error
4	EXE	Execution Error
5	CME	Command Error
6	0	Not Used
7	PON	Power ON

Table 14-3: Bit Configuration of Standard Event Status Register

OPC: Set whenever the last communication command completed its operation; the unit is ready to accept another command

QYE: Query related errors

DDE: Device dependent errors

EXE: Execution related errors

CME: Commands errors

Power ON: Set once at power up

Bit Set	Error code	Error Type	Bit Set	Error code	Error type
5 (CME)	-100 to -199	Command	3 (DDE)	-300 to -399 or 1 to 32767	Device Dependent
4 (EXE)	-200 to -299	Execution	2 (QYE)	-400 to -499	Query

Table 14-4: Standard Event Status Register Error Bits

NOTE

Bits 2, 3, 4, and 5 point to a specific group of errors. For a detailed errors list, refer to **Table 14-5**.

14.11.5 Output Queue

The output queue is a queue that stores the messages sent from the power source to the controlling PC until the message is read. The output queue is cleared at power on or by the *CLS command; refer to **Section 14.12: SCPI Common Commands**.

Whenever the queue holds a message, it sets the MAV bit of the Status Byte Register in the Service Request Enable Group**.**

14.11.6 Error Queue

The error queue holds up to 10 system error messages. The error queue acts as a FIFO (First In, First Out) queue. The first message entering the queue is the first message read by the controlling PC. To read a message, send SYSTem:ERRor?

The query returns the error number and a message if an error message is available. The format of the error message is as follows:

<Error Number><Comma><Opening Quote><Error Description<Closing Quote>

If there is no error, the query returns 0,“No error”.

If more than 10 messages are stored, the last (tenth) message is replaced with -350,“Queue Overflow”.

The error queue is cleared at power on, by the *CLS command (refer to **Section 14.12: SCPI Common Commands**), or by reading all available messages until 0,“No error” is received.

Whenever the queue holds a message, it sets the SYS bit of the Status Byte Register in the Service Request Enable Group**.**

Error Number	Error Description
0	“No error”
-100	“Command error”
-109	“Missing parameter”
-115	“Unexpected number of parameters”
-131	“Invalid suffix”
-151	"Invalid string format"
-200	“Execution error”
-220	“Parameter error”
-222	“Data out of range”
-321	"Out of memory"
-350	"Queue overflow"
-360	“Communication watchdog timeout“
-361	“Checksum error”
-363	"Input buffer overflow"

Error Number	Error Description
-365	"Message timeout"
1	"Settings loaded from EEPROM are invalid. Applying default settings"
2	"Waiting for slave unit"
3	"Advance parallel last slave missing"
4	"Advanced slave fault"
5	"General error"
6	"Parallel error: control comm"
7	"USB failure"
8	"Display failure"
9	"Wave creation failed: input wave is not built-in"
10	"Critical system fault"
11	"Invalid command in DC mode"
12	"Output buffer overflow"
13	"Interharmonics sweep currently running"
14	"Interharmonics command ignored"
15	"Fault stack overflow"
16	"Interharmonics setup failed: invalid setting"
17	"Sequencer initialization failed: PV above OPP"
18	"Sequencer initialization failed: PV out of range"
19	"Sequencer initialization failed: PV below UVL"
20	"Sequencer initialization failed: PV above OVP"
21	"Sequencer initialization failed: setup is incomplete"
22	"Sequencer currently running"
23	"Sequencer initialization failed: PV above Power Rating"
24	"Function not available"
25	"Voltage (RMS) is out of range"
26	"DC voltage rating is missing"
27	"Illegal command while device is unrated"
28	"Device property is locked"
29	"Text message contains an invalid character"
30	"Shorted output shutdown"
31	"Peak over current shutdown"
32	"Over power on low line shutdown"
33	"Over frequency shutdown"
34	"Peak over voltage shutdown"
35	"Under frequency shutdown"
36	"RMS Drop-On-Wire shutdown"
37	"VCF shutdown"
38	"Over power shutdown"
39	"Current imbalance"
40 (*)	"Hardware fault"
41	"Internal communication error"
42	"Interlock shutdown"

Error Number	Error Description
43	"Enable shutdown"
44	"E-STOP shutdown"
45	"Peak PV out of range"
46	"PV above OVP"
47	"PV above peak OVP"
48	"PV below UVL"
49	"PV above OPP"
50	"PV above power rating"
51	"OVP below PV"
52	"Peak OVP below PV"
53	"On during fault"
54	"UVL Above PV"
55	"OPP below PV"
56	"OPP below CP level"
57	"PC above OPP"
58	"PC above power rating"
59	Ambient OTP shutdown"
60	"Balancing failure"
61	"Peak Drop-On-Wire shutdown"
62	"AC shutdown"
63	"OTP shutdown"
64	"Fold-Back shutdown"
65	"Over voltage shutdown"
66	"Output-Off shutdown"
67	"UVP shutdown"
68	"Power OFF"
69	"System setup required"
70	"Booster mode"
71	"Cannot delete built-in wave"
72	"Cannot overwrite built-in wave"
73	"Cannot overwrite active wave"
74	"Cannot delete wave that is present in step sequencer settings"
75	"Read/Write to EEPROM failed"
76	"Cannot delete wave that is present in pulse sequencer settings"
77	"Cannot delete wave that is present in list sequencer settings"
78	"Cannot overwrite wave that is present in initiated step sequencer"
79	"Cannot overwrite wave that is present in initiated pulse sequencer"
80	"Cannot overwrite wave that is present in initiated list sequencer"
81	"Failed to load program: data is empty"
82	"EEPROM file has invalid checksum"
83	"Wave point is outside [-1,1] range"
84	"Wave region is corrupt"
85	"Too few points in wave"
86	"Peak OVP upper bound cannot be less than lower bound"

Error Number	Error Description
87	"Peak OCP upper bound cannot be less than lower bound"
88	"Phase not applicable"
89	"Command ignored: AC fault is active"
90	"Invalid command while output is on"
91	"Wave points are too small"
92	"Cannot delete active wave"
93	"Invalid calibration command sequence"
94	"Previous operation is in progress"
95	"Wave with same name already exists"
96	"Wave name contains an illegal character"
97	"Wave name is too long"
98	"Wave not found"
99	"Wave storage space is full"
100	"Too many dimensions"
101	"Internal checksum error"
102	"Parallel Error"
103	"Waiting for slaves"
104	"Number of units mismatch"
105	"Temperature sensor failure"
106	"LED driver failure"
107	"Empty profile: unable to load"
108	"Firmware is not compatible"
109	"Peak maximum over current shutdown"
110	"Peak DCDC over current shutdown"
111	"Invalid phase number"
112	"Analog programming change while output ON"
114	"Option card not detected"
32767	"Unknown error"

Table 14-5: SCPI Error Messages

(*) The following faults can occur if "Hardware fault" is returned in the error queue.

DAC failure
Output voltage measurement failure
Startup failure
DCDC failure
COMM failure
Latch signals disabled
Fan failure
Global Shutdown
DCAC OVP

Table 14-6: Hardware Faults

14.11.7 Service Request Enable Group Structure

The Service Request Enable Group summarizes the events of the Questionable Condition (Fault Register) Group, the Standard Event Status Group, and the Operational Condition (Status Register) Group, only if those events are enabled. This group also contains a busy bit, a message available bit, and a service request bit. The Status Byte Register of the group can be read with the *STB? Command; refer to **Section 14.12: SCPI Common Commands**. The *CLS command clears the Enable Register. **Table 14-7** describes the bit configuration of the Service Request Enable Group.

Bit Number	Bit Symbol	Description
0	BSY	System is busy (Busy bit)
1	0	Not used
2	SYS	System error message available
3	QUE	Questionable Condition Group summary event
4	MAV	Message available in output queue
5	ESB	Standard Event Status Group summary event
6	MSS/RQS	Service request
7	OPR	Operation Condition Group summary event

Table 14-7: Service Request Enable Register

BSY: the system is busy.
SYS: system error message available. Refer to **Section 14.11.6: Error Queue** to read the available error messages.
QUE: Questionable Condition Group summary event. Refer to **Section 14.11.2: Questionable Condition (Fault Register) Group Structure** to determine which fault has occurred.
MAV: message available.
ESB: Standard Event Status Group summary event. Refer to **Section 14.11.4: Standard Event Status Group Structure** to determine which event has occurred.
RQS: Service request. Whenever the power source requests service, it latches the service request into the service request bit. When the controlling PC services the interrupt, the service request bit is cleared.
OPR: Operational Condition Group summary event. Refer to **Section 14.11.3: Operational Condition (Status Register) Group Structure** to determine which status has changed.

14.11.8 Determining the Cause of a Service Interrupt

A service request (SRQ) is set if the contents of at least one of the Event Registers have changed (from logical **0** to logical **1**). To determine the reason for an SRQ, perform the following actions:

1. Poll with *STB? to determine which bits are active in the Service Request Enable Status Byte.
2. Read the corresponding Event Register of each summary group to determine which events caused the summary bit to be set. When an Event Register is read, it is cleared. This action also clears the corresponding summary bit.

The interrupt re-occurs until the specific condition that caused the event is removed. If this is not possible, the event may be disabled by programming the corresponding bit of any of the status group Enable Registers.
A faster way to prevent the interrupt is to disable the service request by programming the appropriate bit of the Service Request Enable Register.

14.12 SCPI Common Commands

Common commands begin with an * and consist of three letters while queries append a question mark (?) to this format. Common commands are defined by the IEEE 488.2 standard to perform common interface functions.

ABORt

Function	Cancels any sequencer actions in progress. It returns the trigger system to an idle state. The TWI,SSA,TSTEP,TPUL,TLIS,PULS and LIST bits in the Condition Register in the Operational Condition (Status Register) Group are cleared after ABORt is sent.

*CLS

Function	Performs the following actions over the register tree: • clears the Event Register of the following: Standard Event Status Group, Operation Condition (Status Register) Group, and Questionable Condition (Fault Register) Group • clears the Status Byte • clears the Error Queue • clears the Output Queue

*ESE <NR1>

Function	Sets the value of the Enable Register in the Standard Event Status Group. This register determines which events of the Event Register are allowed to set the Standard Event Summary Bit (ESB) of the Status Byte Register in the Service Request Enable Group. **1** in the bit position enables the corresponding event. All the enabled events of the Event Register in the Standard Event Status Group are logically OR-ed to cause the Event Summary Bit (ESB) of the Status Byte Register in the Service Request Enable Group to be set. Use *PSC to clear the Enable Register in the Standard Event Status Group at AC power on. It cannot be cleared using *CLS.
Parameter	0–255
Query	*ESE? Returns the decimal value of the Enable Register in the Standard Event Status Group, which corresponds to the binary-weighted sum of all bits set in the Enable Register.
Return	<NR1>

ESE Register Bit Configuration

Bit Position	7	6	5	4	3	2	1	0
Bit Name	PON	0	CME	EXE	DDE	QYE	0	OPC

PON: Power On, **CME**: Command Error, **EXE**: Execution Error, **DDE**: Device Dependent Error, **QYE**: Query Error, **OPC**: Operation Complete.

0: Not Used

*ESR?

Function	Returns the value of the Event Register in the Standard Event Status Group. The event register is a read-only register that stores (latches) all standard events. The bit configuration of the Event Register is as follows:

Position	7	6	5	4	3	2	1	0
Name	PON	0	CME	EXE	DDE	QYE	0	OPC

PON: Power ON
Set to **1** when power is ON. Set once at power up.
CME: Command Error
Set to **1** when command syntax is incorrect.
EXE: Execution Error
Set to **1** when command syntax is correct, but the command cannot be executed in the current state (i.e., parameters are outside the setting range).
DDE: Device Dependent Error
Set to **1** when command execution is not possible due to an internal problem in the instrument that is not related to a command error or an execution error.
QYE: Query Error
Set to **1** if the output queue is empty or if the data is missing even after a query has been sent.
OPC: Operation Complete.
0: Not Used

Once a bit is set in the Event Register, it remains set until it is cleared by sending *ESR? or *CLS.

Return	<NR1>

*IDN?

Function	Returns a unique power source identification code. The unique identification code is a string that is separated by three " ," (commas). The string includes (in order): manufacturer, model identification code, serial number, and firmware revisions of the interface.
Return	<SRD>
Example	TDK-LAMBDA,GAC-PRO-03AA1C-07H00A,1234567-1234,001.000.000

*OPC

Function	Sets the Operation Complete bit (bit 0) of the Event Register in the Standard Event Status Group on the completion of the current operation.
Query	*OPC? This query returns **1** to the output buffer after all pending commands are completed.
Return	<Bool>

NOTE

Commands cannot be executed until this command completes.

*OPT?

Function	Returns the type of the optional card installed.
Return	<SRD> **0**: No Option Installed **1**: GPIB

*PSC <Bool>

Function	The power ON Status Clear (PSC) command controls the automatic clearing of the Enable Register in the Service Request Enable Group, the Enable Register in the Standard Event Status Group, and the Device Specific Event Enable Registers at power ON.
Parameter	0|1, OFF|ON **0, OFF**: Disables the clearing of the above registers at power ON. **1, ON**: Enables the clearing of the above registers at power ON. This is the default state.
Query	*PSC?
Return	<Bool>

*RCL [<NR1>]

Function	Restores the power source to a state that is stored in memory locations 1–4. These states were previously stored with the *SAV [<NR1>] command or from the front panel (refer to **Section 9.4.6: System Menu)**. Refer to **Table 13-1** for the restored parameters.
Parameter	1–4

NOTES

*RCL without a parameter restores the power source to a state that was stored in memory location 1.

The command can be executed at output OFF only.

The execution of this command may take up to 2 seconds.

*RST

Function	Executes reset; refer to **Table 13-1** (Reset column).

NOTE

The execution of this command may take up to 0.5 seconds.

*SAV [<NR1>]

Function	Saves the state of the power source to a specific memory location; refer to **Table 13-1** for the saved parameters (RECALL and PON Profile column).
Parameter	1–4

NOTE

*SAV without a parameter stores the state of the power source in memory cell 1.

***SRE <NR1>**

Function	Sets the value of the Enable Register in the Service Request Enable Group. This register determines which bits of the Status Byte Register are allowed to set the Request for Service (RQS) summary bit. A **1** in any bit position of the Enable Register enables the corresponding bit in the Status Byte Register. All the enabled bits in the Status Byte Register are logically OR-ed to determine the state of the RQS bit in the Status Byte Register.
Parameter	0–255
Query	*SRE?
Return	<NR1>

SRE register bit configuration

Bit Position	7	6	5	4	3	2	1	0
Bit Name	OPR	0	ESB	MAV	QUE	SYS	0	0

OPR: Operation Condition (Status Register) Group summary, **ESB**: Standard Event Status Group summary, **MAV**: Output Queue Message available, **QUE**: Questionable Condition (Fault Register) Group summary, **SYS**: System Error Queue Message available, **0**: Not Used.

***STB?**

Function	Returns the value of the Status Byte Register in the Service Request Enable Group. Reading the Status Byte Register clears the QUE, ESB, and OPR bits.

Position	7	6	5	4	3	2	1	0
Name	OPR	MSS/ RQS	ESB	MAV	QUE	SYS	0	BSY

OPR: Operation Condition (Status Register) Group summary
MSS/RQS: Request Service
ESB: Standard Event Status Group summary
MAV: Output Queue Message available
QUE: Questionable Condition (Fault Register) Group summary
SYS: The System Error query is not empty
BSY: The operation is not complete
0: Not Used

Return	<NR1>

***TRG**

Function	Generates a trigger for the sequencer subsystem. This command is relevant only if BUS is selected as the trigger source.

NOTES

The command activates the sequencer with a delay. Refer to TRIGger:DELay <NRf> in **Section 14.13.11: TRIGger Subsystem** to set the delay with a communication command. Refer to **Section 9.4.9: Program Menu** to set the delay from the front panel.

Use TRIGger[:IMMediate] from **Section 14.13.11: TRIGger Subsystem** or use trigger from the front panel (refer to **Section 9.4.9: Program Menu**) to override the delay setting.

***TST?**

Function	Self-test query. If one or more tests fail, **1** is returned. The error is stored in the error queue.
Return	<Bool>

***WAI**

Function	Configures the instrument to wait for all pending operations to complete before executing any additional commands over the interface.

14.13 SCPI Subsystem Commands

Subsystem commands are specific to power source functions. These can be a single command or a group of commands. Groups are comprised of commands that extend one or more levels below the root.

NOTES

used in command and queries is the phase number and it ranges from 1 to 3.

In a single-phase system, # is optional. In a multi-phase system, if # is not used with a command, the command is sent to all the phases. If # is not used with a query, only phase 1 replies.

NOTE

All queries are returned without leading zeroes. For example, if the query format is 4.1f, and the measured frequency is 50.1, the queried value is 50.1 and not 0050.1

14.13.1 Display Subsystem

NOTE

When a display command is sent to a power source without a display, it is ignored and no error is generated. If a display setting is queried on a power source without a display, the default setting value is returned.

DISPlay[:WINDow]:BRIGhtness[#] <NR1>

Function	Sets the brightness of the display
Parameter	1–100
Unit	%
Query	DISPlay[:WINDow]:BRIGhtness[#]?
Return	<NR1>

DISPlay[:WINDow]:DIMMing:BRIGhtness[#] <NR1>

Function	Sets the brightness of the display at dimming state
Parameter	0–100
Unit	%
Query	DISPlay[:WINDow]:DIMMing:BRIGhtness[#]?
Return	<NR1>

NOTE

Setting a parameter of 0 blanks the display at dimming state.

DISPlay[:WINDow]:DIMMing:DELay[#] <NR1>

Function	Disables the dimming, or enables the dimming and sets the delay for dimming the front panel display
Parameter	-1|5–3600 **-1**: disables the dimming of the display **5–3600**: enables the dimming of the display and set the delay between 5 and 3600
Unit	s
Query	DISPlay[:WINDow]:DIMMing:DELay[#]?
Return	<NR1>

NOTE

If the dimming option is disabled, the brightness of the display returns to its original level (set with DISPlay[:WINDow]:BRIGhtness[#] <NR1> or set from the front panel (refer to **Section 9.4.7: Display Menu**).

DISPlay[:WINDow]:FLASh[#] <Bool>

Function	Flashes the display
Parameter	0|1 or OFF|ON
Query	DISPlay[:WINDow]:FLASh[#]?
Return	<Bool>

NOTES

In the case of a single phase, the flashing can also be stopped if any of the following actions are carried out on the System Master:

1. Any button on the front panel is pressed
2. The display is tapped
3. An AC recycle
4. The power switch is turned OFF and then ON. A minimum interval of five seconds is required at the power switch OFF state.

In the case of multiple phases, if any phase units other than the units on the System Master phase are flashed using the command, the flashing can be stopped with the command or if any of the following actions are carried out on the System Master:

1. Using the front panel display (refer to **Section 9.4.7: Display Menu**). Under **Flash menu,** select the required phase and click **Start.**
2. An AC recycle
3. The power switch is turned OFF and then ON. A minimum interval of five seconds is required at the power switch OFF state.

DISPlay[:WINDow]:IDLE:TIMeout[#] <NR1>

Function	Sets the display timeout. If the user has not touched the display's touchscreen or one of the buttons for the time specified by the timeout interval, the display returns to the dashboard screen.
Parameter	5–3600
Unit	s
Query	DISPlay[:WINDow]:IDLE:TIMeout[#]?
Return	<NR1>

DISPlay[:WINDow]:LANGuage[#] <DSC>

Function	Sets the display language
Parameter	CHI|DEU|ENG|FRA|JPN|KOR|SPA CHI (Chinese), DEU (German), ENG (English), FRA (French), JPN (Japanese), KOR (Korean) and SPA (Spanish).
Query	DISPlay[:WINDow]:LANGuage[#]?
Return	<DSC>

NOTE

Some content such as abbreviations and fault messages is always displayed in English.

DISPlay[:WINDow]:LOCK:STATe?

Function	Indicates if the front panel is locked or unlocked
Return	<Bool>

DISPlay[:WINDow]:MODE[#] <DSC>

Function	Sets the type of contents to be displayed on the dashboard
Parameter	NORMal|TEXT **NORMal**: displays the normal (standard) content **TEXT**: displays a text message set with DISPlay[:WINDow]:TEXT[#] <STR>
Query	DISPlay[:WINDow]:MODE[#]?
Return	<DSC>

NOTE

If the user touches the dashboard of the System Master in a single-phase or a multi-phase unit while a text message is displayed (**TEXT** mode), the display enters the settings menu.

DISPlay[:WINDow]:PIN:CODE:STATe[#]?

Function	Indicates if a **PIN** code has been set to lock the display
Return	<Bool>

NOTES

The PIN code can only be set using the display menu; refer to **Section 9.4.7: Display Menu**.

The PIN code can be reset using SYSTem:FRST [<DSC>]; refer to **Section 14.13.10: System Subsystem**.

DISPlay[:WINDow][:STATe][#] <Bool>

Function	• Sets the display (including the backlight) to ON or OFF • Enables or disables the front panel buttons
Parameter	0|1 or OFF|ON **0, OFF**: front panel display turns OFF. Disables the front panel buttons. **1, ON**: front panel display turns ON. Enables the front panel buttons.
Query	DISPlay[:WINDow][:STATe][#]?
Return	<Bool>

NOTES

The OUT led always remains lit (if the power source output is ON) even if the front panel display is turned OFF.

The power switch is always active, irrespective of this command.

If the display (including the backlight) is in the OFF state, it reverts to the ON state after an AC recycle or if the power switch was turned OFF and then ON. A minimum interval of five seconds is required at the power switch OFF state.

If the buttons are in the disabled state, they will revert to the enabled state after an AC recycle or if the power switch was turned OFF and then ON. A minimum interval of five seconds is required at the power switch OFF state

DISPlay[:WINDow]:TEST[#] <Bool>

Function	All the pixels on the display are turned ON or normal display is displayed
Parameter	0|1 or OFF|ON **0, OFF**: normal display **1, ON**: all pixels are turned ON (white color, 100% brightness)
Query	DISPlay[:WINDow]:TEST[#]?
Return	<Bool>

NOTES

In the case of a single phase, the test can also be disabled if any of the following actions are carried out on the System Master:

1. Any button on the front panel is pressed
2. The display is tapped
3. An AC recycle
4. The power switch is turned OFF and then ON. A minimum interval of five seconds is required at the power switch OFF state.

In the case of multiple phases, if any phase units other than the units on the System Master phase are tested using the command, the testing can be disabled with the command or if any of the following actions are carried out on the System Master:

1. Use the front panel display (refer to **Section 9.4.7: Display Menu**). Under **Flash menu,** select the required phase and click **Start**.

2. An AC recycle.
3. The power switch is turned OFF and then ON. A minimum interval of five seconds is required at the power switch OFF state.

DISPlay[:WINDow]:TEXT[#] <STR>

Function	Type and display a text message
Parameter	ASCII characters string. The parameter of the command must have quotation marks. Upper-case and lower-case English letters, numbers, and special characters are allowed (i.e., characters 32 to 126 inclusively of the ASCII table). A display message begins in the top-left corner. Use \r and/or \n characters (in plain text) to control the text's location. Use \r to move to the beginning of the line without advancing to the next line. Use \n to move to the next line and at the same initial column set with DISPlay[:WINDow]:TEXT:FORMat[#]. Use \r\n to move to the beginning of the next line. If two or more sentences are to be displayed in separate lines, \n or \r\n must be between the lines (i.e., they must be part of the ASCII string). For example - "Active Test Sequence #1 Operator:\r\nOP2". If \n or \r\n are used for the second sentence individually, the second sentence overwrites the first. For example - If "OP2\r\n" is written after "Active Test Sequence #1 Operator:\r\n", OP2 overwrites Active Test Sequence #1 Operator.
Example	DISPlay:WINDow:TEXT "Active Test Sequence #1 Operator: Sam"
Query	DISPlay[:WINDow]:TEXT[#]?
Return	<USTR>
Example	Active Test Sequence #1 Operator: Sam

NOTES

The front panel display can display up to 288 characters. If the number of characters or lines is exceeded, the text message is truncated.

The number of characters displayed on each line and the total number of lines displayed depend on the font size.

If a text message exceeds the maximum number of characters in a line, the characters are automatically added to the beginning of the next line.

To display the typed text message, set the display to TEXT mode using DISPlay[:WINDow]:MODE[#] <DSC>.

DISPlay[:WINDow]:TEXT:FORMat[#] <NR1>,<NR1>[,<NR1>][,<NR1>]

Function	Sets the formatting of the text on the front panel display
Parameter	<NR1>,<NR1> [,<NR1>] [,<NR1>] The first two parameters are mandatory and specify the X and Y coordinates (in pixels) of the beginning of the text message. X varies from 0 to 479, while Y varies from 0 to 127. The third parameter is the font size, which varies from 1 to 5 and is optional. The font size is mapped to a real-world font size: 1: 14, 2: 16, 3: 18, 4: 24, 5: 40. The default is 5 (size 40). The fourth parameter is the color (input as a hexadecimal RGB code based on the HTML standard) and is optional. The default color is White. Below are a few example colors: #hFFFFFF: White, #hFF0000: Red, #hFFFF00: Yellow, #h00FF00: Green, #h00FFFF - Aqua, #h0000FF: Blue, #hFF00FF: Fuchsia. RGB codes can be obtained from any HTML color picker, e.g., W3 Schools' Color Picker HTML Color Picker (w3schools.com)*.
Example	DISPlay:WINDow:TEXT:FORMat 25,25,4,#h00ff00
Query	DISPlay[:WINDow]:TEXT:FORMat[#]?
Return	<NR1>,<NR1>,<NR1>,<NR1>
Example	25,25,4,#h00ff00

DISPlay[:WINDow]:TOUCh[#] <Bool>

Function	Enables or disables the touch panel
Parameter	0|1 or OFF|ON
Query	DISPlay[:WINDow]:TOUCh[#]?
Return	<Bool>

* W3SCHOOLS is a trademark of Refsnes Data AS.

14.13.2 Initiate Subsystem

INITiate:CONTinuous <Bool>

Function	Sets the re-initiation of the trigger
Parameter	0|1 or OFF|ON **0, OFF**: Trigger system is not initiated continuously. The trigger system must be re-initiated with INITiate for each trigger sequence. **1, ON**: Trigger is initiated continuously
Query	INITiate:CONTinuous?
Return	<Bool>

NOTE

The execution of this command may take up to 1 second.

INITiate[:IMMediate]

Function	Initiates the trigger system. If initiated, the trigger in system is active and is ready to receive a trigger signal. If not initiated, all trigger signals are ignored.

NOTES

When the power source is in the INIT (active) state, sequencer programming parameters cannot be changed. To modify parameters, first stop the sequence using ABORt (refer to **Section 14.12: SCPI Common Commands**) or abort via the front panel (refer to **Section 9.4.9: Program Menu**).

The execution of this command may take up to 1 second.

14.13.3 Instrument Subsystem

INSTrument:[N]SELect <NR1>

Function	Selects the communication address. This logic is supported for the RS485 bus (constructed by the user) only. Refer to SYSTem[:COMMunicate]:RS485:ADDRess <NR1> and SYSTem[:COMMunicate]:RS485:ADDRess:STATe <Bool> in **Section 14.13.10: System Subsystem** to set the address and enable the 485 communication with a communication command. Refer to **Section 9.4.4: Interface Menu** to set the address and enable the 485 communication from the front panel.
Parameter	0–31
Query	INSTrument:[N]SELect?
Return	<NR1>

14.13.4 Measure Subsystem

Common Measurement

MEASure:ALL[#]?

Function	Returns a list of measurements for the selected phase as a comma-separated list. The return order is: ACDC current, AC current, DC current, Maximum peak current, Minimum peak current, Crest Factor, Frequency, Active power, Apparent power, Power Factor, Reactive power, ACDC voltage, AC voltage, and DC voltage.
Return	Array of <NR2>

MEASure:ARRay:PHASe <NRf>

Function	Sets the start phase angle for the measured array returned by MEASure:CURRent:ARRay[#]? and MEASure:VOLTage:ARRay[#]?
Parameter	0–359.9
Unit	º (degree)
Query	MEASure:ARRay:PHASe?
Return	<NR2>

NOTE

In a multi-phase unit, this command sets the start phase angle for Phase 1 only. The start phase angle for all other phases is shifted relative to the start phase angle of Phase 1 by the value set with [SOURce:]PHASe:SHIFt[#] <NRf> (refer to **Section 14.13.8: Source Subsystem)** or set from the front panel (refer to **Section 9.4.8: Parallel Menu**).

MEASure:HARMonic:PERCent[:TYPE] <DSC>

Function	Sets the equation used to calculate the harmonic amplitude and THD in percentage.
Parameter	FUNDamental|TOTal FUNDamental: the percentage value is relative to the fundamental harmonic. $Harmonic\ Amplitude\ [\%] = \frac{U_k}{U_1} \cdot 100$ $THD\ [\%] = \frac{\sqrt{\sum_2^{50} U_k^2}}{U_1} \cdot 100$ TOTal: the percentage value is relative to the total harmonic spectrum. $Harmonic\ Amplitude\ [\%] = \frac{U_k}{\sqrt{\sum_0^{50} U_k^2}} \cdot 100$ $THD\ [\%] = \frac{\sqrt{\sum_2^{50} U_k^2}}{\sqrt{\sum_0^{50} U_k^2}} \cdot 100$ U_k denotes the voltage amplitude of harmonic k. U_1 denotes the fundamental harmonic. The formulas above use voltage as an example. For current, U_k is replaced by I_k.
Query	MEASure:HARMonic:PERCent[:TYPE]?
Return	<DSC>

MEASure:CURRent[:AC][#]?

Function	Returns the AC component of the measured rms output current
Return	<NR2>
Unit	A

NOTE

The measured value includes only the AC component of the waveform.

MEASure:CURRent:ACDC[#]?

Function	Returns the measured rms output current
Return	<NR2>
Unit	A

NOTE

The measured value includes the AC component and DC offset of the waveform.

MEASure:CURRent:ARRay[#]?

Function	Returns an array of the measured instantaneous output current.
Return	Array of <NR2>
Unit	A
Array Size	4096

NOTES

The first parameter in the returned string is the first measured value in time.

The returned string (4096 points) contains at least two cycles of the measured waveform.

If a query is sent during the acquisition of a set of data, the last fully measured set of data is returned.

MEASure:CURRent:CREStfactor[#]?

Function	Returns the measured Crest Factor
Return	<NR2>

MEASure:CURRent:DC[#]?

Function	Returns the DC offset of the measured output current
Return	<NR2>
Unit	A

NOTE

The measured value includes only the DC offset of the waveform.

MEASure:CURRent:HARMonic[#]? <NR1>[,<DSC>]

Function	Returns the measured rms value of the nth harmonic of the output current
Parameter	**<NR1>**: 0–50; the harmonic number. **<DSC>**: ABSolute|PERCent. This is used to express the harmonic amplitude. • **ABSolute**: displays the absolute value • **PERCent**: displays the percent value The equation used to calculate the percent value depends on MEASure:HARMonic:PERCent[:TYPE] <DSC>. The percent type can also be selected from the front panel; refer to **Section 9.4.2: Measurements Menu**.
Return	<NR2>
Unit	A

NOTES

Harmonic 0 is the DC component.

Harmonic 1 is the fundamental frequency.

If argument (<DSC>) is not given, ABSolute is used by default.

MEASure:CURRent:HARMonic:ARRay[#]? <NR1>[,<DSC>]

Function	Returns an array of the measured rms values of the selected number of harmonics of the output current
Parameter	**<NR1>**: 0–50; the harmonic number. **<DSC>**: ABSolute|PERCent. This is used to express the harmonic amplitude. • **ABSolute**: displays the absolute value • **PERCent**: displays the percent value The equation used to calculate the percent value depends on MEASure:HARMonic:PERCent[:TYPE] <DSC>. The percent type can also be selected from the front panel; refer to **Section 9.4.2: Measurements Menu**.
Return	Array of <NR2>
Unit	A
Array Size	Maximum of 51

NOTES

<NR1> defines the last harmonic number for which the value is to be returned. If <NR1> is 25, the rms value of all harmonics from 0 to 25 is returned.

Harmonic 0 is the DC component.

Harmonic 1 is the fundamental frequency.

In DC operation mode, only harmonic 0 (the DC component) is returned. Rest of the harmonics return 0 if the harmonics above harmonic 0 are queried.

If a query is sent during the acquisition of a set of data, the last fully measured set of data is returned.

If argument (<DSC>) is not given, ABSolute is used by default.

MEASure:CURRent:HARMonic:PHASe[#]? <NR1>

Function	Returns the measured phase angle of the nth harmonic of the output current
Parameter	0–50
Returns	<NR2>
Unit	º (degree)

NOTES

Harmonic 0 is the DC component.

Harmonic 1 is the fundamental frequency.

Phase angle is referenced to the fundamental harmonic component.

MEASure:CURRent:HARMonic:PHASe:ARRay[#]? <NR1>

Function	Returns an array of the measured phase angle of the selected number of harmonics of the output current
Parameter	0–50
Return	Array of <NR2>
Unit	º (degree)
Array Size	Maximum of 51

NOTES

<NR1> defines the last harmonic number for which the value is to be returned. If <NR1> is 25, the phase angle of all harmonics from 0 to 25 is returned.

Harmonic 0 is the DC component.

Harmonic 1 is the fundamental frequency.

The phase angle is referenced to the fundamental harmonic component.

If a query is sent during the acquisition of a set of data, the last fully measured set of data is returned.

MEASure:CURRent:HARMonic:THD[#]?

Function	Returns the measured total harmonic distortion of the output current
Return	<NR2>
Unit	%

NOTE

The equation used to calculate the value depends on MEASure:HARMonic:PERCent[:TYPE] <DSC>. The percent type can also be selected from the front panel; refer to **Section 9.4.2: Measurements Menu**.

MEASure:CURRent:PEAK:MAX[#]?

Function	Returns the maximum measured instantaneous output current
Return	<NR2>
Unit	A

NOTE

The instantaneous value is updated if a larger value is measured. The largest measured value is held. To reset the held value, refer to MEASure:CURRent:PEAK:RESet[#] or use the front panel (refer to **Section 9.4.2: Measurements Menu)**.

MEASure:CURRent:PEAK:MIN[#]?

Function	Returns the minimum measured instantaneous output current
Return	<NR2>
Unit	A

NOTE

The instantaneous value is updated if a smaller value is measured. The smallest measured value is held. To reset the held value, refer to MEASure:CURRent:PEAK:RESet[#] or use the front panel (refer to **Section 9.4.2: Measurements Menu)**.

MEASure:CURRent:PEAK:RESet[#]

Function	Resets the measured value (both minimum and maximum) of the instantaneous output current

NOTE

The minimum and maximum instantaneous current samples are always taken. For deleting the old samples and taking new ones, a reset command is required.

Frequency Measurement Subsystem

MEASure:FREQuency[#]?

Function	Returns the measured output frequency
Return	<NR2>
Unit	Hz

NOTES

In a multi-phase system, the frequency setting is the same for all phases; however, the frequency measurement is available for each phase.

Measured frequency is 0 if the output voltage is below 9.5V.

Power Measurement Subsystem

MEASure:POWer:ACTive[#]?

Function	Returns the measured (true/active) output power
Return	<NR2>
Unit	W

MEASure:POWer:APParent[#]?

Function	Returns the measured apparent output power
Return	<NR2>
Unit	VA

MEASure:POWer:PFACtor[#]?

Function	Returns the measured output Power Factor
Return	<NR2>

NOTE

Power Factor is the ratio of the real power to the apparent power.

MEASure:POWer:REACtive[#]?

Function	Returns the measured reactive output power
Return	<NR2>
Unit	VAR

Triggered Measurement Subsystem

MEASure:TRIGger

Function	This generates a trigger for measurements if the trigger source is set to BUS.

NOTE

MEASure:TRIGger is ignored if measurements from a previous trigger event are being acquired at that moment.

MEASure:TRIGger:CURRent:ARRay[#]?

Function	Returns an array of the measured instantaneous output current after a trigger is received.
Return	Array of <NR2>
Unit	A
Array Size	4096

NOTES

The first parameter in the returned string is the first measured value in time.

The returned string (4096 points) contains at least two cycles of the measured waveform.

If a query is sent during the acquisition of a set of data, the last fully measured set of data is returned.

MEASure:TRIGger:CURRent:HARMonic:ARRay[#]? <NR1>[,<DSC>]

Function	Returns an array of the measured rms values of the selected number of harmonics of the output current after a trigger is received.
Parameter	**<NR1>**: 0–50; the harmonic number. **<DSC>**: ABSolute|PERCent. This is used to express the harmonic amplitude. • **ABSolute**: displays the absolute value. • **PERCent**: displays the percent value. The equation used to calculate the percent value depends on MEASure:HARMonic:PERCent[:TYPE] <DSC>. The percent type can also be selected from the front panel; refer to **Section 9.4.2: Measurements Menu**.
Return	Array of <NR2>
Unit	A
Array Size	Maximum of 51

NOTES

<NR1> defines the last harmonic number for which the value is to be returned. If <NR1> is 25, the rms value of all harmonics from 0 to 25 is returned.

Harmonic 0 is the DC component.

Harmonic 1 is the fundamental frequency.

In DC operation mode, only harmonic 0 (the DC component) is returned. Rest of the harmonics return 0 if the harmonics above harmonic 0 are queried.

If a query is sent during the acquisition of a set of data, the last fully measured set of data is returned.

If argument (<DSC>) is not given, ABSolute is used by default.

MEASure:TRIGger:CURRent:HARMonic:PHASe:ARRay[#]? <NR1>

Function	Returns an array of the measured phase angle of the selected number of harmonics of the output current after a trigger is received
Parameter	0–50
Return	Array of <NR2>
Unit	º (degree)
Array Size	Maximum of 51

NOTES

<NR1> defines the last harmonic number for which the value is to be returned. If <NR1> is 25, the phase angle of all harmonics from 0 to 25 is returned.

Harmonic 0 is the DC component.

Harmonic 1 is the fundamental frequency.

The phase angle is referenced to the fundamental harmonic component.

If a query is sent during the data acquisition of a new set of data, the last fully measured set of data is returned.

MEASure:TRIGger:DATA:READy?

Function	Returns the **data ready** flag status. This flag indicates the status of the acquisition and if the data is ready for the user.
Return	<Bool>

NOTE

The **data ready** flag remains at **1** even if the data was acquired by the user. It is recommended to reset the **data ready** flag before reading the next set of data.

MEASure:TRIGger:DATA:READy:RESet

Function	Resets the **data ready** flag

NOTES

If MEASure:TRIGger:DATA:READy? is used to determine if measurement data is ready to be queried, it is recommended to reset the **data ready** flag before reading every set of data.

If the **data ready** flag is not reset, the same set of data is read.

MEASure:TRIGger:DELay <NRf>

Function	Sets a delay for triggered measurement. It is the time between the trigger event from a specified trigger source to the start of any corresponding measurements. This is valid for all trigger sources: BUS, EXT (external), and INT (internal).
Parameter	0–3600
Unit	s
Query	MEASure:TRIGger:DELay?
Return	<NR2>

NOTE

Trigger delay is relative to phase 1 in a multi-phase unit.

MEASure:TRIGger:IMMediate

Function	This generates a trigger for measurements without any delay if the trigger source is set to BUS.

NOTE

This command overrides the trigger delay and activates the trigger immediately.

MEASure:TRIGger:SOURce <DSC>

Function	Selects the trigger source for measurements
Parameter	BUS|EXTernal|INTernal **BUS**: use command (MEASure:TRIGger, MEASure:TRIGger:IMMediate), or front panel. **EXTernal**: use rear panel Trigger In #2 pin (J4-22). **INTernal**: internal trigger that can only be triggered by the sequencer if OUTPut:TTLTrg:MODE[#] <DSC> is set to TRIG and if at least one of the sequencer programs has enabled its output trigger (refer to [PROGram:]STEP:TTLTrg:ENABle[#],

	[PROGram:]PULSe:TTLTrg:ENABle[#], and [PROGram:]LIST:TTLTrg:ENABle[#] in **Section 14.13.7: Program Subsystem**).
Query	MEASure:TRIGger:SOURce?
Return	<DSC>

MEASure:TRIGger:SYNC:ENABle <Bool>

Function	Enables or disables the synchronization of the measurement trigger
Parameter	0|1 or OFF|ON **0, OFF**: disables the synchronization **1, ON**: enables the synchronization
Query	MEASure:TRIGger:SYNC:ENABle?
Return	<Bool>

MEASure:TRIGger:SYNC:PHASe <NRf>

Function	Sets the synchronization phase angle of the measurement trigger
Parameter	0–359.9
Unit	º (degree)
Query	MEASure:TRIGger:SYNC:PHASe?
Return	<NR2>

NOTE

In a multi-phase system, this command only sets the triggering phase angle of Phase 1. The triggering phase angle of all other phases is shifted relative to the phase angle of Phase 1 by the value set with [SOURce:]PHASe:SHIFt[#] <NRf> (refer to **Section 14.13.8: Source Subsystem**) or set from the front panel (refer to **Section 9.4.8: Parallel Menu)**.

MEASure:TRIGger:VOLTage:ARRay[#]?

Function	Returns an array of the measured instantaneous output voltage after a trigger is received.
Return	Array of <NR2>
Unit	V
Array Size	4096

NOTES

The first parameter in the returned string is the first measured value in time.

The returned string (4096 points) contains at least two cycles of the measured waveform.

If a query is sent during the data acquisition of a new set of data, the last fully measured set of data is returned.

MEASure:TRIGger:VOLTage:HARMonic:ARRay[#]? <NR1>[,<DSC>]

Function	Returns an array of the measured rms values of the selected number of harmonics of the output voltage after a trigger is received.
Parameter	**<NR1>**: 0–50; the harmonic number. **<DSC>**: ABSolute|PERCent. This is used to express the harmonic amplitude. • **ABSolute**: displays the absolute value. • **PERCent**: displays the percent value. The equation used to calculate the percent value depends on MEASure:HARMonic:PERCent[:TYPE] <DSC>. The percent type can also be selected from the front panel; refer to **Section 9.4.2: Measurements Menu**.
Return	Array of <NR2>
Unit	V
Array Size	Maximum of 51

NOTES

<NR1> defines the last harmonic number for which the value is to be returned. If <NR1> is 25, the rms value of all harmonics from 0 to 25 is returned.

Harmonic 0 is the DC component.

Harmonic 1 is the fundamental frequency.

In DC operation mode, only harmonic 0 (the DC component) is returned. Rest of the harmonics return 0 if the harmonics above harmonic 0 are queried.

If a query is sent during the data acquisition of a new set of data, the last fully measured set of data is returned.

If argument (<DSC>) is not given, ABSolute is used by default.

MEASure:TRIGger:VOLTage:HARMonic:PHASe:ARRay[#]? <NR1>

Function	Returns an array of the measured phase angle of the selected number of harmonics of the output voltage after a trigger is received
Parameter	0–50
Return	Array of <NR2>
Unit	º (degree)
Array Size	Maximum of 51

NOTES

<NR1> defines the last harmonic number for which the value is to be returned. If <NR1> is 25, the phase angle of all harmonics from 0 to 25 is returned.

Harmonic 0 is the DC component.

Harmonic 1 is the fundamental frequency.

The phase angle is referenced to the fundamental harmonic component.

If a query is sent during the data acquisition of a new set of data, the last fully measured set of data is returned.

Voltage Measurement Subsystem

MEASure:VOLTage[:AC][#]?

Function	Returns the AC component of the measured rms output voltage
Return	<NR2>
Unit	V

NOTE

The measured value includes only the AC component of the waveform.

MEASure:VOLTage:ACDC[#]?

Function	Returns the measured rms output voltage
Return	<NR2>
Unit	V

NOTE

The measured value includes the AC component and DC offset of the waveform.

MEASure:VOLTage:ARRay[#]?

Function	Returns an array of the measured instantaneous output voltage
Return	Array of <NR2>
Unit	V
Array Size	4096

NOTES

The first parameter in the returned string is the first measured value in time.

The returned string (4096 points) contains at least two cycles of the measured waveform.

If a query is sent during the acquisition of a set of data, the last fully measured set of data is returned.

MEASure:VOLTage:DC[#]?

Function	Returns the DC offset of the measured output voltage
Return	<NR2>
Unit	V

NOTE

The measured value includes only the DC offset of the waveform.

MEASure:VOLTage:HARMonic[#]? <NR1>[,<DSC>]

Function	Returns the measured rms value of the nth harmonic of output voltage
Parameter	**<NR1>**: 0–50; the harmonic number. **<DSC>**: ABSolute|PERCent. This is used to express the harmonic amplitude. • **ABSolute**: displays the absolute value • **PERCent**: displays the percent value The equation used to calculate the percent value depends on MEASure:HARMonic:PERCent[:TYPE] <DSC>. The percent type can also be selected from the front panel; refer to **Section 9.4.2: Measurements Menu**.
Return	<NR2>
Unit	V

NOTES

Harmonic 0 is the DC component.

Harmonic 1 is the fundamental frequency.

If no argument (<DSC>) is given, ABSolute is used by default.

MEASure:VOLTage:HARMonic:ARRay[#]? <NR1>[,<DSC>]

Function	Returns an array of the measured rms values of the selected number of harmonics of the output voltage
Parameter	**<NR1>**: 0–50; the harmonic number. **<DSC>**: ABSolute|PERCent. This is used to express the harmonic amplitude. • **ABSolute**: displays the absolute value. • **PERCent**: displays the percent value. The equation used to calculate the percent value depends on MEASure:HARMonic:PERCent[:TYPE] <DSC>. The percent type can also be selected from the front panel; refer to **Section 9.4.2: Measurements Menu**.
Return	Array of <NR2>
Unit	V
Array Size	Maximum of 51

NOTES

<NR1> defines the last harmonic number for which the value is to be returned. If <NR1> is 25, the rms value of all harmonics from 0 to 25 is returned.

Harmonic 0 is the DC component.

Harmonic 1 is the fundamental frequency.

In DC operation mode, only harmonic 0 (the DC component) is returned. Query for the rest of the harmonics return 0 if the harmonics above harmonic 0 are queried.

If a query is sent during the acquisition of a set of data, the last fully measured set of data is returned.

If argument (<DSC>) is not given, ABSolute is used by default.

MEASure:VOLTage:HARMonic:PHASe[#]? <NR1>

Function	Returns the measured phase angle of the nth harmonic of the output voltage
Parameter	0–50
Return	<NR2>
Unit	º (degree)

NOTES

Harmonic 0 is the DC component.

Harmonic 1 is the fundamental frequency.

Phase angle is referenced to the fundamental harmonic component.

MEASure:VOLTage:HARMonic:PHASe:ARRay[#]? <NR1>

Function	Returns an array of the measured phase angle of the selected number of harmonics of the output voltage
Parameter	0–50
Return	Array of <NR2>
Unit	º (degree)
Array Size	Maximum of 51

NOTES

<NR1> defines the last harmonic number for which the value is to be returned. If <NR1> is 25, the phase angle of all harmonics from 0 to 25 is returned.

Harmonic 0 is the DC component.

Harmonic 1 is the fundamental frequency.

The phase angle is referenced to the fundamental harmonic component.

If a query is sent during the acquisition of a set of data, the last fully measured set of data is returned.

MEASure:VOLTage:HARMonic:THD[#]?

Function	Returns the measured total harmonic distortion of the output voltage
Return	<NR2>
Unit	%

NOTE

The equation used to calculate the value depends on MEASure:HARMonic:PERCent[:TYPE] <DSC>. The percent type can also be selected from the front panel; refer to **Section 9.4.2: Measurements Menu**.

14.13.5 Output Subsystem

OUTPut:ECO[:MODE][:ENABle] <Bool>

Function	Sets the power source in ECO mode
Parameter	0|1 or OFF|ON **0, OFF**: energy saving is disabled and allows the fastest OFF to ON transition. **1, ON**: energy saving (ECO mode) is fully enabled. In this mode, most of the internal energy conversion circuits are disabled, allowing maximal energy savings and quiet operation of the power source in the output OFF state. The output OFF to ON transition is significantly slower.
Query	OUTPut:ECO[:MODE][:ENABle]?
Return	<Bool>

NOTES

The speed of the output OFF to ON transition is dependent on the setting of the ECO mode. The transition time is as follows-ECO OFF Mode: <100ms, ECO ON Mode:<2s.

Transition time is measured from the time the output ON command is sent to the time the output relays are enabled.

If ECO mode is enabled, the fans are turned off, and the front panel display shows a small leaf that indicates that the power source is in ECO mode.

For a 3-phase 400V input, the power source is turned off immediately, if the AC input is disconnected. If the unit has a display, an “AC Shutdown” message may not be shown, but the last settings are saved.

OUTPut:ENA:LATCh[:STATe] <Bool>

Function	Enables or disables the latch function of the ENA signal.
Parameter	0|1 or OFF|ON **0, OFF**: latch function is disabled **1, ON**: latch function is enabled. If power source output is disabled by the ENA signal, it is latched. Refer to the NOTE in **Section 11.10.4: ENABLE IN Latch** to recover from a latched condition.
Query	OUTPut:ENA:LATCh[:STATe]?
Return	<Bool>

OUTPut:ENA:POLarity[:STATe] <DSC>

Function	Sets the polarity of the ENA signal. Refer to **Section 11.10: ENABLE IN (ENA) (J4-10)**.
Parameter	REV|NORM **REV**: output is ON if the ENA pin signal is high **NORM**: output is ON if the ENA pin signal is low
Query	OUTPut:ENA:POLarity[:STATe]?
Return	<DSC>

OUTPut:ENA[:STATe] <Bool>

Function	Enables or disables the ENA function. Refer to **Section 11.10: ENABLE IN (ENA) (J4-10)**.
Parameter	0|1 or OFF|ON **0, OFF**: ENA function is disabled and power source ignores the signal on ENA pin and ENA polarity command. **1, ON**: ENA function is enabled and power source acts according to the signal on ENA pin and ENA polarity command.
Query	OUTPut:ENA[:STATe]?
Return	<Bool>

OUTPut:ESTOp:LATCh[:STATe] <Bool>

Function	Enables or disables the latch function of the E-STOP (Emergency Power OFF) signal. Refer to **Section 12.2: Types of Faults and Protective Functions**.
Parameter	0|1 or OFF|ON **0, OFF**: latch function is disabled **1, ON**: latch function is enabled. If power source output is disabled by the ESTOp signal, it is latched.
Query	OUTPut:ESTOp:LATCh[:STATe]?
Return	<Bool>

OUTPut:ESTOp[:STATe] <Bool>

Function	Enables or disables the E-STOP (Emergency Power OFF) function. Refer to **Section 8.5: Emergency Power OFF (EPO) Connector (J5)**.
Parameter	0|1 or OFF|ON **0, OFF**: E-STOP function is disabled, and power source ignores the signal on E-STOP pin **1, ON**: E-STOP function is enabled and power source acts according to signal on ESTOP pin
Query	OUTPut:ESTOp[:STATe]?
Return	<Bool>

OUTPut:FUNCtion:PRIOrity <DSC>

Function	Sets the priority of the operation mode when OUTPUT is set to ON.
Parameter	CV|CC
Query	OUTPut:FUNCtion:PRIOrity?

NOTES

Setting cannot be performed when the output is ON.

This command is available from firmware version 001.006.000 onwards.

OUTPut:ILC:LATCh[:STATe] <Bool>

Function	Enables or disables the latching of the ILC signal.
Parameter	0|1 or OFF|ON **0, OFF**: latch function is disabled **1, ON**: latch function is enabled. If power source output is disabled by the ILC signal, it is latched. Refer to the NOTE in **Section 11.11.3: INTERLOCK Latch** to recover from a latched condition.
Query	OUTPut:ILC:LATCh[:STATe]?
Return	<Bool>

OUTPut:ILC[:STATe] <Bool>

Function	Enables or disables the ILC function. Refer to **Section 11.11: INTERLOCK IN (ILC) (J4-19).**
Parameter	0|1 or OFF|ON **0, OFF**: ILC function is disabled and power source ignores the signal on ILC pin **1, ON**: ILC function is enabled and power source acts according to the signal on ILC pin
Query	OUTPut:ILC[:STATe]?
Return	<Bool>

OUTPut:MODE?

Function	Returns the operating mode of the power source If the power source output is OFF, **OFF** is returned. • **CV** is returned if the power source is in Constant Voltage mode. • **CC** is returned if the power source is in Constant Current mode.
Return	<DSC>

NOTE

In a multi-phase unit, CC is returned if at least one phase is in CC mode.

OUTPut:PHASe:ON <NRf>

Function	Sets the start phase angle of the output waveform when the output is turned on or when switching the immediate (IMMediate) wave with the output already on. If the value of the start phase is-1, the start phase feature is disabled. In this case: • the start phase angle is 0° when the output is turned on. • when changing waves, the start phase angle of the output wave is equal to the end phase angle of the previous output wave.
Parameter	-1|0–359.9
Unit	º (degree)
Query	OUTPut:PHASe:ON?
Return	<NR2>

NOTES

Sync enable can be enabled to activate the synchronization of the phase angle when switching the active wave. Refer to [FUNCtion:]WAVeform[:ACTivate]:SYNC:ENABle[#] <Bool> in **Section 14.13.6: Function Subsystem** to activate the sync with a communication command. Refer to **Section 9.4.5: Configuration Menu** to activate the sync from the front panel.

In a multi-phase unit, this command sets the ON phase angle of Phase 1 only. The ON phase angle of all other phases is shifted relative to the ON phase angle of Phase 1 by the value set with [SOURce:]PHASe:SHIFt[#] <NRf> (refer to **Section 14.13.8: Source Subsystem)** or set from the front panel (refer to **Section 9.4.8: Parallel Menu)**.

Typical Examples:

1. ON phase @ 45°



2. ON Phase disabled; ON phase @ 0°



OUTPut:PHASe:OFF <NRf>

Function	Sets the end phase angle of the output waveform. After receiving the output OFF command, the power source waits until the specified end phase angle is reached before turning the output off. The value of the end phase angle is also the phase angle at which the immediate (IMMediate) output wave stops before the sequencer starts running. If the value of the end phase is -1, the output wave stops immediately (at any angle) before turning off the output or before running the sequencer.
Parameter	-1|0–359.9
Unit	º (degree)
Query	OUTPut:PHASe:OFF?
Return	<NR2>

NOTES

This feature sets the output to low impedance (0 volts) before disconnecting the load (relay)

In a multi-phase unit, this command sets the OFF phase angle of Phase 1 only. The OFF phase angle of all other phases is shifted relative to the OFF phase angle of Phase 1 by the value set with [SOURce:]PHASe:SHIFt[#] <NRf> (refer to **Section 14.13.8: Source Subsystem**) or set from the front panel (refer to **Section 9.4.8: Parallel Menu**).

Typical Examples:

OFF @ 270°



OUTPut:PON:PROFile <DSC>

Function	Sets the power-on (startup) profile: *SAV command, factory reset, or last state.
Parameter	LAST|FRST|1|2|3|4. 1|2|3|4 are associated with *SAV.
Query	OUTPut:PON:PROFile?
Return	<DSC>

NOTES

Before loading a profile (1, 2, 3, or 4), it must be saved with *SAV.

A profile stored with *SAV command will be loaded as soon as AC is applied and power switch is turned on.

If FRST, 1, 2, 3, or 4 is set, OUTPut:PON[:STATe] <DSC> has no effect; output setting will act according to the selected profile.

If power switch is already on, recycling it with a recycling time of at least 5 seconds will reload power on profile.

If FRST is set, the power source start-up time via AC or power switch recycle (power switch recycle time must be at least 5 seconds) is increased by about 2 seconds.

OUTPut:PON:PROFile:FRST:INTerface <DSC>

Function	Selects the communication interface at power-on (startup) if FRST option is set with OUTPut:PON:PROFile <DSC>.
Parameter	USB|RS232|RS485|LAN|OPT
Query	OUTPut:PON:PROFile:FRST:INTerface?
Return	<DSC>

NOTE

OPT is applicable only when the GPIB option is installed.

OUTPut:PON[:STATe] <DSC>

Function	Determines the power source output state after AC recovery, power switch On, ambient OTP fault, ILC (Interlock) signal, and ENA (Enable) signal.
Parameter	SAFE|AUTO **SAFE**: safe start mode; the power source always recovers to OFF. **AUTO**: auto start mode; the power source recovers to the previous state or to the last setting following AC recycle.
Query	OUTPut:PON[:STATe]?
Return	<DSC>

OUTPut:PROTection:CLEar

Function	Clears the latching faults, ILC, and ENA (if ILC and ENA were latched).

NOTE

An actual fault condition must be removed before the latch can be cleared.

OUTPut:PROTection:FOLDback:DELay <NRf>

Function	Sets the time delay from the last foldback event to the output being disabled.
Parameter	0.1–25.5
Unit	s
Query	OUTPut:PROTection:FOLDback:DELay?
Return	<NR2>

OUTPut:PROTection:FOLDback[:MODE] <DSC>

Function	Disable the power source output upon transitioning between operating modes. The output turns OFF if the power source transitions: • from a CV or output OFF to CC mode • from a CC or output OFF to CV mode. When a foldback event is detected and the timeout expires (regardless of whether a foldback delay is set), foldback shutdown will occur only if the actual output state stayed the same as the programmed foldback setting for the entire duration of the timeout. Otherwise, there will be no foldback shutdown.
Parameter	OFF|CC|CV
Query	OUTPut:PROTection:FOLDback[:MODE]?
Return	<DSC>
Example	If foldback state is set to CC mode and foldback delay is set to 10 seconds, the power source output will shut down after 10 seconds only if the output state was maintained at CC for the entire time duration (10 seconds). If foldback state is set to CC mode and foldback delay is set to 10 seconds and actual output mode alternates between CC and CV modes every 5 seconds, foldback shutdown will never occur as the output state doesn't stay in CC mode for the whole 10 seconds.

OUTPut:RELay1:COUNt[#] <NR1>

Function	Sets the number of generated pulses. This is valid only if the state is set to PWM.
Parameter	-1|1–9999
Query	OUTPut:RELay1:COUNt[#]?
Return	<NR1>

NOTE

-1 is treated as infinity.

OUTPut:RELay1:DCYCle[#] <NRf>

Function	Sets the duty cycle ratio. This is valid only if the state is set to PWM.
Parameter	0–1
Unit	%. 0.5=50%, 1=100%
Query	OUTPut:RELay1:DCYCle[#]?
Return	<NR2>

OUTPut:RELay1:PERiod[#] <NR1>

Function	Sets the pulse period. This is valid only if the state is set to PWM.
Parameter	1–3600
Unit	ms
Query	OUTPut:RELay1:PERiod[#]?
Return	<NR1>

OUTPut:RELay1[:STATe][#] <DSC>

Function	Sets the Programmable Pin #1 (J4-21) in the rear panel connector; refer to **Table 11-10**.
Parameter	HIGH|LOW|PWM **HIGH**: the pin state is high **LOW**: the pin state is low **PWM**: the signal is in the form of pulses (Pulse-width Modulation behavior)
Query	OUTPut:RELay1[:STATe][#]?
Return	<DSC>

NOTE

PWM option uses count, duty cycle, and period. Refer to OUTPut:RELay1:COUNt[#] <NR1>, OUTPut:RELay1:DCYCle[#] <NRf>, and the OUTPut:RELay1:PERiod[#] <NR1>. Refer to **Section 9.4.5: Configuration Menu** to set them from the front panel.

OUTPut:RELay2:COUNt[#] <NR1>

Function	Sets the number of generated pulses. This is valid only if the state is set to PWM.
Parameter	-1|1–9999
Query	OUTPut:RELay2:COUNt[#]?
Return	<NR1>

NOTE

-1 is treated as infinity.

OUTPut:RELay2:DCYCle[#] <NRf>

Function	Sets the duty cycle ratio. This is valid only if the state is set to PWM.
Parameter	0–1
Unit	%. 0.50=50%, 1=100%
Query	OUTPut:RELay2:DCYCle[#]?
Return	<NR2>

OUTPut:RELay2:PERiod[#] <NR1>

Function	Sets the pulse period. This is valid only if the state is set to PWM.
Parameter	1–3600
Unit	ms
Query	OUTPut:RELay2:PERiod[#]?
Return	<NR1>

OUTPut:RELay2[:STATe][#] <DSC>

Function	Sets the Programmable Pin #2 (J4-20) in the rear panel connector; refer to **Table 11-10**.
Parameter	HIGH|LOW|PWM **HIGH**: the pin state is high **LOW**: the pin state is low **PWM**: the signal is in the form of pulses (Pulse-width Modulation behavior)
Query	OUTPut:RELay2[:STATe][#]?
Return	<DSC>

NOTE

PWM option uses count, duty cycle, and period. Refer to OUTPut:RELay2:COUNt[#] <NR1>, OUTPut:RELay2:DCYCle[#] <NRf>, and the OUTPut:RELay2:PERiod[#] <NR1>. Refer to **Section 9.4.5: Configuration Menu** to set them from the front panel.

OUTPut[:STATe] <Bool>

Function	Enables or disables the output of the power source
Parameter	0|1 or OFF|ON
Query	OUTPut[:STATe]?
Return	<Bool>

NOTES

Output relays are enabled or disabled depending on the actual state of the output setting.

The query returns the actual state of the output. To know the actual state of the setting, refer to OUTPut:SETTing?

OUTPut:SETTing?

Function	Returns the actual state of the output setting of the power source
Return	<Bool>

NOTE

This query returns the actual state of the output setting. To know the actual state of the output, refer to OUTPut[:STATe] <Bool>.

OUTPut:TRANsition[:STATe]?

Function	Indicates if the output is transitioning from ON to OFF, or vice-versa
Return	<DSC> IDLE|OFF|ON **IDLE:** output is not in a transition state (i.e., it is in an ON or OFF state) **OFF:** output is transiting from ON to OFF. This state is noticeable when a slow output-off slew rate is applied using [SOURce:]VOLTage:AC:SLEW:OFF <NRf> and/or [SOURce:]VOLTage:DC:SLEW:OFF <NRf> (refer to **Section 14.13.8: Source Subsystem**) or applied using the front panel (refer to **Section 9.4.5: Configuration Menu**). In this state, the voltage gradually decreases until it reaches 0V. **ON:** output is transiting from OFF to ON. This transition state is active from the moment output ON command is sent until the output state becomes ON, which can take up to two seconds in ECO mode.

NOTE

The query is not applicable for transition during AC ON/OFF or ON/OFF via the OUT button.

OUTPut:TTLTrg:MODE[#] <DSC>

Function	Sets the operation mode of the Trigger Out signal (J4-23/J6)
Parameter	OFF|FSTR|TRIG|FSTRE **OFF mode**: a trigger is not generated **If the sequencer is disabled:** **TRIG mode**: a trigger is generated if the output state changes **FSTR/FSTRE mode**: a trigger is generated automatically any time an output parameter, such as output state, voltage, current, frequency, wave, or phase is programmed. **If the AC/ACDC sequencer (STEP, PULSE, or LIST) is enabled:** **TRIG mode**: A trigger is generated according to the settings of [PROGram:]STEP:TTLTrg:ENABle[#] <Bool>, [PROGram:]PULSe:TTLTrg:ENABle[#] <Bool>,<Bool>, or [PROGram:]LIST:TTLTrg:ENABle[#] <Bool>{,<Bool>}; refer to **Section 14.13.7: Program Subsystem**. These settings can also be made from the front panel; refer to **Section 9.4.9: Program Menu**. **FSTR mode**: an output pulse is generated automatically any time a step (of a STEP, PULSe or LIST) is completed. **FSTRE mode**: an output pulse is generated automatically when the whole sequence is completed. If the DC Sequencer (WAVE or LIST) is enabled: **TRIG mode**: A trigger is generated automatically any time a step (of a WAVE or LIST) begins. **FSTR mode**: An output pulse is generated automatically any time a step (of a WAVE or LIST) is completed. **FSTRE mode**: An output pulse is generated automatically when the whole sequence is completed.
Query	OUTPut:TTLTrg:MODE[#]?
Return	<DSC>

NOTE

The FSTRE parameter is available from firmware version 001.006.000 onwards.

14.13.6 Function Subsystem

[FUNCtion:]WAVeform[:ACTivate][:NAME][#] <USTR>

Function	Activates the selected waveform
Parameter	name (The name of the selected waveform). Name of the waveform is entered without quotes (USTR data type).
Example	FUNCtion:WAVeform:ACTivate:NAME demo
Query	[FUNCtion:]WAVeform[:ACTivate][:NAME][#]?
Return	<USTR>

NOTES

The waveform name is case sensitive.

Use [FUNCtion:]WAVeform:REGion <NR1> and [FUNCtion:]WAVeform:SCAN? to display the list of the currently loaded waveforms. To select the region from the front panel, refer to **Section 9.4.5: Configuration Menu**. To select the waveform from the front panel, refer to **Section 9.4.1: Output Settings Menu**.

[FUNCtion:]WAVeform[:ACTivate]:SYNC:ENABle[#] <Bool>

Function	Enables or disables the phase synchronization when switching the active wave
Parameter	0|1 or OFF|ON **0, OFF**: phase synchronization is disabled. Switches immediately to the new wave. The start phase angle of the new wave is equal to the phase angle at which the previous wave ended (i.e., no phase change occurs). **1, ON**: phase synchronization is enabled. Before switching to the new wave, wait until the phase angle set with OUTPut:PHASe:OFF <NRf> (refer to **Section 14.13.5: Output Subsystem**) or set from the front panel (refer to **Section 9.4.1: Output Settings Menu**) is reached. The start phase angle of the new wave is equal to the setting set with OUTPut:PHASe:ON <NRf> or set from the front panel.
Query	[FUNCtion:]WAVeform[:ACTivate]:SYNC:ENABle[#]?
Return	<Bool>

[FUNCtion:]WAVeform:CSINe:LEVel[#] <NRf>

Function	Sets the clamping level of the built-in clipped sine wave. The clamping level represents the amplitude at which the sine wave is clamped.
Parameter	0.01–100 For example: **50**: sine wave cut off at 0.5 **100**: full sine wave
Unit	%
Query	[FUNCtion:]WAVeform:CSINe:LEVel[#]?
Return	<NR2>

NOTE

The wave points generated based on the CSINe level are automatically scaled to fit the ±1 wave point range.

[FUNCtion:]WAVeform:CSINe:MODE[#] <DSC>

Function	Selects the CSINe attribute (LEVel or THD) used to generate the CSINe wave
Parameter	LEVel|THD
Query	[FUNCtion:]WAVeform:CSINe:MODE[#]?
Return	<DSC>

NOTE

The attribute types are independent from each other, and the user can freely switch between attributes at any time.

[FUNCtion:]WAVeform:CSINe:THD[#] <NRf>

Function	Modifies the Total Harmonic Distortion (THD) level of the built-in clipped sine wave
Parameter	0–48 For example: **0**: sine wave without any distortion **48**: nearly-perfect square wave
Unit	%
Query	[FUNCtion:]WAVeform:CSINe:THD[#]?
Return	<NR2>

NOTE

The wave points generated based on the CSINe level are automatically scaled to fit the ±1 wave point range.

[FUNCtion:]WAVeform:DELete <USTR>

Function	Deletes the specified waveform
Parameter	name (The name of the selected waveform). Name of the waveform is entered without quotes (USTR data type).
Example	FUNCtion:WAVeform:DELete demo

NOTES

The waveform name is case sensitive.

The command deletes the waveform in the selected region only.

Built-in waveforms: SQUare, TRIangle, CSINe, and SINe cannot be deleted or overwritten, but can be modified using the commands in this section.

User created waveforms cannot be deleted, overwritten, or modified when the waveform is active.

[FUNCtion:]WAVeform:POINts <USTR>,<NRf>,<NRf>{,<NRf>}

Function	Create an arbitrary waveform with up to 1024 points, ranging from -1 to 1. The list of points sent by the user represents a single period of the arbitrary waveform.
Parameter	FnName, array of -1 to 1. FnName is the name of the waveform to be created. The name of the waveform is entered without quotes (USTR data type). Name (FnName) is case-sensitive. The name must not exceed 10 characters including lower-case characters, upper-case characters, and numbers.
Example	FUNCtion:WAVeform:POINts sam,0.5,0.5,-0.5,0.6,.06
Query	[FUNCtion:]WAVeform:POINts? <STR>
Return	Array of <NR2>
Example	0.5,0.5,-0.5,0.6,.06

NOTES

The minimum number of points in the wave is two.

The maximum point, regardless of its value, represents the waveform's amplitude. For example, if all points input by the user are smaller than ±1, the points are internally scaled up to fit the ±1 range. Points with a value of ±1 are outputted at the voltage setting.

Each data point has a maximum resolution of 0.00001. If all points have a value below 0.001, the wave is rejected. Each data point in the query of the user selected waveform has a maximum resolution of 0.00001.

The execution of this command may take up to 25ms.

[FUNCtion:]WAVeform:POINts:OVERwrite <USTR>,<NRf>,<NRf>{,<NRf>}

Function	Overwrites an arbitrary waveform
Parameter	FnName, array of -1 to 1. FnName is the name of the waveform to be over-written/created. The name of the waveform is entered without quotes (USTR data type). Name (FnName) is case-sensitive. The name must not exceed 10 characters including lower-case characters, upper-case characters, and numbers.
Example	FUNCtion:WAVeform:POINts:OVERwrite sam,0.5,0.5,-0.5,0.6,.06

NOTES

Built-in waveforms cannot be over-written.

If the waveform to be overwritten does not exist, it is created.

The minimum number of points in the wave is two.

The maximum point, regardless of its value, represents the waveform's amplitude. For example, if all points input by the user are smaller than ±1, the points are internally scaled up to fit the ±1 range. Points with a value of ±1 are outputted at the voltage setting.

Each data point has a maximum resolution of 0.00001. If all points have a value below 0.001, the wave is rejected.

The waveform's points cannot be overwritten while the wave is active.

The execution of this command may take up to 25ms.

[FUNCtion:]WAVeform:REGion <NR1>

Function	Sets the region in the memory to store/load the created waveform. Only the waveforms programmed with [FUNCtion:]WAVeform:POINts, [FUNCtion:]WAVeform:POINts:OVERwrite, and [FUNCtion:]WAVeform:TEMPlate are stored in these regions. Each region can store 50 waveforms giving a total of 200 waveforms.
Parameter	1–4
Query	[FUNCtion:]WAVeform:REGion?
Return	<NR1>

NOTES

The command can be executed at Output OFF state only.

Waveforms from different regions cannot run together.

To store a waveform in a particular region, first select the region and then create the waveform.

Follow the same procedure for deleting the waveform. Active waveform cannot be deleted.

To know the waveforms residing in each region, first select the region and then run [FUNCtion:]WAVeform:SCAN?

If the region is changed, SINe (built-in sine wave) is set as the active wave.

The execution of this command may take up to 2 seconds

[FUNCtion:]WAVeform:SCAN?

Function	Returns a list of currently loaded waves in the power source in the order the user inserted them
Return	<USTR>
Example	TRIangle, SQUare, CSINe, SINe, Demo

NOTE

The query returns only the waveforms that are present in the selected region (refer to [FUNCtion:]WAVeform:REGion <NR1> or refer to **Section 9.4.5: Configuration Menu)**. TRIangle, SQUare, CSINe, SINe are built-in in the power source and are present in all the regions.

[FUNCtion:]WAVeform:SQUare:DCYCle[#] <NRf>

Function	Sets the duty cycle of the built-in square wave
Parameter	0–100 For example: **0**: wave is always negative **50**: perfect square **100**: wave is always positive
Unit	%
Query	[FUNCtion:]WAVeform:SQUare:DCYCle[#]?
Return	<NR2>

[FUNCtion:]WAVeform:TEMPlate <USTR>,<USTR>,<NR2>

Function	Create a new waveform based on a built-in waveform
Parameter	FnName,BuiltInName,Value **FnName**: the name of the new waveform to be created. The name of the waveform is entered without quotes (USTR data type). If the waveform already exists, its points are overwritten. Names (FnName) are case-sensitive. The name must not exceed 10 characters including lower-case characters, upper-case characters, and numbers. **BuiltInName**: the name of the built-in waveform (SQUare|TRIangle|CSINe, excluding SINe), on the basis of which the new waveform is created. **Value**: The characteristic value of the built-in wave (in percent), used to generate the new wave. • for a SQUare wave, the characteristic value is the duty cycle. • for a TRIangle wave, the characteristic value is the symmetry. • for a CSINe wave, the characteristic value is the clamping level or THD (depending on the setting with [FUNCtion:]WAVeform:CSINe:MODE[#] <DSC>).
Example	FUNCtion:WAVeform:TEMPlate Square20,SQU,20

[FUNCtion:]WAVeform:TRIangle:SYMMetry[#] <NRf>

Function	Sets the symmetry of the built-in triangle wave
Parameter	0–100 For example: **0**: negative ramp **50**: triangle **100**: positive ramp
Unit	%
Query	[FUNCtion:]WAVeform:TRIangle:SYMMetry[#]?
Return	<NR2>

14.13.7 Program Subsystem

	Output Voltage and Current Programming Values
Voltage	**AC mode**: 0–360.2Vac **ACDC mode**: 0–360.2Vac, -360.2–360.2Vdc **DC mode**: -510.2–510.2Vdc
Current	**Models:** 2kVA: 0 to (20+0.2)*n, 3kVA and 4kVA: 0 to (30+0.2)*n 6kVA: 0 to 60.6*n, 9kVA and 12kVA: 0 to 90.6*n 18kVA and 24kVA: 0 to 181.2*n n is the number of power sources connected in parallel. For example: For 3kVA: 0A to 30.2A 9kVA: 0A to 90.6A 6kVA: (3kVA x 2) units in parallel: 0A to 60.4A 9kVA: (3kVA x 3) units in parallel: 0A to 90.6A 18kVA: (9kVA x 2) units in parallel: 0A to 181.2A

	V**oltage Slew Rate Programming Values**
1.2KHz Power Source	0.0001–4400V/ms
5KHz Power Source	0.0001–16340V/ms

	Frequency Programming Values
1.2KHz Power Source	16–1200Hz
5KHz Power Source	16–5000Hz

1.2KHz and 5KHz Power Source	**Frequency Slew Programming Values**
	0.0001–99999.9999Hz/ms

Table 14-8: Programming Values

14.13.7.1 DC Sequencer

[PROGram:]DC:ACTivate <DSC>

Function	Sets the DC sequencer program to LIST or WAVE.
Parameter	LIST|WAVE
Query	[PROGram:]DC:ACTivate?
Return	<DSC>

[PROGram:]DC:COUNter <NR1>|INFinity

Function	Sets the iterations counter for the sequencer
Parameter	1–999999|INFinity Any number greater than 999999 is interpreted as INFinity. Use INFinity to run a sequence indefinitely.
Query	[PROGram:]DC:COUNter?
Return	<NR1>

NOTE

If COUNter > 999999, the response is INF

[PROGram:]DC:LIST:DWELl <NRf>{,<NRf>}

Function	Sets the time interval for each value (point) in a list. The function accepts up to 200 parameters.
Parameter	0.1–12960000
Unit	ms
Example	PROGram:DC:LIST:DWELl .6,1.5,1.5
Query	[PROGram:]DC:LIST:DWELl?
Return	<NR2>{,<NR2>}

NOTE

At least one point must be entered.

[PROGram:]DC:LIST:SIZE <NR1>

Function	Number of nodes to be executed. This command affects LIST and WAVE modes
Parameter	1–200
Query	[PROGram:]DC:LIST:SIZE?
Return	<NR1>

NOTES

The default is 0. SIZE must be set to activate a user programmed waveform.

The settings in each list and each phase are aligned according to the SIZE. If SIZE is more than the number of values in the list, the last value is duplicated. If SIZE is less than the number of values in the list, the excess cells will be discarded during execution.

When a query is sent to a specific phase to get the values of a list before a SIZE command is sent, the number of values will be according to the user's input. If the query is sent after the SIZE command is sent, the number of values will be according to the SIZE.

[PROGram:]DC:LIST:VOLTage[#] <NRf>{,<NRf>}

Function	Sets the output voltage for each value (point) in a list. The function accepts up to 200 parameters.
Parameter	Refer to **Table 14-8**
Unit	V
Example	PROGram:DC:LIST:VOLTage 2.0,2.5,3.0
Query	[PROGram:]DC:LIST:VOLTage[#]?
Return	<NR2>{,<NR2>}

NOTE

At least one point must be entered.

[PROGram:]DC:MODE:ABORt <DSC>

Function	Sets the behavior of the power source when ABORt is sent.
Parameter	OFF|IMMediate|LAST **OFF**: the output is turned off, and all basic source DC settings are restored to their IMMediate values. **IMMediate**: all basic source DC settings are restored to their IMMediate values without changing the output setting. **LAST**: the source settings are not restored to their IMMediate values, i.e., the output remains the way it was at the moment the ABORt command was sent. Note: the output behavior may not reflect the IMMediate changes.
Query	[PROGram:]DC:MODE:ABORt?
Return	<DSC>

[PROGram:]DC:MODE:END <DSC>

Function	Sets the behavior of the power source when the sequencer execution is completed and it enters the IDLE state.
Parameter	OFF|IMMediate|LAST **OFF**: the output is turned off, and all basic source DC settings are restored to their IMMediate values. **IMMediate**: all basic source DC settings are restored to their IMMediate values without changing the output setting. **LAST**: source settings are not restored to their IMMediate values, i.e., the output remains the way it was at the moment the sequencer finished running.
Query	[PROGram:]DC:MODE:END?
Return	<DSC>

NOTE

This command differs from [PROGram:]DC:MODE:ABORt. It defines what happens when the sequencer ends successfully without the user sending ABORt.

[PROGram:]DC:STATe?

Function	Queries the state of the DC sequencer, the current member being executed, and the current repetition.
Return	<DSC>,<NR1>,<NR1> The state of the DC sequencer (<DSC>): **IDLE**: sequencer is in IDLE state **WAIT**: sequencer is waiting for trigger **ACTIVE**: sequencer is running.
Query	[PROGram:]DC:STATe?
Example	ACTIVE,3,100 The DC sequencer is actively running (ACTIVE) the third node and is in its 100th repetition.

NOTE

During Idle and Wait state, the current member and repetition number is always 1. Ex - IDLE,1,1

[PROGram:]DC:STEP <DSC>

Function	Sets the power source to execute the whole sequence or a single step once the trigger is received. **AUTO**: when triggered, the sequencer executes the waveform continuously until the whole sequence is over. **ONCE**: when triggered, the sequencer executes a single step.
Parameter	ONCE|AUTO
Query	[PROGram:]DC:STEP?
Return	<DSC>

[PROGram:]DC:WAVE:TIME <NRf>{,<NRf>}

Function	Specifies the time duration of each slope between 2 points in a WAVE. The function accepts up to 200 parameters.
Parameter	0.1–12960000
Unit	ms
Example	PROGram:DC:WAVE:TIME .6,1.5,1.5
Query	[PROGram:]DC:WAVE:TIME?
Return	<NR2>{,<NR2>}

NOTE

At least one point must be entered.

[PROGram:]DC:WAVE:VOLTage[#] <NRf>{,<NRf>}

Function	Sets the output voltage for each value (point) in a wave. The function accepts up to 200 parameters.
Parameter	Refer to **Table 14-8**
Unit	V
Example	PROGram:DC:WAVE:VOLTage 2.0,2.5,3.0
Query	[PROGram:]DC:WAVE:VOLTage[#]?
Return	<NR2>{,<NR2>}

NOTE

At least one point must be entered.

14.13.7.2 AC/ACDC Sequencer - List Subsystem

NOTE

The settings in each list are aligned according to [PROGram:]LIST:SIZE <NR1>. If SIZE is more than the number of values in the list, the last value is duplicated. If SIZE is less than the number of values in the list, the excess cells will be discarded during execution. For example, refer to the example:

LIST:SIZE 3

LIST:VOLT:AC 1,2,3,4

LIST:DUR 1,2,3,4

In this case, the last value will be discarded and the reply for LIST:VOLT:AC? and LIST:DUR? will be 1.00,2.00,3.00 and 1.0,2.0,3.0 respectively.

[PROGram:]LIST:DURation <NRf>{,<NRf>}

Function	Sets the duration of each member in the list
Parameter	0.1–12960000
Unit	ms
Example	PROGram:LIST:DURation 0.1,0.1,0.2,0,5
Query	[PROGram:]LIST:DURation?
Return	<NR2>{,<NR2>}

[PROGram:]LIST:FREQuency <NRf>{,<NRf>}

Function	Sets the frequency of each member in the list in AC and ACDC mode
Parameter	Refer to **Table 14-8**
Unit	Hz
Example	PROGram:LIST:FREQuency 50,75.5,100,500
Query	[PROGram:]LIST:FREQuency?
Return	<NR2>{,<NR2>}

[PROGram:]LIST:FREQuency:SLEW:DOWN <NRf>{,<NRf>}

Function	Sets the slew rate for down programming the frequency for each member in the list in AC and ACDC mode
Parameter	Refer to **Table 14-8**
Unit	Hz/ms
Example	PROGram:LIST:FREQuency:SLEW:DOWN 99.99,1,22.22,999.99
Query	[PROGram:]LIST:FREQuency:SLEW:DOWN?
Return	<NR2>{,<NR2>}

[PROGram:]LIST:FREQuency:SLEW:UP <NRf>{,<NRf>}

Function	Sets the slew rate for up programming the frequency for each member in the list in AC and ACDC mode
Parameter	Refer to **Table 14-8**
Unit	Hz/ms
Example	PROGram:LIST:FREQuency:SLEW:UP 99.99,1,22.22,999.99
Query	[PROGram:]LIST:FREQuency:SLEW:UP?
Return	<NR2>{,<NR2>}

[PROGram:]LIST:PHASe:END <NRf>{,<NRf>}

Function	Sets the end phase angle of each member in the list
Parameter	-1|0–359.9 If the value of a member's end phase is -1, the end phase angle is disabled. The member stops when its duration has elapsed, regardless of the end phase angle of the previous member.
Unit	º (degree)
Example	PROGram:LIST:PHASe:END 30,40,-1,45
Query	[PROGram:]LIST:PHASe:END?
Return	<NR2>{,<NR2>}

NOTE

In a multi-phase system, this command only sets the end phase angle of Phase 1. The end phase angle of all other phases is shifted relative to the end phase angle of Phase 1 by the value set with [SOURce:]PHASe:SHIFt[#] <NRf> (refer to **Section 14.13.8: Source Subsystem**) or set from the front panel (refer to **Section 9.4.8: Parallel Menu**).

[PROGram:]LIST:PHASe:SHIFt[#] <NRf>

Function	Sets the phase shift angle between phase 1 and other phases (#). The command is applicable only when a sequencer is setup.
Parameter	-1|0–359.9
Unit	º (degree)
Query	[PROGram:]LIST:PHASe:SHIFt[#]?
Return	<NR2>

NOTES

This command is available from firmware version 001.006.000 onwards.

This command is not related to [SOURce:]PHASe:SHIFt[#] <NRf>. When the sequencer is run, [PROGram:]LIST:PHASe:SHIFt[#] <NRf> will be used, instead.

If the value of [PROGram:]LIST:PHASe:SHIFt[#] <NRf> is -1, the phase shift of the list sequence is disabled and [SOURce:]PHASe:SHIFt[#] <NRf> will be used.

This command applies only to phases other than phase 1. Attempts to set phase 1 will result in an error.

[PROGram:]LIST:PHASe:STARt <NRf>{,<NRf>}

Function	Sets the starting phase angle of each member in the list
Parameter	-1|0–359.9 If the value of a member's start phase is -1, the start phase angle of the member is equal to the end phase angle of the previous member.
Unit	º (degree)
Example	PROGram:LIST:PHASe:STARt 30,40,-1,45
Query	[PROGram:]LIST:PHASe:STARt?
Return	<NR2>{,<NR2>}

NOTE

In a multi-phase system, this command only sets the start phase angle of Phase 1. The start phase angle of all other phases is shifted relative to the start phase angle of Phase 1 by the value set with [SOURce:]PHASe:SHIFt[#] <NRf> (refer to **Section 14.13.8: Source Subsystem**) or set from the front panel (refer to **Section 9.4.8: Parallel Menu**).

[PROGram:]LIST:REPeat <NR1>

Function	Sets the number of times the list is repeated
Parameter	-1|1–999999
Query	[PROGram:]LIST:REPeat?
Return	<NR1>

NOTE

-1 is treated as infinity.

[PROGram:]LIST:SIZE <NR1>

Function	Set the number of members to be executed in the list
Parameter	1–200
Query	[PROGram:]LIST:SIZE?
Return	<NR1>

NOTES

The default is 0. SIZE must be set to activate a user programmed waveform.

The settings in each list and each phase are aligned according to the SIZE. If SIZE is more than the number of values in the list, the last value is duplicated. If SIZE is less than the number of values in the list, the excess cells will be discarded during execution.

When a query is sent to a specific phase to get the values of a list before a SIZE command is sent, the number of values will be according to the user's input. If the query is sent after the SIZE command is sent, the number of values will be according to the SIZE.

[PROGram:]LIST:STEP <DSC>

Function	Sets the power source to execute the whole sequence or a single step once the trigger is received
Parameter	ONCE|AUTO **AUTO**: when triggered, the sequencer executes the waveform continuously until the whole sequence is over. **ONCE**: when triggered, the sequencer executes a single step.
Query	[PROGram:]LIST:STEP?
Return	<DSC>

[PROGram:]LIST:STATe?

Function	Queries the state of the list sequencer, the current member being executed, and the repetition number
Query	[PROGram:]LIST:STATe?
Return	<DSC>,<NR1>,<NR1> States of the list sequencer (<DSC>): **IDLE**: sequencer is in IDLE state **WAIT**: sequencer is waiting for trigger **ACTIVE**: sequencer is running
Example	ACTIVE,3,100 The LIST is actively running (ACTIVE) the third node, and it is in its 100th repetition.

NOTE

During Idle and Wait state, the current member and repetition number is always 1. Ex - IDLE,1,1.

[PROGram:]LIST:TTLTrg:ENABle[#] <Bool>{,<Bool>}

Function	Defines the member for which the Trigger Out signal is active when the LIST program is running
Parameter	0|1 or OFF|ON **0, OFF**: a trigger signal is not generated when the LIST program starts executing the given member. **1, ON**: a trigger signal is generated when the LIST program starts executing the given member.
Example	PROGram:LIST:TTLTrg:ENABle OFF,ON,ON,OFF,OFF A trigger signal is generated when members 2 and 3 start executing.
Query	[PROGram:]LIST:TTLTrg:ENABle[#]?
Return	<Bool>{,Bool}

NOTE

Output trigger mode must be set to TRIG to enable this command to affect the Trigger Out signal; refer to OUTPut:TTLTrg:MODE[#] <DSC> in **Section 14.13.5: Output Subsystem**. Refer to **Section 9.4.5: Configuration Menu** to set the output trigger mode from the front panel.

[PROGram:]LIST:VOLTage:AC[#] <NRf>{,<NRf>}

Function	Sets the AC component rms amplitude of the voltage for each member in the list in AC and ACDC mode
Parameter	Refer to **Table 14-8**
Unit	V
Example	PROGram:LIST:VOLTage:AC 20,29,30,30.22
Query	[PROGram:]LIST:VOLTage:AC[#]?
Return	<NR2>{,<NR2>}

[PROGram:]LIST:VOLTage:AC:SLEW:DOWN[#] <NRf>{,<NRf>}

Function	Sets the slew rate for down programming the AC component of the voltage for each member in the list in AC and ACDC mode
Parameter	Refer to **Table 14-8**
Unit	V/ms
Example	PROGram:LIST:VOLTage:AC:DOWN 99.99,1,22.22,999.99
Query	[PROGram:]LIST:VOLTage:AC:SLEW:DOWN[#]?
Return	<NR2>{,<NR2>}

[PROGram:]LIST:VOLTage:AC:SLEW:UP[#] <NRf>{,<NRf>}

Function	Sets the slew rate for up programming the AC component of the voltage for each member in the list in AC and ACDC mode
Parameter	Refer to **Table 14-8**
Unit	V/ms
Example	PROGram:LIST:VOLTage:AC:SLEW:UP 99.99,1,22.22,999.99
Query	[PROGram:]LIST:VOLTage:AC:SLEW:UP[#]?
Return	<NR2>{,<NR2>}

[PROGram:]LIST:VOLTage:DC[#] <NRf>{,<NRf>}

Function	Sets the DC offset of the voltage for each member in the list in ACDC mode
Parameter	Refer to **Table 14-8**
Unit	V
Example	PROGram:LIST:VOLTage:DC 20,29,30,30
Query	[PROGram:]LIST:VOLTage:DC[#]?
Return	<NR2>{,<NR2>}

[PROGram:]LIST:VOLTage:DC:SLEW:DOWN[#] <NRf>{,<NRf>}

Function	Sets the slew rate for down programming the DC offset of the voltage for each member in the list in ACDC mode
Parameter	Refer to **Table 14-8**
Unit	V/ms
Example	PROGram:LIST:VOLTage:DC:SLEW:DOWN 99.99,1,22.22,999.99
Query	[PROGram:]LIST:VOLTage:DC:SLEW:DOWN[#]?
Return	<NR2>{,<NR2>}

[PROGram:]LIST:VOLTage:DC:SLEW:UP[#] <NRf>{,<NRf>}

Function	Sets the slew rate for up programming the DC offset of the voltage for each member in the list in ACDC mode
Parameter	Refer to **Table 14-8**
Unit	V/ms
Example	PROGram:LIST:VOLTage:DC:SLEW:UP 99.99,1,22.22,999.99
Query	[PROGram:]LIST:VOLTage:DC:SLEW:UP[#]?
Return	<NR2>{,<NR2>}

[PROGram:]LIST:WAVeform[#] <USTR>{,<USTR>}

Function	Add a name for the generated list waveform for each member in the list
Parameter	Name. The name of the waveform entered without quotes (USTR data type)
Query	[PROGram:]LIST:WAVeform[#]?
Return	<USTR>{,<USTR>}

NOTE

name is case sensitive.

14.13.7.3 AC/ACDC Sequencer - Pulse Subsystem

[PROGram:]PULSe:DURation:ACTive <NRf>

Function	Sets the duration of the pulse
Parameter	0.1–12960000
Unit	ms
Query	[PROGram:]PULSe:DURation:ACTive?
Return	<NR2>

[PROGram:]PULSe:DURation:INACtive <NRf>

Function	If the pulse is to be repeated several times, this command sets how long the previous setting (inactive part: IMMediate, LIST, STEP) is active before the pulse is repeated
Parameter	0.1–12960000
Unit	ms
Query	[PROGram:]PULSe:DURation:INACTive?
Return	<NR2>

[PROGram:]PULSe:FREQuency <NRf>

Function	Sets the frequency of the pulse output in AC and ACDC mode
Parameter	Refer to **Table 14-8**
Unit	Hz
Query	[PROGram:]PULSe:FREQuency?
Return	<NR2>

[PROGram:]PULSe:FREQuency:SLEW:DOWN <NRf>

Function	Sets the slew rate for down programming the frequency of the pulse output in AC and ACDC mode
Parameter	Refer to **Table 14-8**
Unit	Hz/ms
Query	[PROGram:]PULSe:FREQuency:SLEW:DOWN?
Return	<NR2>

[PROGram:]PULSe:FREQuency:SLEW:UP <NRf>

Function	Sets the slew rate for up programming the frequency of the pulse output in AC and ACDC mode
Parameter	Refer to **Table 14-8**
Unit	Hz/ms
Query	[PROGram:]PULSe:FREQuency:SLEW:UP?
Return	<NR2>

[PROGram:]PULSe:PHASe:END <NRf>

Function	Sets the phase angle at which the pulse ends
Parameter	-1|0–359.9 If the value of the end phase is -1, the end phase angle is disabled and the pulse stops when its active duration has elapsed, regardless of the end phase angle of the previous wave.
Unit	º (degree)
Query	[PROGram:]PULSe:PHASe:END?
Return	<NR2>

NOTE

In a multi-phase system, this command only sets the end phase angle of Phase 1. The end phase angle of all other phases is shifted relative to the end phase angle of Phase 1 by the value set with [SOURce:]PHASe:SHIFt[#] <NRf> (refer to **Section 14.13.8: Source Subsystem**) or set from the front panel (refer to **Section 9.4.8: Parallel Menu**).

[PROGram:]PULSe:PHASe:SHIFt[#] <NRf>

Function	Sets the phase shift angle between phase 1 and other phases (#). The command is applicable only when a sequencer is setup.
Parameter	-1|0–359.9
Unit	º (degree)
Query	[PROGram:]PULSe:PHASe:SHIFt[#]?
Return	<NR2>

NOTES

This command is available from firmware version 001.006.000 onwards.

This command is not related to [SOURce:]PHASe:SHIFt[#] <NRf>. When the sequencer is run, [PROGram:]PULSe:PHASe:SHIFt[#] <NRf> will be used.

If the value of PROGram:]PULSe:PHASe:SHIFt[#] <NRf> is -1, the phase shift of the pulse sequence is disabled and [SOURce:]PHASe:SHIFt[#] <NRf> will be used, instead.

This command applies only to phases other than phase 1. Attempts to set phase 1 will result in an error.

[PROGram:]PULSe:PHASe:STARt <NRf>

Function	Sets the phase angle at which the pulse starts
Parameter	-1|0–359.9 If the value of the start phase is -1, the start phase angle of the pulse is equal to the end phase angle of the previous wave.
Unit	º (degree)
Query	[PROGram:]PULSe:PHASe:STARt?
Return	<NR2>

NOTE

In a multi-phase system, this command only sets the start phase angle of Phase 1. The start phase angle of all other phases is shifted relative to the start phase angle of Phase 1 by the value set with [SOURce:]PHASe:SHIFt[#] <NRf> (refer to **Section 14.13.8: Source Subsystem**) or set from the front panel (refer to **Section 9.4.8: Parallel Menu**).

[PROGram:]PULSe:REPeat <NRf>

Function	Sets the number of times the pulse is repeated
Parameter	-1|1–999999
Query	[PROGram:]PULSe:REPeat?
Return	<NR1>

NOTE

-1 is treated as infinity

[PROGram:]PULSe:STATe?

Function	Queries the state of the pulse sequencer and the repetition number being executed
Query	[PROGram:]PULSe:STATe?
Return	<DSC>,<NR1> States of the pulse sequencer (<DSC>): **IDLE**: sequencer is in IDLE state **WAIT**: sequencer is waiting for a trigger **ACTIVE**: sequencer is running using pulse settings **INACTIVE**: sequencer is running using previous settings (immediate, list, or step)
Example	ACTIVE,3 The Pulse is actively running (ACTIVE) and is in its third repetition.

NOTE

During Idle and Wait state, the repetition number is always 1. Ex - IDLE,1

[PROGram:]PULSe:TTLTrg:ENABle[#] <Bool>,<Bool>

Function	Defines if the Trigger Out signal is active when the PULSE program enters the ACTIVE and/or INACTIVE states
Parameter	0|1 or OFF|ON The first argument is related to the ACTIVE state of PULSE program, while the second argument is related to the INACTIVE state. **0, OFF:** a trigger signal is not generated when the PULSE program enters the designated state. **1, ON**: a trigger signal is generated when the PULSE program enters the designated state.
Example	PROGram:PULSe:TTLTrg:ENABle 1,1. The trigger is generated when the PULSE program enters the ACTIVE as well as the INACTIVE state.
Query	[PROGram:]PULSe:TTLTrg:ENABle[#]?
Return	<Bool>,<Bool>

NOTE

Output trigger mode must be set to TRIG to enable this command to affect the Trigger Out signal; refer to OUTPut:TTLTrg:MODE[#] <DSC> in **Section 14.13.5: Output Subsystem**. Refer to **Section 9.4.5: Configuration Menu** to set the output trigger mode from the front panel.

[PROGram:]PULSe:VOLTage:AC[#] <NRf>

Function	Sets the AC component rms amplitude of the pulse voltage in AC and ACDC mode
Parameter	Refer to **Table 14-8**
Unit	V
Query	[PROGram:]PULSe:VOLTage:AC[#]?
Return	<NR2>

[PROGram:]PULSe:VOLTage:AC:SLEW:DOWN[#] <NRf>

Function	Sets the slew rate for down programming the AC component of the pulse voltage in AC and ACDC mode
Parameter	Refer to **Table 14-8**
Unit	V/ms
Query	[PROGram:]PULSe:VOLTage:AC:SLEW:DOWN[#]?
Return	<NR2>

[PROGram:]PULSe:VOLTage:AC:SLEW:UP[#] <NRf>

Function	Sets the slew rate for up programming the AC component of the pulse voltage in AC and ACDC mode
Parameter	Refer to **Table 14-8**
Unit	V/ms
Query	[PROGram:]PULSe:VOLTage:AC:SLEW:UP[#]?
Return	<NR2>

[PROGram:]PULSe:VOLTage:DC[#] <NRf>

Function	Sets the DC offset of the pulse voltage in ACDC mode
Parameter	Refer to **Table 14-8**
Unit	V
Query	[PROGram:]PULSe:VOLTage:DC[#]?
Return	<NR2>

[PROGram:]PULSe:VOLTage:DC:SLEW:DOWN[#] <NRf>

Function	Sets the slew rate for down programming the DC offset of the pulse voltage in ACDC mode
Parameter	Refer to **Table 14-8**
Unit	V/ms
Query	[PROGram:]PULSe:VOLTage:DC:SLEW:DOWN[#]?
Return	<NR2>

[PROGram:]PULSe:VOLTage:DC:SLEW:UP[#] <NRf>

Function	Sets the slew rate for up programming the DC offset of the pulse voltage in ACDC mode
Parameter	Refer to **Table 14-8**
Unit	V/ms
Query	[PROGram:]PULSe:VOLTage:DC:SLEW:UP[#]?
Return	<NR2>

[PROGram:]PULSe:WAVeform[#] <USTR>

Function	Adds a name to the pulse waveform
Parameter	Name. The name of the waveform entered without quotes (USTR data type)
Query	[PROGram:]PULSe:WAVeform[#]?
Return	<USTR>

NOTE

Name is case sensitive.

14.13.7.4 AC/ACDC Sequencer - Step Subsystem

[PROGram:]STEP:FREQuency <NRf>

Function	Sets the frequency of the step output in AC and ACDC mode
Parameter	Refer to **Table 14-8**
Unit	Hz
Query	[PROGram:]STEP:FREQuency?
Return	<NR2>

[PROGram:]STEP:FREQuency:SLEW:DOWN <NRf>

Function	Sets the slew rate for down programming the frequency of the step output in AC and ACDC mode
Parameter	Refer to **Table 14-8**
Unit	Hz/ms
Query	[PROGram:]STEP:FREQuency:SLEW:DOWN?
Return	<NR2>

[PROGram:]STEP:FREQuency:SLEW:UP <NRf>

Function	Sets the slew rate for up programming the frequency of the step output in AC and ACDC mode
Parameter	Refer to **Table 14-8**
Unit	Hz/ms
Query	[PROGram:]STEP:FREQuency:SLEW:UP?
Return	<NR2>

[PROGram:]STEP:PHASe:SHIFt[#] <NRf>

Function	Sets the phase shift angle between phase 1 and other phases (#). The command is applicable only when a sequencer is setup.
Parameter	-1|0–359.9
Unit	º (degree)
Query	[PROGram:]STEP:PHASe:SHIFt[#]?
Return	<NR2>

NOTES

This command is available from firmware version 001.006.000 onwards.

This command is not related to [SOURce:]PHASe:SHIFt[#] <NRf>. When the sequencer is run, [PROGram:]STEP:PHASe:SHIFt[#] <NRf> will be used.

If the value of [PROGram:]STEP:PHASe:SHIFt[#] <NRf> is -1, the phase shift of the step sequence is disabled and [SOURce:]PHASe:SHIFt[#] <NRf> will be used, instead.

This command applies only to phases other than phase 1. Attempts to set phase 1 will result in an error.

[PROGram:]STEP:PHASe:STARt <NRf>

Function	Sets the phase angle at which the step starts
Parameter	-1|0–359.9 If the value of the start phase is -1, the start phase angle of the step is equal to the end phase angle of the previous wave.
Unit	º (degree)
Query	[PROGram:]STEP:PHASe:STARt?
Return	<NR2>

NOTE

In a multi-phase system, this command only sets the start phase angle of Phase 1. The start phase angle of all other phases is shifted relative to the start phase angle of Phase 1 by the value set with [SOURce:]PHASe:SHIFt[#] <NRf> (refer to **Section 14.13.8: Source Subsystem**) or set from the front panel (refer to **Section 9.4.8: Parallel Menu**).

[PROGram:]STEP:STATe?

Function	Queries the state of the step sequencer
Query	[PROGram:]STEP:STATe?
Return	<DSC> States of the step sequencer: **IDLE**: sequencer is in IDLE state. **WAIT**: sequencer is waiting for a trigger.

[PROGram:]STEP:TTLTrg:ENABle[#] <Bool>

Function	Defines if the Trigger Out signal becomes active when the STEP program enters the active state
Parameter	0|1 or OFF|ON **0, OFF**: a trigger signal is not generated when the STEP program enters the active state. **1, ON**: a trigger signal is generated when the STEP program enters the active state.
Query	[PROGram:]STEP:TTLTrg:ENABle[#]?
Return	<Bool>

NOTE

Output trigger mode must be set to TRIG to enable this command to affect the Trigger Out signal; refer to OUTPut:TTLTrg:MODE[#] <DSC> in **Section 14.13.5: Output Subsystem**. Refer to **Section 9.4.5: Configuration Menu** to set the output trigger mode from the front panel.

[PROGram:]STEP:VOLTage:AC[#] <NRf>

Function	Sets the AC component rms amplitude of the step voltage in AC and ACDC mode
Parameter	Refer to **Table 14-8**
Unit	V
Query	[PROGram:]STEP:VOLTage:AC[#]?
Return	<NR2>

[PROGram:]STEP:VOLTage:AC:SLEW:DOWN[#] <NRf>

Function	Sets the slew rate for down programming the AC component of the step voltage in AC and ACDC mode
Parameter	Refer to **Table 14-8**
Unit	V/ms
Query	[PROGram:]STEP:VOLTage:AC:SLEW:DOWN[#]?
Return	<NR2>

[PROGram:]STEP:VOLTage:AC:SLEW:UP[#] <NRf>

Function	Sets the slew rate for up programming the AC component of the step voltage in AC and ACDC mode
Parameter	Refer to **Table 14-8**
Unit	V/ms
Query	[PROGram:]STEP:VOLTage:AC:SLEW:UP[#]?
Return	<NR2>

[PROGram:]STEP:VOLTage:DC[#] <NRf>

Function	Sets the DC offset of the step voltage in ACDC mode
Parameter	Refer to **Table 14-8**
Unit	V
Query	[PROGram:]STEP:VOLTage:DC[#]?
Return	<NR2>

[PROGram:]STEP:VOLTage:DC:SLEW:DOWN[#] <NRf>

Function	Sets the slew rate for down programming the DC offset of the step voltage in ACDC mode
Parameter	Refer to **Table 14-8**
Unit	V/ms
Query	[PROGram:] STEP:VOLTage:DC:SLEW:DOWN[#]?
Return	<NR2>

[PROGram:]STEP:VOLTage:DC:SLEW:UP[#] <NRf>

Function	Sets the slew rate for up programming the DC offset of the step voltage in ACDC mode
Parameter	Refer to **Table 14-8**
Unit	V/ms
Query	[PROGram:]STEP:VOLTage:DC:SLEW:UP[#]?
Return	<NR2>

[PROGram:]STEP:WAVeform[#] <USTR>

Function	Adds a name for the generated step waveform
Parameter	Name. The name of the waveform entered without quotes (USTR data type)
Query	[PROGram:]STEP:WAVeform[#]?
Return	<USTR>

NOTE

name is case sensitive

14.13.7.5 PROGram MODE Commands

NOTE

A few commands in this section have the same type of parameters. The parameters are summarized in **Table 14-9**.

Parameter	Explanation
IMMediate	Sets the basic configuration value immediately without waiting for a trigger
STEP	Sets the segment value when the trigger is applied and remains at that value
PULSe	Sets the segment value for the segment duration time when the trigger is applied. When duration finishes, the system returns to basic configuration value.
LIST	Sets the parameters according to the list sequence and controlled according to list control

Table 14-9: Mode Parameters

[PROGram:]MODE:ABORt <DSC>

Function	Sets the behavior of the power source when ABORt is sent
Parameter	OFF|IMMediate|LAST **OFF**: the output is turned off and all basic source settings (AC voltage, DC offset voltage, frequency, AC slew rates, DC offset slew rates, frequency slew rates, start and end phase angle) are restored to their IMMediate values. **IMMediate**: all basic source settings (AC voltage, DC offset voltage, frequency, AC slew rates, DC offset slew rates, frequency slew rates, start and end phase angle) are restored to their IMMediate values without changing the output setting. **LAST**: the power source settings are not restored to their IMMediate values, i.e., the output setting remains the way it was the moment the ABORt command was sent. Note: Output behavior may not reflect the IMMediate changes.

Query	[PROGram:]MODE:ABORt?
Return	<DSC>

NOTES

Use ABORt to abort the sequence.

[PROGram:]MODE:ABORt may not have any significance when used with the step sequencer as the step may be completed before ABORt is executed.

[PROGram:]MODE:END <DSC>

Function	Sets the behavior of the power source when the sequencer execution is completed and it enters the IDLE state.
Parameter	OFF|IMMediate|LAST **OFF**: the output is turned off and all basic source settings (AC voltage, DC offset voltage, frequency, AC slew rates, DC offset slew rates, frequency slew rates, start and end phase angle) are restored to their IMMediate values. **IMMediate**: all basic source settings (AC voltage, DC offset voltage, frequency, AC slew rates, DC offset slew rates, frequency slew rates, start and end phase angle) are restored to their IMMediate values without changing the output setting. **LAST**: the power source settings are not restored to their IMMediate values, i.e., the output setting remains the way it was the moment the sequencer finished running. Note: be aware that the output behavior may not reflect the IMMediate changes.
Query	[PROGram:]MODE:END?
Return	<DSC>

NOTES

This command differs from [PROGram:]MODE:ABORt <DSC>. It defines what happens when the sequencer ends successfully without the user sending ABORt.

[PROGram:]MODE:END <DSC> must always be set with **LAST** for the step sequencer.

[PROGram:]MODE:END <DSC> with **OFF** parameter may not have any significance when used with the step sequencer as the power source may turn OFF even before the step is executed.

[PROGram:]MODE:END <DSC> with **IMM** and **LAST** parameters behave in the same way when used with the pulse sequencer as the sequencer stops with the IMM values.

[PROGram:]MODE:FREQuency <DSC>

Function	Sets the mode of the frequency
Parameter	Refer to **Table 14-9**
Query	[PROGram:]MODE:FREQuency?
Return	<DSC>

[PROGram:]MODE:FREQuency:SLEW <DSC>

Function	Sets the mode of the slew rate of the output frequency
Parameter	Refer to **Table 14-9**
Query	[PROGram:]MODE:FREQuency:SLEW?
Return	<DSC>

[PROGram:]MODE:PHASe:END <DSC>

Function	Sets the mode of the end phase
Parameter	OFF|PULSe|LIST|FLEX **OFF**: the sequencer does not affect the end phase angle at each new segment. The segment ends as soon as its duration has expired, without waiting for a specific end phase angle. **PULSe**: the sequencer sets the end phase angle when the PULSE sequencer is triggered **LIST**: the sequencer sets the end phase angle of each new segment according to the list of the end phases **FLEX**: all types of sequencers can set the end phase angle. The value is taken from the settings of the program that is triggered. If several programs are triggered at once, the end phase angle is taken in the following order: PULSE (highest priority) and then LIST (lowest priority).
Query	[PROGram:]MODE:PHASe:END?
Return	<DSC>

[PROGram:]MODE:PHASe:SHIFt <DSC>

Function	Sets the phase shift mode during the sequencer.
Parameter	Refer to **Table 14-9**
Query	[PROGram:]MODE:PHASe:SHIFt?
Return	<DSC>

NOTE

This command is available from firmware version 001.006.000 onwards.

[PROGram:]MODE:PHASe:STARt <DSC>

Function	Sets the mode of the start phase
Parameter	OFF|STEP|PULSe|LIST|FLEX **OFF**: the sequencer does not affect the start phase angle at each new segment. The start phase angle at a new segment is continuous (i.e., it continues from the end phase angle of the previous segment). **STEP**: the sequencer sets the start phase angle when the STEP sequencer is triggered **PULSe**: the sequencer sets the start phase angle when the PULSE sequencer is triggered **LIST**: the sequencer sets the start phase angle of each new segment according to the list of the start phases **FLEX**: all types of sequencers can set the start phase angle. The start phase angle value is taken from the settings of the program that is triggered. If several programs are triggered at once, the start phase angle is taken in the following order: STEP (highest priority), PULSE, and then LIST (lowest priority).
Query	[PROGram:]MODE:PHASe:STARt?
Return	<DSC>

[PROGram:]MODE:VOLTage:AC <DSC>

Function	Sets the sequence mode to set the rms amplitude of the voltage in AC and ACDC mode
Parameter	Refer to **Table 14-9**
Query	[PROGram:]MODE:VOLTage:AC?
Return	<DSC>

[PROGram:]MODE:VOLTage:AC:SLEW <DSC>

Function	Sets the mode of the slew rate for AC component of the output voltage in AC and ACDC mode
Parameter	Refer to **Table 14-9**
Query	[PROGram:]MODE:VOLTage:AC:SLEW?
Return	<DSC>

[PROGram:]MODE:VOLTage:DC <DSC>

Function	Sets the sequence mode to set the DC offset in ACDC mode
Parameter	Refer to **Table 14-9**
Query	[PROGram:]MODE:VOLTage:DC?
Return	<DSC>

[PROGram:]MODE:WAVeform <DSC>

Function	Sets the mode of the waveform
Parameter	Refer to **Table 14-9**
Query	[PROGram:]MODE:WAVeform?
Return	<DSC>

[PROGram:]MODE:VOLTage:DC:SLEW <DSC>

Function	Sets the mode of the slew rate for DC offset of the output voltage in ACDC mode
Parameter	Refer to **Table 14-9**
Query	[PROGram:]MODE:VOLTage:DC:SLEW?
Return	<DSC>

14.13.7.6 AC/DC/ACDC Sequencer - Memory Commands

[PROGram:]CLEAr:AC <NR1>

Function	Clears an AC sequence from the memory. Refer to **Table 13-3**.
Parameter	1–4
Query	[PROGram:]CLEAr:AC? <NR1> <NR1> is the number of the memory cell. 0 is returned if the memory cell has data. 1 is returned if memory cell is empty.
Return	<Bool>
Example	PROGram:CLEAr:AC? 1 returns 0 if memory cell 1 has data in it, else it returns 1.

NOTE

The execution of this command may take up to 150ms.

[PROGram:]CLEAr:DC <NR1>

Function	Clears a DC sequence from the memory. Refer to **Table 13-3**.
Parameter	1–4
Query	[PROGram:]CLEAr:DC? <NR1> <NR1> is the number of the memory cell. 0 is returned if the memory cell has data. 1 is returned if memory cell is empty.
Return	<Bool>
Example	PROGram:CLEAr:DC? 1 returns 0 if memory cell 1 has data in it, else it returns 1.

NOTE

The execution of this command may take up to 50ms.

[PROGram:]LOAD:AC <NR1>

Function	Loads an AC sequence from the memory that was previously stored with [PROGram:]STORe:AC <NR1> or stored from the front panel (refer to **Section 9.4.9: Program Menu)**. The command loads all STEP, PULSe, LIST, and MODE settings. Refer to **Table 13-3**.
Parameter	1–4
Query	[PROGram:]LOAD:AC? This query indicates which AC memory cell is loaded.
Return	<NR1>

NOTES

The execution of this command may take up to 30ms.

If any loaded sequence data has been changed but has not been stored yet, or if no sequence is loaded, the reply is 0.

[PROGram:]LOAD:DC <NR1>

Function	Loads a DC sequence from the memory that was previously stored with [PROGram:]STORe:DC <NR1> or stored from the front panel (refer to **Section 9.4.9: Program Menu)**. Refer to **Table 13-3**.
Parameter	1–4
Query	[PROGram:]LOAD:DC? This query indicates which memory cell is loaded.
Return	<NR1>

NOTES

The execution of this command may take up to 10ms.

If any loaded sequence data has been changed but has not been stored yet or if no sequence is loaded, the reply is 0.

[PROGram:]STORe:AC <NR1>

Function	Stores all STEP, PULSe, LIST, and MODE settings to memory. Refer to **Table 13-3**.
Parameter	1–4

NOTE

The execution of this command may take up to 180ms.

[PROGram:]STORe:DC <NR1>

Function	Stores a DC sequence settings to memory. Refer to **Table 13-3**.
Parameter	1–4

NOTE

The execution of this command may take up to 60ms.

14.13.8 Source Subsystem

	Output Voltage and Current Programming Values
Voltage	**AC mode**: 0–360.2Vac **ACDC mode**: 0–360.2Vac, -360.2–360.2Vdc **DC mode**: -510.2–510.2Vdc
Current	**Models:** 2kVA: 0 to (20+0.2)*n, 3kVA and 4kVA: 0 to (30+0.2)*n 6kVA: 0 to 60.6*n, 9kVA and 12kVA: 0 to 90.6*n 18kVA and 24kVA: 0 to 181.2*n n is the number of power sources connected in parallel. For example: For 3kVA: 0A to 30.2A 9kVA: 0A to 90.6A 6kVA: (3kVA x 2) units in parallel: 0A to 60.4A 9kVA: (3kVA x 3) units in parallel: 0A to 90.6A 18kVA: (9kVA x 2) units in parallel: 0A to 181.2A

	V**oltage Slew Rate Programming Values**
1.2KHz Power Source	0.0001–4400V/ms
5KHz Power Source	0.0001–16340V/ms

	Frequency Programming Values
1.2KHz Power Source	16–1200Hz
5KHz Power Source	16–5000Hz

1.2KHz and 5KHz Power Source	**Frequency Slew Programming Values**
	0.0001–99999.9999Hz/ms

Table 14-10: Programming Values

[SOURce:]CURRent[:LEVel][:IMMediate][:AC][#] <NRf>

Function	Sets the rms amplitude of the output current in AC mode
Parameter	Refer to **Table 14-10**
Unit	A
Query	[SOURce:]CURRent[:LEVel][:IMMediate][:AC][#]?
Return	<NR2>

[SOURce:]CURRent[:LEVel][:IMMediate]:ACDC[#] <NRf>

Function	Sets the rms amplitude of the output current in ACDC mode
Parameter	Refer to **Table 14-10**
Unit	A
Query	[SOURce:]CURRent[:LEVel][:IMMediate]:ACDC[#]?
Return	<NR2>

[SOURce:]CURRent[:LEVel][:IMMediate]:DC[#] <NRf>

Function	Sets the amplitude of the output current in DC mode
Parameter	Refer to **Table 14-10**
Unit	A
Query	[SOURce:]CURRent[:LEVel][:IMMediate]:DC[#]?
Return	<NR2>

[SOURce:]CURRent:PROTection:PEAK:HIGH[:LEVel][#] <NRf>

Function	Sets the upper limit of the peak Over-Current Protection (OCP) level
Parameter	(0.5*n)–(130*n), where n is the number of power sources connected in parallel
Unit	A
Example	**3kVA**: 0.5A to 130A **9kVA**: 1.5A to 390A
Query	[SOURce:]CURRent:PROTection:PEAK:HIGH[:LEVel][#]?
Return	<NR2>

NOTES

Setting per phase can be made starting from firmware revision 001.010.000. For older revisions, settings are global.

This protection setting does not limit the value of the current setting.

A minimum difference of 5A must be maintained between the OCP high and low limits.

[SOURce:]CURRent:PROTection:PEAK:LOW[:LEVel][#] <NRf>

Function	Sets the lower limit of the peak Over-Current Protection (OCP) level
Parameter	(-130*n)–(-0.5*n), where n is the number of power sources connected in parallel
Unit	A
Example	**3kVA**: -130A to -0.5A **9kVA**: -390A to -1.5A
Query	[SOURce:]CURRent:PROTection:PEAK:LOW[:LEVel][#]?
Return	<NR2>

NOTES

Setting per phase can be made starting from firmware revision 001.010.000. For older revisions, settings are global.

This protection setting does not limit the value of the current setting.

A minimum difference of 5A must be maintained between the OCP high and low limits.

[SOURce:]FREQuency[:IMMediate] <NRf>

Function	Sets the frequency for the output waveform in AC and ACDC mode.
Parameter	Refer to **Table 14-10**
Unit	Hz
Query	[SOURce:]FREQuency[:IMMediate]?
Return	<NR2>

[SOURce:]FREQuency[:IMMediate]:SLEW:DOWN <NRf>

Function	Sets the slew rate for down programming the frequency in AC and ACDC mode.
Parameter	Refer to **Table 14-10**
Unit	Hz/ms
Query	[SOURce:]FREQuency[:IMMediate]:SLEW:DOWN?
Return	<NR2>

[SOURce:]FREQuency[:IMMediate]:SLEW:UP <NRf>

Function	Sets the slew rate for up programming the frequency in AC and ACDC mode.
Parameter	Refer to **Table 14-10**
Unit	Hz/ms
Query	[SOURce:]FREQuency[:IMMediate]:SLEW:UP?
Return	<NR2>

[SOURce:]MODE <DSC>

Function	Sets the mode of operation of the device
Parameter	AC|ACDC|DC
Query	[SOURce:]MODE?
Return	<DSC>

NOTE

The command can be executed at Output OFF state only.

[SOURce:]PHASe:SHIFt[#] <NRf>

Function	Sets the difference in phase angle between phase 1 and the other phases (#).
Parameter	0–359.9
Unit	° (degrees)
Query	[SOURce:]PHASe:SHIFt[#]?
Return	<NR2>

NOTES

This command is applicable for a multi-phase system only.

This command is not applicable if the power source is externally controlled using the FULL function. Refer to SYSTem:EXTernal:FUNCtion[#] <DSC> in **Section 14.13.10: System Subsystem** or to **Section 9.4.5: Configuration Menu**.

[SOURce:]POWer:PROTection[:AC][:LEVel][#] <NRf>

Function	Sets the level of Over-Power Protection (OPP) in AC mode
Parameter	((1% of Pmax) * n)–((110% of Pmax) * n), where n is the number of power sources connected in parallel.
Unit	VA
Example	**3kVA**: 30VA to 3300VA **9kVA**: 90VA to 9900VA
Query	[SOURce:]POWer:PROTection[:AC][:LEVel][#]?
Return	<NR2>

NOTE

Setting per phase can be made starting from firmware revision 001.010.000. For older revisions, settings are global.

[SOURce:]POWer:PROTection:ACDC[:LEVel][#] <NRf>

Function	Sets the level of Over-Power Protection (OPP) in ACDC mode
Parameter	((1% of Pmax) * n)–((110% of Pmax) * n), where n is the number of power sources connected in parallel.
Unit	VA
Example	**3kVA**: 30VA to 3300VA **9kVA**: 90VA to 9900VA
Query	[SOURce:]POWer:PROTection:ACDC[:LEVel][#]?
Return	<NR2>

NOTE

Setting per phase can be made starting from firmware revision 001.010.000. For older revisions, settings are global.

[SOURce:]POWer:PROTection:DC[:LEVel][#] <NRf>

Function	Sets the level of Over-Power Protection (OPP) in DC mode
Parameter	((1% of Pmax) * n)–((110% of Pmax) * n), where n is the number of power sources connected in parallel.
Unit	W
Example	**3kVA**: 30W to 3300W **9kVA**: 90W to 9900W
Query	[SOURce:]POWer:PROTection:DC[:LEVel][#]?
Return	<NR2>

NOTE

Setting per phase can be made starting from firmware revision 001.010.000. For older revisions, settings are global.

[SOURce:]VOLTage:AC[:IMMediate]:SLEW:DOWN[#] <NRf>

Function	Sets the slew rate for down programming the AC component of the output voltage in AC and ACDC mode
Parameter	Refer to **Table 14-10**
Unit	V/ms
Query	[SOURce:]VOLTage:AC[:IMMediate]:SLEW:DOWN[#]?
Return	<NR2>

[SOURce:]VOLTage:AC[:IMMediate]:SLEW:UP[#] <NRf>

Function	Sets the slew rate for up programming the AC component of the output voltage in AC and ACDC mode
Parameter	Refer to **Table 14-10**
Unit	V/ms
Query	[SOURce:]VOLTage:AC[:IMMediate]:SLEW:UP[#]?
Return	<NR2>

[SOURce:]VOLTage:AC:SLEW:OFF <NRf>

Function	Sets the slew rate of the AC component of the output voltage in AC and ACDC mode during ON to OFF transition
Parameter	Refer to **Table 14-10**
Unit	V/ms
Query	[SOURce:]VOLTage:AC:SLEW:OFF?
Return	<NR2>

NOTES

The value takes effect once the output setting has been set to OFF. Even if the user tries to change the AC voltage setting or slew rate of the AC component during transition, slew OFF setting is unaffected.

Turning the output ON during the slew OFF period, disables slew OFF function. The power source slews up using the slew ON settings.

[SOURce:]VOLTage:AC:SLEW:ON <NRf>

Function	Sets the slew rate of the AC component of the output voltage in AC and ACDC mode during OFF to ON transition
Parameter	Refer to **Table 14-10**
Unit	V/ms
Query	[SOURce:]VOLTage:AC:SLEW:ON?
Return	<NR2>

NOTES

The value takes effect once the output has been set to ON, and until the AC voltage's target setting is reached or the AC voltage's target setting is changed.

Even if the power source enters the CC mode while it is slewing, the slew rate values are not affected. Once the CC boundary is cleared (power source enters CV mode), the slew continues using the startup value.

[SOURce:]VOLTage:BALance:AC <NRf>

Function	Sets the voltage correction level for the AC component in AC and ACDC modes. If the difference between the AC voltage setting and the measured output voltage is smaller than the voltage correction level, the power source gradually increases or decreases its reference AC voltage automatically until the setting and output are equal. The correction is applied to the voltage amplitude. If the difference is greater than the voltage correction level, a fault is reported (balance fail) and the output is turned off, if the balance fail setting is enabled; refer to [SOURce:]VOLTage:BALance:FAIL[:ENABle] <Bool> or refer to **Section 9.4.5: Configuration Menu**.
Parameter	0–360.2
Unit	V
Query	[SOURce:]VOLTage:BALance:AC?
Return	<NR2>

[SOURce:]VOLTage:BALance:AC:ENABle <Bool>

Function	Enables or disables the voltage correction of the AC component in AC and ACDC modes
Parameter	0|1 or OFF|ON
Query	[SOURce:]VOLTage:BALance:AC:ENABle?
Return	<Bool>

[SOURce:]VOLTage:BALance:DC <NRf>

Function	Sets the voltage correction level for the DC offset in DC and ACDC modes. If the difference between the DC voltage setting and the measured output voltage is smaller than the voltage correction level, the power source gradually increases or decreases its reference DC voltage automatically until the setting and output are equal. If the difference is greater than the voltage correction level, a fault is reported (balance fail) and the output is turned off, if the balance fail setting is enabled; refer to [SOURce:]VOLTage:BALance:FAIL[:ENABle] <Bool> or refer to **Section 9.4.5: Configuration Menu**.
Parameter	-510.2–510.2
Unit	V
Query	[SOURce:]VOLTage:BALance:DC?
Return	<NR2>

[SOURce:]VOLTage:BALance:DC:ENABle <Bool>

Function	Enables or disables the voltage correction for the DC offset in DC and ACDC mode
Parameter	0|1 or OFF|ON
Query	[SOURce:]VOLTage:BALance:DC:ENABle?
Return	<Bool>

[SOURce:]VOLTage:BALance:FAIL[:ENABle] <Bool>

Function	Enables or disables the balancing failure fault. If disabled, the balancing fault does not turn the output off, and the fault is not reported.
Parameter	0|1 or OFF|ON
Query	[SOURce:]VOLTage:BALance:FAIL[:ENABle]?
Return	<Bool>

[SOURce:]VOLTage:BALance:RESPonse[:SPEed] <DSC>

Function	Sets the response speed of voltage balancing in CV and CC mode. This also affects the transition time between CV and CC. The faster the response, the quicker the voltage is corrected.
Parameter	SLOW|MEDium|FAST
Query	[SOURce:]VOLTage:BALance:RESPonse[:SPEed]?
Return	<DSC>

[SOURce:]VOLTage:DC[:IMMediate]:SLEW:DOWN[#] <NRf>

Function	Sets the slew rate for down programming the DC offset of the output voltage in ACDC and DC mode
Parameter	Refer to **Table 14-10**
Unit	V/ms
Query	[SOURce:]VOLTage:DC[:IMMediate]:SLEW:DOWN[#]?
Return	<NR2>

[SOURce:]VOLTage:DC[:IMMediate]:SLEW:UP[#] <NRf>

Function	Sets the slew rate for up programming the DC offset of the output voltage in ACDC and DC mode
Parameter	Refer to **Table 14-10**
Unit	V/ms
Query	[SOURce:]VOLTage:DC[:IMMediate]:SLEW:UP[#]?
Return	<NR2>

[SOURce:]VOLTage:DC:SLEW:OFF <NRf>

Function	Sets the slew rate for the DC offset of the output voltage in ACDC and DC mode during ON to OFF transition
Parameter	Refer to **Table 14-10**
Unit	V/ms
Query	[SOURce:]VOLTage:DC:SLEW:OFF?
Return	<NR2>

NOTES

The value takes effect once the setting has been set to OFF. Even if the user tries to change the DC voltage setting or slew rate, the slew OFF setting is unaffected.

Turning the output ON during the slew OFF period, disables the slew OFF function. The power source slews up using the slew ON settings.

[SOURce:]VOLTage:DC:SLEW:ON <NRf>

Function	Sets the slew rate for the DC offset of the output voltage in ACDC and DC mode during OFF to ON transition
Parameter	Refer to **Table 14-10**
Unit	V/ms
Query	[SOURce:]VOLTage:DC:SLEW:ON?
Return	<NR2>

NOTES

This slew rate is valid once the output has been turned on, and until the DC voltage's target setting is reached or the DC voltage's target setting is changed.

Even if the power source enters the CC mode while it is slewing, the slew rate values are not affected. Once the CC boundary is cleared, the slew continues using the startup value.

[SOURce:]VOLTage[:LEVel][:IMMediate][:AC][#] <NRf>

Function	Sets the rms amplitude of the output voltage in AC mode
Parameter	Refer to **Table 14-10**
Unit	V
Query	[SOURce:]VOLTage[:LEVel][:IMMediate][:AC][#]?
Return	<NR2>

[SOURce:]VOLTage[:LEVel][:IMMediate]:ACDC[:AC][#] <NRf>

Function	Sets the rms amplitude of the AC component of the output voltage in ACDC mode
Parameter	Refer to **Table 14-10**
Unit	V
Query	[SOURce:]VOLTage[:LEVel][:IMMediate]:ACDC[:AC][#]?
Return	<NR2>

[SOURce:]VOLTage[:LEVel][:IMMediate]:ACDC:DC[#] <NRf>

Function	Sets the DC offset of the output voltage in ACDC mode
Parameter	Refer to **Table 14-10**
Unit	V
Query	[SOURce:]VOLTage[:LEVel][:IMMediate]:ACDC:DC[#]?
Return	<NR2>

[SOURce:]VOLTage[:LEVel][:IMMediate]:DC[#] <NRf>

Function	Sets the output voltage in DC mode
Parameter	Refer to **Table 14-10**
Unit	V
Query	[SOURce:]VOLTage[:LEVel][:IMMediate]:DC[#]?
Return	<NR2>

[SOURce:]VOLTage:PROTection[:AC][:LEVel][#] <NRf>

Function	Sets the rms limit of Over-Voltage Protection (OVP) in AC mode
Parameter	5–385
Unit	V
Query	[SOURce:]VOLTage:PROTection[:AC][:LEVel][#]?
Return	<NR2>

NOTES

Setting per phase can be made starting from firmware revision 001.010.000. For older revisions, settings are global.

Minimum setting value is limited to 5% above actual voltage programming setting value or 5V.

[SOURce:]VOLTage:PROTection[:AC]:LOW[:LEVel][#] <NRf>

Function	Sets the rms limit of the Under-Voltage Protection (UVP) in AC mode.
Parameter	0–333.33
Unit	V
Query	[SOURce:]VOLTage:PROTection[:AC]:LOW[:LEVel][#]?
Return	<NR2>

NOTES

Setting per phase can be made starting from firmware revision 001.010.000. For older revisions, settings are global.

Maximum setting value is limited to 5% below actual voltage programming setting value.

[SOURce:]VOLTage:PROTection[:AC]:LOW:STATe[#] <Bool>

Function	Enables or disables the Under-Voltage protection (UVP) function in AC mode.
Parameter	0|1 or OFF|ON **0, OFF**: UVP disabled. This mode disables the UVP function. **1, ON**: UVP enabled. This mode enables the UVP function and disables the output when the measured voltage reaches the UVP level.
Query	[SOURce:]VOLTage:PROTection[:AC]:LOW:STATe[#]?
Return	<Bool>

NOTES

Setting per phase can be made starting from firmware revision 001.010.000. For older revisions, settings are global.

UVP function is disabled if Under-Voltage limit setting is below 5% of the rated power source voltage.

[SOURce:]VOLTage:PROTection[:AC]:PEAK:HIGH[:LEVel][#] <NRf>

Function	Sets the upper limit of the peak Over-Voltage Protection (OVP) in AC mode
Parameter	0–550
Unit	V
Query	[SOURce:]VOLTage:PROTection[:AC]:PEAK:HIGH[:LEVel][#]?
Return	<NR2>

NOTE

Setting per phase can be made starting from firmware revision 001.010.000. For older revisions, settings are global.

[SOURce:]VOLTage:PROTection[:AC]:PEAK:LOW[:LEVel][#] <NRf>

Function	Sets the lower limit of the peak Over-Voltage Protection (OVP) in AC mode
Parameter	-550–0
Unit	V
Query	[SOURce:]VOLTage:PROTection[:AC]:PEAK:LOW[:LEVel][#]?
Return	<NR2>

NOTE

Setting per phase can be made starting from firmware revision 001.010.000. For older revisions, settings are global.

[SOURce:]VOLTage:PROTection:ACDC[:LEVel][#] <NRf>

Function	Sets the rms limit of Over-Voltage Protection (OVP) in ACDC mode
Parameter	5–385
Unit	V
Query	[SOURce:]VOLTage:PROTection:ACDC[:LEVel][#]?
Return	<NR2>

NOTES

Setting per phase can be made starting from firmware revision 001.010.000. For older revisions, settings are global.

Minimum setting value is limited to 5% above actual voltage programming setting value or 5V.

[SOURce:]VOLTage:PROTection:ACDC:LOW[:LEVel][#] <NRf>

Function	Sets the rms limit of the Under-Voltage protection (UVP) in ACDC mode.
Parameter	0–333.33
Unit	V
Query	[SOURce:]VOLTage:PROTection:ACDC:LOW[:LEVel][#]?
Return	<NR2>

NOTES

Setting per phase can be made starting from firmware revision 001.010.000. For older revisions, settings are global.

Maximum setting value is limited to 5% below actual voltage programming setting value.

[SOURce:]VOLTage:PROTection:ACDC:LOW:STATe[#] <Bool>

Function	Enables or disables the Under-Voltage Protection (UVP) function in ACDC mode.
Parameter	0|1 or OFF|ON **0, OFF**: UVP disabled. This mode disables the UVP function. **1, ON**: UVP enabled. This mode enables the UVP function and disables the output when the measured voltage reaches the UVP level.
Query	[SOURce:]VOLTage:PROTection:ACDC:LOW:STATe[#]?
Return	<Bool>

NOTE

Setting per phase can be made starting from firmware revision 001.010.000. For older revisions, settings are global.

[SOURce:]VOLTage:PROTection:ACDC:PEAK:HIGH[:LEVel][#]<NRf>

Function	Sets the upper limit of the peak Over-Voltage Protection (OVP) in ACDC mode
Parameter	0–550
Unit	V
Query	[SOURce:]VOLTage:PROTection:ACDC:PEAK:HIGH[:LEVel][#]?
Return	<NR2>

NOTE

Setting per phase can be made starting from firmware revision 001.010.000. For older revisions, settings are global.

[SOURce:]VOLTage:PROTection:ACDC:PEAK:LOW[:LEVel][#] <NRf>

Function	Sets the lower limit of the peak Over-Voltage Protection (OVP) in ACDC mode
Parameter	-550–0
Unit	V
Query	[SOURce:]VOLTage:PROTection:ACDC:PEAK:LOW[:LEVel][#]?
Return	<NR2>

NOTE

Setting per phase can be made starting from firmware revision 001.010.000. For older revisions, settings are global.

[SOURce:]VOLTage:PROTection:DC[:LEVel][#] <NRf>

Function	Sets the limit of Over-Voltage Protection (OVP) in DC mode.
Parameter	5–550
Unit	V
Query	[SOURce:]VOLTage:PROTection:DC[:LEVel][#]?
Return	<NR2>

NOTES

Setting per phase can be made starting from firmware revision 001.010.000. For older revisions, settings are global.

Minimum setting value is limited to 5% above actual voltage programming setting value or 5V.

[SOURce:]VOLTage:PROTection:DC:LOW[:LEVel][#] <NRf>

Function	Sets the limit of the Under-Voltage Protection (UVP) in DC mode.
Parameter	0–476.2
Unit	V
Query	[SOURce:]VOLTage:PROTection:DC:LOW[:LEVel][#]?
Return	<NR2>

NOTES

Setting per phase can be made starting from firmware revision 001.010.000. For older revisions, settings are global.

Maximum setting value is limited to 5% below actual voltage programming setting value.

[SOURce:]VOLTage:PROTection:DC:LOW:STATe[#] <Bool>

Function	Enables or disables the Under-Voltage Protection (UVP) function in DC mode.
Parameter	0|1 or OFF|ON **0, OFF**: UVP disabled. This mode disables the UVP function. **1, ON**: UVP enabled. This mode enables the UVP function and disables the output when the measured voltage reaches the UVP level.
Query	[SOURce:]VOLTage:PROTection:DC:LOW:STATe[#]?
Return	<Bool>

NOTE

Setting per phase can be made starting from firmware revision 001.010.000. For older revisions, settings are global.

[SOURce:]VOLTage:PROTection:DC:PEAK:HIGH[:LEVel][#] <NRf>

Function	Sets the upper limit of the peak Over-Voltage Protection (OVP) in DC mode
Parameter	0–550
Unit	V
Query	[SOURce:]VOLTage:PROTection:DC:PEAK:HIGH[:LEVel][#]?
Return	<NR2>

NOTE

Setting per phase can be made starting from firmware revision 001.010.000. For older revisions, settings are global.

[SOURce:]VOLTage:PROTection:DC:PEAK:LOW[:LEVel][#] <NRf>

Function	Sets the lower limit of the peak Over-Voltage Protection (OVP) in DC mode
Parameter	-550–0
Unit	V
Query	[SOURce:]VOLTage:PROTection:DC:PEAK:LOW[:LEVel][#]?
Return	<NR2>

NOTE

Setting per phase can be made starting from firmware revision 001.010.000. For older revisions, settings are global.

[SOURce:]VOLTage:PROTection:DROP[:LEVel] <NRf>

Function	Sets the maximum level of voltage drop-on-wire
Parameter	0–35
Unit	V
Query	[SOURce:]VOLTage:PROTection:DROP[:LEVel]?
Return	<NR2>

[SOURce:]VOLTage:PROTection:LOW:DELay <NRf>

Function	Sets the time delay between the UVP fault event and disabling of the output.
Parameter	0.1–25.5
Unit	s
Query	[SOURce:]VOLTage:PROTection:LOW:DELay?
Return	<NR2>

14.13.9 Status Subsystem

STATus:ALM:CONFigure <NR1>

Function	Sets the alarm signal logic. The command receives a register of 32 bits. Each bit that is high corresponds to fault/event which generates alarm event.
Parameter	0–4294967295
Query	STATus:ALM:CONFigure?
Return	<NR1>

STATus:OPERation:CONDition?

Function	Returns the value of the Condition Register in the Operational Condition (Status Register) Group. This is a read-only register that holds the real-time operational status of the power source. Refer to STATus:OPERation[:EVENt]? for the complete list of the register.
Return	<NR1>

STATus:OPERation:ENABle <NR1>

Function	Sets the value of the Enable Register in the Operational Condition (Status Register) Group. This register is a mask for enabling specific bits from the Condition Register to the Event Register. Refer to STATus:OPERation[:EVENt]? for the complete list of the register bits that can be masked.
Parameter	0–4294967295
Query	STATus:OPERation:ENABle?
Return	<NR1>

STATus:OPERation[:EVENt]?

Function

Returns the value of the Event Register in the Operational Condition (Status Register) Group. This is a read-only register.

The value depends on the setting of the Condition Register and the Enable Register in that group; refer to **Figure 14-1**.

Events are updated on the transition from 0 to 1. Reading the register clears it.

The bit configuration of the Event Register is as follows:

Position	31	30	29	28	27	26	25	24
Name	0	0	0	0	0	UVP_ ACDC	UVP_ DC	ENA
Position	**23**	**22**	**21**	**20**	**19**	**18**	**17**	**16**
Name	ILC	0	VFB	LIST	PULS	TLIS	TPUL	TSTEP

Position	15	14	13	12	11	10	9	8
Name	0	0	0	EVR	CFB	ENAE	ILCE	UVP_AC
Position	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
Name	LOC	SSA	STOP	AST	TWI	NFLT	CC	CV

0: Not Used

UVP_ACDC: ACDC Under-Voltage Protection.
Set to **1** when protection mode is enabled in ACDC mode.

EVR: External Voltage Reference.
Set to **1** when the analog voltage programming channel is set.

	UVP_DC: DC Under-Voltage Protection. Set to **1** when protection mode is enabled in DC mode. **ENA**: Enable Active. Set to **1** when the Enable function is active (power source turned off by ENA signal). **ILC**: Interlock Active. Set to **1** when the Interlock function is active (power source turned off by ILC signal). **VFB**: Voltage Foldback Enabled. Set to **1** when Constant Voltage foldback mode is enabled. **LIST**: LIST sequencer is running. Set to **1** when the LIST sequencer is in the ACTIVE state. **PULS**: PULSE sequencer is running. Set to **1** when the PULSE sequencer is in the ACTIVE or INACTIVE state. **TLIS**: Trigger Wait for the LIST sequencer. Set to **1** when the LIST sequencer is waiting for a trigger. **TPUL**: Trigger Wait for the PULSE Sequencer. Set to **1** when the PULSE sequencer is waiting for trigger. **TSTEP**: Trigger Wait for the STEP Sequencer. Set to **1** when the STEP sequencer is waiting for a trigger.	**CFB**: Current Foldback Enabled. Set to **1** when Constant Current Foldback mode is enabled. **ENAE**: Enable Enabled. Set to **1** when the Enable function is enabled. **ILCE**: Interlock Enabled. Set to **1** when the Interlock function is enabled. **UVP_AC**: AC Under-Voltage Protection. Set to **1** when protection function is enabled in AC mode. **LOC**: Local/Remote. Set to **1** when power source is in the Local mode. **SSA**: Sequencer Step Active (DC Sequencer). Set to **1** when the DC sequencer is running. **STOP**: E-Stop enabled. Set to **1** when E-Stop is enabled **AST**: Auto-Start Enabled. Set to **1** when Auto-Start mode is enabled **TWI**: Trigger Wait (DC sequencer). Set to **1** when the power source is waiting for a trigger. **NFLT**: No Fault. Set to **1** when there are no faults, according to the Questionable Condition Group Enable register. **CC**: Constant Current. Set to **1** when the power source is in Constant Current mode. **CV**: Constant Voltage. Set to **1** when the power source is in Constant Voltage mode.
Return	<NR1>	

STATus:QUEStionable:CONDition?

Function	Returns the value of the Condition Register in the Questionable Condition (Fault Register) Group. This is a read-only register that holds the real-time conditional status of the power source. Refer to STATus:QUEStionable[:EVENt]? for the complete list of the register.
Return	<NR1>

STATus:QUEStionable:ENABle <NR1>

Function	Sets the value of the Enable Register in the Questionable Condition (Fault Register) Group. This register is a mask for enabling specific bits from the Condition Register to the Event Register. Refer to STATus:QUEStionable[:EVENt]? for the complete list of the register bits that can be masked.
Parameter	0–4294967295
Query	STATus:QUEStionable:ENABle?
Return	<NR1>

STATus:QUEStionable[:EVENt]?

Function

Returns the value of the Event Register in the Questionable Condition (Fault Register) Group. This is a read-only register.

The value depends on the setting of the Condition Register and the Enable Register in that group; refer to **Figure 14-1.**

Events are updated on the transition from 0 to 1. Reading the register clears it.

The bit configuration of the Event Register is as follows:

Position	31	30	29	28	27	26	25	24
Name	0	0	0	DCDC_ MOCP	PK_ MOCP	CBAL	VCF	UFP
Position	23	22	21	20	19	18	17	16
Name	OFP	SHORT	PK_OCP	OPP_LINE	SW_OTP	HW	PDOW	DOW

Position	15	14	13	12	11	10	9	8
Name	OVP_P	STOP	0	POFF	PWS	PERR	GERR	PACK
Position	7	6	5	4	3	2	1	0
Name	UVP	OFF	OPP	OVP	FLD	OTP	AC	0

0: Not Used

DCDC_MOCP: DCDC Maximum Over Current Protection fault (hardware).
Set to 1 when the DCDC peak current is outside the maximum allowed peak current (by hardware).

PK_MOCP: Peak Maximum Over Current Protection fault (hardware OCP triggered at approx. 135A). Set to **1** when the DC-AC bridge current is outside of the maximum allowed peak current (by hardware).

SW_OTP: Ambient Over-Temperature Protection.
Set to **1** when Ambient Over- Temperature fault occurs.

HW: Hardware Fault.
Set to **1** when a Hardware Fault occurs. Contact service if error persists

PDOW: Peak Drop on Wire.
Set to **1** when Peak Drop on Wire Over-Voltage Protection fault occurs.

DOW: Drop on Wire.
Set to **1** when Drop on Wire Over-Voltage Protection fault occurs.

	CBAL: Current Imbalance fault. Set to **1** when DCAC output bridges sense Current Imbalance between the multiple inverter channels. Contact service if error persists. **VCF**: Voltage Control Frequency (Power Factor output voltage) shutdown fault. Set to **1** when VCF Shutdown occurs. Contact service if error persists **UFP**: Under Frequency Protection fault. Set to **1** when the measured output frequency is less than 15 Hz. **OFP**: Over-Frequency Protection fault Set to **1** when the measured output. frequency is greater than 1400Hz for 1200Hz power source, or greater than 5200Hz for 5000Hz power source. **SHORT (*)**: Shorted Output fault. Set to **1** when the output is shorted. **PK_OCP**: Peak Over Current Protection fault. Set to **1** when the peak output current measurement is outside the peak OCP setting of the user **OPP_LINE**: Over-Power Protection fault due to AC input line being low for 1-Phase input. Set to **1** when 1-phase AC input line goes low (below 170Vac) and the measured output power exceeds 1500 Volt-Amps or Watts.	**OVP_P**: Peak Over-Voltage Protection. Set to **1** when Peak Over-Voltage Protection fault occurs. **STOP**: E-STOP Shutdown. Set to **1** when E-STOP fault occurs. **POFF**: Power OFF. Set to **1** when the power source power switch is OFF. **PWS** – Parallel Wait Slave. Set to **1** when master power source is waiting for slaves to become ready. **PERR**: Parallel Error. Set to **1** when an error occurs in parallel system (parallel system communication failure). **GERR**: General Error. Set to **1** when unrecoverable system fault occurs. Recycle the AC input. **PACK**: Parallel Acknowledge Set to **1** to acknowledge the new parallel configuration **UVP**: Under-Voltage Protection. Set to **1** when Under Voltage Protection fault occurs. **OFF**: Front panel output OFF. Set to **1** when the front panel OFF button is pressed. **OPP**: Over-Power Protection. Set to **1** when the Over-Power Protection fault occurs. **OVP**: Over-Voltage Protection (rms). Set to **1** when Over-Voltage Shutdown (rms) occurs **FLD**: Foldback. Set to **1** when Foldback fault occurs. **OTP**: Hardware Over-Temperature Protection. Set to **1** when Over-Temperature Protection fault occurs. **AC**: AC Set to **1** when AC fault occurs.
Return	<NR1>	

(*) NOTE

The power source output is turned OFF if three conditions occur simultaneously:

1. The measured impedance is less than 0.25Ω.
2. The set voltage is greater than 2V
3. The measured current is greater than 10A for a continuous period exceeding 16 milliseconds.

14.13.10 System Subsystem

SYSTem:CAPability <USTR>

Function	Add new capabilities to the power source.
Parameter	64 Hex characters activation key
Example	SYSTem:CAPability 3532304230303430303039303030303048303 08E5A187F085FAB37FEDBB89573 When a user orders a particular standard, they will receive a string. Use the command to enter the string and activate the standard.
Query	SYSTem:CAPability?
Return	<USTR>
Example	3532304230303430303039303030303048303 08E5A187F085FAB37FEDBB89573

NOTE

This command is available from software version 001.009.000 onwards.

SYSTem[:COMMunicate]:BAUDrate <DSC>

Function	Sets the baudrate for RS232/RS485 communication
Parameter	19200|38400|57600|115200|230400|460800|921600
Query	SYSTem[:COMMunicate]:BAUDrate?
Return	<DSC>

SYSTem[:COMMunicate]:GPIB:ADDRess <NR1>

Function	Sets the GPIB communication address
Parameter	0–31
Query	SYSTem[:COMMunicate]:GPIB:ADDRess?
Return	<NR1>

SYSTem[:COMMunicate]:IDLED <Bool>

Function	Flashes or stops the flashing of the display and the rear panel LAN status LED (green); refer to **Figure 10-2**.
Parameter	0|1 or OFF|ON **0, OFF**: stops the flashing of the display and the rear panel LAN status LED. **1, ON**: flashes the display and the rear panel LAN status LED.

NOTE

The rear panel LAN status LED (green) flashes only if LAN is enabled.

SYSTem[:COMMunicate]:INTerface <DSC>

Function	Sets the communication interface
Parameter	USB|LAN|RS232|RS485|OPTion
Query	SYSTem[:COMMunicate]:INTerface?
Return	<DSC>

NOTE

RS485 addressing is lost after an interface change if RS485 addressing was enabled. Use INSTrument:[N]SELect <NR1> for addressing again.

SYSTem[:COMMunicate]:LAN:CONNections <NR1>

Function	Sets the maximum overall number of TCP connections and VISA connections.
Parameter	1–4
Query	SYSTem[:COMMunicate]:LAN:CONNections?
Return	<NR1>

NOTES

This command closes the LAN connection.

This command excludes the number of opened web sessions and UDP connections.

SYSTem[:COMMunicate]:LAN:DEFGateway <SRD>

Function	Sets the default gateway
Parameter	xxx.xxx.xxx.xxx
Example	SYSTem:COMMunicate:LAN:DEFGateway 10.97.4.5
Query	SYSTem[:COMMunicate]:LAN:DEFGateway?
Return	<SRD>
Example	10.97.4.5

NOTES

This command closes the LAN connection.

Leading zeroes are not added to the reply.

SYSTem[:COMMunicate]:LAN:DEFGateway:ACTual?

Function	Returns the actual default gateway
Return	<SRD>
Example	10.97.4.5

NOTE

Leading zeroes are not added to the reply.

SYSTem[:COMMunicate]:LAN:DESCription <STR>

Function	Sets the description
Parameter	The Description name
Example	SYSTem:COMMunicate:LAN:DESCription "TDK-GAC-PRO"
Query	SYSTem[:COMMunicate]:LAN:DESCription?
Return	<USTR>
Example	Genesys Power Source-111

NOTE

This command closes the LAN connection.

SYSTem[:COMMunicate]:LAN:DNSserver?

Function	Returns the actual DNS server
Return	<SRD>

NOTES

Leading zeroes are not added to the reply.

If the power source IP source is set to static, there is no DNS server; 0.0.0.0 is returned.

SYSTem[:COMMunicate]:LAN:HOSTname <STR>

Function	Sets the Host name
Parameter	The Host name
Example	SYSTem:COMMunicate:LAN:HOSTname "GACPRO555"
Query	SYSTem[:COMMunicate]:LAN:HOSTname?
Return	<USTR>
Example	GAC-PRO-03AA1C

NOTE

This command closes the LAN connection.

SYSTem[:COMMunicate]:LAN:IPSource <DSC>

Function	Sets the source of the IP address (STATIC/DHCP)
Parameter	STATic|DHCP
Query	SYSTem[:COMMunicate]:LAN:IPSource?
Return	<DSC>

NOTE

This command closes the LAN connection.

SYSTem[:COMMunicate]:LAN:IP:ACTual?

Function	Returns the actual IP address used by the unit
Query	SYSTem[:COMMunicate]:LAN:IP:ACTual?
Return	<SRD>
Example	192.200.0.10

NOTES

Leading zeroes are not added to the reply.

If the interface is not configured as LAN or if the IP address could not be obtained, 0.0.0.0 is returned.

SYSTem[:COMMunicate]:LAN:IP[:STATic] <SRD>

Function	Sets a static IP address
Parameter	xxx.xxx.xxx.xxx
Example	SYSTem:COMMunicate:LAN:IP:STATic 192.200.0.10
Query	SYSTem[:COMMunicate]:LAN:IP[:STATic]?
Return	<SRD>
Example	192.200.0.10

NOTES

The query returns the setting of the static IP address. For current IP, refer to SYSTem[:COMMunicate]:LAN:IP:ACTual?

Leading zeroes are not added to the reply.

SYSTem[:COMMunicate]:LAN:MAC?

Function	Returns the MAC address of the unit
Query	SYSTem[:COMMunicate]:LAN:MAC?
Return	<SRD>
Example	A0:12:34:FF:01:6D

SYSTem[:COMMunicate]:LAN:MDNSenable <Bool>

Function	Enables or disables MDNS
Parameter	0|1 or OFF|ON
Query	SYSTem[:COMMunicate]:LAN:MDNSenable?
Return	<Bool>

SYSTem[:COMMunicate]:LAN:PINGenable <Bool>

Function	Enables or disables the ping server
Parameter	0|1 or OFF|ON
Query	SYSTem[:COMMunicate]:LAN:PINGenable?
Return	<Bool>

SYSTem[:COMMunicate]:LAN:RESet

Function	Sets the LAN parameters to default; refer to **Table 10-8** for the default parameters**.**

SYSTem[:COMMunicate]:LAN:SUBNetmask <SRD>

Function	Sets the subnet mask
Parameter	xxx.xxx.xxx.xxx
Example	SYSTem:COMMunicate:LAN:SUBNetmask 255.255.255.0
Query	SYSTem[:COMMunicate]:LAN:SUBNetmask?
Return	<SRD>
Example	255.255.254.0

NOTES

This command closes the LAN connection.

Leading zeroes are not added to the reply.

SYSTem[:COMMunicate]:LAN:SUBNetmask:ACTual?

Function	Returns the actual subnet mask used by the unit
Return	<SRD>
Example	255.255.254.0

NOTE

Leading zeroes are not added to the reply.

SYSTem[:COMMunicate]:LAN:TIMEout <NR1>

Function	Sets the timeout for TCP socket, VISA, and web page connection
Parameter	0|30–60000
Unit	s
Query	SYSTem[:COMMunicate]:LAN:TIMEout?
Return	<NR1>

NOTE

Parameter-0: disabled, Default: 1800

SYSTem[:COMMunicate]:LAN:UDP:ENABle <Bool>

Function	Enables or disables UDP
Parameter	0|1 or OFF|ON
Query	SYSTem[:COMMunicate]:LAN:UDP:ENABle?
Return	<Bool>

SYSTem[:COMMunicate]:LAN:VXIdiscovery <Bool>

Function	Enables or disables the VXI discovery
Parameter	0|1 or OFF|ON
Query	SYSTem[:COMMunicate]:LAN:VXIdiscovery?
Return	<Bool>

SYSTem[:COMMunicate]:RS232:CONTrol <Bool>

Function	Enables or disables the RTS/CTS flow control
Parameter	0|1 or OFF|ON
Query	SYSTem[:COMMunicate]:RS232:CONTrol?
Return	<Bool>

SYSTem[:COMMunicate]:RS485:ADDRess <NR1>

Function	Sets the RS485 communication address
Parameter	0–31
Query	SYSTem[:COMMunicate]:RS485:ADDRess?
Return	<NR1>

NOTES

This logic is supported only for the RS485 bus.

Power source addressing is lost after an address change, AC recycle, or power switch recycle. A minimum interval of five seconds is required at the power switch OFF state.

SYSTem[:COMMunicate]:RS485:ADDRess:STATe <Bool>

Function	Enables or disables the RS485 communication addressing system.
Parameter	0|1 or OFF|ON
Query	SYSTem[:COMMunicate]:RS485:ADDRess:STATe?
Return	<Bool>

NOTES

RS485 addressing system is disabled by default.

Enable if multiple power sources share a single RS485 or additional equipment is connected.

SYSTem[:COMMunicate]:RS485:TERMination:STATe <Bool>

Function	Enables or disables the RS485 bus termination.
Parameter	0|1 or OFF|ON
Query	SYSTem[:COMMunicate]:RS485:TERMination:STATe?
Return	<Bool>

NOTES

RS485 termination is enabled by default.

Set termination on the ends of the bus when power sources share a single RS485 or additional equipment is connected.

SYSTem:DATE?

Function	Returns the date of the last calibration. **Format**: yyyy/mm/dd
Return	<SRD>
Example	2024/12/17

SYSTem:ERRor:ALL?

Function	Returns a list of all unread errors in the error queue and removes them from the queue. The response is a semicolon separated list of up to 10 messages formatted as number-string pairs in FIFO order.
Return	<SRD>

NOTES

When no error exists, 0,"No error" is returned.

For a multi-phase unit, the phase number will also be added to the error message, if the command sent supports phase option. For example: VOLT1 50000 will return -222,"Data out of range: phase 1".

SYSTem:ERRor:ENABle <Bool>

Function	Enables or disables the log of the last 10 error messages in an error queue.
Parameter	0|1 or OFF|ON
Query	SYSTem:ERRor:ENABle?
Return	<Bool>

NOTES

System error log is enabled by default

If disabled, the system error queue is cleared.

SYSTem:ERRor[:NEXT]?

Function	Returns an error number and a corresponding error message
Return	<SRD>
Example	0,”No error”

NOTES

The error messages are stored in an error queue. This queue works as a FIFO (First In, First Out).

When no error exists, 0, "No error" is returned.

If the error queue goes above 10 messages, the 11th query returns -350, "Queue Overflow".

For a multi-phase unit, the phase number will also be added to the error message, if the command sent supports phase option. For example: VOLT1 50000 will return -222,"Data out of range: phase 1".

SYSTem:EXTernal:ENABle[#] <Bool>

Function	Enables or disables programming with an external voltage reference
Parameter	0|1 or OFF|ON **0, OFF**: front panel or communication programming (digital) is enabled **1, ON**: external voltage programming (analog) is enabled
Query	SYSTem:EXTernal:ENABle[#]?
Return	<Bool>

NOTE

The command can be executed at Output OFF state only

SYSTem:EXTernal:FUNCtion[#] <DSC>

Function	Sets the analog programming function. The argument indicates which parameter is controlled via analog programming.
Parameter	FULL|AC|DC|FREQuency The external voltage programming selection range is 2.5V–10V; refer to SYSTem:EXTernal:RANGe[#] <NR2> or refer to **Section 9.4.5: Configuration Menu**. Programming range depends on selection range. There are four different types of voltage programming:

Mode	Value Set	Programming Range (V)
FULL	Instantaneous (AC, DC, Frequency)	±2.5 to ±10. (Applicable for GAC-PRO models only, refer to order code.)
AC	AC Voltage	2.5 to 10
DC	DC Offset Voltage	±2.5 to ±10. (Applicable for GAC-PRO models only, refer to order code.)
FREQuency	Frequency	2.5 to 10 (Applicable for GAC-PRO models only, refer to order code.)

Example	If frequency mode (FREQuency) is selected, and if SYSTem:EXTernal:RANGe[#] <NR2> is set with 5V, the programming range is 0–5V which is equivalent to 16 to 1200Hz or 16 to 5000Hz. If DC mode (DC) is selected, and if SYSTem:EXTernal:RANGe[#] <NR2> is set with 2.5V, the programming range is -2.5 to 2.5V which is equivalent to -510 to 510V. Refer to **Section 11.9: External (Analog) Voltage Programming (J4-9)** for some examples.
Query	SYSTem:EXTernal:FUNCtion[#]?
Return	<DSC>

NOTES

In Full mode, balancing of the external voltage reference, and voltage and frequency slew are disabled.

The command can be executed at Output OFF state only.

In a multi-phase system, FULL and FREQ control are not available.

SYSTem:EXTernal:MONitor:CURRent[:MAX][:LEVel][#] <NRf>

Function	Sets the maximum analog current monitoring value when the external monitor mode is set to full; refer to SYSTem:EXTernal:MONitor[:MODE][#] <DSC> or refer to **Section 9.4.5: Configuration Menu**.
Parameter	(Current rating)–120
Unit	A
Query	SYSTem:EXTernal:MONitor:CURRent[:MAX][:LEVel][#]?
Return	<NR2>

NOTE

The command can be executed at Output OFF state only.

SYSTem:EXTernal:MONitor[:MODE][#] <DSC>

Function	Sets the analog monitoring function. The argument indicates which parameter is measured via analog monitoring.
Parameter	RMS|FULL **RMS control**: RMS measurement of output voltage/current. The monitoring value is in the range of 0 to the programming/monitoring range.

Mode	**Maximum Monitoring Value**
AC and ACDC	rms voltage/current rating
DC	DC voltage/current rating

FULL control: arbitrary measurement of the output voltage/current. The measurement follows the output voltage/current. The monitoring value is in the range of (-programming/monitoring range to programming/monitoring range).

Mode	**Maximum Monitoring Value**
AC, DC, and ACDC	DC voltage/current rating

Refer to **Section 11.8: External Voltage Monitoring (J4-8)** and **Section 11.17: External Current Monitoring (J4-26)** for examples.

Query	SYSTem:EXTernal:MONitor[:MODE][#]?
Return	<DSC>

NOTES

The command can be executed at Output OFF state only.

In a parallel system that has multiple units per phase:

Full control: each unit, regardless of its role, outputs its own voltage/current.

RMS control: the Phase Master outputs the total voltage/current of its phase.

SYSTem:EXTernal:RANGe[#] <NR2>

Function	Sets the range for analog programming and monitoring. **Programming**: 2.5–10V, **Monitoring**: 2.5–10V
Parameter	2.5–10.0
Query	SYSTem:EXTernal:RANGe[#]?
Return	<NR2>

NOTE

The command can be executed at Output OFF state only

SYSTem:EXTernal:STATe[#]?

Function	Returns the actual type of the source of voltage programming
Query	If external programming is enabled using SYSTem:EXTernal:ENABle[#] <Bool> or using the front panel (refer to **Section 9.4.5: Configuration Menu**) and the LOC/REM rear-panel pin (**J4-6**) is connected to common, an external voltage source is used to program the power source and the reply to the query is 1. In all other cases, the front panel or communication is used and the reply to the query is 0.
Return	<Bool>

SYSTem:FIRMware:BOOT[:VERSion]?

Function	Returns boot versions (in order): Interface, Control, Display, and Option (if available).
Return	<SRD>
Example	001.003.000,001.003.000,001.003.000

NOTE

The boot version of the option card can be read via all the communication modes (USB, RS232, RS485, LAN, and OPT).

SYSTem:FIRMware[:VERSion]?

Function	Returns firmware versions (in order): Interface, Control, Display, and Option (if available).
Return	<SRD>
Example	991.009.000,991.008.000,001.007.000

NOTE

The firmware version of the option card can be read via all the communication modes (USB, RS232, RS485, LAN, and OPT).

SYSTem:FRST [<DSC>]

Function	Restores factory default settings and sets communication interface. Refer to **Table 13-1** for the factory default settings.
Parameter	USB|RS232|RS485|LAN|OPT
Example	SYSTem:FRST USB returns the unit to factory default settings with USB as the default interface

NOTES

Factory Reset does not affect acknowledgment of parallel configuration (does not affect power source configuration).

SYSTem:FRST sent without a parameter sets USB communication interface.

The execution of this command may take up to 2 seconds.

SYSTem:FRST:WIPe [<DSC>]

Function	Carries out the following functions: • Fully wipes the non-volatile memory and user-created waveforms in all four regions. • Restores factory default parameters. • Sets communication interface according to <DSC> parameter. This command also sanitizes the entire non-volatile memory.
Parameter	USB|RS232|RS485|LAN|OPT

NOTES

This command is available from software version 001.008.000 onwards.

Factory Reset does not affect acknowledgment of parallel configuration (does not affect power source configuration).

Command sent without a parameter sets USB communication interface.

The execution of this command may take up to 15 seconds.

SYSTem:INFormation?

Function	Returns a list of the capabilities of the power source
Return	<USTR>
Example	RTCA/DO 160,MIL-STD 704,A350 (Airbus ABD100.1.8.1),IEC61000-4-11,IEC61000-4-13,MIL-STD-1399-300 PART 1

NOTE

This command is available from software version 001.009.000 onwards.

SYSTem:PARallel:CURRent?

Function	Returns a comma separated list of the measured RMS output current of all power sources in the system.
Return	<NR2>

SYSTem:PARallel:FIRMware[:VERSion]?

Function	Returns a list of firmware versions of all power sources in the system (in order): Interface, Control, Display and Optional interface (if installed).
Return	<SRD>
Example	991.009.000,991.008.000,001.007.000|991.009.000,991.008.000,001.007.000

NOTE

The firmware version of the option card can be read via all the communication modes (USB, RS232, RS485, LAN, and OPT).

SYSTem:PARallel:MODel? [<NR1>]

Function	Returns a comma separated list of model names of all power sources in the system or the model name of the entire system.
Parameter	1|3|6. The IDN level to query. Default or 1: returns the IDN details of all sources connected (either for sources that are connected in parallel by the user or sources that are in a parallel system). 3|6: returns the IDN details of the parallel system.
Return	<SRD>
Example	Default query or query with parameter 1 returns GAC-PRO-03AA1C-07H00A,GAC-PRO-03AA1C-07H00A,GAC-PRO-03AA2C-01A00A Query with parameter 3 returns GAC-PRO-09AC1C-07H00A,-,-

NOTE

Query with parameter 3 or 6 for a parallel unit created by the user returns -,-,-.

SYSTem:PARallel:SERial? [<NR1>]

Function	Returns a comma separated list of serial number of all power sources in the system or the model name of the entire system.
Parameter	1|3|6. The IDN level to query. Default or 1: returns the serial number of all sources connected (either sources that are connected in parallel by the user or sources that are in a parallel system). 3|6: returns the serial number of the parallel system.
Return	<SRD>
Example	Default query or query with parameter 1 returns 520B001-1111,520B001-3333,520B001-2222. Query with parameter 3 for a parallel system returns 608I362-0001,-,-

NOTE

Query with parameter 3 or 6 for a parallel unit created by the user returns -,-,-.

SYSTem:PHASe:CONFiguration <NR1>

Function	Sets the number of phases in the system
Parameter	1–3
Query	SYSTem:PHASe:CONFiguration?
Return	<SRD> or <NR1>

NOTES

The execution of this command may take up to 1.5 seconds

The command can be executed at output OFF state only.

When system setup is required, NA is returned since the number of phases is unknown and it must be set by the operator.

CAUTION

Ensure that the output of all power sources on the same phase is shorted.

Ensure that output N (neutral points) of all power sources is shorted.

SYSTem:PHASe:CONFiguration:ALL?

Function	Returns a comma-separated list of all possible phase configurations. A phase configuration is the number of voltage lines in the system. A phase configuration is possible if the number of power sources can be evenly divided by the number of lines.
Return	<NR1>
Example	If the system contains 6 power sources, the possible configurations are: 1, 2 or 3. In the three-phase configuration, each phase contains two power source. In the two-phase setup, each phase contains three power sources.

SYSTem:PON:TIME?

Query	Returns the total time the power source is connected to the AC with the power Switch ON. Max value: 4294967295
Unit	minutes
Return	<NR1>

SYSTem:PON:TIME:AC?

Function	Returns the total time the power source is connected to the AC. Max value: 4294967295
Unit	minutes
Return	<NR1>

SYSTem:PSOK:DELay <NRf>

Function	Sets the delay for the PS_OK (power source OK) signal following output ON
Parameter	0–10
Unit	s
Query	SYSTem:PSOK:DELay?
Return	<NR2>

NOTE

The delay affects only the OFF-to-ON transition. The ON-to-OFF transition is not affected.

SYSTem:RATing?

Function	Returns a comma separated list of rating of the power source (in order): voltage, current, power, and frequency.
Return	<SRD>
Example	360.00,30.000,3000.0,5000.00

SYSTem:REMote[:STATe] <DSC>

Function	Sets the control of the power source to local, remote, or Local Lockout (LLO) mode
Parameter	LOCal|REMote|LLO **LOCal:** (Local) enables the front panel control **REMote**: (Remote) disables the change of settings from the front panel. Preview of the settings is possible. **LLO**: (Local Lockout) the same as remote, and it also disables the unlocking of the panel.
Query	SYSTem:REMote[:STATe]?
Return	<DSC>

NOTES

LLO mode can be deactivated with a communication command or with AC recycling only.

The system state changes from LLO to REM with re-cycling of the AC.

System state changes from LOC to REM only if a communication command that changes a setting is sent. Queries do not change the system state to REM mode.

SYSTem:SENSe[:STATe] <DSC>

Function	Sets the output sensing point: local or remote
Parameter	LOCal|REMote **LOCal**: local sensing is selected **REMote**: remote sensing is selected
Query	SYSTem:SENSe[:STATe]?
Return	<DSC>

NOTE

The command can be executed at output OFF state only.

SYSTem:TEMPerature[:AMBient]?

Function	Returns the measured ambient temperature
Unit	ºC
Return	<NR2>

SYSTem:VERSion?

Function	Returns the version of the SCPI language
Return	<SRD>

14.13.11 TRIGger Subsystem

NOTE

The Trigger subsystem must be enabled from the Initiate subsystem. If disabled, commands from the trigger subsystem does not affect the power source output.

TRIGger:DELay <NRf>

Function	Sets a time delay between the trigger event from a specified trigger source to the start of any corresponding trigger action. This is valid for both trigger sources: BUS and EXT (external).
Parameter	0–3600
Unit	s
Query	TRIGger:DELay?
Return	<NR2>

TRIGger[:IMMediate]

Function	Generates an immediate trigger. This command is relevant only if BUS is selected as a trigger source.

NOTE

This command overrides the trigger delay settings; it activates trigger immediately. To activate trigger with a delay function, refer to *TRG in **Section 14.12: SCPI Common Commands** or use the front panel (refer to **Section 9.4.9: Program Menu**).

TRIGger:PROGram <DSC>

Function	Defines which sequencer modes (STEP, PULSE, or LIST) are affected by the sequencer trigger signal. One or more modes can be set by the command. This is applicable for AC and ACDC operating mode only. DC mode has its own sequencer system.
Parameter	STEP|PULSe|LIST
Example	TRIGger:PROGram STEP, TRIGger:PROGram STEP,PULSe,LIST
Query	TRIGger:PROGram?
Return	<DSC>

TRIGger:SOURce <DSC>

Function	Sets a trigger source for sequencer operation
Parameter	BUS|EXTernal BUS: *TRG, TRIGger[:IMMediate], or the front panel. EXTernal: Rear panel Trigger In #1 pin (J4-4).
Query	TRIGger:SOURce?
Return	<DSC>

14.13.12 IHARmonics (Interharmonics Subsystem)

NOTE

All types of voltage balancing and slew modes (voltage and frequency) are disabled in Interharmonics mode.

IHARmonics:DURation <NRf>

Function	Sets the total duration of the interharmonics sweep
Parameter	0.1–12960000
Unit	ms
Query	IHARmonics:DURation?
Return	<NR2>

IHARmonics:FREQuency:END <NRf>

Function	Sets the end frequency of the interharmonics wave sweep
Parameter	Refer to **Table 14-10**
Unit	Hz
Query	IHARmonics:FREQuency:END?
Return	<NR2>

IHARmonics:FREQuency:PAUSe <NRf>

Function	Pause the interharmonics sweep at the selected frequency
Parameter	-1| Refer to **Table 14-10**
Unit	Hz
Query	IHARmonics:FREQuency:PAUSe?
Return	<NR2>

NOTE

To disable the pause frequency, set it to -1 or outside the range of the frequency sweep (below the start frequency or above the end frequency).

IHARmonics:FREQuency:STARt <NRf>

Function	Sets the start frequency of the interharmonics wave sweep
Parameter	Refer to **Table 14-10**
Unit	Hz
Query	IHARmonics:FREQuency:STARt?
Return	<NR2>

IHARmonics:LEVel <NRf>

Function	Sets the weight (in percentage) of the interharmonics amplitude relative to the amplitude of the fundamental frequency
Parameter	0–100
Unit	%
Query	IHARmonics:LEVel?
Return	<NRf>

NOTE

During an interharmonics sweep, changing the values of the immediate voltage amplitude (AC, DC) does not affect the output. When the sweep is completed, the immediate values are applied to the output.

IHARmonics:STATe <DSC>

Function	Sets the state of the Interharmonics sweep
Parameter	STARt|STOP|PAUSe|CONTinue
Query	IHARmonics:STATe?
Return	<DSC>

NOTES

If an interharmonics wave sweep is paused, the power source's output is the interharmonics wave of the step in which the sweep was paused. Send CONTinue to continue the wave sweep.

An interharmonics wave sweep cannot be started while the Sequencer is initiated or running.

IHARmonics:STEP:DWELl <NRf>

Function	Sets the duration of each step in the interharmonics sweep
Parameter	0.1–12960000
Unit	ms
Query	IHARmonics:STEP:DWELl?
Return	<NR2>

NOTE

If the duration of all the steps is less than the total duration of the wave sweep, the wave sweep continuously oscillates between the start and end frequency until the total sweep duration has elapsed.

IHARmonics:STEP:PHASe <NRf>

Function	Sets the start phase angle of each step in the interharmonics wave sweep
Parameter	0–359.9
Unit	º (degree)
Query	IHARmonics:STEP:PHASe?
Return	<NR2>

IHARmonics:STEP:PHASe:SYNC:ENABle <Bool>

Function	Enables or disables the phase angle synchronization during the interharmonics wave sweep.
Parameter	0|1 or ON|OFF **1/ON**: a step occurs once the dwell time has passed and once the base wave has reached its start phase angle. The start phase angle of the base wave is always specified by the setting of OUTPut:PHASe:ON <NRf> (refer to **Section 14.13.5: Output Subsystem** or refer to **Section 9.4.1: Output Settings Menu**). The secondary wave added to the base wave starts with the phase angle set with IHARmonics:STEP:PHASe <NRf>. **0/OFF**: if disabled, each step starts at the phase angle at which the previous step ended.
Query	IHARmonics:STEP:PHASe:SYNC:ENABle?
Return	<Bool>

IHARmonics:STEP:SIZE <NRf>

Function	Sets the step size applied during sweep between start and end frequency
Parameter	1–1200 or 1–5000, depending on the rated frequency
Unit	Hz
Query	IHARmonics:STEP:SIZE?
Return	<NR2>

NOTE

If the size is greater than the difference between the end and start frequency, only one step is executed.

IHARmonics:WAVeform <USTR>

Function	Sets the waveform used for the interharmonics
Parameter	name. The name of the waveform is entered without quotes (USTR data type).
Query	IHARmonics:WAVeform?
Return	<USTR>

NOTES

name is case sensitive.

The fundamental waveform is taken from [FUNCtion]:WAVeform[:ACTivate][:NAME][#] <USTR>; refer to **Section 14.13.6: Function Subsystem**.

The fundamental waveform and the Interharmonics waveform must be from the same region.

A sweep cannot be started if the sequencer is running or initiated.

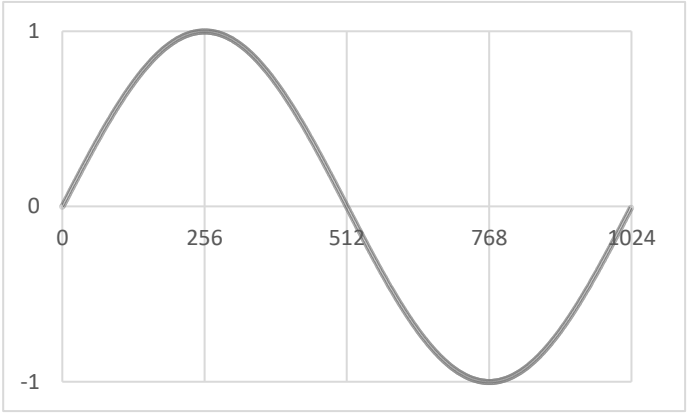
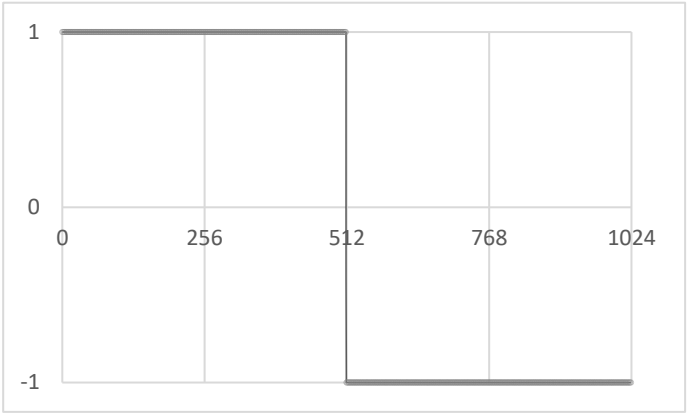
CHAPTER 15: WAVEFORMS

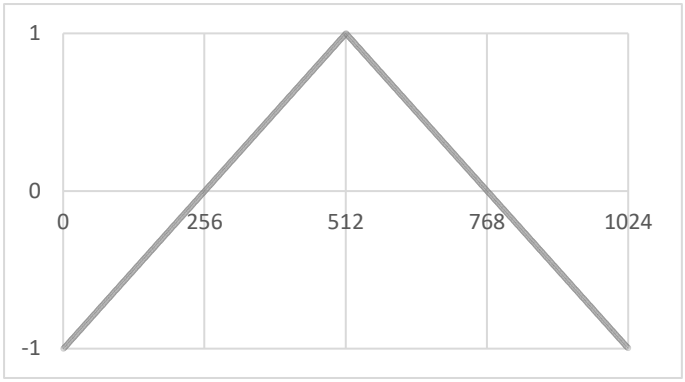
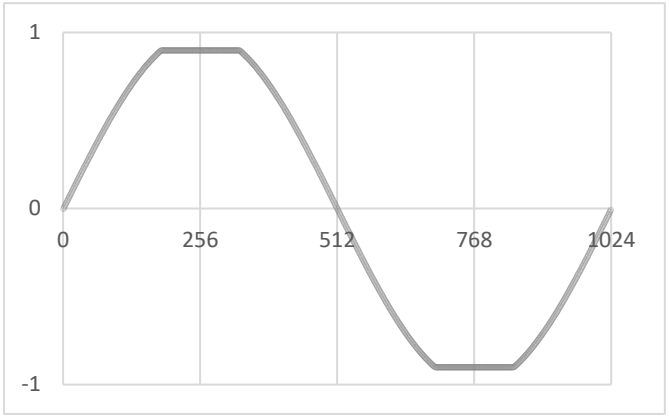
15.1 Introduction

The Genesys Series Programmable AC Power Source comes with built-in SINE, SQUARE, TRIANGLE, and CSINE waveforms that are stored in the internal memory.
By using these built-in waveforms, the user can create other custom waveforms.

15.2 Built-In Waveforms

The built-in waveforms that are stored in the internal memory are generated based on 1024 equally distributed points that construct the shape of the output wave. Each point in the wave has a limitation between -1 and 1. There is an equal amount of time between two points in the wave period. The time duration between two points cannot be changed.
For example, consider the built-in sine wave. Point number 512 indicates 180° and 1024 indicates 360°.
The same principle is used for the built-in square, triangle, and csine wave.

Description	Image
SINE	
SQUARE	

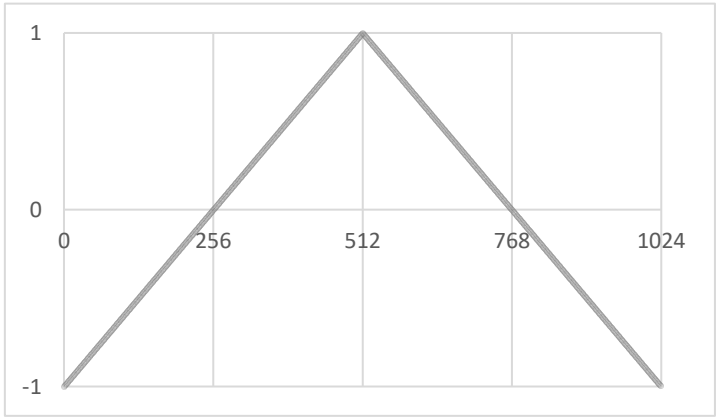
Description	Image
TRIANGLE	
CSINE (Clipped Sine)	

15.3 Custom Waveforms

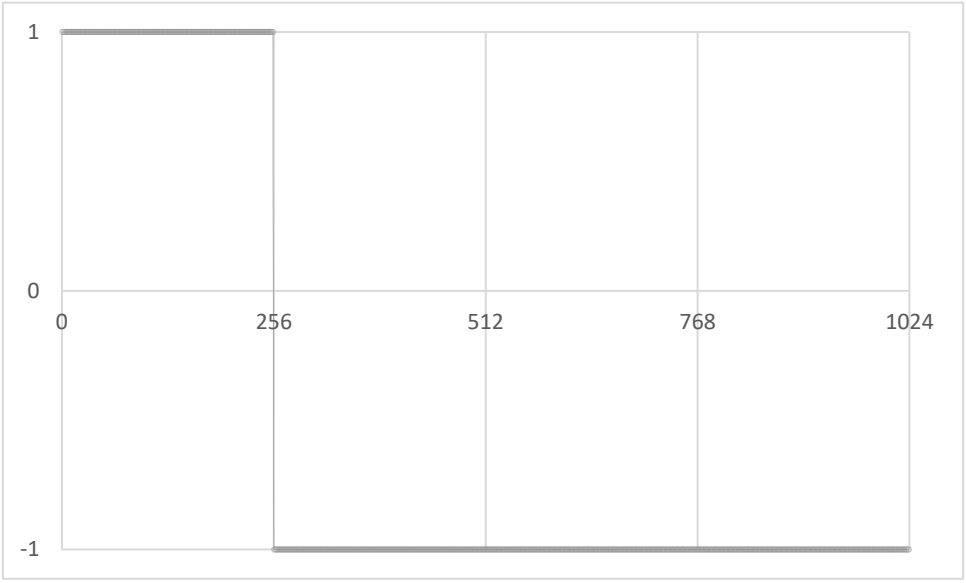
15.3.1 Waveforms Based On Built-In Waveforms

By using the built-in waveforms, the user can generate additional waveforms by modifying the points that were used to generate the built-in waveform. Still, the amplitude of the points is between -1 and 1 and the number of points is 1024. Refer to **Section 14.13.6: Function Subsystem.**

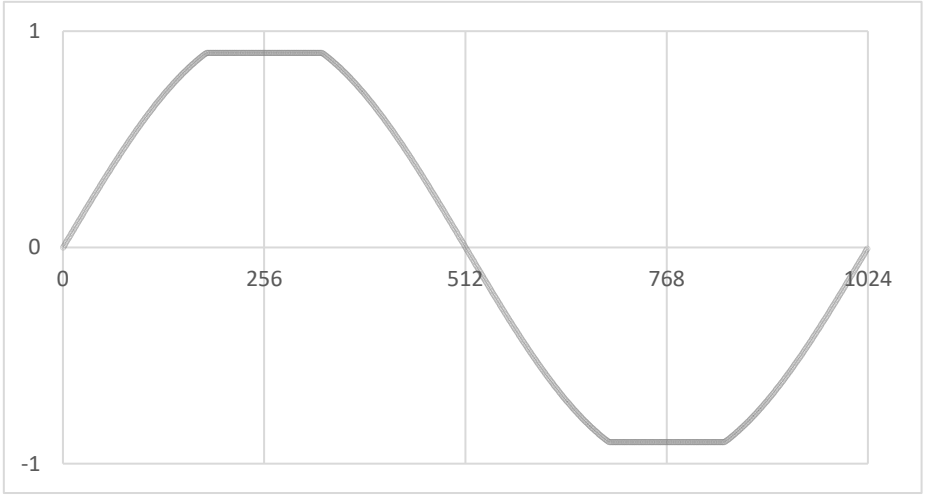
For example, use FUNCtion:WAVeform:TRIangle:SYMMetry 50 to change the symmetry of the built-in triangular waveform to 50%.



Use FUNCtion:WAVeform:SQUare:DCYCle 25 to change the duty cycle of the built-in square wave to 25%.



Use FUNCtion:WAVeform:CSINe:LEVel 90 to set the clipping level of the built-in csine wave to 10.



15.3.2 Arbitrary Waveforms

The user can also create arbitrary waveforms by sending up to 1024 points, ranging from -1 to 1. The list of points sent by the user represents a single period of the arbitrary waveform. Refer to **Section 14.13.6: Function Subsystem.**

For example, send FUNCtion:WAVeform:POINts tri1,-1,1,-1 to generate a triangular wave with 50% symmetry.

NOTE

Up to 1024 points can be used for the creation of the waveform. Three points, for example, are enough to create a triangle waveform.

16.1 Introduction

The DC sequencer allows advanced waveform programming of the power source output. The sequencer controls the output voltage via predefined steps. Each output value is a separate step in the sequence and defines the DC state of the output. When these steps combine over a selected period, any simulation can be achieved.

There are two programmable modes: LIST and WAVE.

To select the mode via the front panel, refer to **Section 9.4.9: Program Menu**.

To set the mode via a communication command, refer to [PROGram:]DC:ACTivate <DSC> in **Section 14.13.7.1: DC Sequencer**.

16.2 List Mode

In the LIST mode, the output value is changed in steps that are determined by the parameters in the LIST.

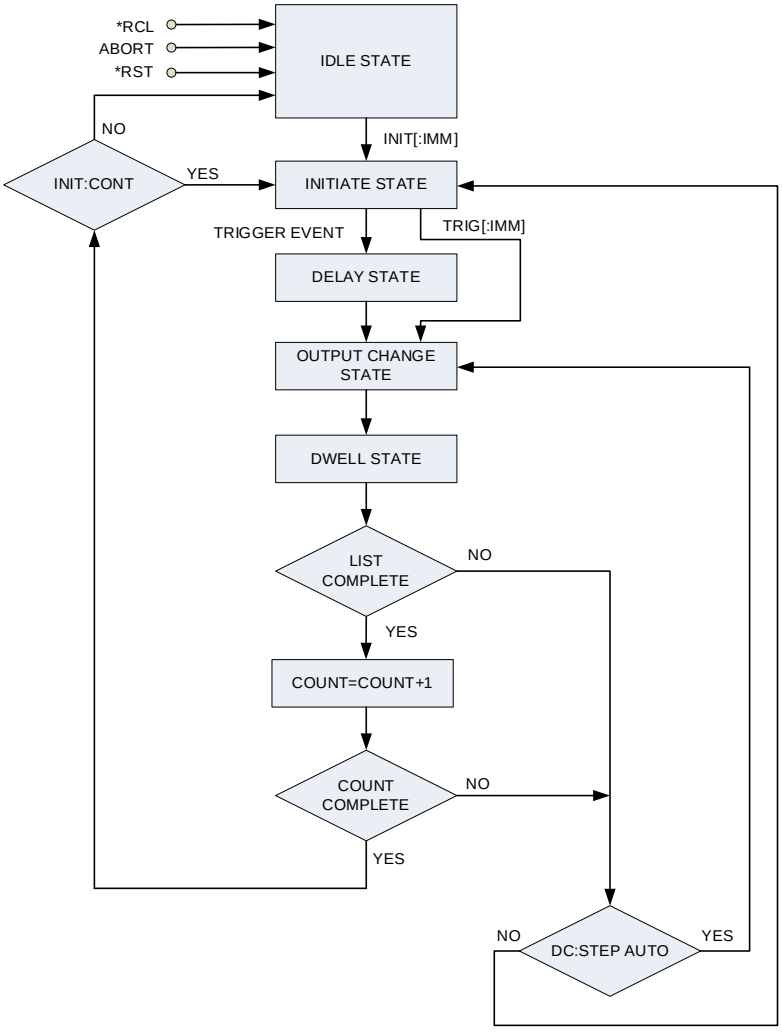


Figure 16-1: LIST Sequence Flowchart

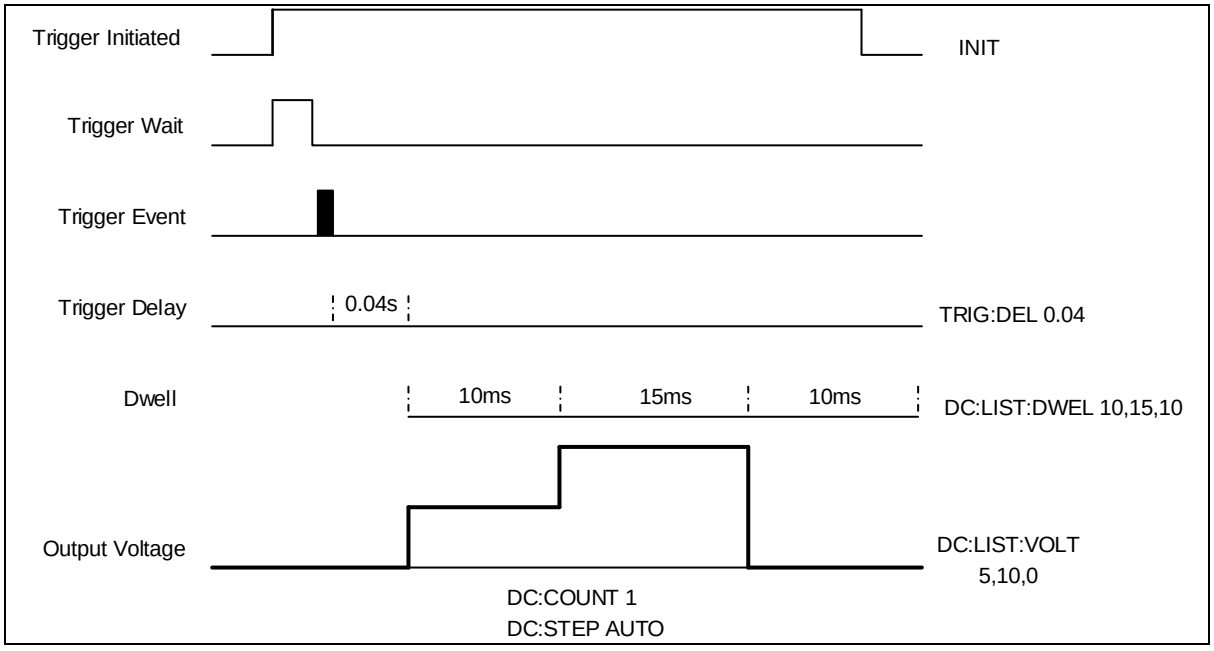


Figure 16-2: LIST Sequence Example

When the sequence is completed, the behavior of the system is determined by [PROGram:]DC:MODE:END <DSC>; refer to **Section 14.13.7.1: DC Sequencer.** The behavior can also be set from the front panel; refer to **Section 9.4.9: Program Menu**.

16.3 Wave Mode

In the WAVE mode, the output value is changed in slopes as determined by the parameters in the WAVE.

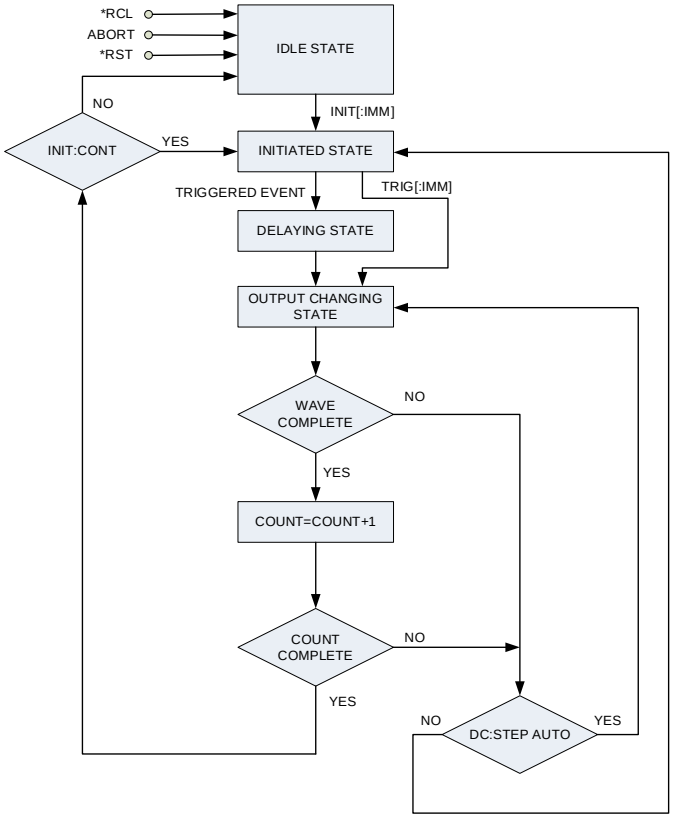


Figure 16-3: WAVE Sequence Flowchart

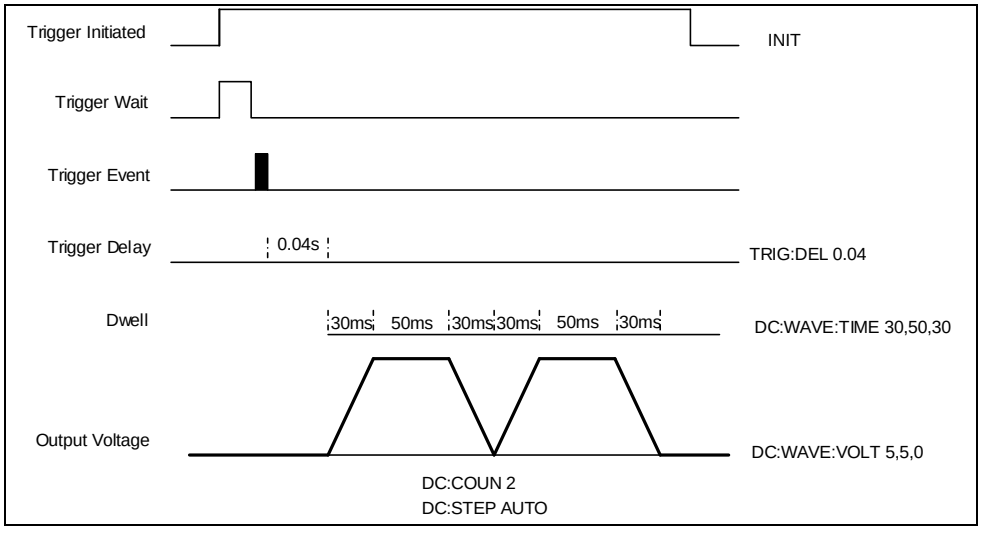


Figure 16-4: Wave Sequence Example

When the sequence is completed, the behavior of the system is determined by [PROGram:]DC:MODE:END <DSC>; refer to **Section 14.13.7.1: DC Sequencer**. The behavior can also be set from the front panel; refer to **Section 9.4.9: Program Menu**.

16.4 Sequencer States and Signals

16.4.1 Idle State

When the power source is turned ON, the device is in an idle state. In this state, the sequencer system ignores the triggers. When any sequence is completed, the system may return to this state.
The system also returns to the idle state if ABORt, *RST, or *RCL is sent; refer to **Section 14.12: SCPI Common Commands**. To send them from the front panel, refer to S**ection 9.4.6: System Menu** and **Section 9.4.9: Program Menu**.

16.4.2 Initiate State

The initiate function moves the sequencer system from the idle state to the initiated state. This allows the power source to receive triggers and execute the sequencer. Refer to **Section 14.13.2: Initiate Subsystem**.

16.4.3 Continuous Flag

The Initiate function moves the sequencer system from the idle state to the initiated state. In some applications, it may be required to have the sequencer system return directly to the initiated state after the sequence has completed. Continuous Flag **1** returns the system to the initiated state and bypasses the idle state, thus preventing the need for re-initiation. The setting can be made from the front panel (refer to **Section 9.4.9: Program Menu)** or with INITiate:CONTinuous <Bool> (refer to **Section 14.13.2: Initiate Subsystem)**.

16.4.4 Trigger System

The trigger system, consisting of the Trigger In and Trigger Out functions synchronizes sequencer waveforms. In addition, the Trigger Out function provides the ability to generate output triggers.

16.4.4.1 Trigger Initialize

Trigger initialization is required to activate the Trigger In function. The activation can be done from the front panel (refer to **Section 9.4.9: Program Menu)** or with INITiate[:IMMediate] (refer to **Section 14.13.2: Initiate Subsystem)**.

16.4.4.2 Trigger In

Trigger In triggers an execution of a sequence. There are three available trigger sources:

- external: Positive edge triggered pulse available on J4-4
- front panel (bus): (refer to **Section 9.4.9: Program Menu**)
- communication (bus): *TRG (refer to **Section 14.12: SCPI Common Commands**) or TRIG[:IMMediate] (refer to **Section 14.13.11: TRIGger Subsystem).**

Trigger In source can be selected from the front panel (refer to **Section 9.4.9: Program Menu**) or with TRIGger:SOURce <DSC> (refer to **Section 14.13.11: TRIGger Subsystem**).

16.4.4.3 Trigger Out

Trigger Out is an active high output signal located on the rear panel connector: J4-23 or J6. There are four trigger out modes: OFF, TRIG, FSTR, and FSTRE.
Refer to OUTPut:TTLTrg:MODE[#] <DSC> in **Section 14.13.5: Output Subsystem**. These settings can also be made from the front panel, refer to **Section 9.4.5: Configuration Menu.**

16.4.4.4 Delaying State and Trigger Delay

When a trigger event occurs, the sequencer system may transfer to the delaying state.
In this state, the system waits for the specified trigger delay before moving to the next state (refer to **Section 9.4.9: Program Menu** or TRIGger:DELay <NRf> in **Section 14.13.11: TRIGger Subsystem)**.

16.4.5 Sequencer Functions

16.4.5.1 List/Wave Selection

Set the sequencer to List or Wave.

16.4.5.2 Counter

Sets the number of performed iterations.

16.4.5.3 List/Wave Value

Sets the output voltage points in a list or wave.

16.4.5.4 Dwell State (List)

Sets the time for which a specific value in the LIST mode remains in effect.

16.4.5.5 Time State (Wave)

Sets the time taken (slope) to move between two points in the WAVE.

16.4.5.6 List/Wave Size

Sets the size (the number of steps in the list/wave sequencer).

16.4.5.7 Step

Executes a single step or a complete sequence.

16.4.5.8 End

Sets the behavior of the power source when it enters the IDLE state after the sequencer execution is completed.

16.4.6 Abort

Sets the behavior of the power source when it enters the IDLE state after the sequencer execution is aborted.
To stop the sequencer execution and return the system to the idle state, use ABORt (refer to **Section 14.12: SCPI Common Commands**) or abort from the front panel (refer to **Section 9.4.9: Program Menu**).
If abort is sent while the continuous flag is **1**, the system returns to the idle state.

NOTE

Mode selection, Counter, List/Wave Value, Dwell State (List), Time State (Wave), List/Wave Size, Step, End, and Abort can be set via the front panel (refer to **Section 9.4.9: Program Menu**) or with commands (refer to **Section 14.13.7.1: DC Sequencer**).

16.4.7 Load

Loads a sequence from a memory cell.

16.4.8 Store

Stores a sequence into a memory cell.

NOTE

Loading and storing can be done via the front panel (refer to **Section 9.4.9: Program Menu**) or with [PROGram:]LOAD:DC <NR1> and [PROGram:]STORe:DC <NR1> (refer to **Section 14.13.7.6: AC/DC/ACDC Sequencer - Memory Commands)**.

16.4.9 LIST Mode Example

NOTE

Start condition: Power source output is on; Initial voltage point is 0 Volts.

DC:ACT LIST	Sets the DC sequencer to LIST Mode
DC:LIST:VOLT 30,60,90,30	Sets the voltage values to 30,60,90,30 (volts)
DC:LIST:DWEL 1000,1000,500,1500	Sets the dwell values to 1000,1000,500,1500 (ms)
DC:STEP AUTO	Sets the execution mode to AUTO
DC:COUN 1	Set the number of iterations to 1
DC:LIST:SIZE 4	Set the list size to 4
TRIG:SOUR BUS	Select the trigger source to BUS
INIT:CONT 0	Trigger system is enabled for a single trigger action
DC:MODE:END LAST	The output remains the way it was at the moment the sequencer finished running
INIT	Trigger initialized
*TRG	Trigger command

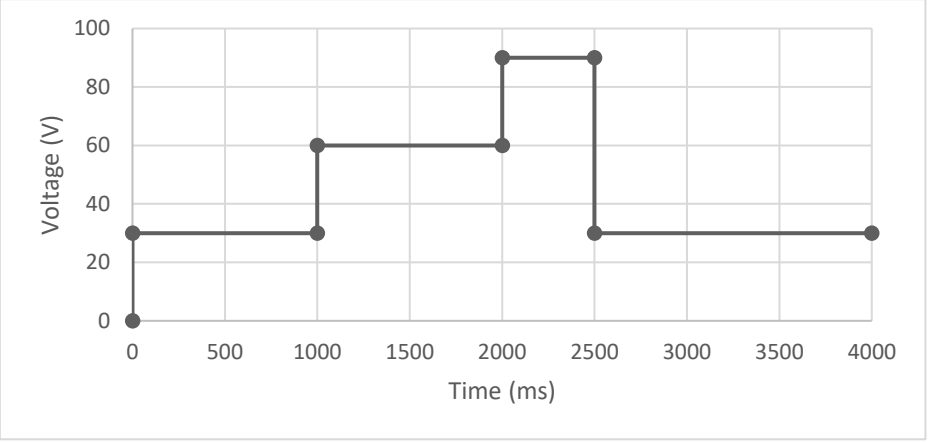


Figure 16-5: LIST Mode Example

16.4.10 WAVE Mode Example

NOTE

Start condition: Power source output is on; Initial voltage point is 0 Volts.

DC:ACT WAVE	Sets the sequencer to WAVE Mode
DC:WAVE:VOLT 20,40,40,90,90,30,30	Sets the voltage values to 20,40,40,90,90,30,30 (volts)
DC:WAVE:TIME 1000,500,500,500,500,1500,500	Set the time values to 1000,500,500,500,500,1500,500 (ms)
DC:STEP AUTO	Sets the execution mode to AUTO
DC:COUN 1	Set the number of iterations to 1
DC:LIST:SIZE 7	Set the list size to 7
TRIG:SOUR BUS	Select the trigger source to BUS
INIT:CONT 0	Trigger system is enabled for a single trigger action
DC:MODE:END LAST	The output remains the way it was at the moment the sequencer finished running
INIT	Trigger initialized
*TRG	Trigger command

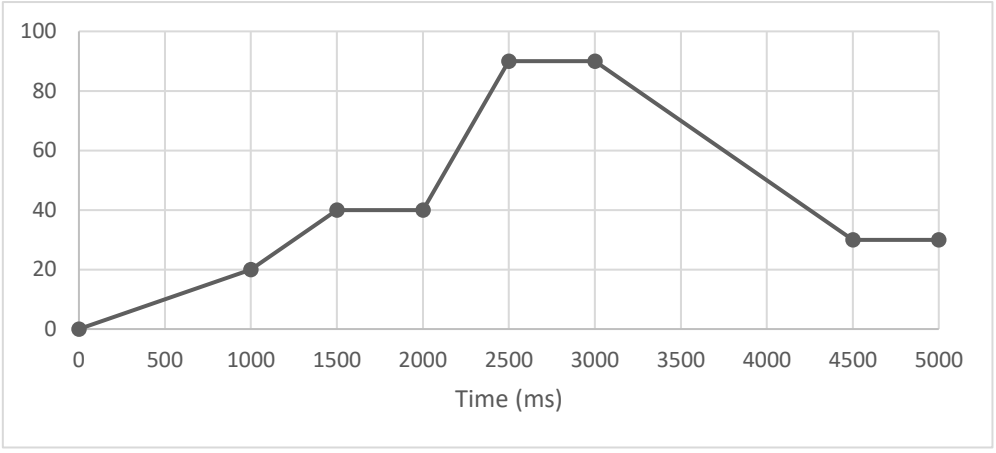


Figure 16-6: WAVE Mode Example

NOTES

For LIST and WAVE modes, if the sequencer system is enabled (INITIATED STATE):

1. The power source does not accept additional LIST/WAVE and dwell/time parameters. Use the Abort command before applying new parameters.
2. The power source does not load previously stored sequences. Use the Abort command before applying new parameters.
3. Analog Programming is disabled.

CHAPTER 17: ADVANCED FUNCTIONS-AC/ACDC SEQUENCER

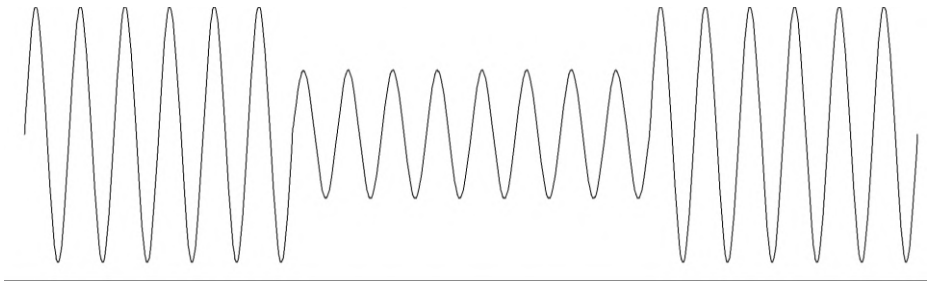
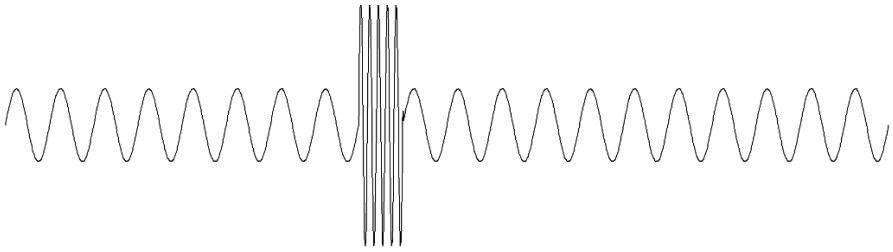
17.1 Introduction

The AC/ACDC sequencer allows accurate time-controlled modification of voltage and frequency. A sequencer is composed of one or more steps that can be executed sequentially.

The following operations can be performed with the sequencers:

- simulate peaks, sags, and brown-outs with precise phase and timing
- create output changes with rapid changes in time
- synchronize output changes with a specific phase
- synchronize output changes with internal or external triggers

Using these sequences, several simulation can be achieved. A few examples are shown below.

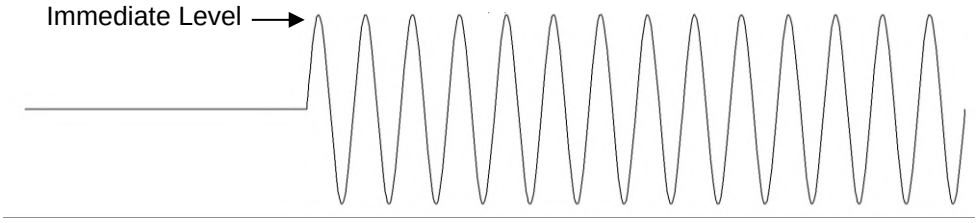
Sags	
Peaks	
Power Loss	

17.2 Sequencer Modes

A sequencer waveform can be controlled either by the immediate, step, pulse, or list mode or a combination of all these modes.

17.2.1 Immediate Mode

This mode sets the basic value immediately without waiting for any trigger.



17.2.2 Step Mode

When a trigger is received, a transition takes place to the triggered level. When the sequence is completed, the behavior of the system is determined by [PROGram:]MODE:END <DSC>; refer to **Section 14.13.7.5: PROGram MODE Commands.** The behavior can also be set from the front panel; refer to **Section 9.4.9: Program Menu**. **Figure 17-1** shows that with the trigger, the voltage changes and remains at that level. **Figure 17-2** shows that with the trigger, the frequency changes and remains at that level and **Figure 17-3** shows that with the trigger, the AC level, the DC level, and the frequency changes.

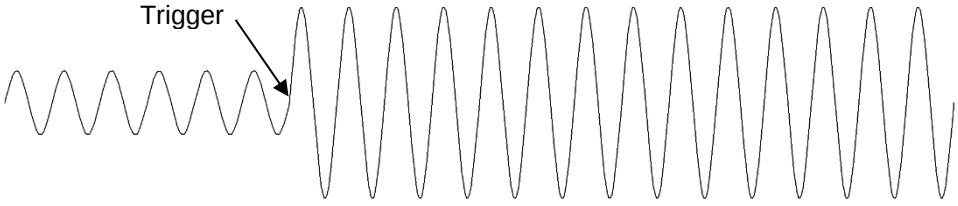


Figure 17-1: Step Voltage

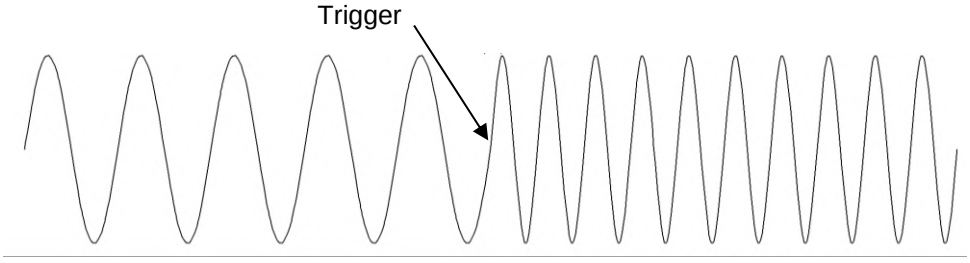


Figure 17-2: Step Frequency

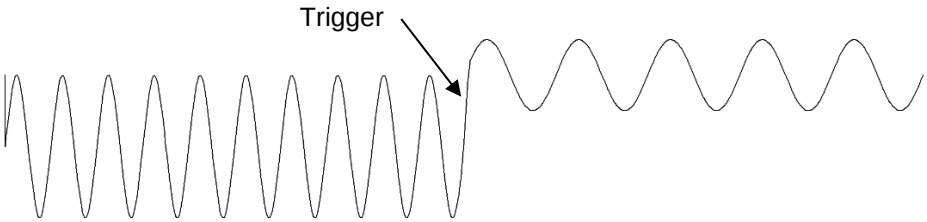


Figure 17-3: Step AC and DC Voltage, Frequency

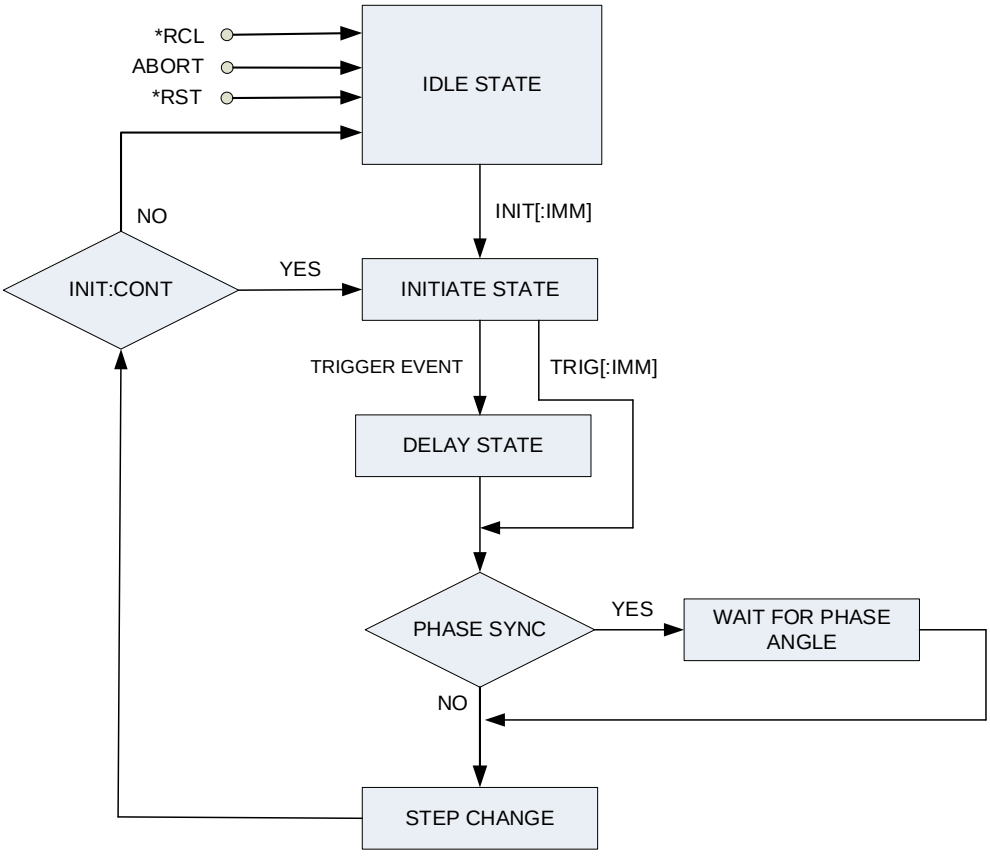


Figure 17-4: Step Sequence Flowchart

17.2.3 Pulse Mode

When a trigger is received, a transition takes place to the triggered level for a predetermined amount of time. The major parameters to create a pulse sequencer are the pulse count, pulse active and pulse inactive time. When the sequence is completed, the behavior of the system is determined by [PROGram:]MODE:END <DSC>; refer to **Section 14.13.7.5: PROGram MODE Commands.** The behavior can also be set from the front panel; refer to **Section 9.4.9: Program Menu**.

Figure 17-5 shows that the pulse count is 3 and each count has an active duration. The output voltage changes during the active time.

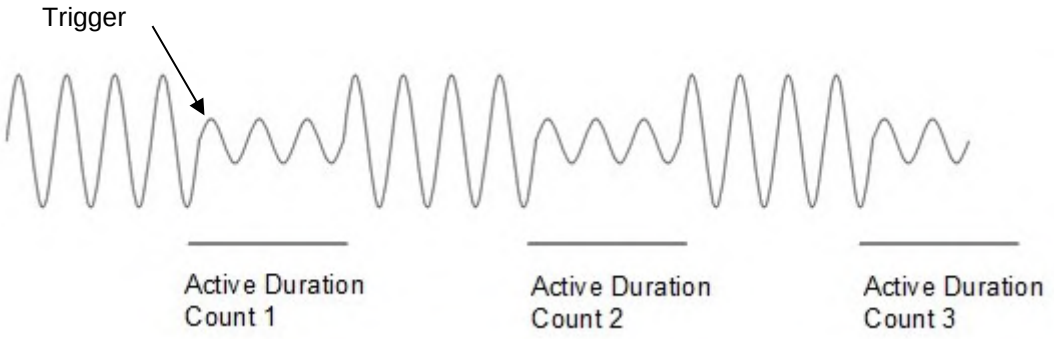


Figure 17-5: Pulse Voltage

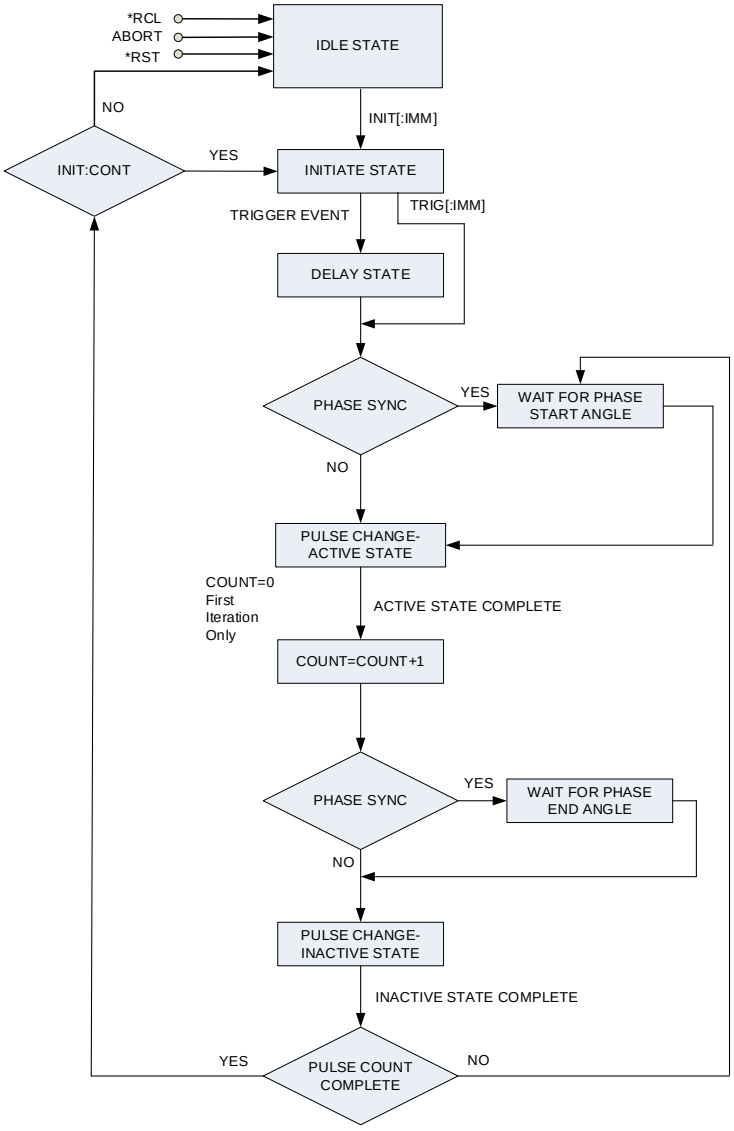


Figure 17-6: Pulse Sequence Flowchart

17.2.4 List Mode

The list mode allows a most timely way of controlling the output by allowing a list of parameters to be programmed in a timely sequence. When the sequence is completed, the behavior of the system is determined by [PROGram:]MODE:END <DSC>; refer to **Section 14.13.7.5: PROGram MODE Commands** The behavior can also be set from the front panel; refer to **Section 9.4.9: Program Menu**. **Figure 17-7** shows different voltage and frequency levels separated by 0-volt levels.

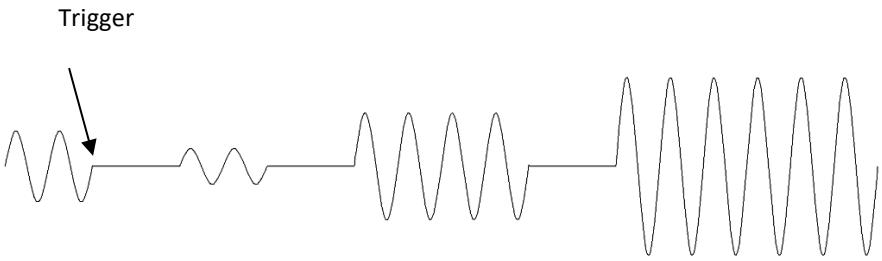


Figure 17-7: List Sequence

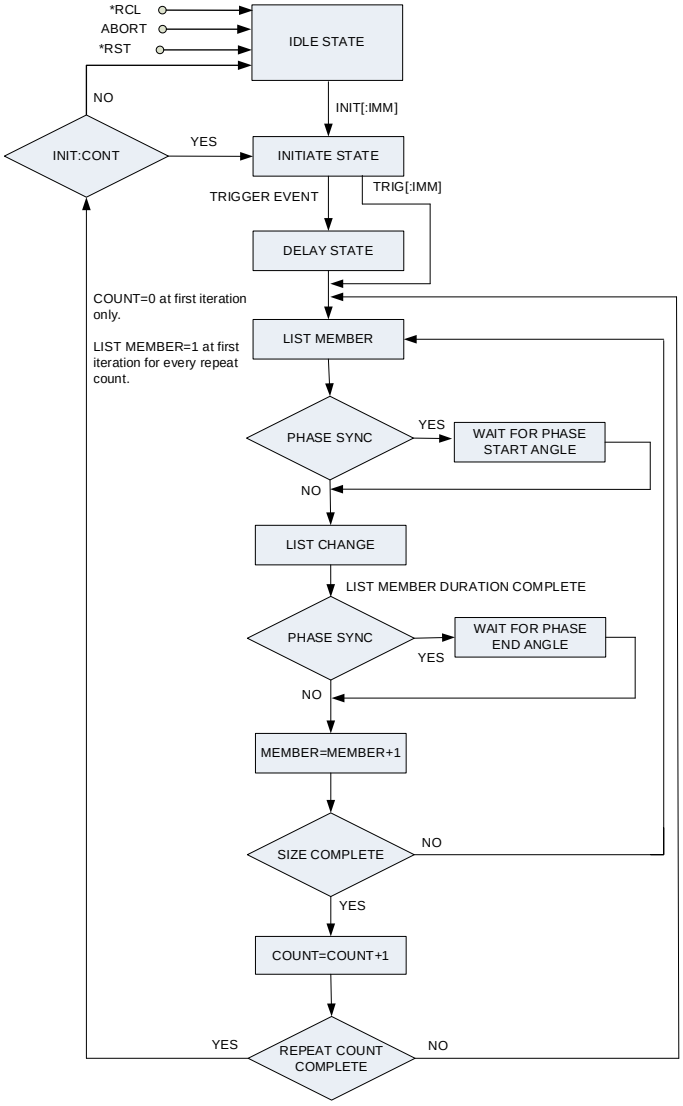


Figure 17-8: List Sequencer Flowchart

17.3 Sequencer States and Signals

17.3.1 Idle State

When the power source is turned ON, the device is in an idle state. In this state, the sequencer system ignores the triggers. When any sequence is completed, the system may return to this state.
The system also returns to the idle state if ABORt, *RST, or *RCL is sent. Refer to **Section 14.12: SCPI Common Commands**. To send them from the front panel, refer to S**ection 9.4.6: System Menu** and **Section 9.4.9: Program Menu**.

17.3.2 Initiate State

The initiate function moves the sequencer system from the idle state to the initiated state. This allows the power source to receive triggers and execute the sequencer. Refer to **Section 14.13.2: Initiate Subsystem**.

17.3.3 Continuous Flag

The Initiate function moves the sequencer system from the idle state to the initiated state. In some applications, it may be required to have the sequencer system return directly to the initiated state after the sequence has completed. Continuous Flag **1** returns the system to the initiated state and bypasses the idle state, thus preventing the need for re-initiation. The setting can be made from the front panel (refer to **Section 9.4.9: Program Menu**) or with INITiate:CONTinuous <Bool> (refer to **Section 14.13.2: Initiate Subsystem**).

17.3.4 Trigger System

The trigger system, consisting of the Trigger In and Trigger Out functions synchronizes sequencer waveforms. In addition, the Trigger Out function provides the ability to generate output triggers.

17.3.4.1 Trigger Initialize

Trigger initialization is required to activate the Trigger In function. The activation can be done from the front panel (refer to **Section 9.4.9: Program Menu**) or with INITiate[:IMMediate] (refer to **Section 14.13.2: Initiate Subsystem**).

17.3.4.2 Trigger In

Trigger In triggers an execution of a sequence. There are three available trigger sources:

- external: positive edge triggered pulse available on J4-4
- front panel: (bus) (refer to **Section 9.4.9: Program Menu**)
- communication (bus): *TRG (refer to **Section 14.12: SCPI Common Commands)** or TRIG[:IMMediate] (refer to **Section 14.13.11: TRIGger Subsystem**).

Trigger In source can be selected from the front panel (refer to **Section 9.4.9: Program Menu**) or with TRIGger:SOURce <DSC> (refer to **Section 14.13.11: TRIGger Subsystem**).

17.3.4.3 Trigger Out

Trigger Out is an active high output signal located on the rear panel connector: J4-23 or J6. There are four trigger out modes available: OFF, TRIG, FSTR, and FSTRE.
Refer to OUTPut:TTLTrg:MODE[#] <DSC> in **Section 14.13.5: Output Subsystem**. This setting can also be made from the front panel, refer to **Section 9.4.5: Configuration Menu**.

17.3.5 Delaying State and Trigger Delay

When a trigger event occurs, the sequencer system may transfer to the delaying state.
In this state, the system waits for the specified trigger delay before moving to the next state (refer to **Section 9.4.9: Program Menu** or TRIGger:DELay <NRf> in **Section 14.13.11: TRIGger Subsystem**).

17.3.6 Sequencer Functions – Common

17.3.6.1 End

Sets the behavior of the power source when it enters the IDLE state after the sequencer execution is completed.

17.3.6.2 Abort

Sets the behavior of the power source when it enters the IDLE state after the sequencer execution is aborted.
To stop the sequencer execution and return the system to the idle state, use ABORt (refer to **Section 14.12: SCPI Common Commands)** or abort from the front panel (refer to **Section 9.4.9: Program Menu)**.
If abort is sent while the continuous flag is **1**, the system returns to the idle state.

NOTE

End and Abort can be set from the front panel (refer to **Section 9.4.9: Program Menu**) or with commands (refer to **Section 14.13.7.5: PROGram MODE Commands**).

17.3.6.3 Load

Loads a sequence from a memory cell.

17.3.6.4 Store

Stores a sequence into a memory cell.

NOTE

Loading and storing can be done from the front panel (refer to **Section 9.4.9: Program Menu**) or with [PROGram:]LOAD:AC <NR1> and [PROGram:]STORe:AC <NR1> (refer to **Section 14.13.7.6: AC/DC/ACDC Sequencer - Memory Commands)**.

17.3.7 Sequencer Function - Step Sequencer

17.3.7.1 Step Value

Sets the AC level, DC offset, and frequency.

17.3.7.2 Start Phase Angle

Sets the phase angle at which the step starts.

17.3.7.3 Phase Angle Shift

Sets the phase angle difference between phase 1 and other phases (#).

17.3.7.4 Slew Rate

Sets the slew rate control for the ac level, dc offset, and frequency.

17.3.7.5 Waveform

Sets the waveform of the step.

NOTE

Step Value, Start Phase Angle, Phase Angle Shift, Slew Rate, and Waveform can be set from the front panel (refer to **Section 9.4.9: Program Menu)** or with commands (refer to **Section 14.13.7.4: AC/ACDC Sequencer - Step Subsystem)**.

17.3.8 Sequencer Function - Pulse Sequencer

17.3.8.1 Pulse Value

Sets the AC level, DC offset, and frequency.

17.3.8.2 Start Phase Angle

Sets the phase angle at which the pulse starts.

17.3.8.3 End Phase Angle

Sets the phase angle at which the pulse ends.

17.3.8.4 Phase Angle Shift

Sets the phase angle difference between phase 1 and other phases (#).

17.3.8.5 Slew Rate

Sets the slew rate control for the ac level, dc offset, and frequency.

17.3.8.6 Active State

In the active state, pulses are outputted to the triggered level for a predetermined amount of time. AC level, DC offset, and frequency can be set in the active state pulses.

17.3.8.7 Inactive State

After the active state completes, the system enter the inactive state and return to the non-triggered level for a predetermined amount of time**.**

17.3.8.8 Pulse Counter (Repeat)

Sets the number of times the pulse cycle (active state) is repeated.

17.3.8.9 Pulse Waveform

Sets the waveform of the pulse.

NOTE

Pulse Value, Start Phase Angle, End Phase Angle, Phase Angle Shift, Slew Rate, Active and Inactive State, Pulse Counter, and Pulse Waveform can be set from the front panel (refer to **Section 9.4.9: Program Menu)** or with commands (refer to **Section 14.13.7.3: AC/ACDC Sequencer - Pulse Subsystem**).

17.3.9 Sequencer Function - List Sequencer

17.3.9.1 List Value

Sets the AC level, DC offset, and frequency for each member in the list.

17.3.9.2 Start Phase Angle

Sets the start phase angle for each member in the list.

17.3.9.3 End Phase Angle

Sets the end phase angle for each member in the list.

17.3.9.4 Phase Angle Shift

Sets the phase angle difference between phase 1 and other phases (#).

17.3.9.5 Slew Rate

Sets the slew rate for the ac level, dc offset, and frequency for each member in the list.

17.3.9.6 List Duration

Sets the duration for each member in the list.

17.3.9.7 List Size

Sets the size (the number of steps in the sequencer).

17.3.9.8 List Repeat

Sets the number of times the list is repeated.

17.3.9.9 List Step

The sequence can be set to be executed all at once or a single step at a time.

17.3.9.10 List Waveform

Sets the waveform for each member in the list.

NOTE

List Value, Start Phase Angle, End Phase Angle, Phase Angle Shift, Slew Rate, List Duration, List Size, List Repeat, List Step, and List Waveform can be set from the front panel (refer to **Section 9.4.9: Program Menu)** or with commands (refer to **Section 14.13.7.2: AC/ACDC Sequencer - List Subsystem)**.

17.3.10 Modes Activation

Once all the parameters in **Section 17.3.7, 17.3.8, and 17.3.9** are programmed, some of those parameters need to be assigned to different modes so that they can be used accordingly (according to the customer requirements) when the sequencer starts running. For assigning the parameters to different modes, refer to **Section 14.13.7.5: PROGram MODE Commands**. The examples below provide more explanation on how the assignment of the modes affect the sequencer waveforms.

17.3.11 Typical Sequencer Examples

17.3.11.1 Step Sequencer

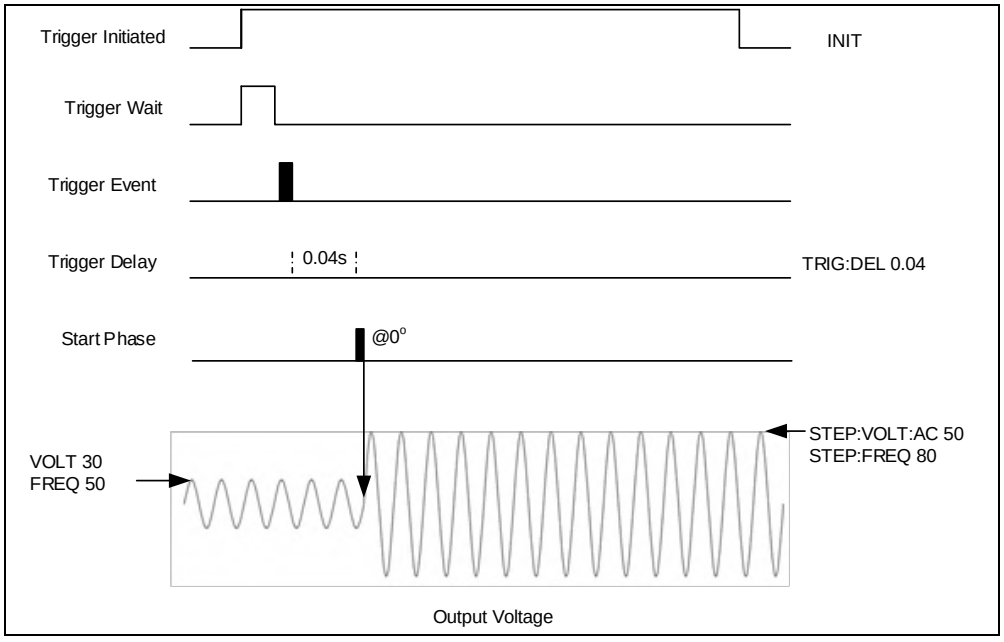


Figure 17-9: Step Sequence Example

Initial Settings (after AC reset): Output ON, AC Mode, built-in sine wave, AC 30V, FREQ 50

Sequencer Settings:

MODE:WAV STEP	Sets the sequence mode of the waveform to STEP
STEP:WAV SIN	Sets the waveform to SINE
MODE:VOLT:AC STEP	Sets the sequence mode of the AC amplitude to STEP
MODE:FREQ STEP	Sets the sequence mode of the frequency to STEP
MODE:VOLT:AC:SLEW STEP	Sets the sequence mode of the slew rate of ac to STEP
MODE:FREQ:SLEW STEP	Sets the sequence mode of the slew rate of frequency to STEP
MODE:PHAS:STAR STEP	Sets the sequence mode of the start phase to STEP
STEP:VOLT:AC 50	Sets the ac amplitude to 50V
STEP:VOLT:AC:SLEW:UP 16340	Sets the slew rate for the up programming of the ac amplitude to 16340 V/ms
STEP:FREQ 80	Sets the frequency to 80Hz
STEP:FREQ:SLEW:UP 99999	Sets the slew rate for the up programming of frequency to 99999 Hz/ms
STEP:PHAS:STAR 0	Sets the start phase angle to 0°
TRIG:PROG STEP	Sets the trigger mode to STEP
TRIG:SOUR BUS	Sets the trigger source to BUS
TRIG:DEL 0.04	Sets the trigger delay to 0.04s
MODE:END LAST	Sets power source settings to LAST after the sequence finishes
INIT:CONT OFF	Trigger system is enabled for a single trigger action
INIT	Trigger initialized
*TRG	Trigger

Table 17-1: Step Sequence Example (For Figure 17-9)

As seen from **Table 17-1**, when the sequencer starts running,

- parameters are assigned to STEP mode.
- output voltage and frequency change to 50V and 80Hz, respectively.

Considering an example, if MODE:FREQ is set to PULSE, the sequencer will not be executed as TRIG:PROG is set to STEP.

NOTE

The waveform name assigned to STEP:WAV must match the name of the waveform in the selected region.

17.3.11.2 Pulse Sequencer

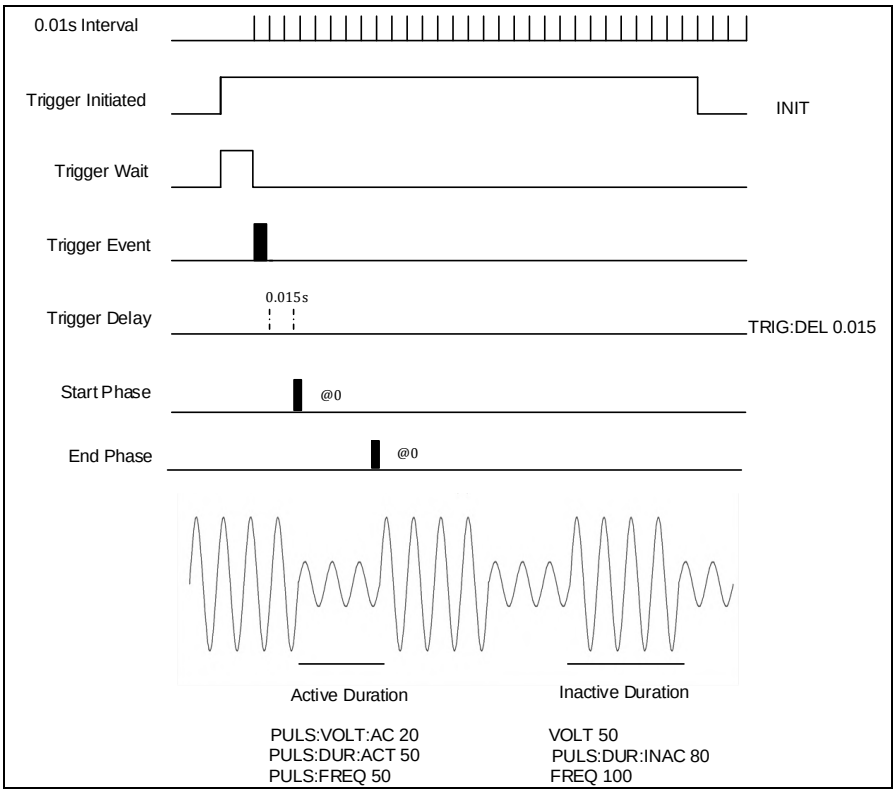


Figure 17-10: Pulse Sequence Example

Initial Settings (after AC reset): Output ON, AC Mode, built-in sine wave, AC 50V, FREQ 100

Sequencer Settings:

MODE:WAV PULS	Sets the sequence mode of the waveform to PULSE
PULS:WAV SIN	Sets the waveform to SINE
MODE:VOLT:AC PULS	Sets the sequence mode of the AC amplitude to PULSE
MODE:FREQ PULS	Sets the sequence mode of the frequency to PULSE
MODE:VOLT:AC:SLEW PULS	Sets the sequence mode of the slew rate of ac to PULSE
MODE:FREQ:SLEW PULS	Sets the sequence mode of the slew rate of frequency to PULSE
MODE:PHAS:STAR PULS	Sets the sequence mode of the start phase to PULSE
MODE:PHAS:END PULS	Sets the sequence mode of the end phase to PULSE
PULS:VOLT:AC 20	Sets the ac amplitude to 20V
PULS:VOLT:AC:SLEW:UP 16340	Sets the slew rate of the up programming of the ac amplitude to 16340 V/ms
PULS:VOLT:AC:SLEW:DOWN 16340	Sets the slew rate of the down programming of the ac amplitude to 16340 V/ms
PULS:FREQ 50	Sets the frequency to 50Hz
PULS:FREQ:SLEW:UP 99999	Sets the slew rate of the up programming of the frequency to 99999 Hz/ms
PULS:FREQ:SLEW:DOWN 99999	Sets the slew rate of the down programming of the frequency to 99999 Hz/ms
PULS:PHAS:STAR 0	Sets the start phase angle to 0°
PULS:PHAS:END 0	Sets the end phase angle to 0°
PULS:DUR:ACT 50	Sets the active duration of the wave to 50ms
PULS:DUR:INAC 80	Sets the inactive duration of the wave to 80ms
PULS:REP 50	Sets the number of repetitions of the pulse (active durations)
TRIG:PROG PULSE	Sets the trigger mode to PULSE
TRIG:SOUR BUS	Sets the trigger source to BUS

TRIG:DEL 0.015	Sets the trigger delay to 0.015s
MODE:END LAST	Sets power source settings to LAST after the sequence finishes
INIT:CONT OFF	Trigger system is enabled for a single trigger action
INIT	Trigger initialized
*TRG	Trigger

Table 17-2: Pulse Sequence Example (For Figure 17-10)

As seen from **Table 17-2**, when the sequencer starts running,

- parameters are assigned to PULSE mode.
- during the pulse ACTIVE time (50ms), the output voltage and frequency change to 20Vac and 50Hz, respectively. During this time, SINE wave is assigned to the output.
- During the pulse INACTIVE time (80ms), the output voltage and frequency change to 50Vac and 100Hz, respectively.

NOTE

During the inactive duration, the immediate value (initial settings) of voltage and frequency is applied.

NOTE

The waveform name assigned to PULS:WAV must match the name of the waveform in the selected region.

17.3.11.3 Step + Pulse Sequencer

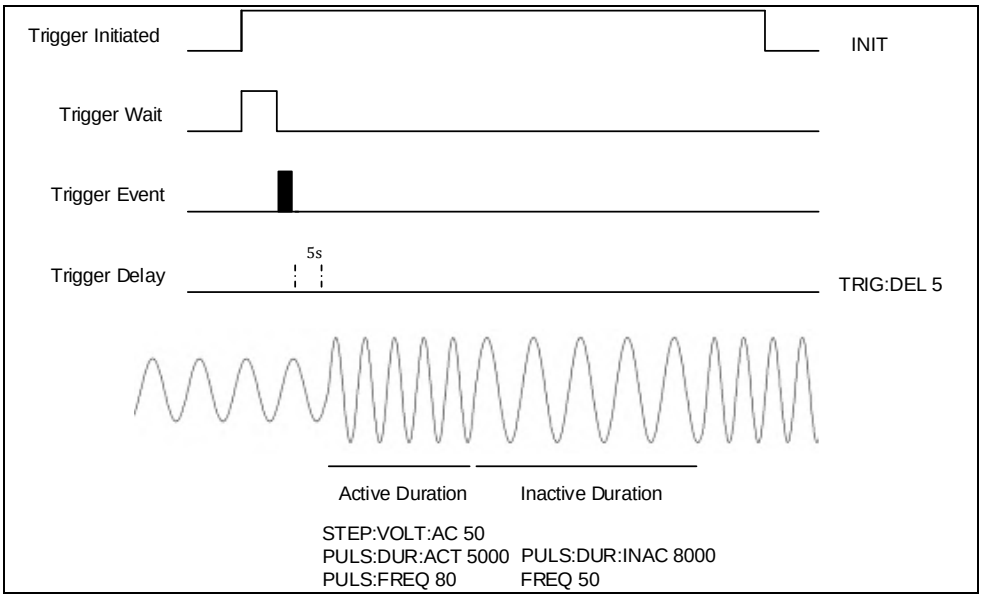


Figure 17-11: Step + Pulse Sequencer

Initial Settings (after AC reset): Output ON, AC Mode, built-in sine wave, AC 30V, FREQ 50

Sequencer Settings:

MODE:WAV STEP	Sets the sequence mode of the waveform mode to STEP
STEP:WAV SIN	Sets the waveform to SINE
MODE:VOLT:AC STEP	Sets the sequence mode of the AC amplitude to STEP
MODE:FREQ PULS	Sets the sequence mode of the frequency to PULSE
MODE:VOLT:AC:SLEW STEP	Sets the sequence mode of the slew rate of ac to STEP
MODE:FREQ:SLEW PULS	Sets the sequence mode of the slew rate of frequency to PULS
STEP:VOLT:AC 50	Sets the ac amplitude to 50V
STEP:VOLT:AC:SLEW:UP 16340	Sets the slew rate for the up programming of the ac amplitude to 16340 V/ms
PULS:FREQ 80	Sets the frequency to 80Hz
PULS:FREQ:SLEW:UP 99999	Sets the slew rate for the up programming of frequency to 99999 Hz/ms
PULS:DUR:ACT 5000	Sets the active duration of the wave to 5s
PULS:DUR:INAC 8000	Sets the inactive duration of the wave to 8s
PULS:REP 10	Sets the number of repetitions of the pulse (active durations)
TRIG:PROG STEP,PULSE	Sets the trigger mode to STEP,PULSE
TRIG:SOUR BUS	Sets the trigger source to BUS
TRIG:DEL 5	Sets the trigger delay to 5s
MODE:END LAST	Sets power source settings to LAST after the sequence finishes
INIT:CONT OFF	Trigger system is enabled for a single trigger action
INIT	Trigger initialized
*TRG	Trigger

Table 17-3: Step + Pulse Sequencer (For Figure 17-11)

As seen from **Table 17-3**, when the sequencer starts running,

- voltage parameters are assigned to STEP mode, and frequency parameters are assigned to PULSE mode.
- output voltage changes to 50V and remains there (STEP mode).
- during the pulse ACTIVE time (5s), the output frequency changes to 80Hz.
- During the pulse INACTIVE time (8s), the frequency changes to 50Hz.
- During both the ACTIVE and INACTIVE time, the output voltage remains at 50V.

Note that TRIG:PROG is set to STEP,PULSE. Hence during sequence execution, both the STEP and PULSE modes are executed.

NOTE

The waveform name assigned to STEP:WAV must match the name of the waveform in the selected region.

17.3.11.4 List Sequencer

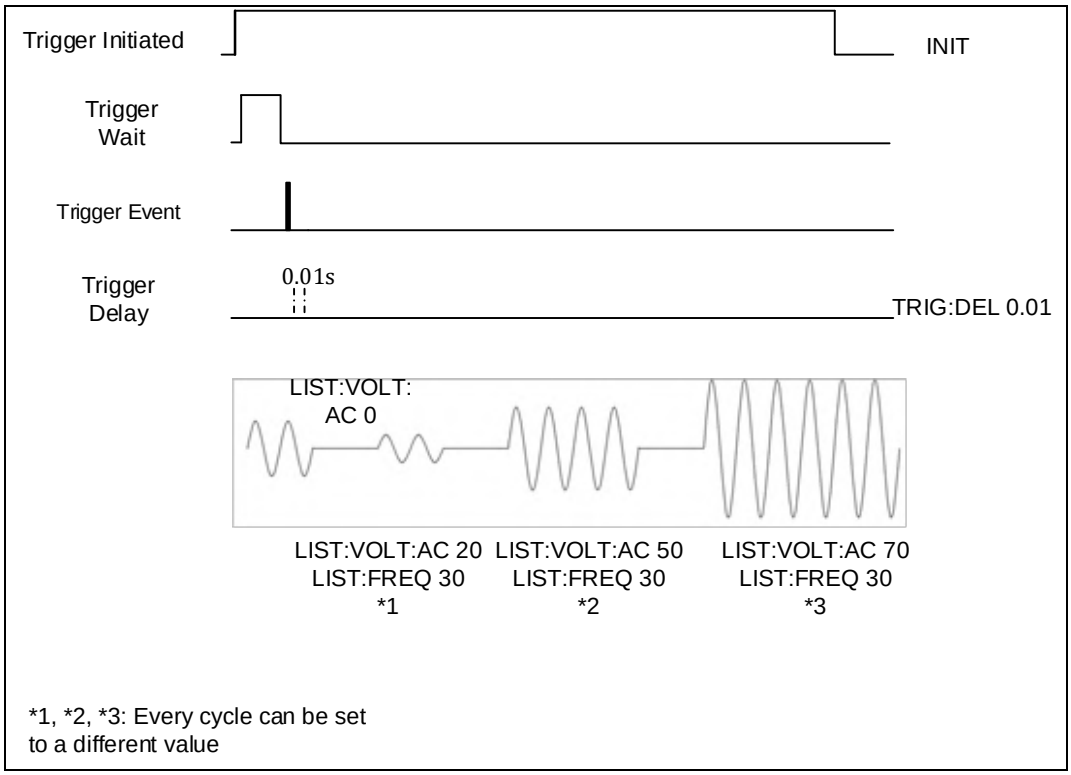


Figure 17-12: List Sequencer Example

Initial Settings (after AC reset): Output ON, AC Mode, built-in sine wave, AC 50V, FREQ 100

Sequencer Settings:

MODE:WAV LIST	Sets the sequence mode of the waveform to LIST
LIST:WAV SIN,SIN,SIN,SIN,SIN,SIN	Sets the waveform of each item in the list to SINE
MODE:VOLT:AC LIST	Sets the sequence mode of the AC amplitude to LIST
MODE:FREQ LIST	Sets the sequence mode of the frequency to LIST
MODE:VOLT:AC:SLEW LIST	Sets the sequence mode of the slew rate of the ac to LIST
MODE:FREQ:SLEW LIST	Sets the sequence mode of the slew rate of the frequency to LIST
LIST:VOLT:AC 0,20,0,50,0,70	Sets the ac amplitude of each item in the list
LIST:VOLT:AC:SLEW:UP 16340,16340,16340,16340,16340,16340	Sets the slew rate of the up programming of each item in the list
LIST:VOLT:AC:SLEW:DOWN 16340,16340,16340,16340,16340,16340	Sets the slew rate of the down programming of each item in the list
LIST:FREQ 20,30,20,30,20,30	Sets the frequency of each item in the list
LIST:FREQ:SLEW:UP 99999,99999,99999,99999,99999,99999	Sets the slew rate of the up programming of each item in the list
LIST:FREQ:SLEW:DOWN 99999,99999,99999,99999,99999,99999	Sets the slew rate of the down programming of each item in the list
LIST:SIZE 6	Sets the number of items to be executed in the list
LIST:DUR 1000,1000,1000,1000,1000,1000	Sets the duration of each item in the list
LIST:REP 5	Sets the number of times the list is repeated
LIST:STEP AUTO	Sets the power source to execute the whole sequence once the trigger is received.
TRIG:PROG LIST	Sets the trigger mode to LIST

TRIG:SOUR BUS	Sets the trigger source to BUS
MODE:END IMM	Sets power source settings to IMM after the sequence finishes
INIT:CONT OFF	Trigger system is enabled for a single trigger action
INIT	Trigger initialized
*TRG	Trigger

Table 17-4: List Sequence Example

As seen from **Table 17-4**, when the sequencer starts running,

- all parameters are assigned to LIST mode
- the waveform of each node in the list is SINE
- output voltage, frequency, and the duration of each node in the list changes according to the values set

NOTE

The waveform name assigned to LIST:WAV must match the name of the waveform in the selected region.

CHAPTER 18: PARALLEL OPERATION

18.1 Introduction

The parallel configuration of the power source consists of power sources configured to various phases to increase the power per phase or to a single phase to increase the power on that single phase. Several power sources may share a phase in parallel, or each power source may be on a separate phase.

18.2 Typical Configurations

NOTE

Units assigned to a specific phase must be sequential, and must be connected directly to one another without units assigned to other phases in between.

NOTE

In local sensing, it is important to minimize wire length to decrease wire resistance. In addition, the positive and negative wires should be as close as possible to each other to achieve better current balance between power sources.

NOTE

In a parallel connection, the total output power is defined by the minimum rated power source. For example, parallel connection of 2kVA power source to a 3 kVA power source results in a total output power of 4kVA.

In parallel mode, the power sources can be configured as:

- **System Master**: This unit is the master for the entire system (single-phase or multi-phase). This is the unit with which the user controls the entire system, and this unit is responsible for configuring and maintaining the system. If any change occurs to the system configuration (e.g., changed serial number, changed software revision), an alert is sent to the user.
- **Phase Master**: The user can program this unit via the System Master only. This unit cannot be programmed via direct communication. The Phase Master controls the slaves that may be connected to it in a particular phase.

  The user can access the phase configuration by adding the phase number as a suffix to the command. For example, refer to [SOURce:]VOLTage[:LEVel][:IMMediate][:AC][#] <NRf>. [#] is the phase number. If [#] is not added, the command will be sent to all the phases. VOLT1 20, for example, will assign 20V to phase 1 only. VOLT 35, for example, will be assigned to all the phases. If the user sends query without the suffix, only the system master replies. The Phase Master power switch is disabled and can be controlled only via the System Master power switch.
- **Slave**: Single unit, controlled by the Phase Master. The user can control the slave unit via the Phase Master only. This unit cannot be programmed via direct communication. The slave unit updates the Phase Master about its current, output state, and fault status only. The slave power switch is disabled and can be controlled only via the System Master power switch.

The 6kVA / 9kVA / 12kVA / 18kVA / 24kVA unit is also based on the principle of a parallel system where,

- in the case of a single-phase system, the first unit is always the System Master, and the rest of the units are slaves.
- in the case of a three-phase system, the first unit is always the System Master and there are two Phase Masters. There may be additional slaves with the System Master and Phase Master.

18kVA/24kVA unit contains six power sources. Refer to the following conditions while using these units.

- Power sources are paired and each pair must be connected to the same phase when operating in a parallel configuration. An example is shown in **Figure 18-1**.

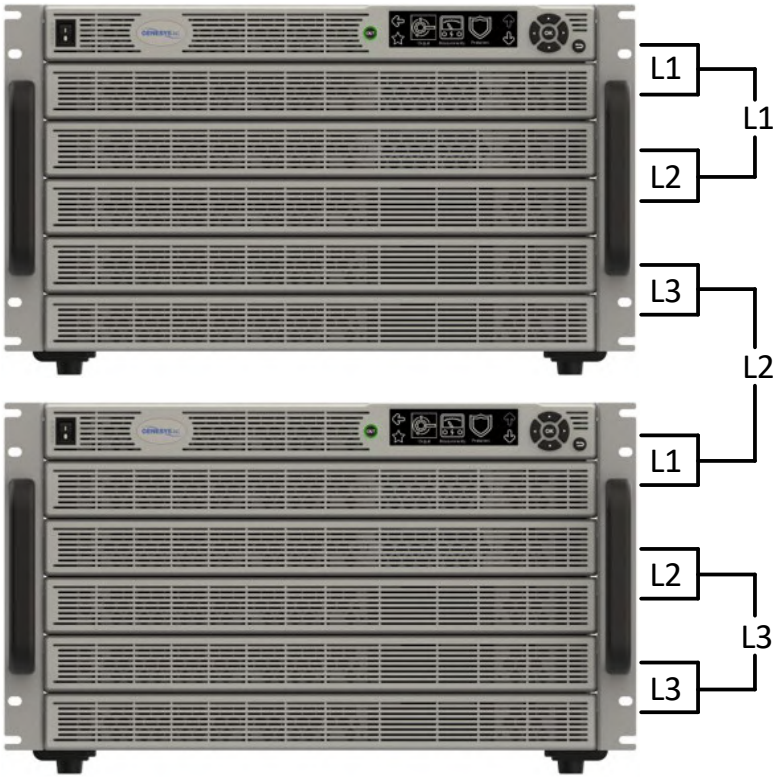


Figure 18-1: Pairing of Power Sources

- The phase designation on the output connector of a 18kVA/24kVA unit does not necessarily represent the actual phase number when the unit is installed in a parallel system. As shown in **Figure 18-2**, two power sources on phases L1 and L2 (four in total) are connected together to create phase 1 (L1).

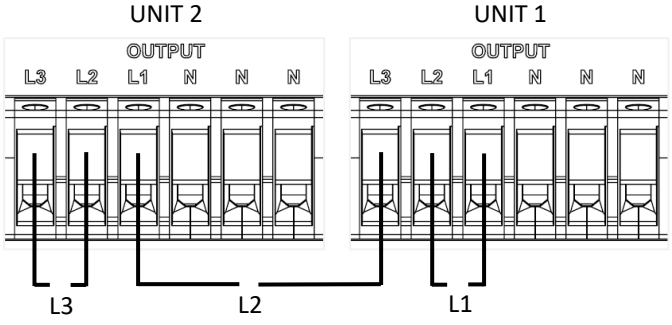


Figure 18-2: 2 x 18kVA/24kVA in Parallel

NOTE

Two-phase configuration is not possible for pre-assembled units rated at 6kVA / 9kVA / 12kVA / 18kVA / 24kVA.

Refer to **Section 7.7.7: Load Connection Options (6kVA, 9kVA, 9kVA PWR, 12kVA, 12kVA PWR, 18kVA, and 24kVA)** for typical configurations.

18.2.1 Rear Panel Connectors Configuration

The rear panel connectors and their pins may be enabled or disabled depending on the configuration of the unit. Refer to **Table 18-1** for the configuration of J1–J8 connectors, J4 connector pins, and the Reset button, depending on the configuration of the unit.

			Role						
Connector			**Single**	**System Master (Single-Phase)**	**System Master (Multi-Phase)**	**Phase Master**	**Slave**	**Booster (Phase Master)**	**Booster (Slave)**
J1		RS232/RS485	+	+	+	-	-	NA	NA
J2		USB	+	+	+	+(*1)	+(*1)	+(*1)	+(*1)
J3		LAN	+	+	+	-	-	NA	NA
J4(*2)	J4-1	CV/CC Monitor	+	+	+	+	-	+	-
	J4-2	Power Source OK 2	+	+	+	-	-	-	-
	J4-3	Power Source OK 1	+	+	+	-	-	-	-
	J4-4	Trigger 1 IN	+	+	+	-	-	-	-
	J4-5	Local/Remote Monitor	+	+	+	+	-	+	-
	J4-6	Local/Remote Control	+	+	+	+	-	+	-
	J4-7	Trigger 2 OUT	+	+	+	-	-	-	-
	J4-8	Voltage Monitor	+	+	+	+	+	+	+
	J4-9	Voltage Control	+	+	+	+	-	+	-
	J4-10	Enable	+	+	+	-	-	-	-
	J4-11	COM_SELV	+	+	+	+	+	+	+
	J4-12	COM_SELV	+	+	+	+	+	+	+
	J4-13	COM_SELV	+	+	+	+	+	+	+
	J4-14	NC	-	-	-	-	-	-	-
	J4-15	NC	-	-	-	-	-	-	-
	J4-16	NC	-	-	-	-	-	-	-
	J4-17	COM_SELV	+	+	+	+	+	+	+
	J4-18	COM_SELV	+	+	+	+	+	+	+
	J4-19	Interlock	+	+	+	-	-	-	-
	J4-20	Programmable Pin 2	+	+	+	+	-	+	-

Connector			Role						
			Single	**System Master (Single-Phase)**	**System Master (Multi-Phase)**	**Phase Master**	**Slave**	**Booster (Phase Master)**	**Booster (Slave)**
	J4-21	Programmable Pin 1	+	+	+	+	-	+	-
	J4-22	Trigger 2 IN	+	+	+	-	-	-	-
	J4-23	Trigger 1 OUT	+	+	+	+	-	+	-
	J4-24	AC OK	+	+	+	+	+	+	+
	J4-25	Alarm	+	+	+	+	+	+	+
	J4-26	Current Monitor	+	+	+	+	+	+	+
J5		E-Stop	+	+	+	-	-	NA	NA
J6		Trigger 1 OUT	+	+	+	+	-	+	-
J7		Voltage Monitor	+	+	+	+	-	+	-
J8		Optional Interface	+	+	+	-	-	NA	NA
Rear Button		Reset	+	+	+	-	-	-	-

(*1): Only queries allowed in each power source which is not Single or System Master.

(*2): J4 is the name of the connector. J4-1 to J4-26 are not name the of the connectors but the pin number on that connector. Fox example: J4-1 is pin 1 on J4 connector.

Table 18-1: Rear Panel Connectors Configuration

Table 18-2 describes the functionality of the pins on the DB26 connector for the Phase Master and the slave (including the booster unit) in parallel configuration. All the pins are enabled for the single unit and the System Master.

DB26 Pins		Phase Master	Slave
J4-1	CV/CC Monitor	A single phase can enter CC Mode while others are still in CV Mode (and vice versa), so each phase should have its own CV/CC Mode Monitoring signal.	CV/CC Mode Monitor signal is monitored only by Phase Master of each phase and irrelevant in slaves.
J4-2	Power Source OK 2	Output ON/OFF state is controlled only by System Master.	Output ON/OFF state is controlled only by System Master.
J4-3	Power Source OK 1	Output ON/OFF state is controlled only by System Master.	Output ON/OFF state is controlled only by System Master.
J4-4	Trigger 1 IN	Used to trigger Sequencer operation, but this operation is global and committed only via System Master.	Used to trigger Sequencer operation, but this operation is global and committed only via System Master.
J4-5	Local/Remote Monitor	Indication of Digital / Analog Programming reference source is valid for each phase separately.	Indication of Digital / Analog Programming reference source is valid only in Phase Master or System Master.

DB26 Pins		Phase Master	Slave
J4-6	Local/Remote Control	Enabling / Disabling power source voltage reference settings by Analog Programming is committed separately for each Phase Master.	Function is irrelevant for Slaves. It is committed only via Phase Masters or System Master.
J4-7	Trigger 2 OUT	Used to indicate that a triggered measurement data is ready, so because triggering is committed globally (via System Master), an indication about data is ready also committed via System Master.	Used to indicate that a triggered measurement data is ready, so because triggering is committed globally (via System Master), an indication about data is ready also committed via System Master.
J4-8	Voltage Monitor	Voltage Monitoring signal appeals to each source separately.	Voltage Monitoring signal appeals to each source separately.
J4-9	Voltage Control	External Analog Programming reference voltage is valid for each phase separately.	External Analog Programming reference voltage is committed only via Phase Master or System Master.
J4-10	Enable	ENA Shutdown is a global control and committed via System Master only.	ENA Shutdown is a global control and committed via System Master only.
J4-19	Interlock	Interlock Shutdown is a global control and committed via System Master only.	Interlock Shutdown is a global control and committed via System Master only.
J4-20	Programmable Pin 2	Programmable Signal 1 control is committed only via Phase Master or System Master.	Programmable Signal 1 control is committed only via Phase Master or System Master.
J4-21	Programmable Pin 1	Programmable Signal 2 control is committed only via Phase Master or System Master.	Programmable Signal 2 control is committed only via Phase Master or System Master.
J4-22	Trigger 2 IN	Used to trigger measurements operation, but this operation is global and committed only via System Master.	Used to trigger measurements operation, but this operation is global and committed only via System Master.
J4-23	Trigger 1 OUT	May indicate Voltage / Current setting change (if set to Function Strobe), so it is valid for each phase separately.	Sequencer operation, output ON/OFF transition, Voltage change, or Current change are not controlled by Slave AC source.
J4-24	AC OK	Signal indicates AC Shutdown in each AC source.	Signal indicates AC Shutdown in each AC source.
J4-25	Alarm	Indicates faults for each unit seperately	Indicates faults for each unit seperately
J4-26	Current Monitor	Current Monitoring signal appeals to each source separately.	Current Monitoring signal appeals to each source separately.

Table 18-2: Rear Panel Connector Description

18.2.2 Typical Parallel Configuration using 2kVA/3kVA/4kVA Units

18.2.2.1 Single-Phase, Local Sense

In this configuration, the first unit is always the System Master, and the rest of the units are slaves. This is a Line-Neutral Connection.

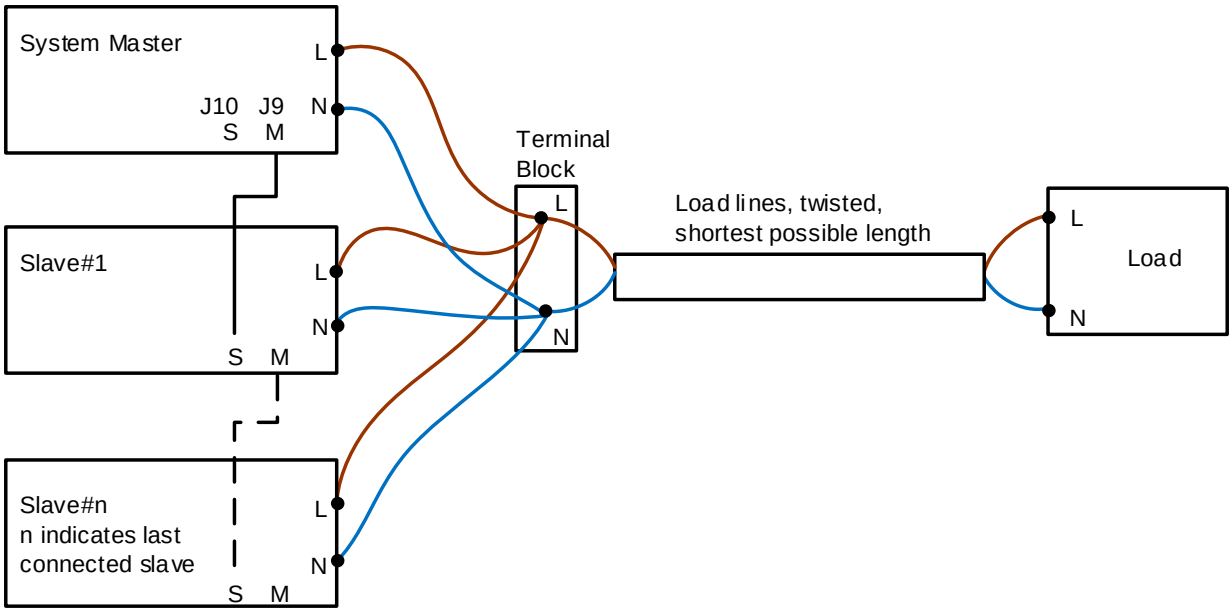


Figure 18-3: Single-Phase, Local Sense

18.2.2.2 Two Phase, Local Sense

In this configuration, there is a System Master with additional slaves, and there is a Phase Master also with additional slaves. This is a Line-Line connection.

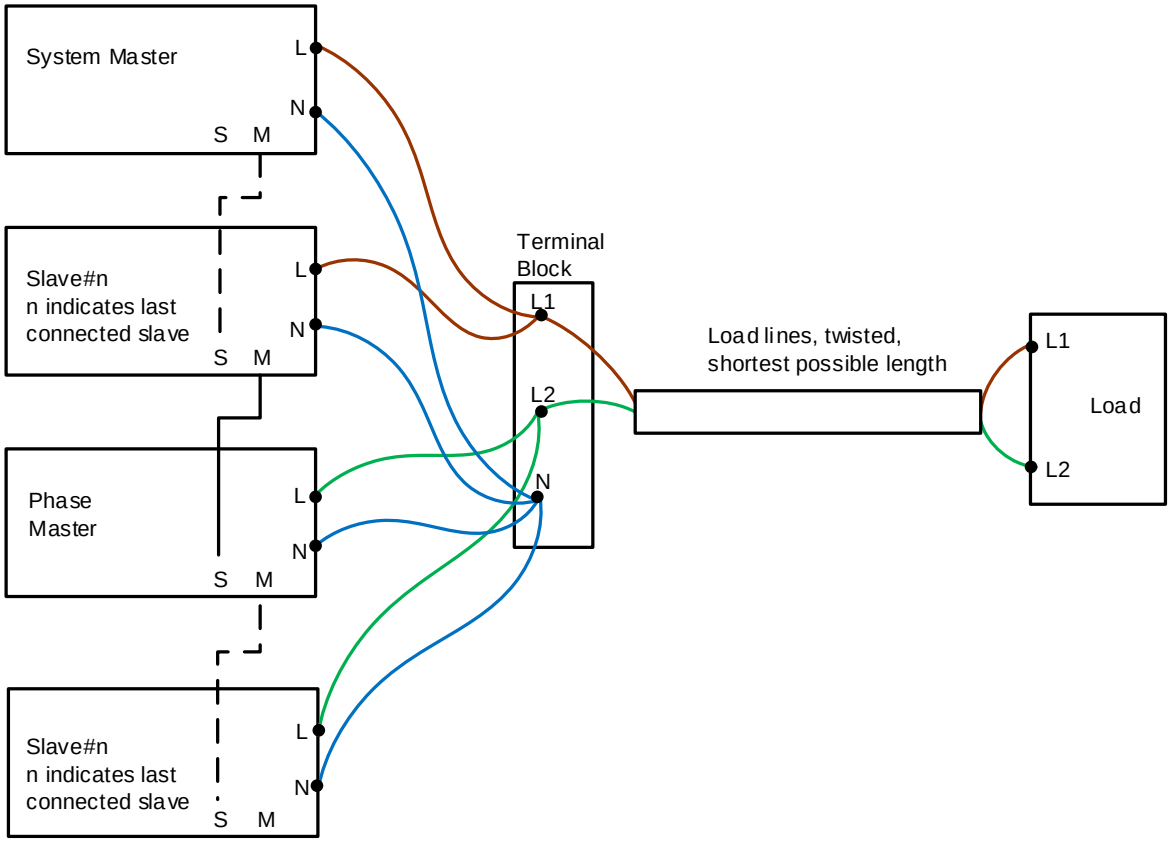


Figure 18-4: Two Phase, Local Sense

18.2.2.3 Three Phase, Local Sense, 4 Wire

In this configuration, there is a System Master and two additional phase masters. This is a Star Connection.

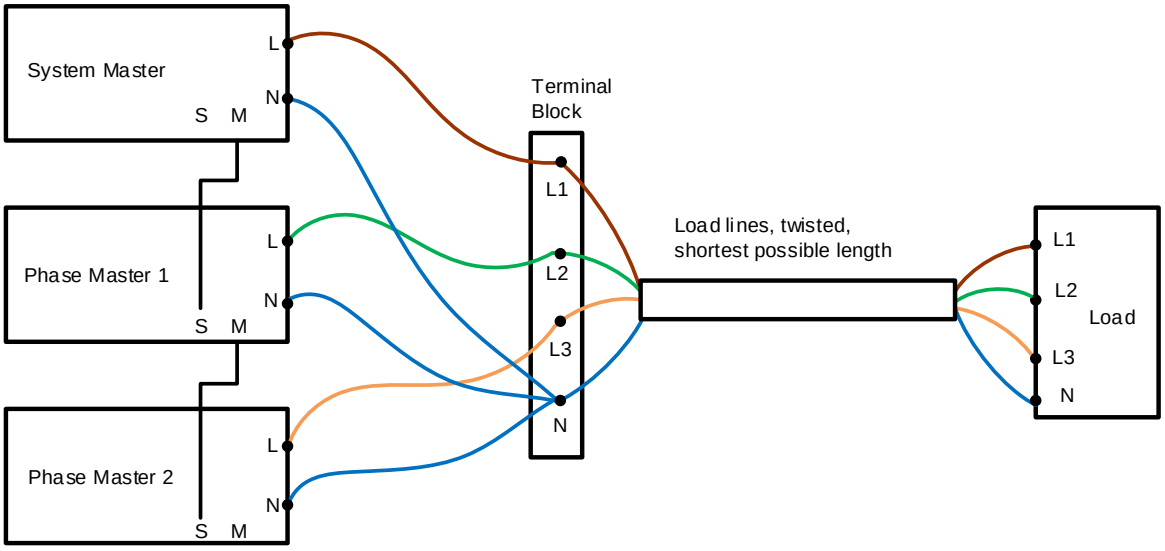


Figure 18-5: Three Phase, Local Sense, 4 Wire

Additional slaves can also be added to the above configuration to increase the total power per phase.

18.2.2.4 Three Phase, Local Sense, 3 Wire

In this configuration, there is a System Master and two additional phase masters. The neutral (N) points of all power sources are shorted together at the power sources end. This is a Delta connection.

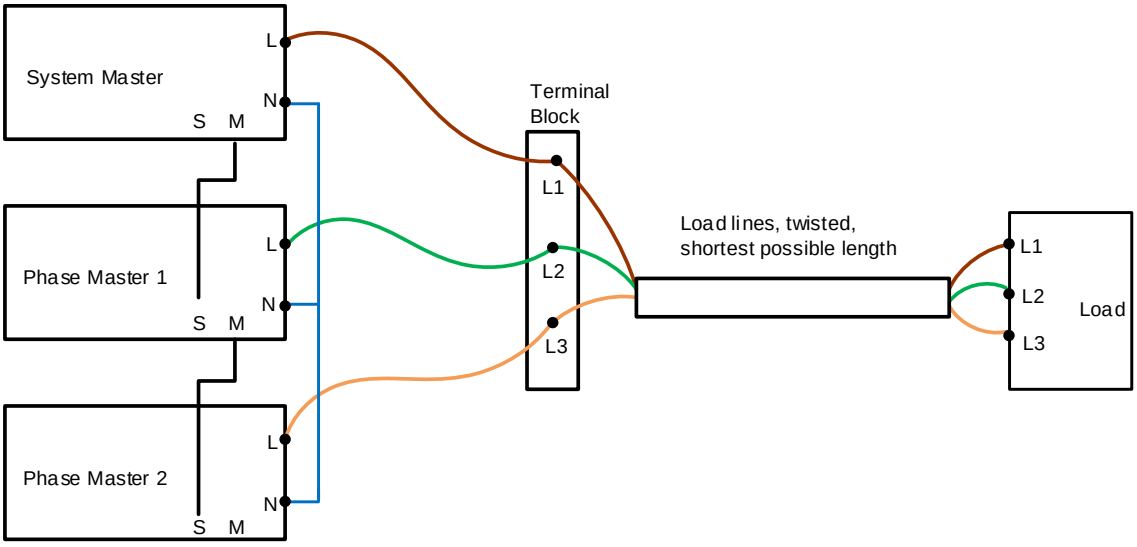


Figure 18-6: Three Phase, Local Sense, 3 Wire

Additional slaves can also be added to the above configuration to increase the total power per phase.

18.2.2.5 Three Phase, Remote Sense

In this configuration, there is a System Master with optional slaves and there are two Phase Masters also with optional slaves.

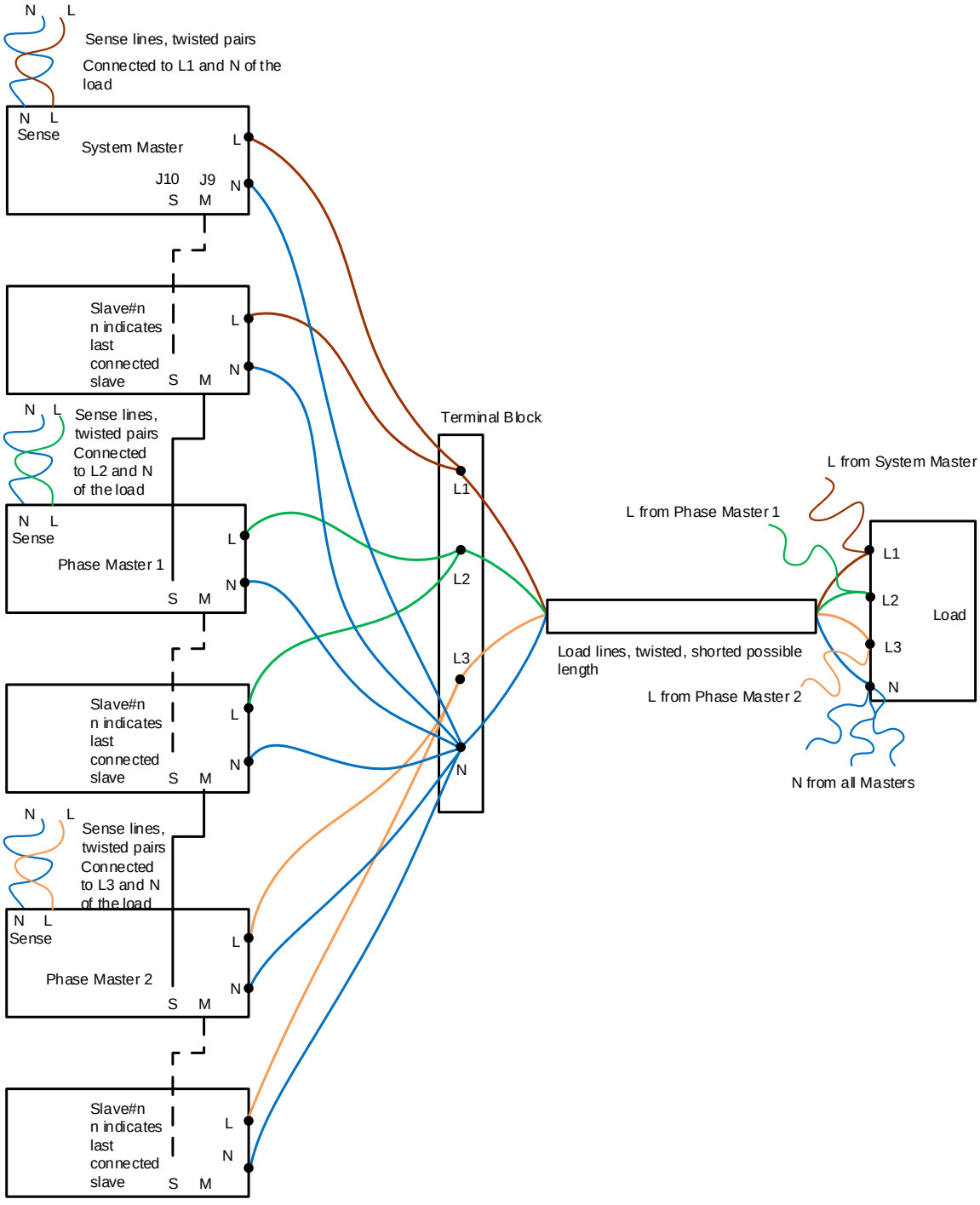


Figure 18-7: Three Phase, Remote Sense

18.2.3 Typical Parallel Configuration using 6kVA/9kVA/12kVA/18kVA/24kVA Units

18.2.3.1 Single-Phase, Local Sense

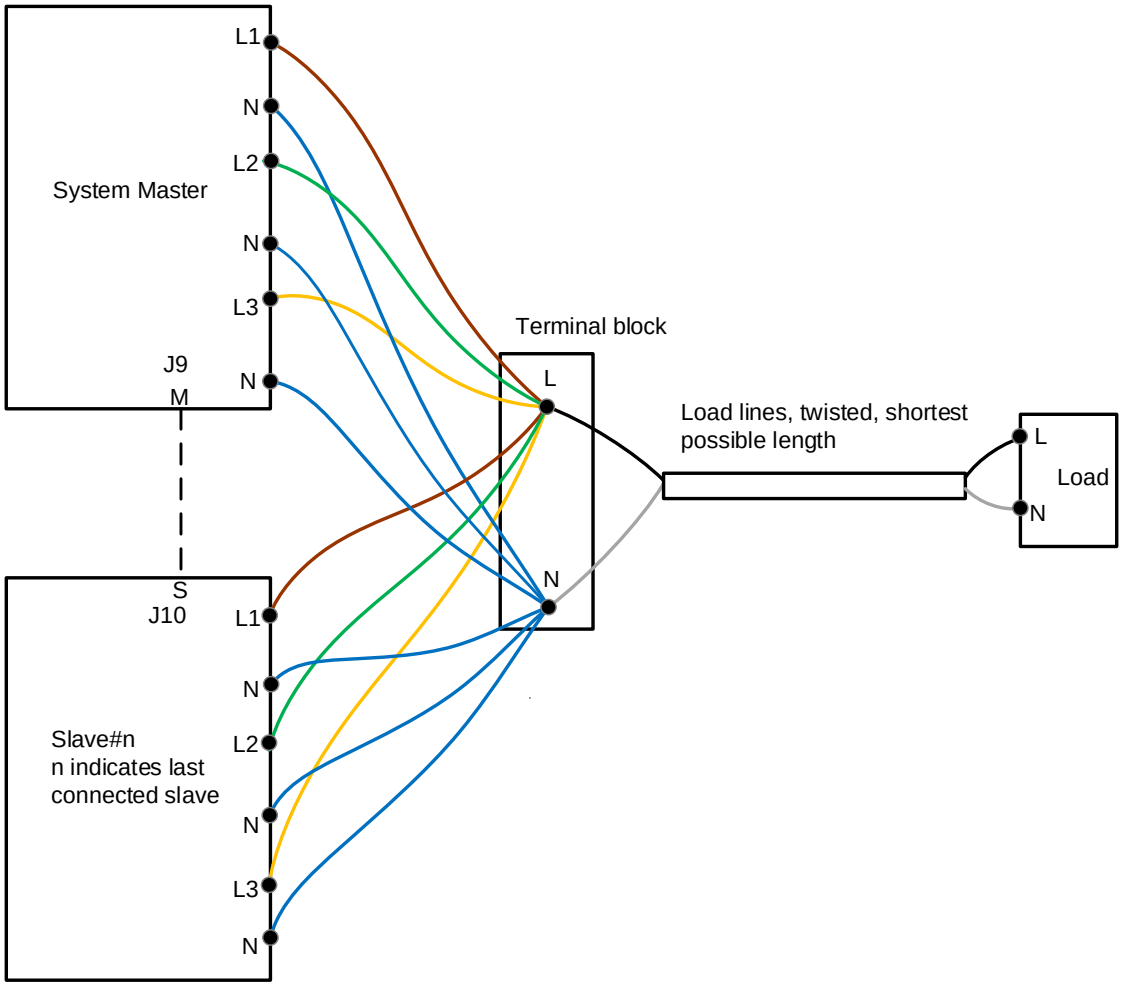


Figure 18-8: Single Phase, Local Sense

The above configuration can create a high power system.

18.2.3.2 Three-Phase, 12kVA/18kVA/24kVA

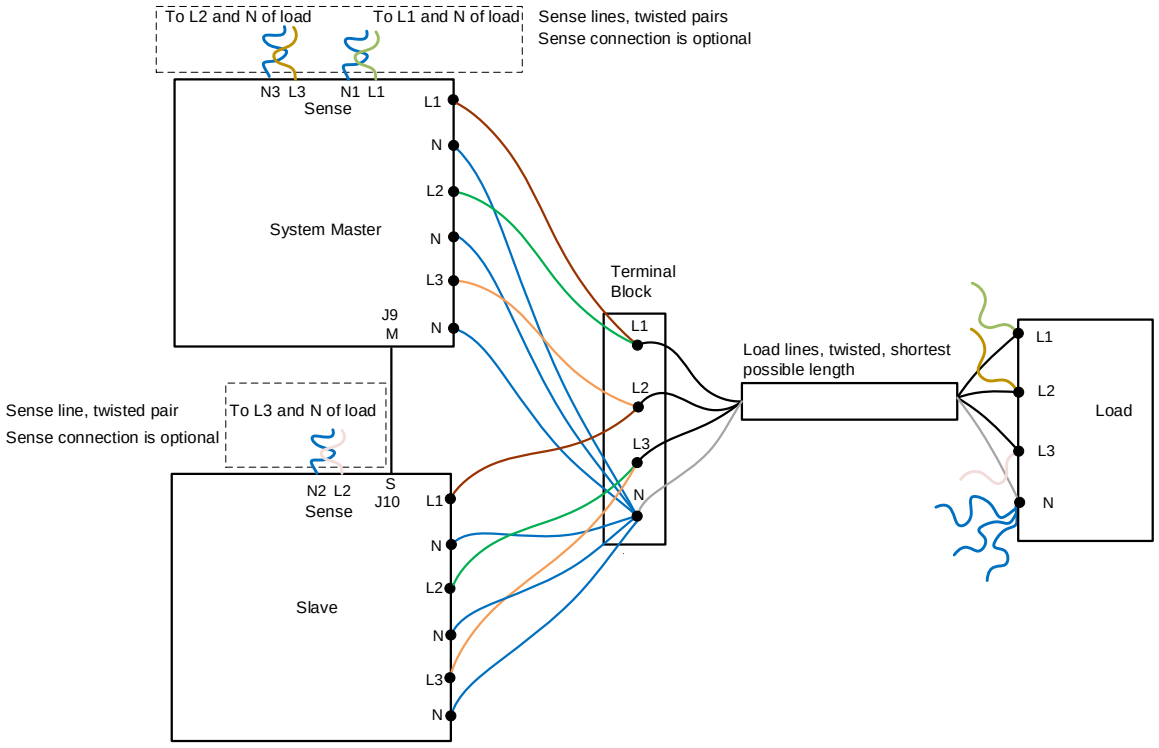


Figure 18-9: Three Phase-12kVA/18kVA/24kVA

18.2.3.3 Three-Phase, 18kVA/27kVA/36kVA

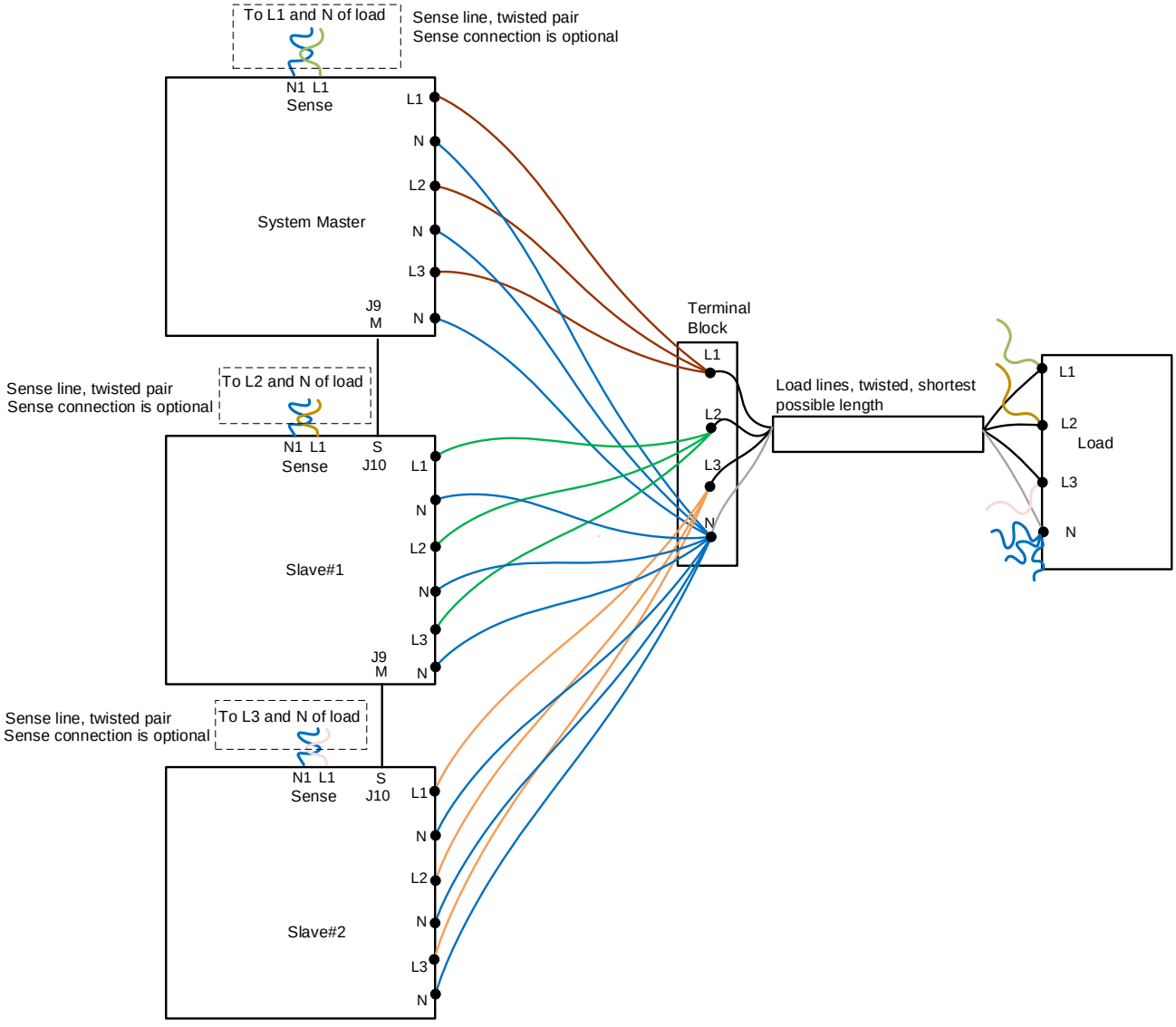


Figure 18-10: Three Phase-18kVA/27kVA/36kVA

18.2.3.4 Three-Phase, 24kVA/36kVA/48kVA

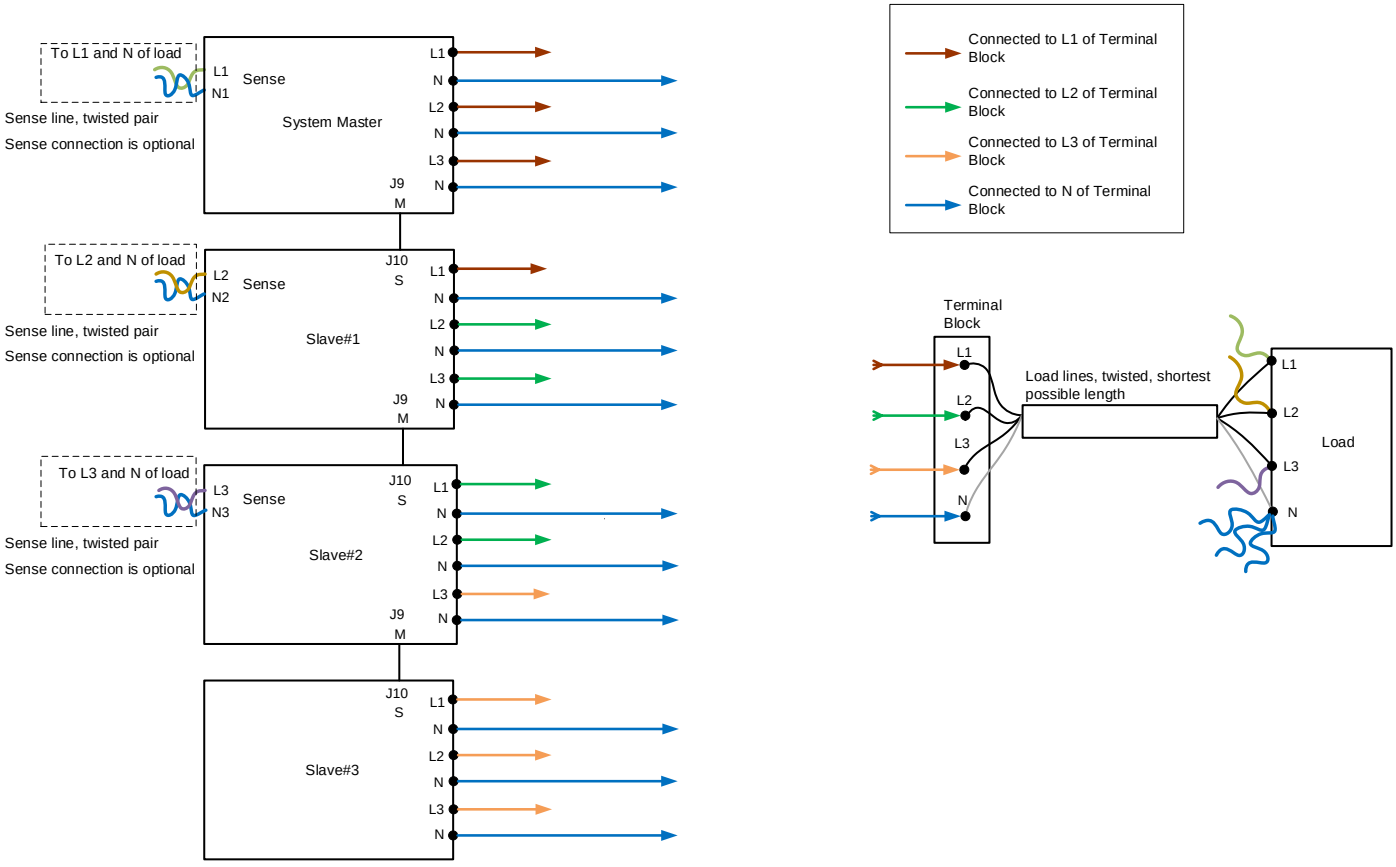


Figure 18-11: Three Phase-24kVA/36kVA/48kVA

18.2.3.5 Three-Phase, 30kVA/45kVA/60kVA

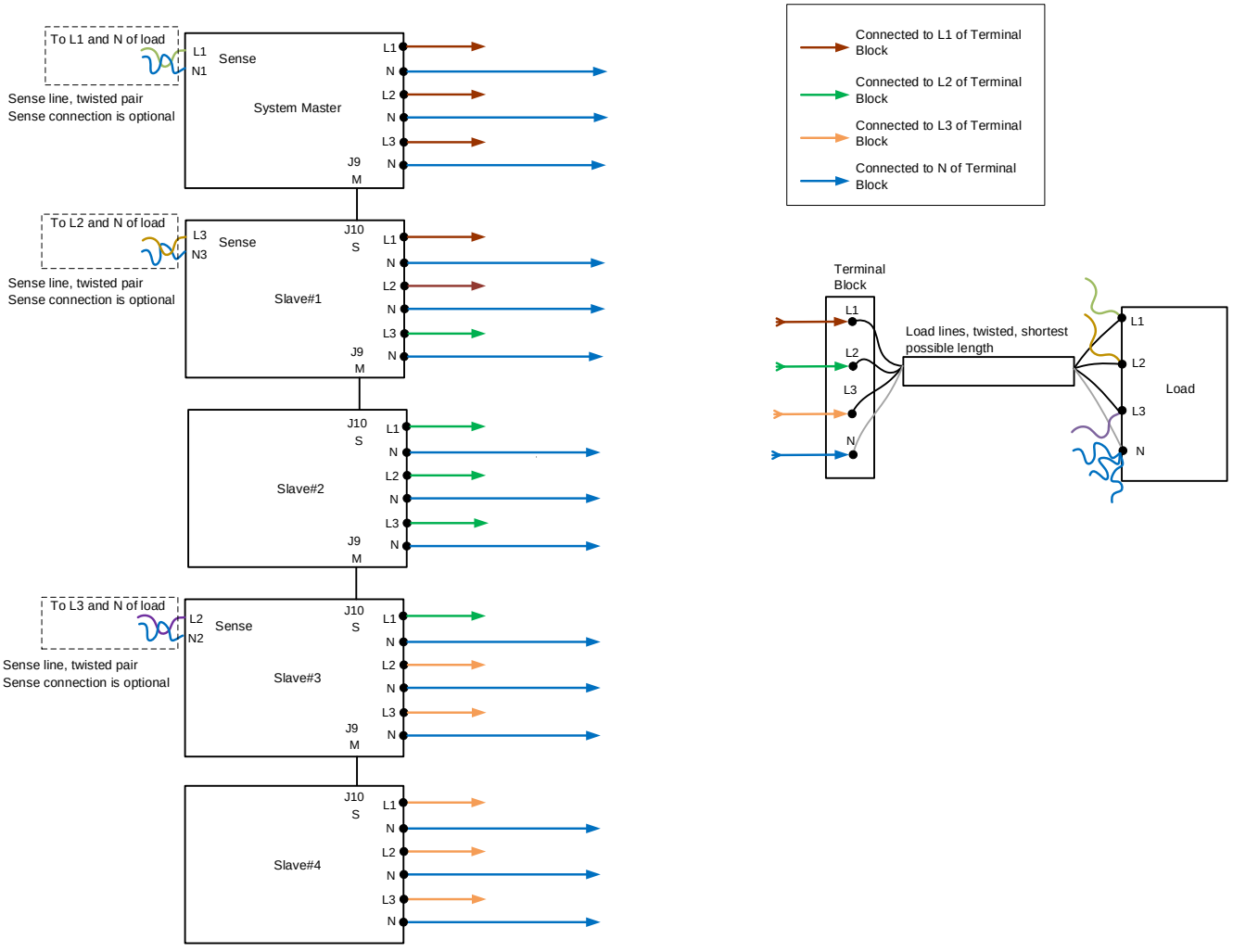


Figure 18-12: Three Phase-30kVA/45kVA/60kVA

18.2.4 Typical Parallel Configuration using GAC-PWR Units

18.2.4.1 Single-Phase, Local Sense, 1 phase GAC + GAC-PWR units

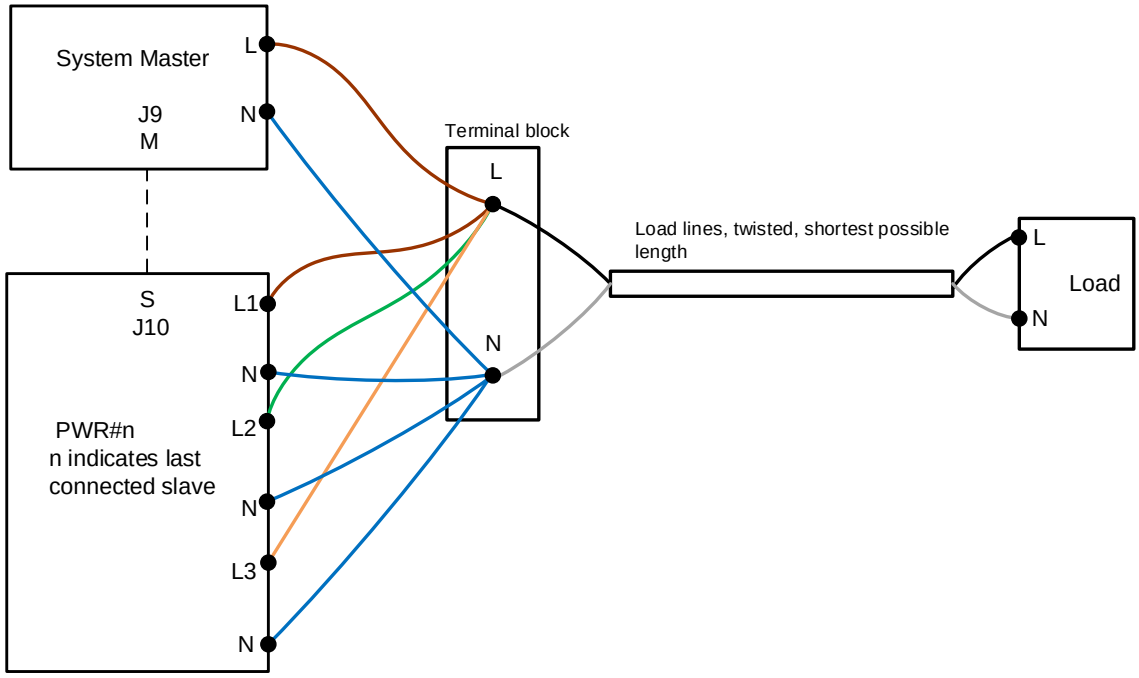


Figure 18-13: Single Phase, Local Sense (GAC + GAC-PWR)

The above configuration can create a high power system.

NOTE

PWR unit cannot be used as standalone and must always be connected to a Master unit.

18.2.4.2 Single-Phase, Remote Sense, 3-phase GAC + GAC-PWR units

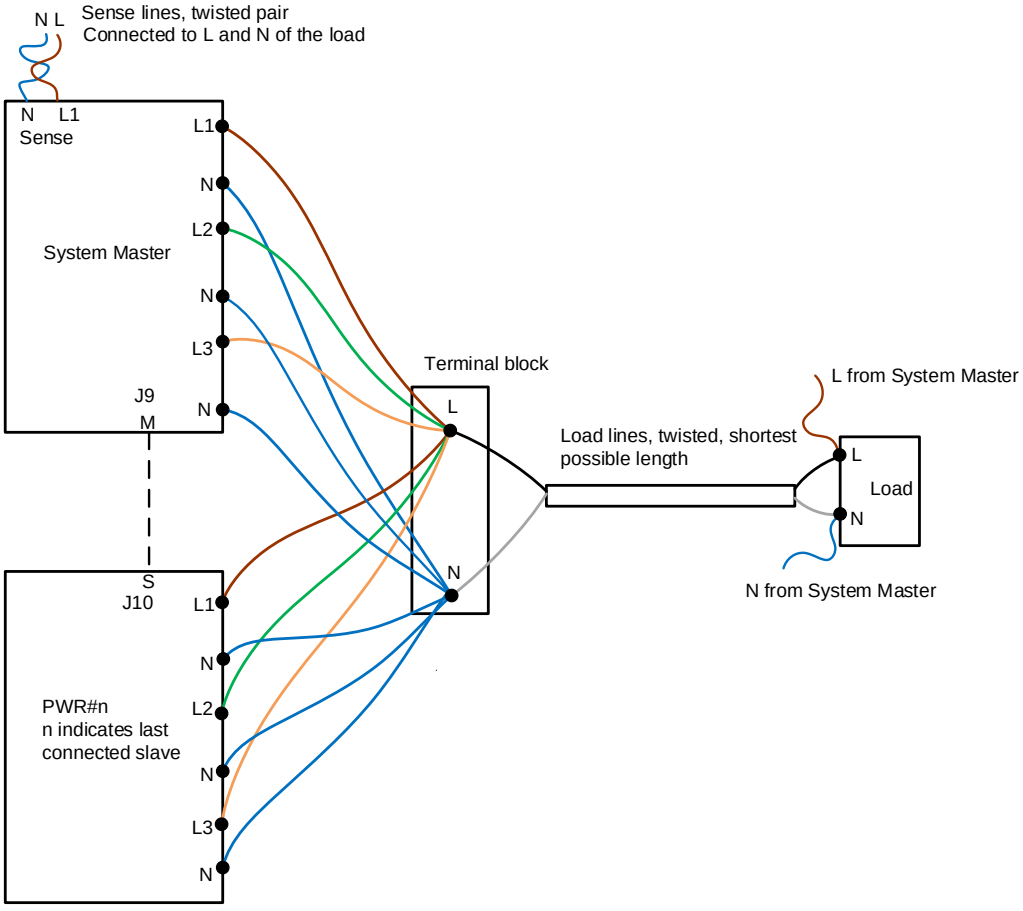


Figure 18-14: Single Phase, Remote Sense (GAC + GAC-PWR)

The above configuration can create a high power system.

NOTE

PWR unit cannot be used as standalone and must always be connected to a Master unit.

18.3 System Setup and Assembly

18.3.1 System Assembly

WARNING

System assembly must be performed only when the whole system is disconnected from the AC mains.



If a parallel setup is prepared, the GAC/P parallel kit must be used, and a cable connection must be made between the master (J9) and the slave (J10) unit.



Parallel connection must be done using the GAC/P kit only. The cable included in the kit must be used and it must be covered with the plastic parts included in the kit.

System assembly is established by using the parallel kit (GAC/P) for connecting all the units.

1. Remove the protective cover from J9 (M) and J10 (S) connectors from all the units to be connected in parallel.
2. Assemble the protection cover.
3. Connect the parallel cables.
4. Cover the parallel connection.

Figure 18-15 shows a system after it is assembled.

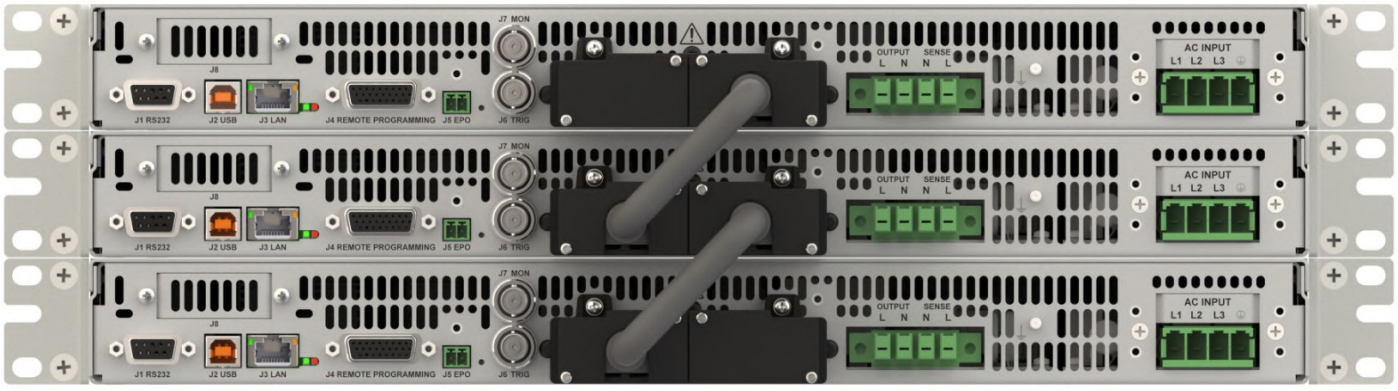


Figure 18-15: System Assembly (2kVA / 3kVA / 4kVA x 3 units)

18.3.2 System Disassembly

CAUTION

System disassembly must be performed only when the whole system is disconnected from the AC power lines.

1. Uncover the parallel connection
2. Remove the parallel cables
3. Remove the protection cover
4. Re-assemble the protective cover back to J9 (M) and J10 (S) connectors.

WARNING

The protective covers must be assembled back on to J9 (M) and J10 (S) connectors in all the units if they are disconnected from the parallel system.

18.3.3 System Acknowledge

The acknowledgement prevents unintended changes in systems assembled in parallel.
Following initial system assembly, the newly assembled systems must be acknowledged. Any further change in the system configuration must also be acknowledged. A change in the configuration may be adding units, removing units, or changing the role of a unit.
When the user acknowledges the system, the System Master attempts to construct the system. If it succeeds, the system is configured and set to working mode. If it cannot, for reasons like lacking units or units under fault, the System Master creates a construction fault and shows the fault on the display.
The acknowledgement process is performed on the System Master, and the process is available via the front panel or communications.

18.3.3.1 Acknowledge via the Front Panel

1. Turn ON all the units and wait for 5 seconds. The following message appears on the System Master.



The following message appears on the other units.



2. Click **Settings** on the System Master.
3. Select the number of phases. The following message appears.



4. Click **Set.**

Figure 18-16 shows a single phase system with one System Master (first unit) and one slave (second unit).



Figure 18-16: Single Phase System

Figure 18-17 shows a two phase system with one System Master (first unit) and one Phase Master (second unit).



Figure 18-17: Two Phase System

18.3.3.2 Acknowledge via communication

1. Turn ON all the units and wait for 5 seconds.
2. Send SYSTem:PHASe:CONFiguration x. x = the number of phases.

18.3.3.3 Acknowledge via communication (Blank Panel)

1. Turn ON all the units and wait for 5 seconds.
2. Send STATus:QUEStionable:CONDition? if the system is ready for acknowledgement, the Parallel Acknowledge bit (PACK) is set; refer to **Section 14.11.2: Questionable Condition (Fault Register) Group Structure**.
3. Send SYSTem:PHASe:CONFiguration x. x = the number of phases.

18.3.3.4 Parallel System Identification (*idn?)

To identify a system connected in parallel, the System/Phase Master updates its identification name. A typical response from a single unit to *IDN? may be TDK-LAMBDA,GAC-PRO-03AA1C07H00A,1234567-1234,001.000.000. If multiple units are used in parallel, the **S** letter follows **GAC,** and **X (X=the output power)** is added. If 2kVA x 3 units are used to create a 6kVA system, *IDN? may look like TDK-LAMBDA,GACS-PRO-06AA1C07H00A,1234567-1234,001.000.000.

18.3.4 Operation of the Slave Units

Slave units are fully controlled by the phase master. Slave only updates the phase master about its current, output state and fault status. During operation, slave units show **OUTPUT ON**, **OUTPUT OFF**, or faults if a fault has occurred. Each slave unit displays its own fault. The display on the slave units are disabled.

18.3.5 Faults System

The fault system combines the faults of all the units. The System Master shows its own faults and faults of other units (Phase Master, slaves) on the display or via communications. Each Phase Master or slave unit shows its own fault on the display only. If the fault occurs in any slave units, the other units show **OUTPUT OFF** and the system acts as if the fault has occurred in the System Master.
If a fault occurs, the Phase Master updates the System Master that a fault has occurred in the system.

18.3.6 Parallel Errors

The parallel system automatically turns the output OFF (output of all the units) if an error occurs in the system Error status can also be detected by reading the bits in the Questionable Register (Fault Register) Refer to **Section 14.11.1: SCPI Register Tree**.

18.4 Typical Sequencer Examples

NOTE

If a waveform is created for a multi-phase system, all units must be connected and operational at that time.

18.4.1 Example 1 – 3-Phase (Pulse Mode)

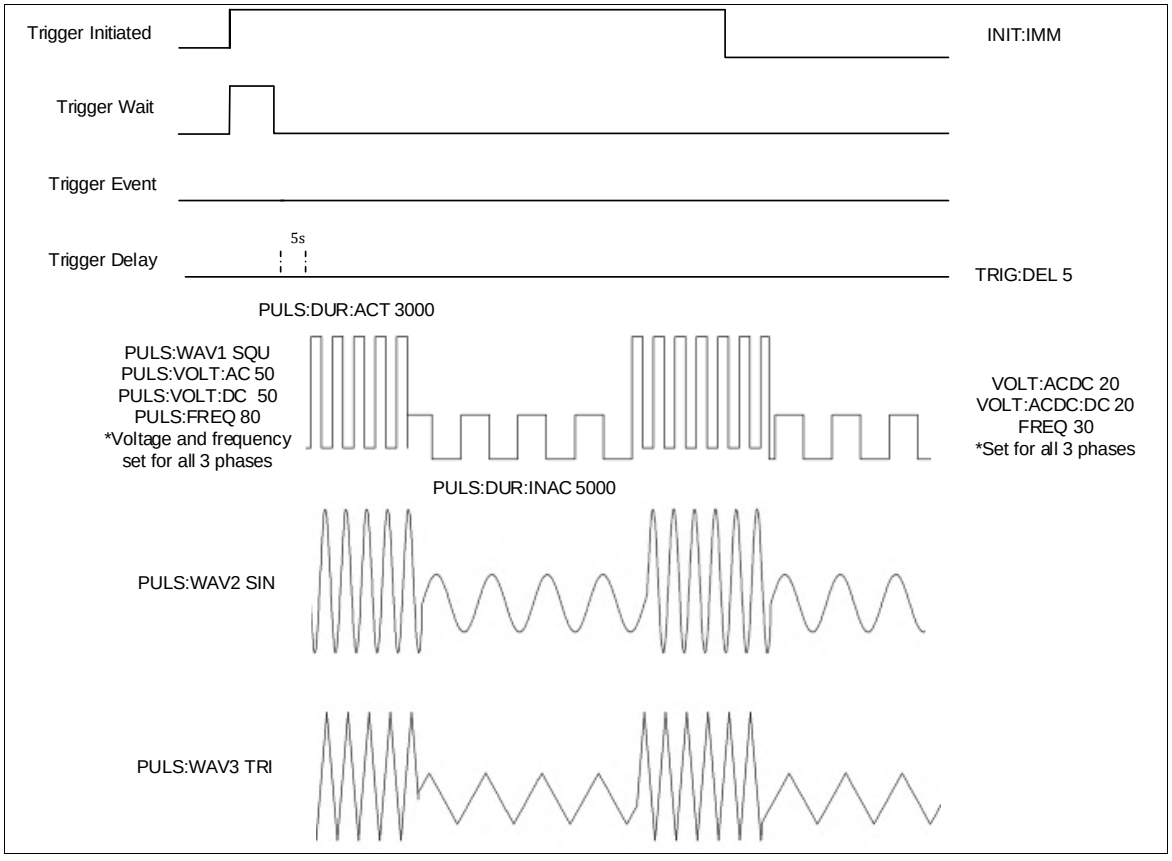


Figure 18-18: Example 1 – 3-Phase (Pulse Mode)

Initial Settings – ACDC mode; Phase1: 20Vac, 20Vdc, 30Hz, SQUARE wave; Phase2: 20Vac, 20Vdc, 30Hz, SINE wave; Phase3: 20Vac, 20Vdc, 30Hz, TRIANGLE wave.

Sequencer Settings:

MODE:WAV PULS	Sets the sequence mode of the waveform to PULSE
PULS:WAV1 SQU	Sets the waveform of the first phase to SQUARE
PULS:WAV2 SIN	Sets the waveform of the second phase to SINE
PULS:WAV3 TRI	Sets the waveform of the third phase to TRIANGLE
MODE:VOLT:AC PULS	Sets the sequence mode of the ac amplitude to PULSE
MODE:VOLT:DC PULS	Sets the sequence mode of the dc amplitude to PULSE
MODE:VOLT:AC:SLEW PULS	Sets the sequence mode of the slew rate of the ac to PULSE
MODE:VOLT:DC:SLEW PULS	Sets the sequence mode of the slew rate of the dc to PULSE
MODE:FREQ PULS	Sets the sequence mode of the frequency to PULSE
MODE:FREQ:SLEW PULS	Sets the sequence mode of the slew rate of frequency to PULSE
MODE:PHAS:STAR PULS	Sets the sequence mode of the phase start to PULSE
MODE:PHAS:END PULS	Sets the sequence mode of the phase end to PULSE
PULS:VOLT:AC 50	Sets the ac amplitude for all three phases to 50V

PULS:VOLT:DC 50	Sets the dc amplitude for all three phases to 50V
PULS:VOLT:AC:SLEW:UP 16340	Sets the slew rate of the up programming of the ac amplitude of all the three phases to 16340 V/ms
PULS:VOLT:AC:SLEW:DOWN 16340	Sets the slew rate of the down programming of the ac amplitude of all the three phases to 16340 V/ms
PULS:VOLT:DC:SLEW:UP 16340	Sets the slew rate of the up programming of the dc amplitude of all the three phases to 16340 V/ms
PULS:VOLT:DC:SLEW:DOWN 16340	Sets the slew rate of the down programming of the dc amplitude of all the three phases to 16340 V/ms
PULS:FREQ 80	Sets the frequency to 80Hz
PULS:FREQ:SLEW:UP 99999	Sets the slew rate of the up programming of the frequency to 99999 Hz/ms
PULS:FREQ:SLEW:DOWN 99999	Sets the slew rate of the down programming of the frequency to 99999 Hz/ms
PULS:DUR:ACT 3000	Sets the active duration of the wave to 3s
PULS:DUR:INAC 5000	Sets the inactive duration of the wave to 5s
PULS:REP 3	Sets the number of repetitions of the pulse (active durations)
PULS:PHAS:STAR 0	Sets the start phase to 0°
PULS:PHAS:END 0	Sets the end phase to 0°
TRIG:PROG PULS	Sets the trigger mode to PULSE
TRIG:SOUR BUS	Sets the trigger source to BUS
TRIG:DEL 5	Sets the trigger delay to 5s
MODE:END LAST	Sets power source settings to LAST after the sequence finishes
INIT:CONT ON	Trigger system is enabled for a continuous trigger action
INIT	Trigger initialized
*TRG	Trigger

Table 18-3: Example 1 – 3-Phase (Pulse Mode) (for Figure 18-16)

As seen in **Figure 18-18** and **Table 18-3**, when the sequencer starts running,

- all the parameters are assigned to PULSE mode.
- during the pulse ACTIVE time (3s), the output voltage and frequency of all the phases is 50Vac+50Vdc (70Vrms) and 80Hz, respectively. During this time, SQUARE wave is assigned to phase 1, SINE to phase 2, and TRIANGLE wave is assigned to phase 3.
- During the pulse INACTIVE time (5s), the output voltage and frequency of all the phases is 20Vac+20Vdc (28Vrms) and 30Hz, respectively. During this time, SQUARE wave is assigned to phase 1, SINE to phase 2, and TRIANGLE wave is assigned to phase 3.

18.4.2 Example 2 – 3-Phase (Step Mode)

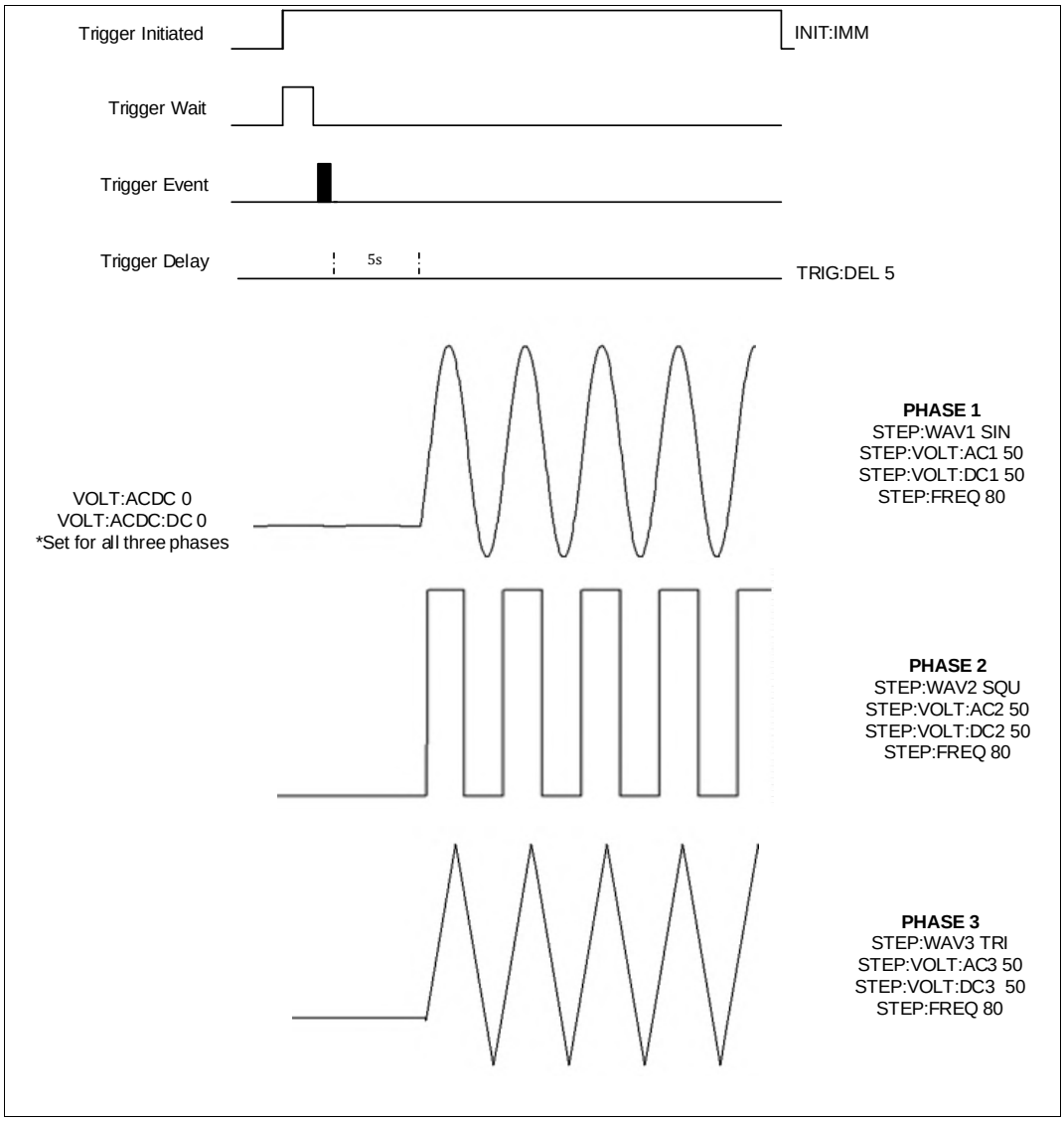


Figure 18-19: Example 2 – 3-Phase (Step Mode)

Initial Settings – ACDC mode; Phase1: 0Vac, 0Vdc, Freq (NA), Wave (NA); Phase2: 0Vac, 0Vdc, Freq (NA), Wave (NA); Phase3: 0Vac, 0Vdc, Freq (NA), Wave (NA). NA=Not Applicable.

Sequencer Settings:

MODE:WAV STEP	Sets the sequence mode of the waveform to STEP
STEP:WAV1 SIN	Sets the waveform for of the first phase to SINE
STEP:WAV2 SQU	Sets the waveform for of the second phase to SQU
STEP:WAV3 TRI	Sets the waveform for of the third phase to TRI
MODE:VOLT:AC STEP	Sets the sequence mode of the ac amplitude to STEP
MODE:VOLT:DC STEP	Sets the sequence mode of the dc amplitude to STEP
MODE:VOLT:AC:SLEW STEP	Sets the sequence mode of the slew rate of the ac to STEP
MODE:VOLT:DC:SLEW STEP	Sets the sequence mode of the slew rate of the dc to STEP
MODE:FREQ STEP	Sets the sequence mode of the frequency to STEP
MODE:FREQ:SLEW STEP	Sets the sequence mode of the slew rate of frequency to STEP
MODE:PHAS:STAR STEP	Sets the sequence mode of the phase start to STEP
STEP:VOLT:AC1 50	Sets the ac amplitude for the first phase to 50V

STEP:VOLT:DC1 50	Sets the dc amplitude for the first phase to 50V
STEP:VOLT:AC2 50	Sets the ac amplitude for the second phase to 50V
STEP:VOLT:DC2 50	Sets the dc amplitude for the second phase to 50V
STEP:VOLT:AC3 50	Sets the ac amplitude for the third phase to 50V
STEP:VOLT:DC3 50	Sets the dc amplitude for the third phase to 50V
STEP:VOLT:AC:SLEW:UP 16340	Sets the slew rate of the up programming of the ac amplitude of all the three phases to 16340 V/ms
STEP:VOLT:AC:SLEW:DOWN 16340	Sets the slew rate of the down programming of the ac amplitude of all the three phases to 16340 V/ms
STEP:VOLT:DC:SLEW:UP 16340	Sets the slew rate of the up programming of the dc amplitude of all the three phases to 16340 V/ms
STEP:VOLT:DC:SLEW:DOWN 16340	Sets the slew rate of the down programming of the dc amplitude of all the three phases to 16340 V/ms
STEP:FREQ 80	Sets the frequency to 80Hz
STEP:FREQ:SLEW:UP 99999	Sets the slew rate of the up programming of the frequency to 99999 Hz/ms
STEP:FREQ:SLEW:DOWN 99999	Sets the slew rate of the down programming of the frequency to 99999 Hz/ms
TRIG:PROG STEP	Sets the trigger mode to STEP
TRIG:SOUR BUS	Sets the trigger source to BUS
TRIG:DEL 5	Sets the trigger delay to 5s
MODE:END LAST	Sets power source settings to LAST after the sequence finishes
INIT:CONT ON	Trigger system is enabled for a continuous trigger action
INIT	Trigger initialized
*TRG	Trigger

Table 18-4: Example 2 – 3-Phase (Step Mode) (for Figure 18-17)

As seen in **Figure 18-19** and **Table 18-4**, when the sequencer starts running,

- all the parameters are assigned to STEP mode.
- SINE wave is assigned to phase 1, SQUARE wave is assigned to phase 2, and TRIANGLE wave is assigned to phase 3.
- The output voltage and frequency of all the phases is 50Vac+50Vdc (70Vrms) and 80Hz, respectively.

18.4.3 Example 3 – 3 Phase (Step + Pulse Mode)

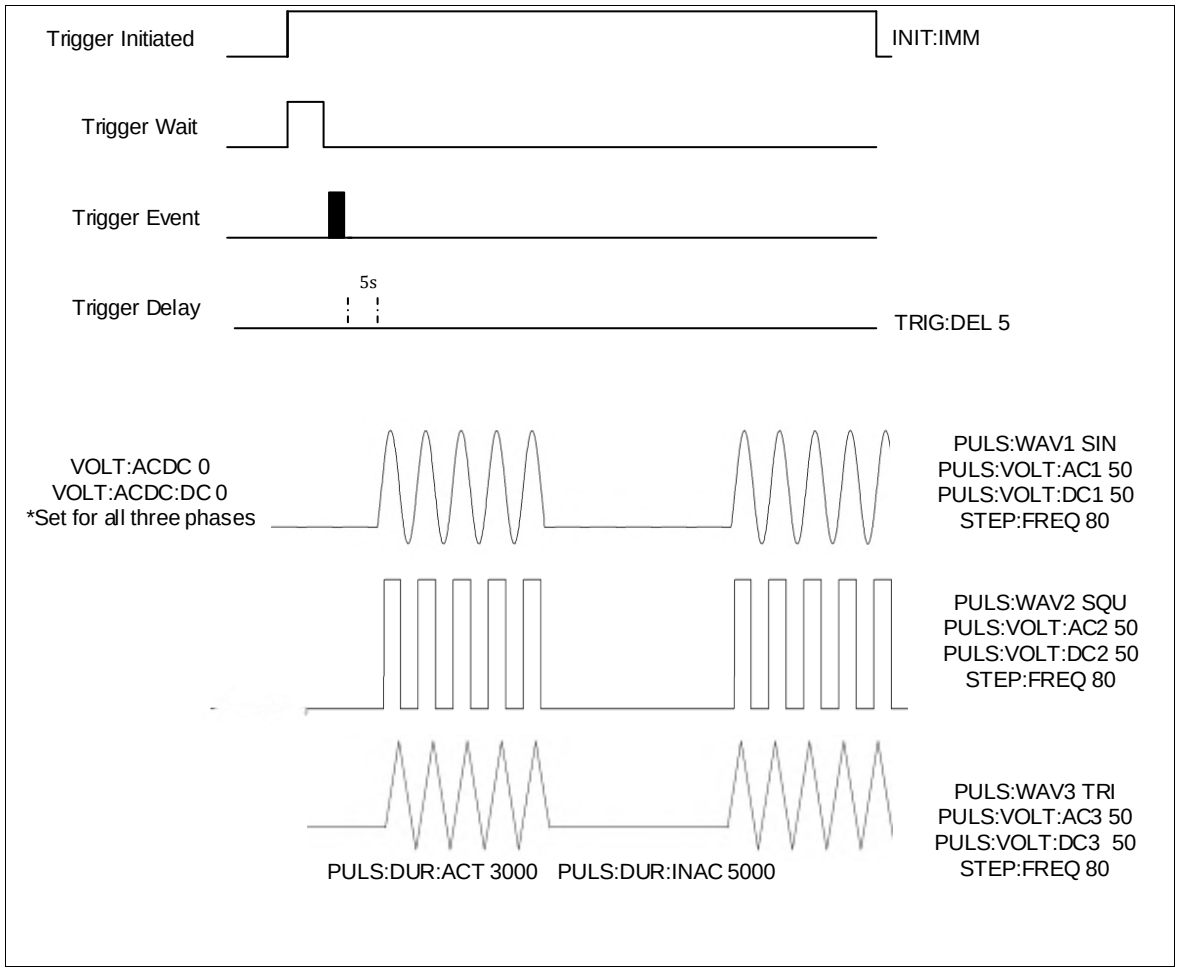


Figure 18-20: Example 3 – 3-Phase (Step + Pulse Mode)

Initial Settings – ACDC mode; Phase1: 0Vac, 0Vdc, Freq (NA), Wave (NA); Phase2: 0Vac, 0Vdc, Freq (NA), Wave (NA); Phase3: 0Vac, 0Vdc, Freq (NA), Wave (NA). NA=Not Applicable.

Sequencer Settings:

MODE:WAV PULS	Sets the sequence mode of the waveform to PULSE
PULS:WAV1 SIN	Sets the waveform for of the first phase to SINE
PULS:WAV2 SQU	Sets the waveform for of the second phase to SQU
PULS:WAV3 TRI	Sets the waveform for of the third phase to TRI
MODE:VOLT:AC PULS	Sets the sequence mode of the ac amplitude to PULSE
MODE:VOLT:DC PULS	Sets the sequence mode of the dc amplitude to PULS
MODE:VOLT:AC:SLEW PULS	Sets the sequence mode of the slew rate of the ac to PULSE
MODE:VOLT:DC:SLEW PULS	Sets the sequence mode of the slew rate of the dc to PULS
MODE:FREQ STEP	Sets the sequence mode of the frequency to STEP
MODE:FREQ:SLEW STEP	Sets the sequence mode of the slew rate of frequency to STEP
PULS:VOLT:AC1 50	Sets the ac amplitude for the first phase to 50V
PULS:VOLT:DC1 50	Sets the dc amplitude for the first phase to 50V
PULS:VOLT:AC2 50	Sets the ac amplitude for the second phase to 50V
PULS:VOLT:DC2 50	Sets the dc amplitude for the second phase to 50V
PULS:VOLT:AC3 50	Sets the ac amplitude for the third phase to 50V
PULS:VOLT:DC3 50	Sets the dc amplitude for the third phase to 50V

PULS:VOLT:AC:SLEW:UP 16340	Sets the slew rate of the up programming of the ac amplitude of all the three phases to 16340 V/ms
PULS:VOLT:AC:SLEW:DOWN 16340	Sets the slew rate of the down programming of the ac amplitude of all the three phases to 16340 V/ms
PULS:VOLT:DC:SLEW:UP 16340	Sets the slew rate of the up programming of the dc amplitude of all the three phases to 16340 V/ms
PULS:VOLT:DC:SLEW:DOWN 16340	Sets the slew rate of the down programming of the dc amplitude of all the three phases to 16340 V/ms
STEP:FREQ 80	Sets the frequency to 80Hz
STEP:FREQ:SLEW:UP 99999	Sets the slew rate of the up programming of the frequency to 99999 Hz/ms
STEP:FREQ:SLEW:DOWN 99999	Sets the slew rate of the down programming of the frequency to 99999 Hz/ms
PULS:DUR:ACT 3000	Sets the active duration of the wave to 3s
PULS:DUR:INAC 5000	Sets the inactive duration of the wave to 5s
PULS:REP 2	Sets the number of repetitions of the pulse (active durations)
TRIG:PROG STEP,PULS	Sets the trigger mode to STEP,PULS
TRIG:SOUR BUS	Sets the trigger source to BUS
TRIG:DEL 5	Sets the trigger delay to 5s
MODE:END LAST	Sets power source settings to LAST after the sequence finishes
INIT:CONT OFF	Trigger system is enabled for a single trigger action
INIT	Trigger initialized
*TRG	Trigger

Table 18-5: Example 3 – 3 Phase (Step + Pulse Mode) (for Figure 18-18)

As seen in **Figure 18-20** and **Table 18-5**, when the sequencer starts running,

- all the parameters except Frequency are assigned to PULSE mode. Frequency is assigned to STEP mode.
- during the pulse ACTIVE duration (3s), the output voltage and frequency of all the phases is 50Vac+50Vdc (70Vrms) and 80Hz, respectively. SINE wave is assigned to phase 1, SQUARE wave is assigned to phase 2, and TRIANGLE wave is assigned to phase 3.
- During the pulse INACTIVE duration (5s), the output voltage on all the phases is 0Vac+0Vdc and the frequency drops to 0 in spite of it being programmed to 80Hz (STEP). If the output voltage would have been programmed to some value for the INACTIVE time, the frequency would have remained at 80Hz.

Notice that the trigger program is set to STEP,PULSE.

CHAPTER 19: GPIB OPTION

19.1 General

The General Purpose Interface Bus (GPIB, also referred to as IEEE), factory installed as an option allows operation of the power source from a controller or computer via IEEE-488. The interface allows the user remote control of the power source, including output voltage setting and monitoring, current setting and monitoring, protection setting, trigger, waveform list operation, power source status, and SRQ reporting.
Communication over the GPIB interface is compliant with the IEEE 488.2 standard for Programmable Instrumentation (SCPI).

19.2 IEEE-488.2 Interface

The IEEE-488 digital programming interface (also called the GPIB interface) is a popular way to connect instruments to a computer. It uses a specialized 24-pin cable with connectors that allow cables to be stacked together. There are eight data wires, eight control wires, and eight ground wires. If the system runs from a personal computer, there are numerous vendors of GPIB controller cards and software.
Because many instruments may be connected and independently controlled by a single GPIB controller, each instrument must have a unique address. The GPIB controller automatically sets its address, identical to the power supply address.
For complete and specific information, refer to the following documents: ANSI/IEEE Std 488.1-1987 IEEE Standard Digital Interface for Programmable Instrumentation and ANSI/IEEE Std 488.2-1987 IEEE Standard Codes, Formats, Protocols and Common Commands.

19.3 Point-to-Point Connection

One GPIB interface can control only one power source. Refer to **Figure 19-1**.

- Each power source must be configured to GPIB communication interface.
- Each power source must have a unique address, ranging from 0 to 31.

NOTE

Address 31 must be avoided as it is used for special command messages.

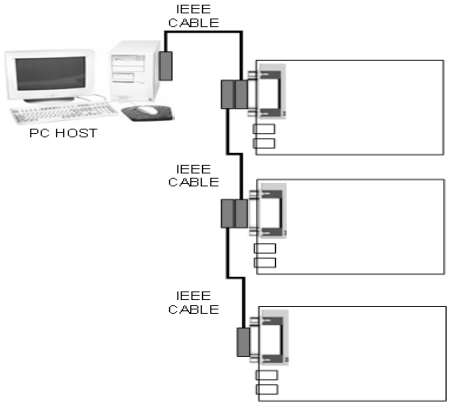


Figure 19-1: Point-to-Point Connection

19.4 Communication Cables

Use standard IEEE-488, 26AWG GPIB cable up to 3 meters in length.

19.5 GPIB Controller Configuration

A typical GPIB controller is a personal computer with a GPIB interface card. Each card vendor supplies its own configuration instructions and interface software.

Each time the software is executed, the controller is configured as follows:

- GPIB instrument address = Power source address
- SCPI protocol
- EOI Flag = TRUE. The **End of Identity** is a control line in the GPIB cable that is initiated when the last character of a message string is sent. It is not supported by this interface.
- EOS Flag = FALSE. The **End of String**, used in some instruments to indicate the last character of a message. It is required for this message.

19.6 Power Source Configuration

To communicate over the GPIB interface, the power source must be configured to GPIB. If GPIB option is installed, by default the power source is pre-configured to GPIB.

If, for any reason, GPIB is not selected, select it from the front panel or with a communication command.

Refer to **Section 9.4.4: Interface Menu** to select GPIB from the front panel.

Refer to **Section 14.13.10: System Subsystem** to select GPIB with a communication command.

19.7 Communication Example

This section provides an example on how to communicate with the GPIB option in the power source using the National Instruments™ MAX application.

1. Run National Instruments™ MAX (Measurement & Automation Explorer)
2. On the side tree, expand My System and select Devices and Interfaces -> GPIB0.
3. In the GPIB Explorer toolbar, click **Scan for Instruments**. Refer to **Figure 19-2**.

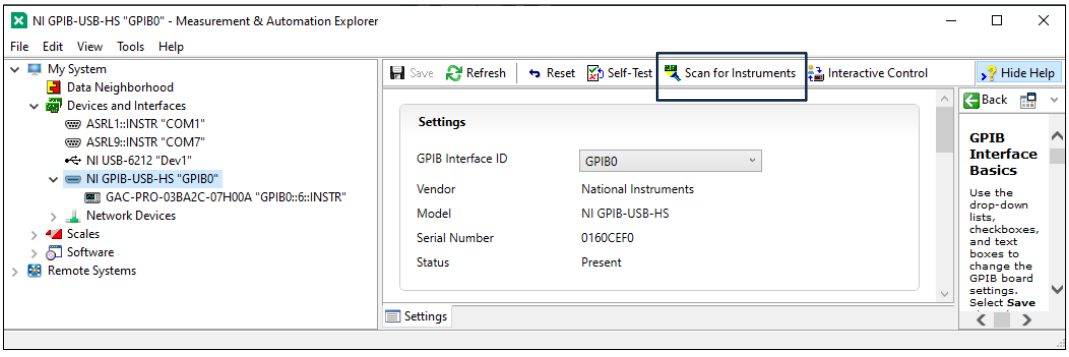


Figure 19-2: Scan for Instruments

4. On the side tree, select **Genesys AC instrument (e.g., GAC-PRO)** and review the device settings. Refer to **Figure 19-3**.

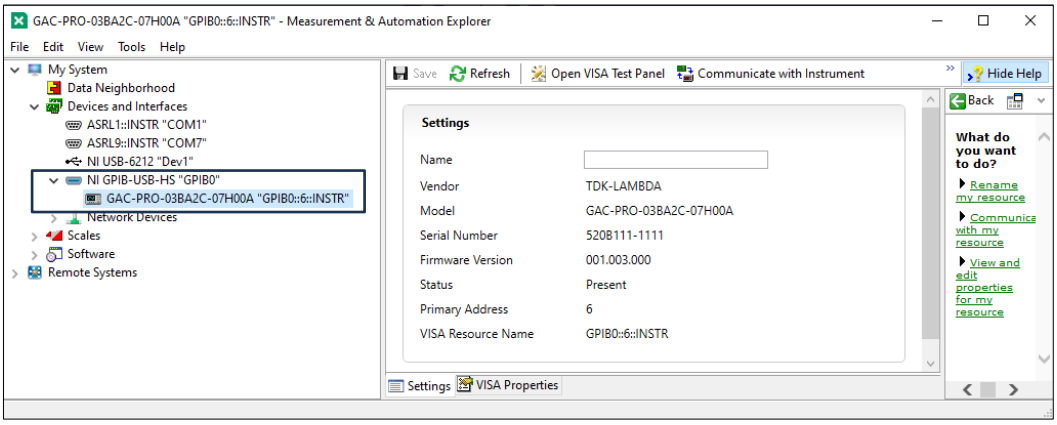


Figure 19-3: Instrument Properties

5. In the GPIB explorer toolbar, click **Communicate with Instrument**. Refer to **Figure 19-4**.

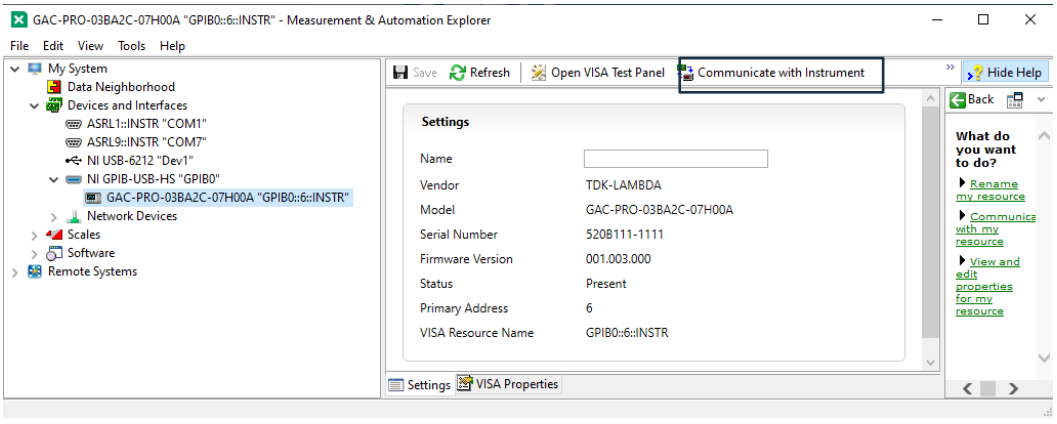


Figure 19-4: Communications

NI-488.2 Communicator appears. Refer to **Figure 19-5**.

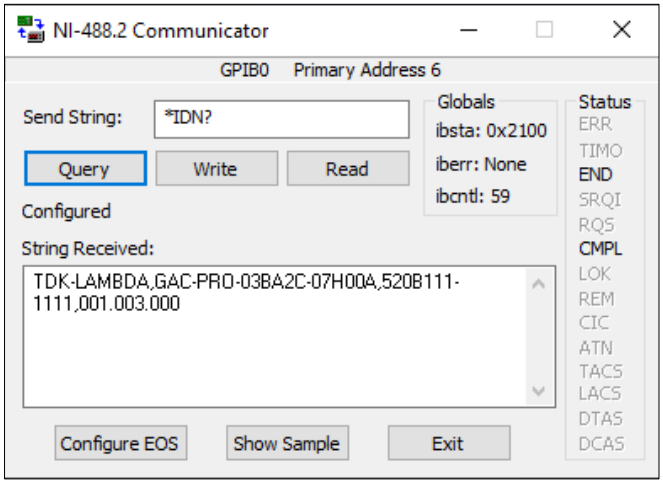


Figure 19-5: ID String Query

In the Send String: text box, *IDN? appears

6. Click **Query**.

The ID string indicates the following:

- Company Name
- Power Source model
- Serial number and main firmware revision

20.1 Programming Procedure

1. Download the programming file.
2. Plug one side of the USB cable into the computer and the other side into the USB connector at the back of the System Master. In a parallel system, the System Master is the top unit.



Figure 20-1: Standalone Unit

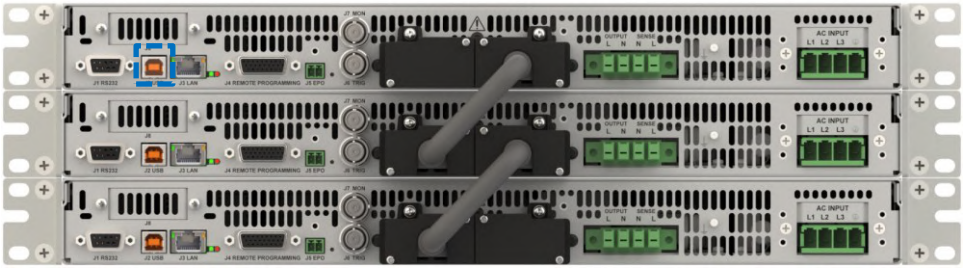


Figure 20-2: System Assembled by the User

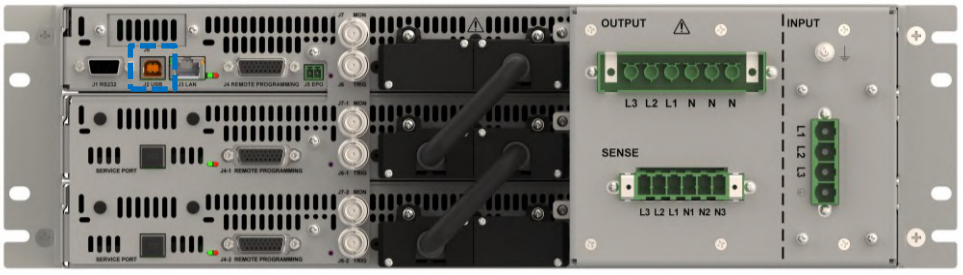
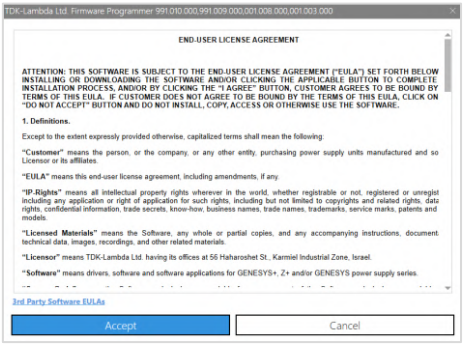
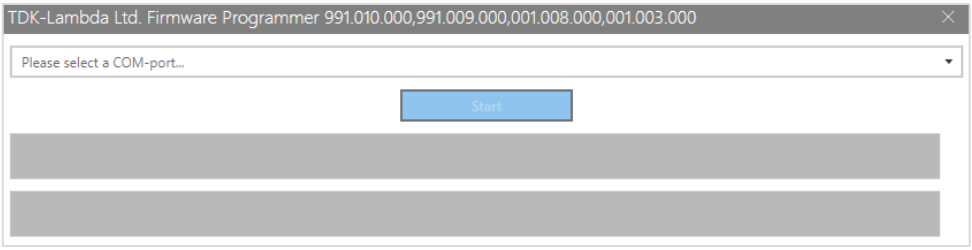


Figure 20-3: System Pre-assembled

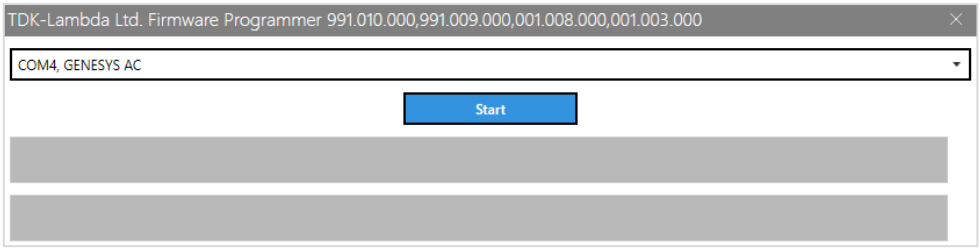
3. Make sure that the AC Source is ON, and the communication interface is set to USB.
4. Click the programmer file . The License Agreement screen opens.



5. Read the terms and conditions and click **Accept**. The next screen opens.



6. Select the COM port from the drop-down menu. After the COM port is selected, the **Start** button is enabled.



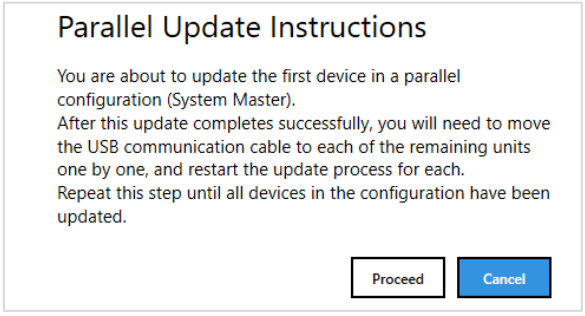
7. Click **Start.**

   A warning stating that the upgrade will also perform a factory reset may appear.

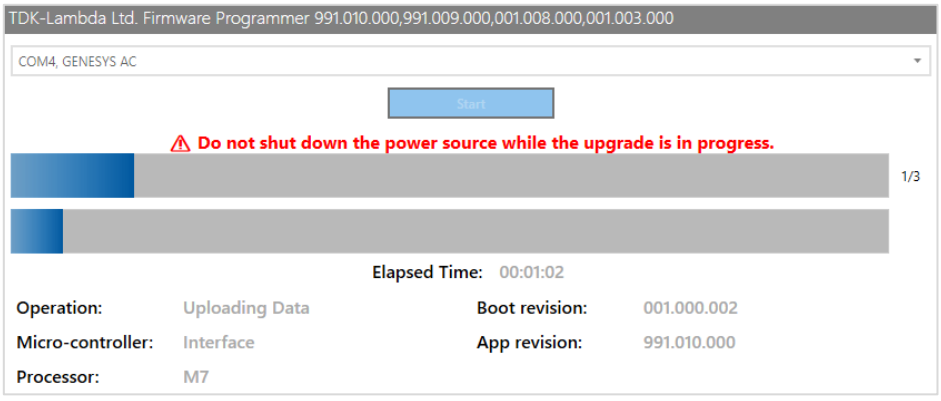


8. Click **Proceed**.

   If a parallel system is present and the USB cable is connected to the System Master, a warning may pop up stating that the slaves also need to be updated.



9. Click **Proceed**. The programming starts.



During the programming process, the front panel indicates that the unit is in BOOT mode. For a parallel system all units display BOOT MODE.



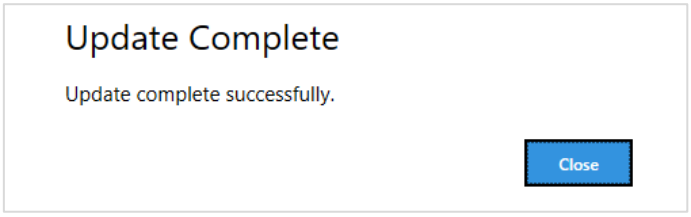
The BOOT mode is also indicated by the two lit LEDs on the rear panel.



NOTE

For the Blank Panel unit and PWR unit, the BOOT mode is indicated only by the two lit LEDs on the rear panel.

When the programming finishes, a message pops up saying that the process is complete.



10. In a parallel system, the screen on the System Master shows that it is waiting for the remaining slaves to be programmed.



11. Move the USB cable to each of the remaining units. Repeat the programming procedure by selecting the COM port and continuing the process (the programming file does not need to be reopened) until all units are updated.

NOTE

For 6kVA, 9kVA, 9kVA PWR, 12kVA, 12kVA PWR, 18kVA, and 24kVA units, remove the plug on the SERVICE PORT in order to connect the USB cable.

After updating all the units, the master asks for the system setup. The following screen appears for a parallel system only.



20.2 Troubleshooting

Slaves not powering up

In a parallel system, the slaves MUST stay connected to the master via the parallel cable. The slaves will not power up without the parallel cables.

Slave not in BOOT mode

If one of the slaves in the system does not enter the BOOT mode during the programming process, it can be manually put into BOOT mode.

When the unit is not in BOOT mode, only the red light on the rear panel will be lit.

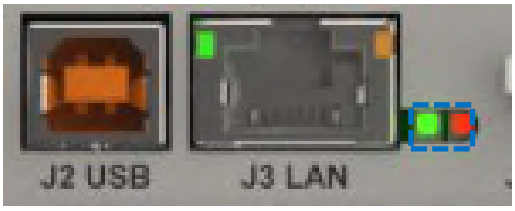


1. Turn off the AC input.
2. Push the reset button.



3. Turn on the AC input while keeping the reset button pressed.

   Both LEDs to the right of the J3 connector will be lit.



   The touchscreen (if the unit has one) will display BOOT mode.

The connected programmer will show **COM#, GENESYS AC (BOOT mode)**. The programming can continue from here onwards.

Firmware Incompatible Error

If the master programs successfully but the slaves fail during the process, the master will give a Firmware Incompatible Error.

Program the slaves as per the programming procedure.